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Physics Division

ATOMIC DATA FOR FUSION - VOLUME VI

SPECTROSCOPIC DATA FOR TITANIUM, CHROMIUM, AND NICKEL
Volume 2. Chromium

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National Institute for Standards and Technology

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Series Preface

The primary objective of the Controlled Fusion Atomic Data Center at Oak Ridge National Laboratory is to publish handbooks containing numerical and graphical cross sections and other physical data relevant to fusion energy research. In 1977, a two-volume compilation was published as ORNL reports ORNL-5206 and ORNL-5207. Since that time, a large volume of pertinent data has become available, necessitating an update of the previous compilation. Plans are to include both cross sections and rate coefficients for collisional processes, and to publish the revised series in handbook form. The specific volumes which are in preparation are listed below, with their expected completion dates.

Vol. 1, "Collisions of H, H_2, He, and Li Atoms and Ions with Atoms and Molecules," C. F. Barnett, ORNL (December 1989).

Vol. 2, "Collisions of Electrons with Atoms and Molecules," J. W. Gallagher, National Institute of Standards and Technology; and D. C. Gregory, ORNL (December 1990).

Vol. 3, "Particle Interactions with Surfaces," E. W. Thomas, Georgia Institute of Technology (January 1985).

Vol. 4, "Spectroscopic Data for Iron," W. L. Wiese, National Bureau of Standards (March 1985).

Vol. 5, "Collisions of Carbon and Oxygen Ions with Electrons, H, H_2, and He," R. A. Phaneuf, ORNL; R. K. Janev, Institute of Physics, Yugoslavia; and M. S. Pindzola, Auburn University (January 1987).

Vol. 6, "Spectroscopic Data for Titanium, Chromium, and Nickel," W. L. Wiese and A. Musgrove, National Institute for Standards and Technology (September 1989).

C. F. Barnett
D. C. Gregory
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Abstract

Comprehensive spectroscopic data tables are presented for all ionization stages of titanium, chromium, and nickel. Tables of ionization potentials, spectral lines, energy levels, and transition probabilities are presented. These tables contain data which have been excerpted from general critical compilations prepared under the sponsorship of the National Standard Reference Data System (NSRDS).

Spectroscopic Data for Titanium, Chromium, and Nickel — Volume 2. Chromium

W. L. Wiese and A. Musgrove, Editors

Table of Contents

General Introduction

This compendium contains a collection of recent spectroscopic data tables for titanium, chromium, and nickel. The tables are issued in three separate volumes, each containing one element. The individual volumes are identified as Oak Ridge National Laboratory ORNL 6551/V1 (titanium); ORNL 6551/V2 (chromium); and ORNL 6551/V3 (nickel). These chemical elements, together with the earlier tabulated[1] element iron, are the principal heavy metals which are widely used as first-wall materials (including limiters, armor plates, etc.) of magnetic fusion research machines, particularly tokamaks. Spectral radiation data for both high and low stages of ionization for Ti, Cr and Ni have thus become important for the assessment and modeling of the effects of impurities on plasma properties and power balance, for the study of plasma-wall interactions as well as for the application of plasma diagnostic techniques.

Numerical data are tabulated for those spectroscopic quantities which are of principal importance for such plasma studies and for plasma diagnostics. The specific spectroscopic quantities are ionization energies, wavelengths of allowed and forbidden lines, atomic energy levels, and atomic transition probabilities. Most of the critical evaluation and compilation work for these data has been done at the National Institute of Standards and Technology, formerly the National Bureau of Standards. The tables are usually parts of larger tabulations[2-7] containing many other chemical elements besides Ti, Cr, and Ni. Excerpting the data from these larger compilations required some modifications in the reprinted material, especially the modification of the introductory remarks with comments and explanations that specifically refer to the Ti, Cr, and Ni spectra. All of the material is quite recent, and is under the sponsorship of the National Standard Reference Data System (NSRDS). Since the various data tables have been completed at different times, there may be occasional slight inconsistencies between overlapping material when the data are based on different sources. Also, sometimes there may be different judgments of independent evaluators on the quality of the source material. For example, wavelengths which are derived from atomic energy levels may be sometimes slightly different from the observed data in the wavelength tables. There also may be slight inconsistencies between the energy level data contained in the wavelength and transition probability tables when compared to the data in the energy level table itself. But any such differences are so small that they do not matter for any plasma applications, and therefore the use of any of the recent tabulations is appropriate. But we generally recommend to use the *primary* tables to obtain data on a specific atomic quantity.

Each of the three volumes of this compendium is divided into six sections which cover:

- Ionization energies,
- General spectral line lists,
- Vacuum ultraviolet lines,
- Magnetic dipole lines,
- Atomic energy levels, and
- Atomic transition probabilities.

The editors gratefully acknowledge the cooperation of the data compilers. We also thank NSRDS, the American Institute of Physics, and American Chemical Society for permission to reprint excerpts of these tables.

References

1. W. L. Wiese, Editor, *Spectroscopic Data for Iron*, ORNL-6089 [1985], Fourth Volume of Oak Ridge Natl. Lab. Series 6086.
2. J. Reader, C. H. Corliss, W. L. Wiese, and G. A. Martin, *Wavelengths and Transition Probabilities for Atoms and Atomic Ions*, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.), 68, 415 pgs. [1980].
3. R. L. Kelly, *Atomic and Ionic Spectral Lines Below 2000 Å (H through Kr)*, J. Phys. Chem. Ref. Data 16, Suppl. 1 (1987).
4. J. Sugar and C. Corliss, *Atomic Energy Levels of the Iron-Period Elements: Potassium through Nickel*, J. Phys. Chem. Ref. Data 14, Suppl. 2 [1985].
5. V. Kaufman and J. Sugar, *Forbidden Lines in ns^2np^k Ground Configurations and nsnp Excitation Configurations of Be through Mo Atoms and Ions*, J. Phys. Chem. Ref. Data 15, 321 – 426 [1986].
6. G. A. Martin, J. R. Fuhr, and W. L. Wiese, *Atomic Transition Probabilities – Scandium through Manganese*, J. Phys. Chem. Ref. Data 17, Suppl. 3 [1988].
7. J. R. Fuhr, G. A. Martin, and W. L. Wiese, *Atomic Transition Probabilities – Iron through Nickel*, J. Phys. Chem. Ref. Data 17, Suppl. 4 [1988].

A. Ionization Energies of Chromium Ions

A. Ionization Energies of Chromium Ions

[Excerpted from: J. Sugar and C. Corliss, J. Phys. Chem. Ref. Data 14, Suppl. 2 (1985)]

Spectrum	Ground State Configuration	Ground Level	Ionization Energy (eV)
Cr I	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s$	$^7S_3$	6.76669
Cr II	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$	$^6S_{5/2}$	16.4858
Cr III	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$	$^5D_0$	30.96
Cr IV	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$	$^4F_{3/2}$	49.16
Cr V	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$	$^3F_2$	69.46
Cr VI	$1s^2 2s^2 2p^6 3s^2 3p^6 3d$	$^2D_{3/2}$	90.6356
Cr VII	$1s^2 2s^2 2p^6 3s^2 3p^6$	$^1S_0$	160.18
Cr VIII	$1s^2 2s^2 2p^6 3s^2 3p^5$	$^2P^\circ_{3/2}$	184.7
Cr IX	$1s^2 2s^2 2p^6 3s^2 3p^4$	$^3P_2$	209.3
Cr X	$1s^2 2s^2 2p^6 3s^2 3p^3$	$^4S^\circ_{3/2}$	244.4
Cr XI	$1s^2 2s^2 2p^6 3s^2 3p^2$	$^3P_0$	270.8
Cr XII	$1s^2 2s^2 2p^6 3s^2 3p$	$^2P^\circ_{1/2}$	298.0
Cr XIII	$1s^2 2s^2 2p^6 3s^2$	$^1S_0$	354.8
Cr XIV	$1s^2 2s^2 2p^6 3s$	$^2S_{1/2}$	384.171
Cr XV	$1s^2 2s^2 2p^6$	$^1S_0$	1010.6
Cr XVI	$1s^2 2s^2 2p^5$	$^2P^\circ_{3/2}$	1097
Cr XVII	$1s^2 2s^2 2p^4$	$^3P_2$	1185
Cr XVIII	$1s^2 2s^2 2p^3$	$^4S^\circ_{3/2}$	1299
Cr XIX	$1s^2 2s^2 2p^2$	$^3P_0$	1396
Cr XX	$1s^2 2s^2 2p$	$^2P^\circ_{1/2}$	1496
Cr XXI	$1s^2 2s^2$	$^1S_0$	1634
Cr XXII	$1s^2 2s$	$^2S_{1/2}$	1721.4
Cr XXIII	$1s^2$	$^1S_0$	7481.8
Cr XXIV	$1s$	$^2S_{1/2}$	7894.87

B. Prominent Spectral Lines for Cr I to Cr V
(Wavelengths for Vacuum Ultraviolet to Near Infrared Regions)

B. Prominent Spectral Lines for Cr I to Cr V

(Vacuum Ultraviolet to Near Infrared Regions)

[Excerpted from: J. Reader, C. H. Corliss, W. L. Wiese, and G. A. Martin, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) 68, 415 pgs. (1980); and J. Reader and C. H. Corliss, in *Handbook of Chemistry and Physics*, 70th Edition (1989)]

These lists were recently prepared under the auspices of the Committee of Line Spectra of the Elements of the National Academy of Sciences – National Research Council as part of a general wavelength table[1,2]. The tables contain the outstanding spectral lines, – from the far ultraviolet to the far infrared, – of neutral (I), singly ionized (II), doubly ionized (III), triply ionized (IV), and quadruply ionized (V) chromium atoms. The lines are selected from larger lists (see references) in such a way as to include the stronger observed lines in each spectral region.

The data were compiled by Charles H. Corliss, NBS (Cr I – Cr V). For Cr I and II, the following literature references were used as the principal sources of data:

W. F. Meggers, C. H. Corliss, and B. F. Scribner, Nat. Bur. Stand. (U.S.), Monogr. 145, Washington, D.C. (1975).

For Cr III, IV and V, the following references were used:

F. L. Moore, Thesis, Princeton University (1949).

J. O. Ekberg, Phys. Scr. 7, 55 (1973).

J. O. Ekberg, Phys. Scr. 7, 59 (1973).

All wavelengths are given in Angstrom units (Å). Below 2000 Å, the wavelengths are in vacuum; above 2000 Å, the wavelengths are in air. Wavelengths given to three decimal places have an uncertainty of less than 0.001 Å and are, therefore, suitable for the calibration of most spectrometers. The line intensities are normally estimates of the relative strengths of lines which are not greatly separated in wavelength. However, because different sources are involved, based on different scales for the intensity estimates, these intensities are only useful as a rough indication of the appearances of the spectra. Furthermore, in the tables of first and second spectra the intensities of the lines of the singly ionized atoms relative to those of the neutral atom should be used with caution, inasmuch as the concentration of the ions in the light source depends greatly on the excitation conditions.

The descriptive symbols used in the tables have the following meaning:

H – hazy
D – line consists of two unresolved lines

References

1. J. Reader, C. H. Corliss, W. L. Wiese, and G. A. Martin, *Wavelengths and Transition Probabilities for Atoms and Atomic Ions*, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.), 68, 415 pgs. (1980).
2. J. Reader and C. H. Corliss, in *Handbook of Chemistry and Physics*, 70th Edition (R. C. Weast, Ed.), CRC Press, Inc., Boca Raton, FL (1989).

Chromium (Cr)

Z = 24

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
	Cr I and II		440	2666.02	II
			280	2668.71	II
	Air		350	2671.81	II
			280	2672.83	II
19000	2055.52	II	1800	2677.16	II
14000	2061.49	II	35	2678.16	I
8900	2065.42	II	320	2678.79	II
80 H	2364.71	I	18	2680.34	II
130	2383.33	I	230	2687.09	II
140	2408.62	I	60	2688.04	I
170	2496.31	I	55	2688.29	II
110	2502.53	I	26	2690.26	I
190	2504.31	I	280	2691.04	II
50	2508.11	I	35	2693.52	II
60	2508.98	I	35	2697.91	II
40	2513.62	I	180	2698.41	II
110	2516.92	I	180	2698.69	II
80	2518.71	I	18	2700.60	I
390	2519.52	I	110	2701.99	I
190	2527.12	I	18	2702.53	I
40	2530.45	I	70	2703.48	I
70	2534.34	II		2703.55	II
50	2545.64	I	35	2703.86	II
160	2549.54	I	18	2705.43	I
40	2553.06	I	60	2708.79	II
80	2557.15	I	35	2709.31	II
130	2560.69	I	140	2712.31	II
150	2571.74	I	45	2716.18	I
100	2577.65	I	55	2717.51	II
50	2588.20	I	45	2718.43	II
380	2591.85	I	170	2722.75	II
35	2603.57	I	18	2724.04	II
35	2622.86	I	420 H	2726.51	I
22	2625.32	I	45	2727.26	II
18	2626.60	I	280 H	2731.91	I
18	2629.82	I	170 H	2736.47	I
35	2642.12	I	70	2739.38	I
250	2653.59	II	70	2740.10	II
250	2658.59	II	95	2741.07	I
70	2661.73	II	95	2742.03	II
320	2663.42	II	95	2742.17	I
70	2663.68	II	250	2743.64	II

Intensity		Wavelength(Å)	Spectrum	Intensity		Wavelength (Å)	Spectrum
35		2746.21	II	45		2849.29	I
110	H	2748.29	I	1200		2849.84	II
330		2748.98	II	120		2851.36	II
390		2750.73	II	55		2853.22	II
45		2751.60	I	55		2855.07	II
280		2751.87	II	880		2855.68	II
110	H	2752.88	I	90		2856.77	II
35		2754.28	II	70		2857.40	II
22		2754.90	I	610		2858.91	II
22		2755.27	I	440		2860.93	II
22		2756.75	I	790		2862.57	II
150		2757.10	I	750		2865.11	II
350		2757.72	II	55		2865.33	II
60		2758.98	II	610		2866.74	II
80		2759.39	II	90		2867.10	II
45		2759.73	II	480		2867.65	II
90	H	2761.76	I	210		2870.44	II
750		2762.59	II	110		2871.63	I
22		2763.06	I	160		2873.48	II
80	H	2764.35	I	90		2873.82	II
750		2766.54	II	320		2875.99	II
22		2767.54	I	230		2876.24	II
250	H	2769.92	I	180		2877.98	II
18		2771.45	I	70		2878.45	II
45		2778.06	II	120		2879.27	I
22		2779.14	I	95		2880.87	II
80		2780.30	II	30		2881.14	I
610		2780.70	I	170		2887.00	I
70		2785.70	II	55		2888.74	II
35		2787.63	II	700		2889.29	I
35		2787.84	I	55		2889.82	II
90		2792.16	II	55		2891.42	I
55		2798.67	II	370		2893.25	I
70		2800.77	II	190		2894.17	I
80		2812.01	II	55		2896.46	II
60		2818.36	II	210		2896.75	I
45		2822.01	II	55	D	2897.67	II
180		2822.37	II			2897.73	II
22		2826.75	I	90		2898.54	II
180		2830.47	II	80		2899.21	I
70		2834.26	II	55		2899.48	II
2500		2835.63	II	26		2903.97	II
45		2836.48	II	55		2904.68	I
55		2838.79	II	180		2905.49	I
110		2840.02	II	260		2909.05	I
1700		2843.25	II	260		2910.90	I
22		2846.02	I	250		2911.14	I

Intensity	Wavelength(Å)	Spectrum
45	2911.68	II
60	2913.73	I
22	2915.23	II
22	2915.46	II
90	2921.24	II
60	2921.82	II
60	2927.08	II
80	2928.15	II
95	2928.30	II
26	2929.44	II
35	2930.85	II
26	2932.70	II
55	2933.97	II
90	2935.14	II
45	2940.22	II
60	2946.84	II
55	2953.36	II
45	2953.71	II
55	2961.73	II
45	2966.05	II
480	2967.64	I
480	2971.11	I
210	2971.91	II
480	2975.48	I
30	2976.72	II
190	2979.74	II
350	2980.79	I
110	2985.32	II
480	2985.85	I
1500	2986.00	I
2100	2986.47	I
660	2988.65	I
160	2989.19	II
480	2991.89	I
230	2994.07	I
300	2995.10	I
700	2996.58	I
210	2998.79	I
1100	3000.89	I
750	3005.06	I
140	3013.03	I
710	3013.71	I
710	3014.76	I
1400	3014.92	I
710	3015.19	I
2800	3017.57	I
430	3018.50	I
240	3018.82	I
430	3020.67	I
2800	3021.56	I
1100	3024.35	I
85	3026.65	II
170	3029.16	I
710	3030.24	I
140	3031.35	I
28	3032.93	II
390	3034.19	.
550	3037.04	I
80	3039.78	I
550	3040.85	I
	3040.91	II
55	3041.74	II
110	3050.14	II
710	3053.88	I
24	3059.52	II
85	3065.07	I
28	3067.16	II
85	3073.68	I
55	3077.83	I
28	3095.86	I
28	3109.34	I
28	3110.86	I
240	3118.65	II
45	3119.25	I
40	3119.71	I
430	3120.37	II
28	3122.60	II
470	3124.94	II
	3125.02	II
120	3128.70	II
590	3132.06	II
140	3136.68	II
140	3147.23	II
85	3148.44	I
100	3155.15	I
100	3163.76	I
240	3180.70	II
30	3181.43	II
65 H	3188.01	I
220	3197.08	II
24	3198.11	I
30	3208.59	II
170	3209.18	II
140	3217.40	II

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
30	3229.20	I	270	3433.60	I
28	3234.06	II	55	3434.11	I
65	3237.73	I	160	3436.19	I
120	3245.54	I	70	3441.12	I
130	3251.84	I	140	3441.44	I
130	3257.82	I	30	3443.79	I
95	3259.98	I	170	3445.62	I
[illegible]0	3295.43	II	30	3447.02	I
24	3307.02	II	170	3447.43	I
55	3324.06	II	70	3447.76	I
28	3326.59	I	190	3453.33	I
30	3328.35	II	40	3453.74	I
30	3329.05	I	130	3455.60	I
95	3336.33	II	100	3460.43	I
130	3339.80	II	65	3465.25	I
110	3342.59	II	40	3467.02	I
30	3343.34	I	70	3467.72	I
95	3346.02	I	45	3469.59	I
95	3346.74	I	16	3472.76	I
95	3347.84	II	24	3472.91	I
65	3349.07	I	40	3473.61	I
55	3349.32	I	70	3481.30	I
30	3351.60	I	55	3481.54	I
55	3351.97	I	55	3494.97	I
55 H	3353.03	I	40	3495.38	II
	3353.13	II	80	3510.54	I
170	3358.50	II	40	35[illegible]1.84	II
160	3360.30	II	120	3550.64	I
65	3361.77	II	80	3558.52	I
55	3362.21	I	130	3566.16	I
430	3368.05	II	130	3573.64	I
30	3376.40	I	80	3574.04	I
55	3378.34	II	330 H	3574.80	I
30	3379.17	I		3574.94	I
30	3379.37	II	19000	3578.69	I
95	3379.83	II	160 H	3584.33	I
140	3382.68	II	130	3585.30	II
95	3391.43	II	17000	3593.49	I
55	3392.99	II	350	3601.67	I
70	3393.84	II	40	3602.57	I
55	3394.30	II	85	3603.74	I
30	3402.40	II		3603.78	II
170	3403.32	II	13000	3605.33	I
360	3408.76	II	40	3608.40	I
210	3421.21	II	40	3609.48	I
270	3422.74	II	40	3610.05	I
140	3433.31	II	70	3612.61	I

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
85	3615.64	I	120	3793.29	I
130	3632.64	I	130	3793.88	I
350	3636.59	I	85	3794.61	I
630	3639.80	I	140	3797.13	I
85	3640.39	I	200	3797.72	I
70	3641.47	I	530	3804.80	I
220	3641.83	I	110	3806.83	I
45	3646.16	I	110	3807.93	I
85	3648.53	I	180	3815.43	I
220	3649.00	I	70	3818.48	I
170	3653.91	I	180	3819.56	I
220	3656.26	I	70	3823.52	I
45	3662.84	I	130	3826.42	I
130	3663.21	I	130	3830.03	I
45	3665.98	I	380	3841.28	I
95	3666.64	I	190	3848.98	I
55	3668.03	I	140	3849.36	I
65	3676.32	I	290	3850.04	I
40	3677.68	II	140	3852.22	I
55	3677.89	II	190	3854.22	I
40	3679.82	I	110	3855.29	I
19	3681.69	I	140	3855.57	I
120	3685.55	I	260	3857.63	I
130	3686.80	I	70	3874.53	I
130	3687.25	I	660	3883.29	I
75	3687.54	I	50	3883.66	I
19	3688.46	I	570	3885.22	I
75	3712.95	II	380	3886.79	I
40	3716.53	I	60	3891.93	I
130	3730.81	I	260	3894.04	I
150	3732.03	I	40	3897.65	I
95	3742.97	I	35	3902.11	I
480	3743.58	I	360	3902.92	I
570	3743.88	I	60	3903.16	I
85	3744.49	I	960	3908.76	I
55	3748.61	I	120 HD	3911.82	I
340	3749.00	I		3912.00	I
50	3757.17	I	120	3915.84	I
230	3757.66	I	[illegible]	3916.24	I
60	3758.04	I	35	3917.60	I
24	3767.43	I	1900	3919.16	I
260	3768.24	I	600	3921.02	I
95	3768.73	I	30	3926.65	I
95	3788.86	I	600	3928.64	I
95	3790.45	I	410	3941.49	I
130	3791.38	I	30	3951.10	I
130	3792.14	I	40	3952.40	I

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
35	3953.16	I	70	4165.52	I
1900	3963.69	I	40	4169.84	I
120	3969.06	I	35	4170.20	I
1600	3969.75	I	40	4172.77	I
85	3971.26	I	170	4174.80	I
1600	3976.66	I	30	4175.94	I
85	3978.68	I	170	4179.26	I
40	3979.80	I	35	4184.90	I
85	3981.23	I	30	4186.36	I
960	3983.91	I	35	4190.13	I
190	3984.34	I	85	4191.27	I
160	3989.99	I	35	4192.10	I
960	3991.12	I	85	4193.66	I
160	3991.67	I	70	4194.95	I
190	3992.84	I	40	4197.23	I
40	3993.97	I	85	4198.52	I
160	4001.44	I	60	4203.59	I
120	4012.47	II	40	4204.47	I
30	4014.67	I	35	4208.36	I
85	4022.26	I	110	4209.37	I
70	4025.01	I	40	4209.76	I
120	4026.17	I	40	4211.35	I
85	4027.10	I	40	4216.36	I
85	4030.68	I	85	4217.63	I
190	4039.10	I	40	4221.57	I
160	4048.78	I	40	4222.73	I
120	4058.77	I	40	4238.96	I
40	4065.72	I	60	4240.70	I
85	4066.94	I	20000	4254.35	I
35	4074.86	I	70	4255.50	I
40	4076.06	I	60	4261.35	I
40	4077.09	I	110	4263.14	I
40	4077.68	I	30	4271.06	I
40	4104.87	I	40	4272.91	I
40	4109.58	I	16000	4274.80	I
40	4120.61	I	85	4280.40	I
40	4121.82	I	10000	4289.72	I
35	4122.16	I	40	4291.96	I
40	4123.39	I	85	4295.76	I
140	4126.52	I	70	4297.74	I
35	4127.30	I	35	4300.51	I
40	4127.64	I	50	4301.18	I
40	4131.36	I	30	4305.45	I
30	4152.78	I	35	4319.64	I
120	4153.82	I	60	4325.08	I
85	4161.42	I	780	4337.57	I
140	4163.62	I	1100	4339.45	I

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
380	4339.72	I	380	4530.74	I
60	4340.13	I	50	4535.15	I
1900	4344.51	I	240	4535.72	I
70	4346.83	I	40	4539.79	I
380	4351.05	I	240	4540.50	I
2300	4351.77	I	240	4540.72	I
570	4359.63	I	35	4541.07	I
70	4363.13	I	19	4541.51	I
530	4371.28	I	24	4542.62	I
70	4373.25	I	140	4544.62	I
110	4374.16	I	24	4545.34	I
70	4375.33	I	600	4545.96	I
50	4381.11	I	50	4556.17	I
530	4384.98	I	22	4558.66	II
60	4387.50	I	19	4564.17	I
70	4391.75	I	120	4565.51	I
60	4403.50	I	95	4569.64	I
24	4410.30	I	120	4571.68	I
60	4411.09	I	22	4575.12	I
35	4412.25	I	360	4580.06	I
50	4413.87	I	24	4586.14	I
60	4424.28	I	360	4591.39	I
24	4428.50	I	70	4595.59	I
50	4430.49	I	50	4600.10	I
50	4432.18	I	480	4600.75	I
110	4458.54	I	50	4601.02	I
30	4459.74	I	240	4613.37	I
30	4465.36	I	600	4616.14	I
30	4482.88	I	70	4619.55	I
40	4488.05	I	85	4621.96	I
50	4489.47	I	70	4622.49	I
60	4492.31	I	24	4622.76	I
660	4496.86	I	550	4626.19	I
50	4498.73	I	24	4632.18	I
70	4500.30	I	40	4637.18	I
50	4501.11	I	50	4637.77	I
22	4501.79	I	50 D	4639.52	I
24	4506.85	I		4639.70	I
95	4511.90	I	1600	4646.17	I
12	4514.37	I	24	4646.81	I
35	4514.53	I	24	4648.13	I
24	4521.14	I	24	4648.87	I
24	4526.11	I	35	4649.46	I
380	4526.47	I	570	4651.28	I
70 D	4527.34	I	840	4652.16	I
	4527.47	I	35	4654.74	I
24	4529.85	I	19	4656.19	I

Intensity		Wavelength(Å)	Spectrum
40		4663.33	I
70		4663.83	I
95		4664.80	I
35		4665.90	I
22		4666.22	I
70		4666.51	I
50		4669.34	I
40		4680.54	I
19		4680.87	I
70		4689.37	I
60		4693.95	I
24		4695.15	I
60		4697.06	I
240	D	4698.46	I
		4698.62	I
35		4700.61	I
190		4706.04	I
240		4718.43	I
50		4723.10	I
50		4724.42	I
50		4727.15	I
24		4729.7[illegible]	I
120		4730.71	I
140		4737.35	I
19		4745.31	I
70		4752.08	I
340		4756.11	I
50		4764.29	I
22		4766.63	I
30		4767.86	I
190		4789.32	I
95		4792.51	I
120		4801.03	I
110		4829.38	I
14		4836.86	I
17		4861.20	I
70		4861.84	I
140		4870.80	I
35		4885.78	I
19		4885.96	I
130		4887.01	I
19		4888.53	I
35		4903.24	I
260		4922.27	I
110		4936.33	I
70		4942.50	I
110		4954.81	I
35		4964.93	I
60		5013.32	I
17		5051.90	I
17		5065.91	I
40		5067.71	I
40		5072.92	I
30		5110.75	I
17		5113.13	I
17		5123.46	I
50		5139.65	I
14		5144.67	I
70		5166.73	I
35		5177.43	I
70		5184.59	I
70		5192.00	I
12		5193.49	I
85		5196.44	I
35		5200.19	I
5300		5204.52	I
8400		5206.04	I
11000		5208.44	I
19		5214.13	I
30		5221.75	I
85		5224.94	I
12		5226.89	I
19		5238.97	I
30		5243.40	I
290		5247.56	I
60		5254.92	I
60		5255.13	I
19		5261.75	I
530		5264.15	I
30		5265.16	I
180		5265.72	I
35		5272.01	I
30		5273.44	I
95	H	5275.17	I
35	H	5275.69	I
70	H	5276.03	I
19		5280.29	I
10		5287.19	I
340		5296.69	I
70	H	5297.36	I
660		5298.27	I
85		5300.75	I
17		5304.21	I
24		5312.88	I

Intensity		Wavelength (Å)	Spectrum
24		5318.78	I
340	H	5328.34	I
70	H	5329.17	I
17	H	5329.72	I
14		5340.44	I
10		5344.76	I
780		5345.81	I
380		5348.32	I
30		5386.98	I
22		5387.57	I
10		5390.39	I
40		5400.61	I
22		5405.00	I
1400		5409.79	I
12		5442.41	I
19		5463.97	I
19		5480.50	I
24		5628.64	I
7		5642.36	I
12	H	5649.37	I
24		5664.04	I
7	H	5681.20	I
7	H	5682.48	I
24		5694.73	I
40		5698.33	I
24		5702.31	I
12		5712.64	I
24		5712.78	I
7		5719.82	I
7		5746.43	I
7		5753.69	I
12	H	5781.20	I
6	H	5781.81	I
24	H	5783.11	I
30	H	5783.93	I
24	H	5785.00	I
19	H	5785.82	I
60	H	5787.99	I
180	H	5791.00	I
35		6330.10	I
22		6362.87	I
19		6661.08	I
11		6669.26	I
5	H	6881.62	I
10	H	6882.38	I
21	H	6883.03	I
27	H	6924.13	I
17	H	6925.20	I
30	H	6978.48	I
11	H	6979.82	I
7		7185.52	I
6	H	7236.20	I
85		7355.90	I
130		7400.21	I
150		7462.31	I
11	H	7942.04	I
5	H	8163.18	I
9		8348.28	I
6		8450.26	I
3		8455.24	I
6		8548.86	I
40		8947.15	I
19		8976.83	I

Cr III

Vacuum

Intensity	Wavelength (Å)	Spectrum
20	969.26	III
40	1000.86	III
40	1001.04	III
30	1002.96	III
50	1017.14	III
50	1017.31	III
50	1017.57	III
30	1028.33	III
60	1030.47	III
30	1030.89	III
50	1033.23	III
50	1033.45	III
100	1033.69	III
50	1035.93	III
100	1036.03	III
30	1040.17	III
40	1040.53	III
40	1045.06	III
40	1045.14	III
60	1059.13	III
60	1060.15	III
60	1061.04	III
50	1062.68	III
30	1064.32	III
30	1064.43	III

Intensity	Wavelength(Å)	Spectrum	Intensity	Wavelength (Å)	Spectrum
50	1066.23	III	80	2047.23	III
80	1068.41	III	100	2113.73	III
30	1100.61	III	100	2113.83	III
30	1101.43	III	50	2114.26	III
30	1102.88	III	50	2114.53	III
30	1117.19	III	100	2114.87	III
30	1132.75	III	100	2117.53	III
50	1136.67	III	80	2123.53	III
50	1161.43	III	80	2139.11	III
30	1187.65	III	100	2141.15	III
60	1206.38	III	80	2144.15	III
80	1209.13	III	50	2147.16	III
80	1211.12	III	50	2147.56	III
40	1221.07	III	50	2148.65	III
40	1221.90	III	50	2149.48	III
30	1225.65	III	50	2152.76	III
30	1228.65	III	100	2157.17	III
30	1231.88	III	50	2163.86	III
50	1232.96	III	60	2166.25	III
40	1236.20	III	100	2170.70	III
40	1238.51	III	50	2183.71	III
50	1252.61	III	100	2185.01	III
40	1259.02	III	50	2190.09	III
40	1261.86	III	100	2190.76	III
30	1262.34	III	100	2191.58	III
35	1263.61	III	100	2197.39	III
35	1264.21	III	100	2198.62	III
40	1287.05	III	100	2203.22	III
30	1455.27	III	60	2208.70	III
40	1584.60	III	200	2226.72	III
30	1603.19	III	100	2231.81	III
30	1679.25	III	100	2233.81	III
30	1690.28	III	200	2235.91	III
60	1692.89	III	150	2237.59	III
60	1696.64	III	150	2244.10	III
60	1701.48	III	80	2251.45	III
80	1707.43	III	50	2257.92	III
40	1707.78	III	100	2273.30	III
45	1762.81	III	80	2275.43	III
30	1766.92	III	100	2276.38	III
30	1769.17	III	80	2277.47	III
30	1827.26	III	150	2284.44	III
			50	2289.23	III
	Air		80	2290.66	III
			60	2295.55	III
60	2036.39	III	50	2309.99	III
50	2039.63	III	80	2314.63	III

Intensity	Wavelength(Å)	Spectrum
100	2319.07	III
150	2324.88	III
60	2340.51	III
50	2456.83	III
100	2472.88	III
100	2479.77	III
100	2483.06	III
60	2488.26	III
80	2506.41	III
80	2530.99	III
80	2537.73	III
80	2544.[illegible]7	III
50	2545.17	III
80	2564.76	III
80	2616.50	III
100	2626.08	III
100	2640.73	III
50	2647.50	III
40	2655.28	III
40	2916.57	III

Cr IV

Vacuum

Intensity	Wavelength (Å)	Spectrum
50	575.05	IV
30	576.24	IV
30	576.62	IV
30	595.09	IV
50	612.64	IV
40	613.75	IV
40	614.03	IV
40	614.90	IV
30	615.34	IV
30	615.60	IV
50	616.82	IV
40	618.23	IV
40	619.13	IV
100	620.66	IV
60	621.36	IV
40	622.09	IV
30	623.54	IV
40	625.04	IV
40	625.99	IV
100	629.26	IV
50	629.74	IV
80	630.30	IV
30	632.62	IV
30	637.34	IV
50	637.55	IV
50	638.13	IV
30	638.54	IV
100	666.55	IV
75	667.30	IV
40	677.55	IV
40	687.12	IV
50	688.46	IV
100	693.92	IV
50	695.21	IV
5[illegible]	705.98	IV
[illegible]0	712.90	IV
80	1055.89	IV
60	1057.85	IV
30	1367.39	IV
40	1375.05	IV
70	1401.82	IV
100	1417.42	IV
30	1485.05	IV
80	1595.04	IV
90	D 1595.59	IV
100	1658.08	IV
120	1672.66	IV
90	1686.07	IV
100	1690.88	IV
80	1725.26	IV
90	1727.07	IV
100	1732.04	IV
40	1733.98	IV
80	1734.16	IV
50	1739.19	IV
70	1746.88	IV
80	1747.13	IV
110	1755.64	IV
120	1758.51	IV
100	1769.64	IV
100	1777.82	IV
40	1791.09	IV
140	1802.72	IV
130	1812.41	IV
60	1819.23	IV
30	1826.21	IV
30	1826.86	IV
100	1840.14	IV

Intensity	Wavelength(Å)	Spectrum
50	1851.89	IV
100	1863.11	IV
140	1873.89	IV
35	1883.16	IV
40	1937.63	IV
30	1946.59	IV
140	1967.18	IV
120	1972.07	IV
40	1990.25	IV
	Air	
50 D	2042.91	IV
40	2055.73	IV
70	2299.21	IV
90	2299.59	IV
100	2316.85	IV
40	2324.06	IV
50	2360.40	IV
70	2405.15	IV
60	2423.32	IV
	Cr v	
	Vacuum	
100	438.62	v
100	464.02	v
50	469.64	v

Intensity	Wavelength (Å)	Spectrum
50	825.60	v
50	968.70	v
50	1045.04	v
60	1060.65	v
50	1112.45	v
60	1114.35	v
100	1116.48	v
80	1117.56	v
50	1118.16	v
150	1121.07	v
150	1127.63	v
100	1193.95	v
80	1196.04	v
50	1210.50	v
50	1259.99	v
100	1263.50	v
150	1465.86	v
50	1481.65	v
50	1482.76	v
50	1484.67	v
100	1489.71	v
150	1497.97	v
170	1519.03	v
220	1579.70	v
170	1591.72	v
150	1603.19	v
60	1638.50	v
50	1639.40	v
200	1837.44	v

C. Vacuum Ultraviolet Lines for Cr I through Cr XXIV (Wavelengths and Classifications)

C. Vacuum Ultraviolet Lines for Cr I through Cr XXIV

[Excerpted from: R. L. Kelly, J. Phys. Chem. Ref. Data 16, Supplement 1 (1987)]

The following tables, including the introductory comments, are excerpted from a new tabulation by R. L. Kelly,[1] which supersedes and revises his previous tables published with Palumbo in 1973.[2]

The listed wavelength data are generally from observations, with lines of the helium-like and hydrogen-like ions (Cr XXIII and Cr XXIV) as notable exceptions. But also in some cases where lines have been observed, wavelengths given here are those resulting from a comprehensive analysis of the spectrum rather than the measured values. A few lines have been predicted from unpublished extrapolations along isoelectronic sequences, and some unobserved weak lines in multiplets have been included for completeness. Such predicted values of wavelength are marked by the symbol P in the column labeled "Notes".

The lines are arranged in order of increasing wavelength within each spectrum, and the vacuum wavelengths are given as they are reported in the reference listed first for each line. A complete listing of these references is given at the end of these introductory comments. Where more than one publication reports the wavelength of the line, the decision as to which to retain was based primarily on the present author's judgement of the best value. This judgement was based on consideration of the dates of publication, on probable accuracy from the type of instrumentation used and the wavelength standards employed, on the spectroscopic source used, and on the comparison of the observations with the wavelengths predicted from the best known values of energy levels as described above.

With respect to the accuracy of the wavelength data, it is conservatively estimated that all wavelengths reported should have uncertainties of ten to twenty in the last digit given.

The listed intensities have been normalized to a maximum of 1000 for convenience in comparing the different references. The normalization procedure used was generally a linear or logarithmic transformation of the intensities reported by the original authors, depending on the particular case. Intensities given by different observers have seldom been found compatible, however, and the tabulated intensities should be used only as a rough estimate.

The transitions are shown in standard spectroscopic notation with the lower level given first, and the energy levels, i.e., energies above the ground state, are presented in units of $1000\,cm^{-1}$, each value being rounded off to conserve space. Additive uncertainties are indicated by B, C, K, etc. which may be thousands of cm^{-1}. The energy level data are taken from the files of the Naval Postgraduate School Spectroscopic Data Center (and thus do not necessarily agree with those tabulated in Section E of this book).

The multiplet numbers assigned by C. E. Moore[3] are given in a separate column. The classifications of the transitions are given in the accepted form, the primary references being the NBS spectroscopy tables.[3,4] For convenience, separate columns are used for showing the configurations, terms, and J-values. In the term column, the symbol g is used to denote the ground term. Otherwise, the term designation follows that of Cowan and Andrew.[5]

The parent terms are given where they are known and where they are not immediately obvious. The older practice of using primes, double primes, etc. to indicate that the parent term of a configuration is an excited state of the next higher ion has been abandoned. But the notation of a, b, c, ... (for even terms) and z, y, x, ... (for odd terms) to indicate the order of appearance of terms of the same multiplicity and same type has been continued.

A few descriptive symbols are used in the "Notes" column which have the following meanings:

- F – line is forbidden by electric dipole selection rules
- A – line observed in absorption
- Q – uncertain classification
- P – predicted value of wavelength

There are three classes of predicted lines:

(a) lines that have been observed but for which calculations of wavelengths from energy levels are superior to the observations as in hydrogenic spectra and in other specific transitions.

(b) lines which have not been observed but for which Ritz calculations between known levels can be made, as in many of the forbidden lines.

(c) lines for which one or both of the energy levels have been found by Hartree-Fock type calculations, by interpolation, or by extrapolation.

These three classes are not separately distinguished in the "Notes" column.

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CHROMIUM, Z = 24
Unclassified Lines

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	0	12.201						716
	0	12.329						716
	0	12.435						716
	0	12.589						716
	0	12.778						716
	10	13.217						716
	2	13.394						1089
		14.53						716
	10	14.775						716
	20	15.21						716
	10	15.680						716
	80	17.107						716
	100	205.82						256
	100	206.53						256
	300	210.16						256
	300	215.38						256
	300	217.19						256
	200	217.55						256
	200	217.61						256
	100	218.06						256
	100	218.15						256
	400	219.29						256
	200	219.94						256
	200	222.16						256
	300	226.89						256
		334.95						251
		380.7						251
		419.2						251

CHROMIUM I (Cr^{0+}), Z = 24
Ground State $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s(^7S_3)$ (24 electrons)
Ionization Potential 54 575.6 cm^{-1}; 6.7666 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1653.06	0.0 - 60.49342	$3d^5(a^6S)4s$ - $3d^4 4s(a^6D)6p$	ga^{7}S - q^{7}D°	3 - 3		490
	300	1747.14	0.0 - 57.23750	$3d^5(a^6S)4s$ - $3d^4 4s(a^6D)6p$	ga^{7}S - p^{7}F°	3 - 4		490
		1798.2					A	882
		1798.6					A	882
		1799.7					A	882
		1800.7					A	882
		1800.9					A	882
		1801.1					A	882
		1801.7					A	882
		1802.4					A	882
		1803.0					A	882
		1803.7					A	882

CR I — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		1805.2					A	882
		1805.4					A	882
		1806.5					A	882
		1807.7					A	882
		1808.4					A	882
		1809.7					A	882
		1810.4					A	882
		1812.2					A	882
		1813.7					A	882
		1815.9					A	882
		1818.4	0.0 - 54.99293	3d^5(a^{6}S)4s - 3d^5(a^{2}D)4p	a^{7}S - v^{5}F°	3 - 2	A	882
	1	1835.2	0.0 - 54.4900	3d^5(a^{6}S)4s - 3d^5(a^{6}S)38p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1835.4	0.0 - 54.4840	3d^5(a^{6}S)4s - 3d^5(a^{6}S)37p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1835.5	0.0 - 54.4806	3d^5(a^{6}S)4s - 3d^5(a^{6}S)36p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1835.7	0.0 - 54.4748	3d^5(a^{6}S)4s - 3d^5(a^{6}S)35p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1835.9	0.0 - 54.4685	3d^5(a^{6}S)4s - 3d^5(a^{6}S)34p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1836.2	0.0 - 54.4603	3d^5(a^{6}S)4s - 3d^5(a^{6}S)33p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1836.4	0.0 - 54.4534	3d^5(a^{6}S)4s - 3d^5(a^{6}S)32p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1836.7	0.0 - 54.4450	3d^5(a^{6}S)4s - 3d^5(a^{6}S)31p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1837.0	0.0 - 54.4361	3d^5(a^{6}S)4s - 3d^5(a^{6}S)30p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1837.4	0.0 - 54.4254	3d^5(a^{6}S)4s - 3d^5(a^{6}S)29p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1837.8	0.0 - 54.4135	3d^5(a^{6}S)4s - 3d^5(a^{6}S)28p	a^{7}S - ^{7}P°	3 - 4	A	882
	5	1838.2	0.0 - 54.4005	3d^5(a^{6}S)4s - 3d^5(a^{6}S)27p	a^{7}S - ^{7}P°	3 - 4	A	882
	5	1838.7	0.0 - 54.3855	3d^5(a^{6}S)4s - 3d^5(a^{6}S)26p	a^{7}S - ^{7}P°	3 - 4	A	882
	0	1839.1					A	882
	5	1839.3	0.0 - 54.3686	3d^5(a^{6}S)4s - 3d^5(a^{6}S)25p	a^{7}S - ^{7}P°	3 - 4	A	882
	5	1839.9	0.0 - 54.3508	3d^5(a^{6}S)4s - 3d^5(a^{6}S)24p	a^{7}S - ^{7}P°	3 - 4	A	882
	10	1840.69	0.0 - 54.3272	3d^5(a^{6}S)4s - 3d^5(a^{6}S)23p	a^{7}S - ^{7}P°	3 - 4		490
	10	1841.5	0.0 - 54.3036	3d^5(a^{6}S)4s - 3d^5(a^{6}S)22p	a^{7}S - ^{7}P°	3 - 4	A	882
	00	1842.4					A	882
	10	1842.6	0.0 - 54.2711	3d^5(a^{6}S)4s - 3d^5(a^{6}S)21p	a^{7}S - ^{7}P°	3 - 4	A	882
	00	1843.1					A	882
	5	1843.[illegible]	0.0 - 54.2388	3d^5(a^{6}S)4s - 3d^5(a^{6}S)20p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1844.6					A	882
	10	1845.1	0.0 - 54.1966	3d^5(a^{6}S)4s - 3d^5(a^{6}S)19p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1846.4					A	882
	10	1846.8	0.0 - 54.1477	3d^5(a^{6}S)4s - 3d^5(a^{6}S)18p	a^{7}S - ^{7}P°	3 - 4	A	882
	5	1847.2					A	882
	00	1847.3	0.0 - 54.13288	3d^5(a^{6}S)4s - 3d^{4}4s(a^{6}D)5p	a^{7}S - s^{7}P°	3 - 3	A	882
	10	1848.8	0.0 - 54.0890	3d^5(a^{6}S)4s - 3d^5(a^{6}S)17p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1849.5					A	882
	10	1851.3	0.0 - 54.0171	3d^5(a^{6}S)4s - 3d^5(a^{6}S)16p	a^{7}S - ^{7}P°	3 - 4	A	882
	10	1854.3	0.0 - 53.9280	3d^5(a^{6}S)4s - 3d^5(a^{6}S)15p	a^{7}S - ^{7}P°	3 - 4	A	882
	15	1858.2	0.0 - 53.8158	3d^5(a^{6}S)4s - 3d^5(a^{6}S)14p	a^{7}S - ^{7}P°	3 - 4	A	882
	5	1859.3	0.0 - 53.78277	3d^5(a^{6}S)4s - 3d^{4}4s(a^{6}D)5p	a^{7}S - s^{7}D°	3 - 4	A	882
	25	1863.2	0.0 - 53.6714	3d^5(a^{6}S)4s - 3d^5(a^{6}S)13p	a^{7}S - ^{7}P°	3 - 4	A	882
	1	1864.3	0.0 - 53.64074	3d^5(a^{6}S)4s - 3d^{4}4s(a^{6}D)5p	a^{7}S - s^{7}D°	3 - 3	A	882
	25	1869.7					A	882
	25	1869.8	0.0 - 53.4826	3d^5(a^{6}S)4s - 3d^5(a^{6}S)12p	a^{7}S - ^{7}P°	3 - 4	A	882
	50	1873.7					A	882
	1	1874.4					A	882
	1	1878.0					A	882
	50	1878.4					A	882
	1	1878.8	0.0 - 53.2268	3d^5(a^{6}S)4s - 3d^5(a^{6}S)11p	a^{7}S - ^{7}P°	3 - 4	A	882

CR I — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	5	1879.1					A	882
	5	1879.2					A	882
	50	1880.39	7.92747 - 61.10795	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - r^5P^\circ$	2 - 2		341
	250	1881.87	7.92747 - 61.06596	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - r^5P^\circ$	2 - 1		341
	1	1882.6	0.0 - 53.11754	$3d^5(a^6S)4s - 3d^4(a^5D)4s4p(^3P^\circ)$	$ga^7S - r^5F^\circ$	3 - 4	A	882
	50	1883.11	8.09521 - 61.19868	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - r^5P^\circ$	3 - 3		341
	1	1884.2	0.0 - 53.07390	$3d^5(a^6S)4s - 3d^4(a^5D)4s4p(^3P^\circ)$	$ga^7S - r^5F^\circ$	3 - 3	A	882
	00	1885.3					A	882
	50	1885.50	7.59316 - 60.62987	$3d^5(a^6S)4s - 3d^5(a^4D)4p$	$a^5S - s^5D^\circ$	2 - 2		490
	500	1886.34	8.09521 - 61.10795	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - r^5P^\circ$	3 - 2		341
	150	1887.60	7.92747 - 60.90484	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	2 - 3		341
	50	1887.85	7.81082 - 60.78125	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	1 - 2		341
	150	1888.17	8.09521 - 61.05641	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	3 - 4		341
	50	1889.20	7.75078 - 60.68353	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	0 - 1		341
	1	1890.0					A	882
	50	1890.4					A	882
	300	1890.78	8.30757 - 61.19577	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	4 - 5		341
		1891.4	0.0 - 52.8695	$3d^5(a^6S)4s - 3d^5(a^6S)10p$	$ga^7S - {}^7P^\circ$	3 - 4	P	375
	50	1892.01	7.92747 - 60.78125	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	2 - 2		341
	50	1892.8					A	882
	50	1893.59	8.09521 - 60.90484	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	3 - 3		341
	5	1894.2					A	882
	50	1895.78	8.30757 - 61.05641	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - o^5F^\circ$	4 - 4		341
	1	1896.9					A	882
	150	1902.43	7.81082 - 60.37494	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	1 - 2		341
	50	1903.30	7.75078 - 60.29104	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	0 - 1		341
	50	1903.57	8.09521 - 60.62796	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	3 - 4		341
	100	1906.67	7.92747 - 60.37494	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	2 - 2		341
	100	1907.28	7.81082 - 60.2415	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	1 - 0		341
	200	1908.46	8.09521 - 60.49342	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	3 - 3		341
	10[illegible]	1909.72	7.92747 - 60.29104	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	2 - 1		341
		1910.3	0.0 - 52.3488	$3d^5(a^6S)4s - 3d^5(a^6S)9p$	$ga^7S - {}^7P^\circ$	3 - 4	P	375
	350	1911.30	8.30757 - 60.62796	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	4 - 4		341
	200	1912.79	8.09521 - 60.37494	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	3 - 2		341
	100	1916.23	8.30757 - 60.49342	$3d^44s^2 - 3d^44s(a^6D)6p$	$a^5D - q^5D^\circ$	4 - 3		341
	10	1924.8					A	882
	15	1927.1					A	882
	10	1928.7					A	882
	10	1929.60	7.59316 - 59.41701	$3d^5(a^6S)4s - 3d^4(a^3F)4s4p(^1P^\circ)$	$a^5S - r^5F^\circ$	2 - 3		490
	50	1940.45	0.0 - 51.5344	$3d^5(a^6S)4s - 3d^5(a^6S)8p$	$ga^7S - v^7P^\circ$	3 - 4	A	882
	50	1940.56	0.0 - 51.5315	$3d^5(a^6S)4s - 3d^5(a^6S)8p$	$ga^7S - v^7P^\circ$	3 - 3	A	882
		1940.64	0.0 - 51.5294	$3d^5(a^6S)4s - 3d^5(a^6S)8p$	$ga^7S - v^7P^\circ$	3 - 2	A	882
49	40	1948.51	8.09521 - 59.41701	$3d^44s^2 - 3d^4(a^3F)4s4p(^1P^\circ)$	$a^5D - r^5F^\circ$	3 - 3		490
	10	1961.93						490
49	200	1989.05	7.92747 - 58.20265	$3d^44s^2 - 3d^5(a^4F)4p$	$a^5D - s^5F^\circ$	2 - 3	P	341
48	750	1989.92	7.81082 - 58.06380	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	1 - 2		341
48	400	1990.27	7.75078 - 57.99504	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	0 - 1		341
	750	1991.22	0.0 - 50.2210	$3d^5(a^6S)4s - 3d^5(a^6S)7p$	$ga^7S - {}^7P^\circ$	3 - 4		341,375
48	300	1992.12	8.09521 - 58.29262	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	3 - 4		341
48	250	1992.65	7.81082 - 57.99504	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	1 - 1		341
48	400	1994.10	7.81082 - 57.95842	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	1 - 0		341
48	750	1994.55	7.92747 - 58.06380	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	2 - 2		341
49	250	1995.69	8.09521 - 58.20265	$3d^44s^2 - 3d^5(a^4F)4p$	$a^5D - s^5F^\circ$	3 - 3		341
49	250	1997.09	8.09521 - 58.16789	$3d^44s^2 - 3d^5(a^4F)4p$	$a^5D - s^5F^\circ$	3 - 4		341

CR I — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
48	500	1997.30	7.92747 - 57.99504	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	2 - 1		341
48	600	1997.90	8.09521 - 58.14776	$3d^44s^2 - 3d^44s(a^6D)5p$	$a^5D - r^5D^\circ$	3 - 3		341

CHROMIUM II (Cr^{1+}), Z = 24
Ground State $1s^22s^22p^63s^23p^63d^5(^6S_{5/2})$ (23 electrons)
Ionization Potential 133 060 cm^{-1}; 16.4975 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1392.83	19.63128 - 91.42631	$3d^4(a^5D)4s - 3d^4(b^3P)4p$	$a^4D - u^2D^\circ$	1/2 - 3/2		490
	100	1406.90	20.02418 - 91.10336	$3d^4(a^5D)4s - 3d^4(b^3F)4p$	$a^4D - w^4G^\circ$	7/2 - 9/2		490
	40	1492.23	0.0 - 67.01228	$3d^5 - 3d^4(a^3P)4p$	$ga^6S - y^4F^\circ$	5/2 - 5/2		490
	20	1504.16	20.02418 - 86.50738	$3d^4(a^5D)4s - 3d^4(a^1F)4p$	$a^4D - v^2D^\circ$	7/2 - 5/2		490
	20	1604.82	11.96200 - 74.27348	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - w^4F^\circ$	1/2 - 3/2		490
	20	1606.67	12.05272 - 74.27348	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - w^4F^\circ$	3/2 - 3/2		490
	50	1626.85	25.04310 - 86.51108	$3d^5 - 3d^4(a^1F)4p$	$b^4D - v^2D^\circ$	3/2 - 3/2		490
	10	1657.18	31.08311 - 91.42631	$3d^4(a^3F)4s - 3d^4(b^3P)4p$	$a^4F - u^2D^\circ$	3/2 - 5/2		490
	10	1661.02	31.35115 - 91.55654	$3d^5 - 3d^4(b^3P)4p$	$a^2D - u^2D^\circ$	5/2 - 3/2		490
	20	1665.98	31.53162 - 91.55654	$3d^5 - 3d^4(b^3P)4p$	$a^2D - u^2D^\circ$	3/2 - 3/2		490
	70	1696.27	32.60373 - 91.55654	$3d^5 - 3d^4(b^3P)4p$	$a^2F - u^2D^\circ$	5/2 - 3/2		490
	10	1712.85	32.60373 - 90.98631	$3d^5 - 3d^4(b^3F)4p$	$a^2F - w^4G^\circ$	5/2 - 7/2		490
	70	1727.11	47.46494 - 105.3652	$3d^4(a^5D)4p - 3d^4(a^3G)5s$	$z^4F^\circ - f^4G$	9/2 - 9/2		490
	10	1727.78	25.04310 - 82.92003	$3d^5 - 3d^4(a^1D)4p$	$b^4D - w^2P^\circ$	1/2 - 3/2		490
	40	1729.79	25.04310 - 82.85400	$3d^5 - 3d^4(a^1D)4p$	$b^4D - w^2P^\circ$	1/2 - 1/2		490
	200	1736.63	33.52123 - 91.10336	$3d^4(a^3G)4s - 3d^4(b^3F)4p$	$b^4G - w^4G^\circ$	7/2 - 9/2		490
	20	1754.36	12.49679 - 69.49827	$3d^4(a^5D)4s - 3d^4(a^3G)4p$	$a^4D - x^4F^\circ$	7/2 - 9/2		490
224	40	1786.11	35.56902 - 91.55654	$3d^4(a^3F)4s - 3d^4(b^3P)4p$	$b^2F - u^2D^\circ$	5/2 - 3/2	P	340
	30	1789.24	21.82482 - 77.71366	$3d^5 - 3d^4(a^1S)4p$	$a^4P - x^2P^\circ$	3/2 - 3/2		490
224	40	1791.51	35.60760 - 91.42631	$3d^4(a^3F)4s - 3d^4(b^3P)4p$	$b^2F - u^2D^\circ$	7/2 - 5/2		340
	10	1794.47	12.14800 - 67.87568	$3d^4(a^5D)4s - 3d^4(a^3F)4p$	$a^4D - x^4D^\circ$	5/2 - 7/2		490
18	60	1808.66	19.63128 - 74.92080	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	1/2 - 1/2		340
	100	1810.08	12.14800 - 67.39380	$3d^4(a^5D)4s - 3d^4(a^3P)4p$	$a^4D - y^4F^\circ$	3/2 - 5/2		340
	20	1812.91	31.35115 - 86.51108	$3d^5 - 3d^4(a^1F)4p$	$a^2D - v^2D^\circ$	5/2 - 3/2	P	340
	20	1813.41	12.30398 - 67.44882	$3d^4(a^5D)4s - 3d^4(a^3P)4p$	$a^4D - y^4F^\circ$	7/2 - 9/2	P	340
	60	1815.32	19.63128 - 74.71805	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	1/2 - 3/2		340
	20	1818.89	31.53162 - 86.51108	$3d^5 - 3d^4(a^1F)4p$	$a^2D - v^2D^\circ$	3/2 - 3/2		340
	100	1819.77	12.49679 - 67.44882	$3d^4(a^5D)4s - 3d^4(a^3P)4p$	$a^4D - y^4F^\circ$	7/2 - 7/2	P	340
	20	1820.77	12.14800 - 67.07048	$3d^4(a^5D)4s - 3d^4(a^3P)4p$	$a^4D - y^4F^\circ$	3/2 - 3/2		490
18	80	1820.84	19.79801 - 74.71805	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	3/2 - 3/2		340
	160	1821.58	12.49679 - 67.39380	$3d^4(a^5D)4s - 3d^4(a^3P)4p$	$a^4D - y^4F^\circ$	7/2 - 5/2		340
	20	1823.07	19.63128 - 74.48425	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	1/2 - 3/2		340
4	60	1825.34	0.0 - 54.78467	$3d^5 - 3d^4(a^5D)4p$	$ga^6S - z^6D^\circ$	5/2 - 7/2		340
	20	1828.56	19.63128 - 74.31886	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - w^4F^\circ$	1/2 - 3/2		490
	60	1828.62	19.79801 - 74.48425	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	3/2 - 5/2		340
4	100	1830.61	0.0 - 54.62576	$3d^5 - 3d^4(a^5D)4p$	$ga^6S - z^6D^\circ$	5/2 - 5/2		340
18	240	1836.23	20.02418 - 74.48425	$3d^4(a^5D)4s - 3d^4(a^3D)4p$	$a^4D - x^4P^\circ$	7/2 - 5/2		340
33	500	1852.13	20.51275 - 74.50451	$3d^5 - 3d^4(a^3D)4p$	$a^4G - w^4F^\circ$	11/2 - 9/2		340
	30	1852.31	20.51833 - 74.50451	$3d^5 - 3d^4(a^3D)4p$	$a^4G - w^4F^\circ$	7/2 - 9/2		490
33	60	1852.37	20.51985 - 74.50451	$3d^5 - 3d^4(a^3D)4p$	$a^4G - w^4F^\circ$	9/2 - 9/2		340
	20	1854.46	20.51262 - 74.43614	$3d^5 - 3d^4(a^1G)4p$	$a^4G - x^2F^\circ$	5/2 - 7/2		340
	60	1854.68	20.51833 - 74.43614	$3d^5 - 3d^4(a^1G)4p$	$a^4G - x^2F^\circ$	7/2 - 7/2		340

CR II — Continued

Multiplet	Rel. Int.	λ_{air} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
33	400	1855.14	20.51985 – 74.42384	3d^5 – 3d^4(a^{3}D)4p	a^{4}G – w^{4}F°	[illegible]		340
33	400	1858.54	20.51262 – 74.31886	3d^5 – 3d^4(a^{3}D)4p	a^{4}G – w^{4}F°	[illegible]		340
33	300	1858.72	20.51833 – 74.31886	3d^5 – 3d^4(a^{3}D)4p	a^{4}G – w^{4}F°	[illegible]		340
33	240	1860.89	20.51262 – 74.27348	3d^5 – 3d^4(a^{3}D)4p	a^{4}G – w^{4}F°	[illegible]	P	340
	20	1865.80	20.51833 – 74.11448	3d^5 – 3d^4(a^{3}G)4p	a^{4}G – z^{2}F°	[illegible]		340
156	300	1866.22	32.35594 – 85.93950	3d^5 – 3d^4(a^{3}F)4p	a^{2}F – v^{2}G°	[illegible]		340
	20	1870.51	20.02418 – 73.48560	3d^4(a^{5}D)4s – 3d^4(a^{3}D)4p	a^{4}D – w^{4}D°	[illegible]	P	340
	60	1875.22	31.35115 – 84.67739	3d^5 – 3d^4(a^{3}F)4p	a^{2}D – u^{2}F°	[illegible]		340
156	200	1879.08	32.35594 – 85.57343	3d^5 – 3d^4(a^{3}F)4p	a^{2}F – v^{2}G°	[illegible]	P	340
	120	1881.06	21.82286 – 74.98493	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – y^{4}P°	[illegible]		340
40	200	1883.35	21.82425 – 74.92080	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – x^{4}P°	[illegible]		340
	20	1884.18	31.53162 – 84.60499	3d^5 – 3d^4(a^{3}F)4p	a^{2}D – u^{2}F°	[illegible]	P	340
	120	1887.96	20.51833 – 73.48560	3d^5 – 3d^4(a^{3}D)4p	a^{4}G – w^{4}D°	[illegible]		340
40	600	1890.55	21.82286 – 74.71805	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – x^{4}P°	[illegible]		340
40	700	1898.92	21.82286 – 74.48425	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – x^{4}P°	[illegible]		340
	30	1900.66	21.82286 – 74.43644	3d^5 – 3d^4(a^{3}G)4p	a^{4}P – x^{4}P°	[illegible]		490
	60	1907.40	12.49679 – 64.92630	3d^4(a^{5}D)4s – 3d^4(a^{3}F)4p	a^{4}D – y^{2}D°	[illegible]	P	340
155	140	1911.26	32.35594 – 84.67739	3d^5 – 3d^4(a^{3}F)4p	a^{2}F – u^{2}F°	[illegible]	P	340
	80	1918.30	20.51985 – 72.64879	3d^4(a [illegible])4p^2	a^{4}G – x^{4}G°	9/2 – 7/2		340
155	160	1923.02	32.60373 – 84.60499	3d^5 – 3d^4(a^{3}F)4p	a^{2}F – u^{2}F°	5/2 – 7/2		340
	10	1928.61	34.65948 – 86.51108	3d^4(a^{3}P)4s – 3d^4(a^{3}F)4p	a^{2}P – v^{2}D°	3/2 – 5/2		490
285	240	1929.96	39.74236 – 91.55654	3d^5 – 3d^4(b^{3}P)4p	c^{2}F – u^{2}D°	5/2 – 3/2		340
273	100	1932.64	39.68400 – 91.42631	3d^4(a^{1}G)4s – 3d^4(b^{3}P)4p	c^{2}G – u^{2}D°	7/2 – 5/2		340
39	500	1935.63	21.82286 – 73.48560	3d^5 – 3d^4([illegible])4p	a^{4}P – w^{4}D°	5/2 – 7/2	P	340
39	400	1937.56	21.82482 – 73.43627	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – w^{4}D°	3/2 – 5/2		340
39	60	1938.42	21.82286 – 73.41194	3d^5 – 3d^4(a^{3}D)4p	a^{4}P – w^{4}D°	5/2 – 3/2		340
136	120	1939.[illegible]5	31.35115 – 82.92003	3d^5 – 3d^4(a^{3}D)4p	a^{2}D – w^{2}P°	3/2 – 1/2		340
285	100	1939.[illegible]0	39.87728 – 91.42631	3d^5 – 3d^4(b^{3}P)4p	c^{2}F – u^{2}D°	7/2 – 5/2		340
136	200	1945.98	31.53162 – 82.92003	3d^5 – 3d^4(a^{3}D)4p	a^{2}D – w^{2}P°	5/2 – 3/2		340
136	200	1948.[illegible]7	31.53162 – 82.85400	3d^5 – 3d^4(a^{3}D)4p	a^{2}D – w^{2}P°	3/2 – 1/2	P	340
205	800	1949.10	34.63114 – 85.93950	3d^4(a^{3}H)4s – 3d^4(a^{3}F)4p	a^{2}H – v^{2}G°	9/2 – 9/2		340
272	700	1949.22	39.68400 – 90.98631	3d^4(a^{1}G)4s – 3d^4(b^{3}F)4p	c^{2}G – w^{2}G°	7/2 – 7/2		340
272	1000	1950.12	39.82452 – 91.10336	3d^4(a^{1}G)4s – 3d^4(b^{3}F)4p	c^{2}G – w^{2}G°	9/2 – 9/2	P	340
205	300	1955.[illegible]3	34.81306 – 85.93950	3d^4(a^{3}H)4s – 3d^4(a^{3}F)4p	a^{2}H – v^{2}G°	11/2 – 9/2		340
205	300	1963.[illegible]0	34.63114 – 85.57343	3d^4(a^{3}H)4s – 3d^4(a^{3}F)4p	a^{2}H – v^{2}G°	9/2 – 7/2		340
31	440	1985.42	20.51275 – 70.87995	3d^5 – 3d^4(a^{3}G)4p	a^{4}G – x^{4}G°	11/2 – 11/2	P	340
31	240	1985.6[illegible]	20.51985 – 70.87995	3d^5 – 3d^4(a^{3}G)4p	a^{4}G – x^{4}G°	9/2 – 11/2		340
	10	1987.19	19.63128 – 69.95420	3d^4(a^{5}D)4s – 3d^4(a^{3}P)4p	a^{4}D – y^{2}D°	1/2 – 3/2		490
154	100	1987.4[illegible]	32.60373 – 82.92003	3d^5 – 3d^4(a^{3}D)4p	a^{2}F – w^{2}P°	5/2 – 3/2		340
236	200	1990.7[illegible]	35.70766 – 85.93950	3d^5 – 3d^4(a^{3}F)4p	b^{2}H – v^{2}G°	11/2 – 9/2		340
31	300	1993.37	20.51275 – 70.67922	3d^5 – 3d^4(a^{3}G)4p	a^{4}G – x^{4}G°	11/2 – 9/2		340
31	500	1993.63	20.51985 – 70.67922	3d^5 – 3d^4(a^{3}G)4p	a^{4}G – x^{4}G°	9/2 – 9/2		340
	60	1996.62	20.02418 – 70.10783	3d^4(a^{5}D)4s – 3d^4(a^{3}F)4p	a^{4}D – y^{2}G°	7/2 – 9/2		340
204	40	1998.14	34.63114 – 84.67739	3d^4(a^{3}H)4s – 3d^4(a^{3}F)4p	a^{2}H – u^{2}F°	9/2 – 7/2		340

CHROMIUM III (Cr^{2+}), Z = 24
Ground State $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$ ($^5D_0$) (22 electrons)
Ionization Potential 249 700 cm^{-1}; 30.96 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	200	735.89						490
	80	748.35						490
	10	755.69						490
	1	756.567	17.16856 – 149.34408	$3d^4 - 3d^3(b^2D)4p$	$a^3P - {}^3F^o$	1 – 2		893
	1	763.107	18.58339 – 149.62630	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3F^o$	4 – 4		893
	10	767.30						490
	10	767.61						490
	20	767.83						490
	20	768.21	16.77136 – 146.93618	$3d^4 - 3d^3(b^2D)4p$	$a^3P - {}^3D^o$	0 – 1		490
	30	768.51	18.45184 – 148.57381	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3D^o$	2 – 2		490
	40	769.20						490
	30	769.66						490
	1	777.362	20.78364 – 149.34408	$3d^4 - 3d^3(b^2D)4p$	$a^3G - {}^3F^o$	3 – 2		893
	25	777.425	20.99604 – 149.62630	$3d^4 - 3d^3(b^2D)4p$	$a^3G - {}^3F^o$	5 – 4		893
	10	777.86						490
	10	778.026	20.85295 – 149.38364	$3d^4 - 3d^3(b^2D)4p$	$a^3G - {}^3F^o$	4 – 3		893
	40	778.165	18.58339 – 147.09073	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3D^o$	4 – 3		893
	4	778.306	18.45184 – 146.93618	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3D^o$	2 – 1		893
	25	778.438	18.51118 – 146.97333	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3D^o$	3 – 2		893
	10	779.43						490
	50	780.87						490
	40	781.42						490
	30	781.88						490
	20	782.26						490
	10	782.45						490
	10	788.032	25.13887 – 152.03721	$3d^4 - 3d^3(b^2D)4p$	$a^1G - {}^1F^o$	4 – 3		893
	30	788.90						490
	10	789.59						490
	10	789.81						490
	10	790.65						490
	4	794.246	25.78094 – 151.68744	$3d^4 - 3d^3(b^2D)4p$	$a^3D - {}^3P^o$	2 – 1		893
	10	796.025	25.72644 – 151.35127	$3d^4 - 3d^3(b^2D)4p$	$a^3D - {}^3P^o$	3 – 2		893
	10	798.31						490
	30	801.06						490
	10	814.71						490
	10	814.90						490
	10	815.40						490
	10	815.99						490
	10	816.57						490
	10	817.87						490
	20	821.74						490
	4	823.971	25.72644 – 147.09073	$3d^4 - 3d^3(b^2D)4p$	$a^3D - {}^3D^o$	3 – 3		893
	1	825.141	25.78094 – 146.97333	$3d^4 - 3d^3(b^2D)4p$	$a^3D - {}^3D^o$	2 – 2		893
	10	825.593	25.84831 – 146.97333	$3d^4 - 3d^3(b^2D)4p$	$a^3D - {}^3D^o$	1 – 2		893
	4	834.131	32.15199 – 152.03721	$3d^4 - 3d^3(b^2D)4p$	$a^1D - {}^1F^o$	2 – 3		893
	10	843.37						490
	10	845.90						490
	4	846.977	.35655 – 118.42299	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3D^o$	3 – 2		893
	10	866.19						490
	40	869.327	37.00516 – 152.03721	$3d^4 - 3d^3(b^2D)4p$	$a^1F - {}^1F^o$	3 – 3		893
	20	875.05	18.45184 – 132.73422	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3D^o$	2 – 1		490
	4	875.147	17.85118 – 132.11750	$3d^4 - 3d^3(a^2F)4p$	$a^3P - {}^3D^o$	2 – 3		893
	10	876.785	17.39692 – 131.45016	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3G^o$	5 – 5		893
	200	877.255	17.27370 – 131.26566	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3G^o$	4 – 4		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	90	877.807	17.53065 – 131.45016	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3G^\circ$	6 – 5		893
	90	878.203	17.39692 – 131.26566	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3G^\circ$	5 – 4		893
	60	878.407	17.27370 – 131.11636	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3G^\circ$	4 – 3		893
	50	883.00						490
	20	884.18						490
	25	886.007	18.58339 – 131.45016	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3G^\circ$	4 – 5		893
	4	886.879	18.51118 – 131.26566	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3G^\circ$	3 – 4		893
	4	887.588	18.45184 – 131.11636	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3G^\circ$	2 – 3		893
	10	888.25						490
	30	888.54	.57608 – 113.11521	$3d^4 - 3d^3(a^2G)4p$	$a^5D - {}^5G^\circ$	4 – 4		490
	80	889.33						490
	10	892.09						490
	10	894.86						490
	30	895.19						490
	4	896.310	37.80516 – 148.57381	$3d^4 - 3d^3(b^2D)4p$	$a^3F - {}^3D^\circ$	3 – 2		893
	50	896.82	17.27370 – 128.78413	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3F^\circ$	4 – 3		490
	4	897.229	17.39692 – 128.85049	$3d^4 - 3d^3(a^2F)4p$	$a^3H - {}^3F^\circ$	5 – 4		893
	4	901.454	17.85118 – 128.78413	$3d^4 - 3d^3(a^2F)4p$	$a^3P - {}^3F^\circ$	2 – 3		893
	250	904.479	20.70364 – 131.26566	$3d^4 - 3d^3(a^2F)4p$	$a^3G - {}^3G^\circ$	3 – 4		893
	60	905.354	20.99604 – 131.45016	$3d^4 - 3d^3(a^2F)4p$	$a^3G - {}^3G^\circ$	5 – 5		893
	90	905.688	20.85295 – 131.26566	$3d^4 - 3d^3(a^2F)4p$	$a^3G - {}^3G^\circ$	4 – 4		893
	30	905.92						490
	4	906.290	18.51118 – 128.85049	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3F^\circ$	3 – 4		893
	4	906.358	18.45184 – 128.78413	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3F^\circ$	2 – 3		893
	10	906.596	18.45184 – 128.75462	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3F^\circ$	2 – 2		893
	40	906.844	18.51118 – 128.78413	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3F^\circ$	3 – 3		893
	60	906.896	18.58339 – 128.85049	$3d^4 - 3d^3(a^2F)4p$	$a^3F - {}^3F^\circ$	4 – 4		893
	10	910.763	.35655 – 110.15489	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 – 4		893
	60	911.168	25.13887 – 134.88754	$3d^4 - 3d^3(a^2F)4p$	$a^1G - {}^1F^\circ$	4 – 3		893
	10	912.26						490
	120	912.587	.57608 – 110.15489	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	4 – 4		893
	60	912.911	.18316 – 109.72279	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 – 3		893
	10	913.172	.0622 – 109.57089	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 – 2		893
	30	913.75						490
	4	914.115	.0622 – 109.45811	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	1 – 0		893
	60	914.178	.18316 – 109.57089	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 – 2		893
	25	914.360	.35655 – 109.72279	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 – 3		893
	10	914.67						490
	20	915.02						490
	150	915.631	.35655 – 109.57089	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 – 2		893
	60	916.200	.57608 – 109.72279	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	4 – 3		893
	10	917.40						490
	20	917.75	.57608 – 109.53425	$3d^4 - 3d^3(a^2G)4p$	$a^5D - {}^5H^\circ$	4 – 4		490
	40	918.183	.0622 – 108.97290	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	1 – 2		893
	25	918.571	0. – 108.86498	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	0 – 1		893
	25	918.859	25.13887 – 133.96957	$3d^4 - 3d^3(a^2F)4p$	$a^1G - {}^1G^\circ$	4 – 4		893
	10	919.095	.0622 – 108.86498	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 – 1		893
	120	919.200	.18316 – 108.97290	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	2 – 2		893
	25	920.119	.18316 – 108.86498	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 – 1		893
	25	920.511	.0622 – 108.69763	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 – 0		893
4	90	920.699	.18316 – 108.79584	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	2 – 3		893
4	250	922.171	.35655 – 108.79584	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	3 – 3		893
4	120	922.517	.0622 – 108.46140	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	1 – 2		893
4	250	923.543	.18316 – 108.46140	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	2 – 2		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
4	150	923.704	0. - 108.25889	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	0 - 1		893
4	350	924.045	.57088 - 108.79584	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	4 - 3		893
4	300	924.310	.0622 - 108.25889	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	1 - 1		893
4	350	925.026	.35655 - 108.46140	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	3 - 2		893
27	25	925.237	20.70864 - 128.70413	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^o$	3 - 3		893
4	250	925.343	.18316 - 108.25889	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	2 - 1		893
27	250	925.487	20.70864 - 128.75462	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^o$	3 - 2		893
27	25	925.945	20.85295 - 128.85049	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^o$	4 - 4		893
27	300	926.510	20.85295 - 128.70413	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^o$	4 - 3		893
	90	926.703	43.44199 - 151.35127	$3d^4 - 3d^3(b^2D)4p$	$b^3P - {}^3F^o$	2 - 2		893
27	300	927.173	20.99606 - 128.85049	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^o$	5 - 4		893
	10	927.897	43.91609 - 151.68704	$3d^4 - 3d^3(b^2D)4p$	$b^3P - {}^3F^o$	1 - 1		893
	10	929.831	44.14136 - 151.68704	$3d^4 - 3d^3(b^2D)4p$	$b^3P - {}^3F^o$	0 - 1		893
	25	930.794	43.91609 - 151.35127	$3d^4 - 3d^3(b^2D)4p$	$b^3P - {}^3F^o$	1 - 2		893
	4	934.991	25.70804 - 132.73422	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 - 1		893
	40	935.575	25.84031 - 132.73422	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	1 - 1		893
	4	936.580	25.72644 - 132.49976	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 - 2		893
	90	937.040	25.70804 - 132.49976	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 - 2		893
	120	939.926	25.72644 - 132.11750	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 - 3		893
	200	940.304	43.28671 - 149.62630	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	4 - 4		893
	10	940.704	43.32217 - 149.62630	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	3 - 4		893
	40	942.534	43.28671 - 149.38364	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	4 - 3		893
	10	942.694	43.30453 - 149.38364	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	2 - 3		893
	150	942.849	43.32217 - 149.38364	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	3 - 3		893
	150	943.045	43.30453 - 149.34488	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	2 - 2		893
	40	943.204	43.32217 - 149.34488	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3F^o$	3 - 2		893
	100	953.94						490
	100	954.07						490
	150	963.352	43.28671 - 147.09073	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3D^o$	4 - 3		893
	25	963.683	43.32217 - 147.09073	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3D^o$	3 - 3		893
	25	964.615	43.30453 - 146.97333	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3D^o$	2 - 2		893
	120	964.770	43.32217 - 146.97333	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3D^o$	3 - 2		893
	90	964.956	43.30453 - 146.93618	$3d^4 - 3d^3(b^2D)4p$	$b^3F - {}^3D^o$	2 - 1		893
	4	965.295	17.85118 - 121.44677	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3S^o$	2 - 1		893
11	200	966.238	17.27370 - 120.76726	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	4 - 3		893
11	25	966.410	17.27370 - 120.74955	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	4 - 4		893
11	250	967.555	17.39692 - 120.74955	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	5 - 4		893
11	25	968.021	17.39692 - 120.70827	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	5 - 5		893
11	200	969.272	17.53066 - 120.70827	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	6 - 5		893
	120	969.703	25.72644 - 128.85049	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	3 - 4		893
	90	970.840	25.70804 - 128.70413	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	2 - 3		893
	60	971.758	25.84031 - 128.75462	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	1 - 2		893
	10	973.374	32.15199 - 134.88754	$3d^4 - 3d^3(a^2F)4p$	$a^3D - {}^3F^o$	2 - 3		893
	4	974.915	17.27370 - 119.84647	$3d^4 - 3d^3(a^2D)4p$	$a^3H - {}^3F^o$	4 - 3		893
	90	977.809	49.76065 - 152.09721	$3d^4 - 3d^3(b^2D)4p$	$b^3G - {}^3F^o$	4 - 3		893
	10	984.54	17.85118 - 119.42142	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3P^o$	2 - 2		490
	10	984.95	.57088 - 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	4 - 4		490
	4	985.189	17.39692 - 118.90053	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3G^o$	5 - 4		393
	10	986.250	16.77136 - 118.16515	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3D^o$	0 - 1		893
	60	987.530	.18316 - 101.44457	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^o$	2 - 2		893
	10	987.611	17.16856 - 118.42209	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3D^o$	1 - 2		893
	120	992.572	17.85118 - 118.59911	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3D^o$	2 - 3		893
	20	994.08						490
	40	994.313	17.85118 - 118.42209	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3D^o$	2 - 2		893

Cr III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	150	996.004	17.53065 – 117.92389	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3I^o$	6 – 7		893
	10	996.50	32.15199 – 132.49978	$3d^4 - 3d^3(a^2F)4p$	$a^3D - {}^3D^o$	2 – 2		490
	150	999.002	17.39692 – 117.40095	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3I^o$	5 – 6		893
26	150	999.363	20.70364 – 120.76726	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	3 – 3		893
26	10	999.541	20.70364 – 120.74955	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	3 – 4		893
19	150	999.837	18.58339 – 118.59911	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3D^o$	4 – 3		893
19	40	1000.291	18.45184 – 118.42299	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3D^o$	2 – 2		893
	40	1000.421	17.53065 – 117.40095	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3I^o$	6 – 6		893
	120	1000.813	32.15199 – 132.07071	$3d^4 - 3d^3(a^2F)4p$	$a^3D - {}^3D^o$	2 – 2		893
19	150	1000.882	18.51118 – 118.42299	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3D^o$	3 – 2		893
26	150	1001.028	20.85295 – 120.74955	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	4 – 4		893
	120	1001.277	17.27370 – 117.14585	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3I^o$	4 – 5		893
26	60	1001.531	20.85295 – 120.70027	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	4 – 5		893
26	40	1002.489	20.99604 – 120.74955	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	5 – 4		893
	25	1002.518	17.39692 – 117.14585	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3I^o$	5 – 5		893
19	200	1002.872	18.45184 – 118.16515	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3D^o$	2 – 1		893
26	200	1002.964	20.99604 – 120.70027	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3G^o$	5 – 5		893
	10	1003.213	16.77136 – 116.45119	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3S^o$	0 – 1		893
	90	1003.37						047
	90	1007.220	17.16856 – 116.45119	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3S^o$	1 – 1		893
	4	1008.647	20.70364 – 119.84647	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^o$	3 – 3		893
	1	1010.810	17.85118 – 116.78285	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3D^o$	2 – 2		893
	4	1010.888	17.85118 – 116.77400	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3D^o$	2 – 1		893
	10	1014.031	20.99604 – 119.61280	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3H^o$	5 – 5		893
	150	1014.193	17.85118 – 116.45119	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3S^o$	2 – 1		893
	60	1015.807	17.85118 – 116.37292	$3d^4 - 3d^3(a^2D)4p$	$a^3P - {}^3P^o$	2 – 1		893
18	40	1015.664	18.51118 – 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3F^o$	3 – 3		893
9	90	1015.770	17.39692 – 115.84458	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	5 – 6		893
9	150	1016.295	17.27370 – 115.67074	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	4 – 5		893
18	200	1016.405	18.58339 – 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3F^o$	4 – 3		893
	25	1016.983	18.45184 – 116.78285	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3D^o$	2 – 2		893
	60	1017.064	18.45184 – 116.77400	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3D^o$	2 – 1		893
9	500	1017.148	17.53065 – 115.84458	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	6 – 6		893
9	300	1017.304	17.27370 – 115.57196	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	4 – 4		893
9	400	1017.564	17.39692 – 115.67074	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	5 – 5		893
9	10	1018.594	17.39692 – 115.57196	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	5 – 4		893
9	10	1018.962	17.53065 – 115.67074	$3d^4 - 3d^3(a^2H)4p$	$a^3H - {}^3H^o$	6 – 5		893
	10	1019.60	18.45184 – 116.53295	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3D^o$	2 – 3	Q	490
	4	1019.914	20.85295 – 118.90053	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^1G^o$	4 – 4		893
	40	1020.181	18.51118 – 116.53295	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3D^o$	3 – 3		893
	40	1020.273	17.16856 – 115.18215	$3d^4 - 3d^3(a^2P)4p$	$a^3P - {}^3D^o$	1 – 2		893
	150	1020.929	18.58339 – 116.53295	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3D^o$	4 – 3		893
18	10	1021.029	18.45184 – 116.39166	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3F^o$	2 – 2		893
	4	1021.230	18.45184 – 116.37292	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3P^o$	2 – 1		893
18	150	1021.642	18.51118 – 116.39166	$3d^4 - 3d^3(a^2D)4p$	$a^3F - {}^3F^o$	3 – 2		893
	60	1023.512	17.85118 – 115.55428	$3d^4 - 3d^3(a^2P)4p$	$a^3P - {}^3D^o$	2 – 3		893
	40	1025.137	17.16856 – 114.71679	$3d^4 - 3d^3(a^2P)4p$	$a^3P - {}^3D^o$	1 – 1		893
3	200	1025.433	.18316 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^o$	2 – 3		893
	120	1026.369	17.16856 – 114.59914	$3d^4 - 3d^3(a^2P)4p$	$a^3P - {}^3P^o$	1 – 2		893
3	120	1027.456	.35655 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^o$	3 – 3		893
3	250	1028.336	.0622 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^o$	1 – 2		893
	120	1029.567	16.77136 – 113.89943	$3d^4 - 3d^3(a^2P)4p$	$a^3P - {}^3P^o$	0 – 1		893
3	90	1029.785	.57608 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^o$	4 – 3		893
	120	1029.835	18.45184 – 115.55428	$3d^4 - 3d^3(a^2P)4p$	$a^3F - {}^3D^o$	2 – 3		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
3	150	1030.092	0. - 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	0 - 1		893
2	400	1030.461	.57608 - 97.61908	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	4 - 5		893
3	40	1030.762	.0622 - 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 - 1		893
2	150	1030.890	.35665 - 97.35981	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	3 - 4		893
	120	1031.239	18.58339 - 115.55428	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	4 - 3		893
3	90	1031.466	.35665 - 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 - 2		893
2	80	1031.586	.18316 - 97.12142	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	2 - 3		893
3	25	1032.053	.18316 - 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 - 1		893
1	60	1032.421	.0622 - 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 - 2		893
2	350	1033.228	.57608 - 97.35981	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	4 - 4		893
1	90	1033.339	0. - 96.77438	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	0 - 1		893
2	350	1033.433	.35665 - 97.12142	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	3 - 3		893
	150	1033.606	17.85118 - 114.59914	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^\circ$	2 - 2		893
1	300	1033.693	.35665 - 97.09828	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 - 4		893
	90	1033.807	18.45184 - 115.18215	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	2 - 2		893
1	150	1033.996	.0622 - 96.77438	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 - 1		893
	120	1034.199	17.16856 - 113.86147	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^\circ$	1 - 0		893
	120	1034.428	18.51118 - 115.18215	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	3 - 2		893
1	150	1034.853	.0622 - 96.69397	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	1 - 0		893
	60	1035.031	25.78094 - 122.39649	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	2 - 1		893
	40	1035.212	17.16856 - 113.76713	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3D^\circ$	1 - 2		893
1	250	1035.261	.18316 - 96.77438	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 - 1		893
1	250	1035.565	.35665 - 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 - 2		893
2	200	1035.785	.57608 - 97.12142	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	4 - 3		893
1	350	1035.938	.18316 - 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	2 - 3		893
1	350	1036.035	.57608 - 97.09828	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	4 - 4		893
	250	1036.334	20.99604 - 117.48895	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3H^\circ$	5 - 6		893
1	250	1037.007	.35665 - 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	3 - 3		893
2	300	1038.163	.0622 - 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	1 - 2		893
24	90	1038.794	20.70364 - 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^\circ$	3 - 3		893
24	60	1038.976	20.85295 - 117.10158	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^\circ$	4 - 4		893
	20	1039.40						067
2	150	1040.046	0. - 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	0 - 1		893
1	150	1040.173	.57608 - 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5D^\circ$	4 - 3		893
24	150	1040.410	20.85295 - 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^\circ$	4 - 3		893
24	250	1040.521	20.99604 - 117.10158	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^\circ$	5 - 4		893
2	40	1040.723	.0622 - 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	1 - 1		893
	120	1040.811	20.70364 - 116.78205	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3D^\circ$	3 - 2		893
	90	1041.135	17.85118 - 113.89943	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^\circ$	2 - 1		893
2	120	1041.345	.35665 - 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	3 - 2		893
2	40	1042.036	.18316 - 95.14925	$3d^4 - 3d^3(a^4F)4p$	$a^5D - {}^5F^\circ$	2 - 1		893
	40	1042.578	17.85118 - 113.76713	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3D^\circ$	2 - 2		893
	60	1042.866	17.53065 - 113.41993	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3H^\circ$	6 - 5		893
	40	1043.389	17.27370 - 113.11521	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3G^\circ$	4 - 4		893
	25	1043.529	20.70364 - 116.53295	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3D^\circ$	3 - 3		893
	60	1044.729	17.39692 - 113.11521	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3G^\circ$	5 - 4		893
	400	1045.06	20.70364 - 116.39166	$3d^4 - 3d^3(a^2D)4p$	$a^3G - {}^3F^\circ$	3 - 2		490
	150	1045.150	20.85295 - 116.53295	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3D^\circ$	4 - 3		893
	1	1045.306	25.78094 - 121.44677	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3S^\circ$	2 - 1		893
	60	1045.719	25.13887 - 120.76726	$3d^4 - 3d^3(a^2H)4p$	$a^1G - {}^1G^\circ$	4 - 3		893
	25	1047.061	17.85118 - 113.35704	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3S^\circ$	2 - 2		893
	25	1049.152	18.45184 - 113.76713	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^1D^\circ$	2 - 2		893
	60	1050.494	17.27370 - 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3F^\circ$	4 - 3		893
	40	1051.532	17.27370 - 112.37288	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3F^\circ$	4 - 4		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	120	1051.985	37.88516 – 132.89871	$3d^4 - 3d^3(a\,^4F)4p$	$a\,^3F - ^3D°$	3 - 2		893
	40	1052.365	27.37232 – 122.39649	$3d^4 - 3d^3(a\,^4P)4p$	$a\,^1S - ^1P°$	0 - 1		893
	25	1052.901	17.39892 – 112.37288	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3F°$	5 - 4		893
	40	1054.080	18.45184 – 113.32080	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	2 - 3		893
	60	1054.093	20.78864 – 115.57196	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^3G - ^3H°$	3 - 4		893
	120	1054.313	20.99884 – 115.84458	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^3G - ^3H°$	5 - 6		893
	4	1054.451	18.58339 – 113.41993	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3H°$	4 - 5		893
	150	1054.655	20.85295 – 115.67894	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^3G - ^3H°$	4 - 5		893
	25	1055.659	18.58339 – 113.32080	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	4 - 3		893
	25	1055.763	20.85295 – 115.57196	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^3G - ^3H°$	4 - 4		893
	400	1055.885	25.13087 – 119.84647	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^1G - ^1F°$	4 - 3		893
	120	1056.131	26.01409 – 120.70827	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^1I - ^3G°$	6 - 5		893
	40	1056.250	20.99884 – 115.67894	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^3G - ^3H°$	5 - 5		893
	1	1057.041	18.51118 – 113.11521	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	3 - 4		893
	5	1057.30	17.27370 – 111.85097	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3G°$	4 - 5		490
	200	1057.800	18.58339 – 113.11521	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	4 - 4		893
	3	1058.63	17.39892 – 111.85097	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3G°$	5 - 5		047
	350	1059.316	26.01409 – 120.63299	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^1I - ^1I°$	6 - 6		893
8	400	1060.150	17.53065 – 111.85097	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3G°$	6 - 5		893
8	350	1061.035	17.39892 – 111.64676	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3G°$	5 - 4		893
	1	1062.475	25.72644 – 119.84647	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3F°$	3 - 3		893
8	300	1062.660	17.27370 – 111.37609	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3G°$	4 - 3		893
	40	1063.089	25.78094 – 119.84647	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3F°$	2 - 3		893
17	40	1063.663	18.45184 – 112.46701	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	2 - 3		893
17	300	1064.326	18.51118 – 112.46701	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	3 - 3		893
17	300	1064.422	18.45184 – 112.39986	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	2 - 2		893
17	90	1065.085	18.51118 – 112.39986	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	3 - 2		893
17	90	1065.152	18.58339 – 112.46701	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	4 - 3		893
17	40	1065.398	18.51118 – 112.37288	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	3 - 4		893
17	350	1066.213	18.58339 – 112.37288	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3F°$	4 - 4		893
	90	1066.356	25.84831 – 119.62562	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3P°$	1 - 0		893
	90	1066.531	25.13087 – 118.90053	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^1G - ^1G°$	4 - 4		893
	120	1067.145	25.78094 – 119.40902	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3P°$	2 - 1		893
	150	1067.289	25.72644 – 119.42142	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3P°$	3 - 2		893
	120	1067.910	25.78094 – 119.42142	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3P°$	2 - 2		893
	400	1068.401	26.01409 – 119.61280	$3d^4 - 3d^3(a\,^2H)4p$	$a\,^1I - ^1H°$	6 - 5		893
	1	1068.682	25.84831 – 119.42142	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3P°$	1 - 2		893
	20	1069.45						490
	60	1069.979	25.13087 – 118.99911	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^1G - ^3D°$	4 - 3		893
	30	1070.55	.35655 – 93.76621	$3d^4 - 3d^3(a\,^4F)4p$	$a\,^5D - ^5G°$	3 - 2		490
16	200	1072.114	18.58339 – 111.85097	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	4 - 5		893
16	150	1073.727	18.51118 – 111.64676	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	3 - 4		893
	10	1073.993	17.39892 – 110.90718	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3H - ^3H°$	5 - 6		893
16	60	1074.546	18.58339 – 111.64676	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	4 - 4		893
16	150	1076.147	18.45184 – 111.37609	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	2 - 3		893
	25	1076.641	17.27370 – 110.15489	$3d^4 - 3d^3(a\,^4P)4p$	$a\,^3H - ^3D°$	4 - 4		893
32	120	1076.746	25.72644 – 118.99911	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3D°$	3 - 3		893
16	10	1076.833	18.51118 – 111.37609	$3d^4 - 3d^3(a\,^2G)4p$	$a\,^3F - ^3G°$	3 - 3		893
32	10	1077.378	25.78094 – 118.99911	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3D°$	2 - 3		893
	10	1077.598	16.77136 – 109.57062	$3d^4 - 3d^3(a\,^4P)4p$	$a\,^3P - ^3P°$	0 - 1		893
32	40	1078.794	25.72644 – 118.42299	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3D°$	3 - 2		893
32	120	1079.423	25.78094 – 118.42299	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3D°$	2 - 2		893
	(-)	1079.97						490
32	10	1080.211	25.84831 – 118.42299	$3d^4 - 3d^3(a\,^2D)4p$	$a\,^3D - ^3D°$	1 - 2		893

Cr III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	150	1082.898	17.53065 – 109.94498	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3H^o$	6 – 5		893
	25	1082.231	17.16856 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^o$	1 – 1		893
32	25	1082.444	25.78094 – 118.16515	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3D^o$	2 – 1		893
32	90	1083.230	25.84031 – 118.16515	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3D^o$	1 – 1		893
	20	1083.72						490
	10	1083.889	17.27370 – 109.53425	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3H^o$	4 – 4		893
	20	1084.26						490
	20	1084.84						490
	40	1085.344	17.39692 – 109.53425	$3d^4 - 3d^3(a^2G)4p$	$a^3H - {}^3H^o$	5 – 4		893
	20	1085.96						490
	10	1087.70						490
	10	1088.28						490
	10	1089.30	17.16856 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^o$	1 – 2		490
	60	1089.761	20.70364 – 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3F^o$	3 – 3		893
	90	1090.202	17.85118 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^o$	2 – 1		893
	1	1090.564	20.70364 – 112.39904	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3F^o$	3 – 2		893
	25	1091.546	20.85295 – 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3F^o$	4 – 3		993
	60	1092.665	20.85295 – 112.37208	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3F^o$	4 – 4		893
	50	1093.17	16.77136 – 108.25000	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^o$	0 – 1		490
31	150	1094.387	25.72644 – 117.10158	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3F^o$	3 – 4		893
	60	1094.557	18.58339 – 109.94498	$3d^4 - 3d^3(a^2G)4p$	$a^3F - {}^3H^o$	4 – 5		893
31	40	1095.983	25.72644 – 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3F^o$	3 – 3		893
31	150	1096.644	25.78094 – 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3F^o$	2 – 3		893
	120	1096.899	65.76321 – 156.92993	$3d^4 - 3d^3(b^2D)4p$	$b^3D - {}^3F^o$	2 – 1		893
	100	1097.25	18.58339 – 109.72279	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^o$	4 – 3		490
	60	1097.438	17.85118 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3P^o$	2 – 2		893
	60	1098.231	25.72644 – 116.78205	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 – 2		893
	40	1098.626	18.51118 – 109.53425	$3d^4 - 3d^3(a^2G)4p$	$a^3F - {}^3H^o$	3 – 4		893
	25	1098.740	17.85118 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$a^3P - {}^3D^o$	2 – 1		893
	120	1098.888	25.78094 – 116.78205	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 2		893
	60	1098.989	25.78094 – 116.77480	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 1		893
	150	1099.454	32.15199 – 123.10584	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3D^o$	2 – 2		893
	90	1099.882	25.84031 – 116.77480	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	1 – 1		893
23	300	1100.585	20.99604 – 111.85697	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3G^o$	5 – 5		893
	90	1101.267	25.72644 – 116.53295	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 – 3		893
23	250	1101.422	20.85295 – 111.64676	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3G^o$	4 – 4		893
	120	1101.907	25.78094 – 116.53295	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 3		893
23	200	1102.869	20.70364 – 111.37689	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3G^o$	3 – 3		893
31	25	1103.630	25.78094 – 116.39166	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3F^o$	2 – 2		893
	4	1103.727	25.84031 – 116.45119	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3S^o$	1 – 1		893
31	150	1104.444	25.84031 – 116.39166	$3d^4 - 3d^3(a^2D)4p$	$a^3D - {}^3F^o$	1 – 2		893
	60	1104.672	20.85295 – 111.37689	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3G^o$	4 – 3		893
	90	1105.797	25.13887 – 115.57196	$3d^4 - 3d^3(a^2H)4p$	$a^3G - {}^3H^o$	4 – 4		893
	200	1108.898	32.15199 – 122.39649	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	2 – 1		893
	10	1112.60						490
30	250	1113.245	25.72644 – 115.55428	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 – 3		893
30	25	1113.921	25.78094 – 115.55428	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 3		893
22	250	1117.174	20.99604 – 110.50718	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3H^o$	5 – 6		893
30	60	1117.867	25.72644 – 115.18215	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	3 – 2		893
30	250	1118.541	25.78094 – 115.18215	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 2		893
30	25	1119.400	25.84031 – 115.18215	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	1 – 2		893
	25	1119.892	32.15199 – 121.44677	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3S^o$	2 – 1		893
	90	1121.399	43.32217 – 132.49978	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3D^o$	3 – 2		893
22	120	1122.43	20.85295 – 109.94498	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3H^o$	4 – 5		490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	90	1122.870	43.44199 – 132.49978	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3D^o$	2 – 2		893
	30	1123.37	20.70364 – 109.72279	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3D^o$	3 – 3		490
	150	1123.587	27.37232 – 116.37292	$3d^4 - 3d^3(a^2D)4p$	$a^1S - {}^1P^o$	0 – 1		893
30	40	1124.405	25.78094 – 114.71679	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 1		893
30	120	1125.257	25.84831 – 114.71679	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	1 – 1		893
22	300	1125.736	20.70364 – 109.53425	$3d^4 - 3d^3(a^2G)4p$	$a^3G - {}^3H^o$	3 – 4		893
	90	1125.902	25.78094 – 114.59914	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	2 – 2		893
	10	1126.35						490
	250	1127.706	43.44199 – 132.11750	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3D^o$	2 – 3		893
	90	1128.757	44.14136 – 132.73422	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3D^o$	0 – 1		893
	120	1128.878	43.91659 – 132.49978	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3D^o$	1 – 2		893
	150	1131.50						490
	150	1132.742	25.13887 – 113.41993	$3d^4 - 3d^3(a^2G)4p$	$a^1G - {}^1H^o$	4 – 5		893
	90	1133.913	25.13887 – 113.32880	$3d^4 - 3d^3(a^2G)4p$	$a^1G - {}^1F^o$	4 – 3		893
	60	1134.256	43.28671 – 131.45016	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3G^o$	4 – 5		893
	90	1136.535	25.78094 – 113.76713	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	2 – 2		893
	400	1136.666	25.13887 – 113.11521	$3d^4 - 3d^3(a^2G)4p$	$a^1G - {}^1G^o$	4 – 4		893
	10	1136.91						490
	90	1137.091	43.32217 – 131.26566	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3G^o$	3 – 4		893
	10	1137.408	25.84831 – 113.76713	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^o$	1 – 2		893
	90	1138.797	43.30453 – 131.11636	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3G^o$	2 – 3		893
	10	1139.024	43.32217 – 131.11636	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3G^o$	3 – 3		893
	10	1141.155	25.72644 – 113.35704	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3S^o$	3 – 2		893
	25	1142.226	25.78094 – 113.32880	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^1F^o$	2 – 3		893
	150	1143.63						490
	250	1144.096	26.01489 – 113.41993	$3d^4 - 3d^3(a^2G)4p$	$a^1I - {}^1H^o$	6 – 5		893
	200	1144.308	25.72644 – 113.11521	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^1G^o$	3 – 4		893
	300	1146.335	25.13887 – 112.37288	$3d^4 - 3d^3(a^2G)4p$	$a^1G - {}^3F^o$	4 – 4		893
29	40	1152.859	25.72644 – 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3F^o$	3 – 3		893
29	200	1153.580	25.78094 – 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3F^o$	2 – 3		893
29	200	1154.109	25.72644 – 112.37288	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3F^o$	3 – 4		893
29	25	1154.679	25.78094 – 112.39984	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3F^o$	2 – 2		893
29	150	1155.378	25.84831 – 112.39984	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3F^o$	1 – 2		893
	4	1155.710	27.37232 – 113.89943	$3d^4 - 3d^3(a^2P)4p$	$a^1S - {}^3P^o$	0 – 1		893
	20	1156.42						490
	25	1159.096	65.76321 – 152.03721	$3d^4 - 3d^3(b^2D)4p$	$b^1D - {}^1F^o$	2 – 3		893
	350	1161.428	37.00516 – 123.10584	$3d^4 - 3d^3(a^2D)4p$	$a^1F - {}^1D^o$	3 – 2		893
	10	1162.610	32.15199 – 118.16515	$3d^4 - 3d^3(a^2D)4p$	$a^1D - {}^3D^o$	2 – 1		893
	10	1166.23						490
	25	1168.292	25.78094 – 111.37609	$3d^4 - 3d^3(a^2G)4p$	$a^3D - {}^3G^o$	2 – 3		893
	120	1168.726	43.28671 – 128.85049	$3d^4 - 3d^3(a^2F)4p$	$b^3F - {}^3F^o$	4 – 4		893
	25	1169.208	43.32217 – 128.85049	$3d^4 - 3d^3(a^2F)4p$	$b^3F - {}^3F^o$	3 – 4		893
	90	1170.111	43.32217 – 128.78413	$3d^4 - 3d^3(a^2F)4p$	$b^3F - {}^3F^o$	3 – 3		893
	90	1170.273	43.30453 – 128.75462	$3d^4 - 3d^3(a^2F)4p$	$b^3F - {}^3F^o$	2 – 2		893
	30	1170.64						490
	40	1173.19						490
	50	1173.34						490
	100	1173.77						490
	300	1174.825	49.76865 – 134.88754	$3d^4 - 3d^3(a^2F)4p$	$b^1G - {}^1F^o$	4 – 3		893
	30	1178.55						490
	20	1178.80						490
	10	1178.99	32.15199 – 116.96909	$3d^4 - 3d^3(a^2D)4p$	$a^1D - {}^3F^o$	2 – 3		490
	30	1179.68						490
	4	1180.579	17.39692 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3F^o$	5 – 4		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	60	1180.81						490
	10	1181.03						490
	10	1181.45						490
	30	1181.63	32.15199 – 116.78285	$3d^4 - 3d^3(a^4P)4p$	$a^1D - {}^1D^o$	2 – 2		490
	90	1181.723	32.15199 – 116.77480	$3d^4 - 3d^3(a^4P)4p$	$a^1D - {}^1D^o$	2 – 1		893
	120	1186.254	32.15199 – 116.45119	$3d^4 - 3d^3(a^4P)4p$	$a^1D - {}^3S^o$	2 – 1		893
	150	1187.350	32.15199 – 116.37292	$3d^4 - 3d^3(a^2D)4p$	$a^1D - {}^3P^o$	2 – 1		893
	250	1187.637	49.76865 – 133.96957	$3d^4 - 3d^3(a^2F)4p$	$b^3G - {}^3G^o$	4 – 4		893
	150	1192.686	25.72644 – 109.57089	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3D^o$	3 – 2		893
	200	1193.466	25.78094 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	2 – 1		893
	10	1193.89	63.17430 – 146.93618	$3d^3(a^4P)4s - 3d^3(b^2D)4p$	${}^3P - {}^3D^o$	2 – 1		490
	30	1194.44	25.84831 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	1 – 1		490
	30	1194.96						490
	10	1195.42						490
	30	1196.04	25.84831 – 109.45811	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	1 – 0		490
15	90	1196.328	18.51118 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	3 – 4		893
15	500	1197.365	18.58339 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	4 – 4		893
	10	1197.60						490
	70	1198.31	65.89238 – 149.34403	$3d^3(a^2G)4s - 3d^3(b^2D)4p$	${}^3G - {}^3F^o$	3 – 2		490
15	120	1200.567	18.45184 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	2 – 3		893
	50	1200.91						490
	50	1201.00						490
	400	1201.247	25.72644 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	3 – 2		893
15	300	1201.426	18.51118 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	3 – 3		893
	60	1202.043	25.78094 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	2 – 2		893
15	120	1202.460	18.58339 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	4 – 3		893
	150	1203.604	25.78094 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3D^o$	2 – 1		893
	20	1203.95						490
	1	1204.375	32.15199 – 115.18215	$3d^4 - 3d^3(a^4P)4p$	$a^1D - {}^3D^o$	2 – 2		893
7	90	1204.440	17.39692 – 100.42301	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^o$	5 – 5		893
	60	1204.580	25.84831 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3D^o$	1 – 1		893
15	350	1204.929	18.45184 – 101.44457	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	2 – 2		893
	10	1205.15						490
15	120	1205.787	18.51118 – 101.44457	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^o$	3 – 2		893
	10	1206.12						490
7	570	1206.381	17.53065 – 100.42301	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^o$	6 – 5		893
	30	1206.70	49.62825 – 132.49978	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	${}^3F - {}^3D^o$	2 – 2		490
	20	1206.99	25.84831 – 108.69763	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3D^o$	1 – 0		490
	200	1207.017	25.84831 – 108.69763	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3D^o$	1 – 0		893
	200	1207.124	37.00516 – 119.84647	$3d^4 - 3d^3(a^2D)4p$	$a^1F - {}^1F^o$	3 – 3		893
7	90	1207.340	17.27370 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^o$	4 – 4		893
	350	1207.580	66.76321 – 148.57381	$3d^4 - 3d^3(b^2D)4p$	$b^1D - {}^1D^o$	2 – 2		893
	25	1208.684	25.72644 – 108.46140	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	3 – 2		893
7	500	1209.133	17.39692 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^o$	5 – 4		893
	10	1209.42	65.89238 – 148.57381	$3d^3(a^2G)4s - 3d^3(b^2D)4p$	${}^3G - {}^1D^o$	3 – 2		490
	10	1209.66	49.82891 – 132.49978	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	${}^3F - {}^3D^o$	3 – 2		490
7	400	1211.123	17.27370 – 99.84167	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^o$	4 – 3		893
	10	1211.84						490
	50	1212.98	49.62825 – 132.07071	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	${}^3F - {}^1D^o$	2 – 2		490
	50	1213.51	25.84831 – 108.25089	$3d^4 - 3d^3(a^4P)4p$	$a^3D - {}^3P^o$	1 – 1		490
	10	1213.82						490
	100	1218.60						490
	50	1218.89						490
	50	1219.55						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	200	1220.14						490
	350	1221.076	37.00516 – 118.90053	$3d^4 - 3d^3(a^2H)4p$	$a^1F - {}^1G°$	3 – 4		893
	10	1221.45						490
14	400	1221.908	18.58339 – 100.42301	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	4 – 5		893
	25	1223.266	32.15199 – 113.89943	$3d^4 - 3d^3(a^2F)4p$	$a^1D - {}^3P°$	2 – 1		893
	30	1224.43						490
	100	1225.02						490
	300	1225.263	32.15199 – 113.76713	$3d^4 - 3d^3(a^2F)4p$	$a^1D - {}^1D°$	2 – 2		893
	150	1225.32						490
14	300	1225.645	18.51118 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	3 – 4		893
	10	1226.18						490
14	150	1226.735	18.58339 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	4 – 4		893
	20	1227.11	27.37232 – 108.86498	$3d^4 - 3d^3(a^4F)4p$	$a^1S - {}^3D°$	0 – 1		490
	10	1228.03						490
	10	1228.37						490
14	350	1228.647	18.45184 – 99.84167	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	2 – 3		893
14	200	1229.552	18.51118 – 99.84167	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	3 – 3		893
	10	1230.35						490
	10	1230.49						490
21	250	1230.802	20.85295 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F°$	4 – 4		893
	510	1231.878	32.15199 – 113.32880	$3d^4 - 3d^3(a^2G)4p$	$a^1D - {}^1F°$	2 – 3		893
21	570	1232.975	20.99604 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F°$	5 – 4		893
	10	1233.28						490
21	200	1233.919	20.70364 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F°$	3 – 3		893
21	500	1236.197	20.85295 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F°$	4 – 3		893
	40	1236.424	27.37232 – 108.25089	$3d^4 - 3d^3(a^4F)4p$	$a^1S - {}^3P°$	0 – 1		893
	10	1236.51	70.98126 – 151.85212	$3d^3(a^2D)4s - 3d^3(b^2D)4p$	${}^3D - {}^3P°$	1 – 0		490
	10	1236.71						490
21	400	1238.529	20.70364 – 101.44457	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F°$	3 – 2		893
	20	1241.32						490
	10	1242.08						490
	20	1243.43						490
	25	1243.627	17.27370 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3D°$	4 – 3		893
	40	1243.97						490
	10	1244.41	71.67719 – 152.03721	$3d^3(a^2H)4s - 3d^3(b^2D)4p$	${}^3H - {}^3F°$	4 – 3		490
	100	1244.56	17.27370 – 97.61948	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^5F°$	4 – 5		490
	90	1245.097	32.15199 – 112.46701	$3d^4 - 3d^3(a^2G)4p$	$a^1D - {}^1F°$	2 – 3		893
6	200	1245.231	16.77136 – 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D°$	0 – 1		893
	100	1246.83						490
6	350	1247.846	17.16856 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D°$	1 – 2		893
	90	1248.621	17.53065 – 97.61948	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^5F°$	6 – 5		893
	20	1250.33						490
	20	1250.57	17.39692 – 97.35981	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^5F°$	5 – 4		490
6	250	1251.424	17.16856 – 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D°$	1 – 1		893
6	350	1252.616	17.85118 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D°$	2 – 3		893
	5	1253.87	17.16856 – 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^5D°$	1 – 2		490
	20	1256.066						067
20	150	1256.754	20.85295 – 100.42301	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G°$	4 – 5		893
6	250	1258.568	17.85118 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D°$	2 – 2		893
20	570	1259.014	20.99604 – 100.42301	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G°$	5 – 5		893
20	400	1259.487	20.70364 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G°$	3 – 4		893
	250	1259.794	16.77136 – 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^5F°$	0 – 1		893
	20	1261.53	17.85118 – 97.32142	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^5F°$	2 – 3		490
20	570	1261.864	20.85295 – 100.10066	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G°$	4 – 4		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
6	40	1262.229	17.85118 – 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D^\circ$	2 – 1		893
	250	1262.347	17.16856 – 96.30631	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3F^\circ$	1 – 2		893
13	200	1263.064	18.51118 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	3 – 3		893
20	300	1263.617	20.70364 – 99.84167	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G^\circ$	3 – 3		893
13	350	1264.206	18.58339 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	4 – 3		893
	200	1265.239	18.58339 – 97.61948	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^\circ$	4 – 5		893
20	40	1266.000	20.85295 – 99.84167	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G^\circ$	4 – 3		893
	300	1266.125	17.16856 – 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3F^\circ$	1 – 1		893
	40	1266.551	43.44199 – 122.39649	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3P^\circ$	2 – 1		893
5	250	1268.025	17.85118 – 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3D^\circ$	2 – 3		893
13	60	1268.148	18.45184 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	2 – 2		893
13	400	1269.110	18.51118 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	3 – 2		893
13	250	1271.839	18.45184 – 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	2 – 1		893
	200	1273.312	17.85118 – 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3F^\circ$	2 – 2		893
	150	1275.34	18.51118 – 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	3 – 2		047
	200	1276.76	18.45184 – 96.77438	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	2 – 1		047
	25	1277.174	17.85118 – 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3P - {}^3F^\circ$	2 – 1		893
12	20	1278.71	18.51118 – 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	3 – 3		490
12	250	1279.906	18.58339 – 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3D^\circ$	4 – 3		893
	1	1281.055	71.32327 – 149.38364	$3d^3(a^2D)4s - 3d^3(b^2D)4p$	${}^3D - {}^3F^\circ$	2 – 3		893
	300	1281.977	43.44199 – 121.44677	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3S^\circ$	2 – 1		893
	60	1283.132	18.45184 – 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^\circ$	2 – 2		893
	200	1284.103	18.51118 – 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^\circ$	3 – 2		893
	10	1284.46						490
	10	1285.90						490
	400	1287.05	18.45184 – 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3F^\circ$	2 – 1		490
	250	1289.824	43.91659 – 121.44677	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3S^\circ$	1 – 1		893
37	300	1290.940	43.30453 – 120.76726	$3d^4 - 3d^3(a^2H)4p$	$b^3F - {}^3G^\circ$	2 – 3		893
37	60	1291.240	43.32217 – 120.76726	$3d^4 - 3d^3(a^2H)4p$	$b^3F - {}^3G^\circ$	3 – 3		893
37	350	1291.531	43.32217 – 120.74955	$3d^4 - 3d^3(a^2H)4p$	$b^3F - {}^3G^\circ$	3 – 4		893
37	400	1291.763	43.28671 – 120.70027	$3d^4 - 3d^3(a^2H)4p$	$b^3F - {}^3G^\circ$	4 – 5		893
	200	1293.569	44.14136 – 121.44677	$3d^4 - 3d^3(a^4F)4p$	$b^3P - {}^3S^\circ$	0 – 1		893
	40	1296.01						490
	40	1299.56						490
	20	1302.45						490
	4	1302.739	37.00516 – 113.76713	$3d^4 - 3d^3(a^2P)4p$	$a^1F - {}^1D^\circ$	3 – 2		893
	5	1302.85	17.27370 – 94.02999	$3d^4 - 3d^3(a^4F)4p$	$a^3H - {}^3G^\circ$	4 – 3		490
	40	1303.47						490
	25	1305.088	20.99604 – 97.61948	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3F^\circ$	5 – 5		893
	10	1306.168	43.28671 – 119.84647	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^\circ$	4 – 3		893
	25	1306.479	43.30453 – 119.84647	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^\circ$	2 – 3		893
	100	1307.24						490
	10	1307.47						490
	60	1307.64						490
	150	1308.27						490
28	350	1309.348	25.72644 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	3 – 4		893
	60	1310.179	43.28671 – 119.61280	$3d^4 - 3d^3(a^2H)4p$	$b^3P - {}^3H^\circ$	4 – 5		893
	150	1314.968	43.44199 – 119.48902	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^\circ$	2 – 1		893
28	60	1315.450	25.72644 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	3 – 3		893
	350	1316.151	43.44199 – 119.42142	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^\circ$	2 – 2		893
28	300	1316.306	25.78094 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	2 – 3		893
	60	1320.844	43.91659 – 119.62562	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^\circ$	1 – 0		893
28	40	1321.639	25.78094 – 101.44497	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	2 – 2		893
28	250	1322.819	25.84031 – 101.44497	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	1 – 2		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1323.240	43.91659 - 119.40902	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^o$	1 - 1		893
	250	1324.415	43.91659 - 119.42142	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^o$	1 - 2		893
	40	1327.180	44.14136 - 119.40902	$3d^4 - 3d^3(a^2D)4p$	$b^3P - {}^3P^o$	0 - 1		893
	120	1327.806	43.28671 - 118.59911	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3D^o$	4 - 3		893
	25	1328.421	43.32217 - 118.59911	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3D^o$	3 - 3		893
	10	1328.78	18.51118 - 93.76621	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G^o$	3 - 2		490
	20	1329.11						490
	20	1329.29						490
	25	1331.224	43.30453 - 118.42299	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3D^o$	2 - 2		893
	150	1331.543	43.32217 - 118.42299	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3D^o$	3 - 2		893
	10	1341.17						490
	40	1342.24						490
	100	1345.12						490
	70	1345.46						490
	10	1351.94						490
	10	1354.16						490
36	25	1354.735	43.28671 - 117.10158	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^o$	4 - 4		893
	10	1356.25						490
	20	1356.86						490
36	200	1357.180	43.28671 - 116.96909	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^o$	4 - 3		893
	20	1357.69						490
36	5	1357.85	43.32217 - 116.96909	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^o$	3 - 3		490
	30	1358.65						490
	20	1358.75						490
	60	1360.40						490
	20	1360.56						490
	40	1360.960	43.30453 - 116.78205	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	2 - 2		893
	250	1361.106	43.30453 - 116.77400	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	2 - 1		893
	300	1361.276	43.32217 - 116.78205	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	3 - 2		893
	50	1362.85						490
	20	1363.73	20.70364 - 94.02999	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G^o$	3 - 3		490
	50	1364.26						490
	40	1365.06						490
	300	1365.257	43.28671 - 116.53295	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	4 - 3		893
	60	1365.921	43.32217 - 116.53295	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	3 - 3		893
	70	1366.06						490
	120	1366.63						490
	20	1366.88						490
	40	1367.13	43.30453 - 116.45119	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3S^o$	2 - 1		490
36	20	1368.23	43.30453 - 11o.39166	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^o$	2 - 2		490
36	200	1368.563	43.32217 - 116.39166	$3d^4 - 3d^3(a^2D)4p$	$b^3F - {}^3F^o$	3 - 2		893
	20	1370.20						490
	20	1370.74						490
	60	1372.27						490
	10	1374.91						490
	60	1376.800	44.14136 - 116.77400	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3D^o$	0 - 1		893
	30	1381.67						490
	100	1382.19						490
35	350	1383.749	43.28671 - 115.55428	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3D^o$	4 - 3		893
35	60	1384.420	43.32217 - 115.55428	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3D^o$	3 - 3		893
	10	1385.07						490
	40	1388.13						490
	20	1388.24						490
	70	1389.55	37.00516 - 108.97290	$3d^4 - 3d^3(a^4P)4p$	$a^3F - {}^3P^o$	3 - 2		490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	250	1389.699	25.72644 - 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	3 - 3		893
	120	1390.760	25.78094 - 97.68399	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	2 - 3		893
35	40	1391.247	43.30453 - 115.18215	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3D^\circ$	2 - 2		893
35	250	1391.580	43.32217 - 115.18215	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3D^\circ$	3 - 2		893
	10	1391.78						490
	100	1392.40	49.62825 - 121.44677	$3d^3(a^4F)4s - 3d^3(a^4P)4p$	${}^5F - {}^5S^\circ$	2 - 1		490
	10	1393.00						490
	10	1393.22						490
	10	1393.98						490
	100	1394.33						490
	70	1394.58						490
	10	1396.26						490
	100	1396.42						490
	30	1396.63						490
	60	1397.033	25.72644 - 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	3 - 2		893
	30	1397.40						490
	10	1397.69						490
	30	1397.90						490
	150	1398.090	25.78094 - 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	2 - 2		893
	100	1399.05						490
	60	1399.415	25.84831 - 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	1 - 2		893
	25	1400.036	57.42340 - 128.85009	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	${}^3F - {}^3F^\circ$	4 - 4		893
35	250	1400.316	43.30453 - 114.71679	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3D^\circ$	2 - 1		893
	10	1400.62	25.72644 - 97.12142	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	3 - 3		490
	10	1400.72						490
	100	1401.55						490
	30	1402.07						490
	10	1402.589	25.78094 - 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	2 - 1		893
	40	1402.985	43.32217 - 114.59914	$3d^4 - 3d^3(a^2P)4p$	$b^3F - {}^3P^\circ$	3 - 2		893
	10	1403.200	43.91659 - 115.18215	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3D^\circ$	1 - 2		893
	70	1403.42						490
	120	1403.906	25.84831 - 97.07796	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	1 - 1		893
	10	1404.50						490
	30	1405.37	43.44199 - 114.59914	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3P^\circ$	2 - 2		490
	40	1405.657	25.78094 - 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	2 - 2		893
	20	1405.72	49.62825 - 120.76726	$3d^3(a^4F)4s - 3d^3(a^2H)4p$	${}^5F - {}^3G^\circ$	2 - 3		490
	40	1406.31						490
	10	1407.22						490
	40	1407.89						490
	10	1408.477	49.76065 - 120.76726	$3d^4 - 3d^3(a^2H)4p$	$b^3G - {}^3G^\circ$	4 - 3		893
	120	1408.688	25.72644 - 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	3 - 3		893
	10	1409.10						490
	90	1409.796	25.78094 - 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	2 - 3		893
	20	1410.03	49.82891 - 120.74955	$3d^3(a^4F)4s - 3d^3(a^2H)4p$	${}^5F - {}^3G^\circ$	3 - 4		490
	20	1410.82						490
	10	1411.53	25.84831 - 96.69397	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3D^\circ$	1 - 0		490
	30	1412.67						490
	10	1413.32						490
	40	1413.77						490
	50	1414.62						490
	10	1414.780	43.91659 - 114.59914	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3P^\circ$	1 - 2		893
	60	1415.235	25.72644 - 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	3 - 2		893
	10	1415.81						490
	90	1416.315	25.78094 - 96.38631	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^\circ$	2 - 2		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	70	1417.13						490
	25	1417.667	25.84831 - 96.30631	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	1 - 2		893
	10	1419.794	43.44199 - 113.89943	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3P^o$	2 - 1		893
	100	1420.81						490
	40	1421.091	25.78094 - 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	2 - 1		893
	50	1421.20						490
	10	1421.80						490
	40	1422.47	25.84831 - 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^3F^o$	1 - 1		490
	20	1422.5[illegible]						490
	10	1425.30						490
	200	1426.988	49.76865 - 119.84647	$3d^4 - 3d^3(a^2D)4p$	$b^3G - {}^3F^o$	4 - 3		893
	10	1427.20						490
	10	1427.71	43.28671 - 113.32880	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	4 - 3		490
	10	1428.46	43.32217 - 113.32880	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	3 - 3		490
	50	1429.04						490
	50	1429.17						490
	10	1429.703	43.91659 - 113.86147	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3P^o$	1 - 0		893
	4	1430.023	49.49246 - 119.42142	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	${}^3F - {}^3P^o$	1 - 2		893
	30	1430.15						490
	50	1430.42						490
	1	1431.620	43.91659 - 113.76713	$3d^4 - 3d^3(a^2P)4p$	$b^3P - {}^3D^o$	1 - 2		893
	250	1431.758	49.76865 - 119.61280	$3d^4 - 3d^3(a^2H)4p$	$b^3G - {}^3H^o$	4 - 5		893
	50	1433.26						490
	10	1434.19						490
	20	1436.65						490
	70	1437.17						490
	20	1437.76						490
	10	1438.03						490
	5	1438.90						490
	60	1441.06						490
	50	1441.90						490
	10	1442.78						490
	20	1443.08						490
	60	1443.82						490
	1	1444.305	25.13887 - 94.37629	$3d^4 - 3d^3(a^4F)4p$	$a^3G - {}^3G^o$	4 - 4		893
	20	1444.84						490
	10	1445.876	43.30453 - 112.46701	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	2 - 3		893
	90	1446.247	43.32217 - 112.46701	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	3 - 3		893
	300	1446.511	49.76865 - 118.90053	$3d^4 - 3d^3(a^2H)4p$	$b^3G - {}^3G^o$	4 - 4		893
	250	1446.673	65.76321 - 134.88754	$3d^4 - 3d^3(a^2P)4p$	$b^3D - {}^3F^o$	2 - 3		893
	40	1447.284	43.30453 - 112.39984	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	2 - 2		893
	20	1447.50	43.28671 - 112.37288	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	4 - 4		490
	4	1448.221	43.32217 - 112.37288	$3d^4 - 3d^3(a^2G)4p$	$b^3F - {}^3F^o$	3 - 4		893
	20	1449.89	49.62825 - 118.59911	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	${}^3F - {}^3D^o$	2 - 3		490
	5	1450.22						490
	10	1450.52						490
	80	1451.95						490
	50	1454.00	27.37232 - 96.14925	$3d^4 - 3d^3(a^4F)4p$	$a^1S - {}^3F^o$	0 - 1		490
	30	1457.22						490
	10	1458.17						490
	80	1458.41						490
	30	1462.12						490
	10	1463.87						490
	20	1467.04						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	50	1467.68						490
	50	1468.05						490
	50	1469.55						490
	10	1470.60						490
	60	1471.842	63.17430 - 131.11636	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	$^3P - ^3G^\circ$	2 - 3		893
	20	1472.45						490
	30	1473.32						490
	10	1473.82						490
	50	1476.06						490
	10	1477.49						490
	20	1478.08						490
	20	1478.64						490
	100	1480.16						490
	20	1483.11						490
	10	1483.45						490
	50	1483.75						490
	10	1484.39						490
	10	1486.02						490
	10	1486.54						490
	40	1487.03						490
	10	1487.86						490
	20	1488.72						490
	20	1489.10	49.62825 - 116.78205	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3F - ^3D^\circ$	2 - 2		490
	20	1489.35						490
	40	1489.93						490
	20	1491.50						490
	40	1492.05						490
	50	1492.98						490
	10	1493.462	49.49246 - 116.45119	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	$^3F - ^3S^\circ$	1 - 1		893
	10	1493.68						490
	50	1494.45						490
	20	1495.01						490
	20	1495.21	49.49246 - 116.37292	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3P^\circ$	1 - 1		490
	20	1495.36						490
	10	1496.47	49.62825 - 116.45119	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	$^3F - ^3S^\circ$	2 - 1		490
	30	1501.38	65.89238 - 132.49978	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	$^3G - ^3D^\circ$	3 - 2		490
	30	1502.87						490
	30	1503.65						490
	100	1505.76						490
	10	1506.82						490
	10	1506.95						490
	30	1507.93						490
	200	1508.122	65.76321 - 132.07071	$3d^4 - 3d^3(a^2F)4p$	$b^3D - ^3D^\circ$	2 - 2		893
	4	1508.740	43.44199 - 109.72279	$3d^4 - 3d^3(a^4F)4p$	$b^3P - ^3D^\circ$	2 - 3		893
	30	1509.31						490
	10	1510.05	65.89238 - 132.11750	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	$^3G - ^3D^\circ$	3 - 3		490
	10	1510.62						490
	80	1511.78						490
	300	1512.205	43.44199 - 109.57062	$3d^4 - 3d^3(a^4F)4p$	$b^3P - ^3P^\circ$	2 - 1		893
	10	1513.18	66.03001 - 132.11750	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	$^3G - ^3D^\circ$	4 - 3		490
	10	1513.39						490
	20	1515.01						490
	80	1515.44						490
	20	1517.43	49.76866 - 115.67074	$3d^4 - 3d^3(a^2H)4p$	$b^3G - ^3H^\circ$	4 - 5		490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	20	1517.85						490
	40	1518.48						490
	10	1519.66	49.76865 – 115.57196	$3d^4 - 3d^3(a^2H)4p$	$b^3G - {}^3H^o$	4 – 4		490
	70	1520.01						490
	40	1520.79						490
	10	1521.29						490
	30	1521.59						490
	5	1522.29	49.49246 – 115.18215	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	${}^5F - {}^3D^o$	1 – 2		490
	200	1523.133	43.91659 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3P^o$	1 – 1		893
	80	1523.21	43.32217 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3P^o$	3 – 2		490
	20	1524.65						490
	10	1525.27	43.30453 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$b^3F - {}^3D^o$	2 – 1		490
	5	1525.42	49.62825 – 115.18215	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	${}^5F - {}^3D^o$	2 – 2		490
	150	1525.751	43.91659 – 109.45811	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3P^o$	1 – 0		893
	250	1525.993	43.44199 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3P^o$	2 – 2		893
	90	1528.362	44.14136 – 109.57062	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3P^o$	0 – 1		893
	120	1528.517	43.44199 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3D^o$	2 – 1		893
	20	1528.91						490
	20	1529.16						490
	5	1530.59	63.42192 – 128.75462	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	${}^3P - {}^3F^o$	3 – 2		490
	20	1532.09						490
	40	1532.517	84.37412 – 149.62630	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	${}^3F - {}^3F^o$	4 – 4		893
	4	1532.906	66.03001 – 131.26566	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	${}^3G - {}^3G^o$	4 – 4		893
	90	1533.094	69.65974 – 134.88754	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	${}^1G - {}^1F^o$	4 – 3		893
	4	1533.176	66.22509 – 131.45016	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	${}^3G - {}^3G^o$	5 – 5		893
	80	1534.09						490
	10	1534.40						490
	10	1535.66						490
	1	1536.201	37.00516 – 102.10076	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^5F^o$	3 – 4		893
	150	1537.133	43.91659 – 108.97290	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3P^o$	1 – 2		893
	40	1537.997	43.44199 – 108.46140	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^5P^o$	2 – 2		893
	10	1538.43	94.80170 – 159.8033	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	${}^5G^o - f^5F$	5 – 4		490
	30	1539.70	43.91659 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3D^o$	1 – 1		490
	90	1540.865	84.48476 – 149.38364	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	${}^3F - {}^3F^o$	3 – 3		893
	10	1541.57						490
	10	1542.52						490
	150	1543.665	43.91659 – 108.69763	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^5D^o$	1 – 0		893
	4	1543.884	84.57253 – 149.34403	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	${}^3F - {}^1F^o$	2 – 2		893
	120	1545.031	44.14136 – 108.86498	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^3D^o$	0 – 1		893
	30	1546.34						490
	30	1546.55						490
	30	1547.05						490
	20	1548.86	32.15199 – 96.71404	$3d^4 - 3d^3(a^4F)4p$	$a^3D - {}^5D^o$	2 – 3		490
	10	1549.306	43.91659 – 108.46140	$3d^4 - 3d^3(a^4P)4p$	$b^3P - {}^5P^o$	1 – 2		893
	20	1550.09						490
	10	1550.94						490
	50	1551.43						490
	40	1552.31						490
	10	1552.95						490
	40	1553.30						490
	50	1553.38						490
	30	1554.71						490
	30	1555.94	49.62825 - 113.89943	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	${}^5F - {}^3P^o$	2 - 1		490
	30	1557.01						490

CR III — Continued

Multiplet	Rel. Int.	λ_{air} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	30	1558.14						490
	10	1559.67	56.65137 – 120.76726	$3d^3(a^4F)4s$ – $3d^3(a^2H)4p$	^5F – $^3G^o$	2 – 3		490
	10	1561.72	109.53425 – 173.5659	$3d^3(a^2G)4p$ – $3d^3(a^2H)4d$	$^3H^o$ – g^3H	4 – 5		490
	10	1564.07						490
	10	1564.32						490
	20	1565.40						490
	20	1565.54						490
	80	1567.41						490
	10	1567.80						490
	60	1568.471	56.99308 – 120.74955	$3d^3(a^4F)4s$ – $3d^3(a^2H)4p$	^5F – $^3G^o$	3 – 4		893
	30	1569.07						490
	20	1569.36						490
	50	1569.51						490
	40	1570.67	109.53425 – 173.2885	$3d^3(a^2G)4p$ – $3d^3(a^2H)4d$	$^3H^o$ – f^3I	4 – 5		490
	250	1571.055	49.76865 – 113.41993	$3d^4$ – $3d^3(a^2G)4p$	b^3G – $^3H^o$	4 – 5		893
	20	1571.38						490
	50	1571.98						490
	20	1572.13	94.02999 – 157.6373	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	3 – 3		490
	10	1572.54						490
	20	1572.89						490
	10	1573.34	49.76865 – 113.32880	$3d^4$ – $3d^3(a^2G)4p$	b^3G – $^3F^o$	4 – 3		490
	70	1573.87	93.76621 – 157.3032	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	2 – 1		490
	40	1574.00	94.37629 – 157.9080	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	4 – 4		490
	20	1574.63						490
	20	1576.24						490
73	100	1577.14	94.02999 – 157.4351	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	3 – 2		490,488
	50	1577.36						490
	10	1578.01	110.50718 – 173.8763	$3d^3(a^2G)4p$ – $3d^3(a^2H)4d$	$^3H^o$ – f^3I	6 – 7		490
	10	1578.39						490
	120	1578.624	49.76865 – 113.11521	$3d^4$ – $3d^3(a^2G)4p$	b^3G – $^3G^o$	4 – 4		893
	90	1580.116	49.82891 – 113.11521	$3d^3(a^4F)4s$ – $3d^3(a^2G)4p$	^5F – $^3G^o$	3 – 4		893
	10	1580.34	57.42340 – 120.70027	$3d^3(a^4F)4s$ – $3d^3(a^2H)4p$	^5F – $^3G^o$	4 – 5		490
73	200	1580.73	94.37629 – 157.6373	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	4 – 3		490,488
	100	1581.15						490
	20	1581.57						490
	250	1582.62						490
	200	1582.93						490
	20	1583.70						490
	25	1583.965	69.60150 – 132.73422	$3d^3(a^4P)4s$ – $3d^3(a^2F)4p$	^3P – $^3D^o$	0 - 1		893
	10	1584.09						490
73	400	1584.60	94.80170 – 157.9080	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5G^o$ – f^5F	5 – 4		490,488
	30	1584.84						490
	30	1585.01	96.71404 – 159.8033	$3d^3(a^4F)4p$ – $3d^3(a^4F)5s$	$^5D^o$ – f^3F	3 – 4		490
	150	1586.35						490
	60	?1586.779	65.76321 – 128.78413	$3d^4$ – $3d^3(a^2F)4p$	b^3D – $^3F^o$	2 – 3		893
	10	1587.35						490
	20	1587.54	65.76321 – 128.75462	$3d^4$ – $3d^3(a^2F)4p$	b^3D – $^3F^o$	2 – 2		490
	20	1588.00						490
	150	1588.42						490
	200	1588.87						490
	20	1589.91						490
	20	1590.49						490
	40	1590.789	65.89238 – 128.75462	$3d^3(a^2G)4s$ – $3d^3(a^2F)4p$	^3G – $^3F^o$	3 – 2		893
	50	1591.09						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	100	1592.39						490
	40	1593.16	56.65137 - 119.42142	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3F^\circ$	2 - 2		490
	40	1593.38						490
	25	1593.523	66.03001 - 128.70413	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	$^3G - ^3F^\circ$	4 - 3		893
	10	1593.71						490
	80	1594.03						490
	40	1594.474	84.37412 - 147.09073	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	$^3F - ^3D^\circ$	4 - 3		893
	20	1595.86	96.71404 - 159.3756	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	3 - 3		490
	10	1596.06						490
	150	1596.52	49.82091 - 112.46701	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	3 - 3		490
	10	1596.76	66.22509 - 128.85049	$3d^3(a^2G)4s - 3d^3(a^2F)4p$	$^3G - ^3F^\circ$	5 - 4		490
	120	1597.46						490
	10	1597.86						490
	50	1598.05						490
	30	1598.48						490
	30	1599.81						490
	70	1600.02						490
	50	1600.21						490
	40	1601.57						490
	100	1602.17						490
	100	1602.79						490
	300	1603.19	50.09117 - 112.46701	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	4 - 3		490
	10	1603.93						490
	10	1604.34						490
	20	1605.18						490
	10	1606.19	96.77438 - 159.0318	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	1 - 2		490
	60	1606.490	70.48701 - 132.73422	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	$^3P - ^3D^\circ$	0 - 1		893
	10	1607.57	70.29286 - 132.49978	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	$^3P - ^3D^\circ$	2 - 2		490
	20	1607.78						490
	30	1607.92						490
	10	1608.19						490
	30	1609.01						490
	200	1609.35						490
	150	1609.79	97.68399 - 159.8033	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	3 - 4		490
	200	1609.91						490
	10	1610.10	96.92202 - 159.0318	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	2 - 2		490
	40	1610.56	49.76065 - 111.85697	$3d^4 - 3d^3(a^2G)4p$	$b^3G - ^3G^\circ$	4 - 5		490
	10	1610.88	96.30631 - 158.4636	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F^\circ - e^5F$	2 - 3		490
	100	1611.08	111.85697 - 173.9266	$3d^3(a^2G)4p - 3d^3(a^2H)4d$	$^3G^\circ - g^3H$	5 - 6		490
	10	1611.57						490
	30	1612.07						490
	10	1612.57						490
	10	1613.02						490
	100	1614.04						490
	80	1614.17						490
	10	1615.21	97.12142 - 159.0318	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5F^\circ - f^5F$	3 - 2		490
	90	1616.040	70.19101 - 132.07071	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	$^3P - ^3D^\circ$	2 - 2		893
	10	1616.661	87.77068 - 149.62630	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	$^1F - ^1F^\circ$	3 - 4		893
	20	1617.23						490
	90	1617.475	70.29286 - 132.11750	$3d^3(a^4P)4s - 3d^3(a^2F)4p$	$^3P - ^3D^\circ$	2 - 3		893
	5	1617.72	49.82091 - 111.64476	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3G^\circ$	3 - 4		490
	10	1617.90						490
	25	1619.359	70.98126 - 132.73422	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^1D - ^1D^\circ$	1 - 1		893
	100	1619.94	96.71404 - 158.4429	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D^\circ - e^5G$	3 - 4		490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	25	1620.004	70.34556 – 132.07071	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3P - ^3D^o$	1 - 2		893
	10	1620.44						490
	10	1620.76						490
	30	1621.10						490
	10	1621.60						490
	30	1621.87						490
	10	1623.01	87.77068 – 149.38364	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	$^3F - ^3F^o$	3 - 3		490
	30	1625.32	97.09828 – 158.6237	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	4 - 4		490
	10	1625.78						490
	100	1626.33						490
	30	1627.25						490
	20	1627.80						490
	150	1628.381	71.32327 – 132.73422	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - ^3D^o$	2 - 1		893
	10	1628.58						490
	100	1628.98						490
	100	1629.56	97.09828 – 158.4636	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	4 - 3		490
	100	1630.94						490
	20	1631.49						490
	20	1631.68	96.14925 – 157.4351	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3F^o - f^3F$	1 - 2		490
	20	1631.89						490
	100	1632.62	96.30631 – 157.6373	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3F^o - f^3F$	2 - 3		490
	20	1632.85						490
	20	1633.17						490
	20	1633.60						490
	120	1634.12	96.71404 – 157.9080	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3D^o - f^3F$	3 - 4		490
	10	1634.61	57.42340 – 118.99911	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3D^o$	4 - 3		490
	100	1635.10	97.30659 – 158.4636	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	2 - 3		490
	100	1635.48	97.09828 – 158.2418	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3D^o - f^3F$	4 - 5		490
	200	1636.35						490
	10	1636.69						490
	100	1637.53						490
	100	1637.90						490
	10	1638.10						490
	10	1638.78	97.30659 – 158.3283	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	2 - 2		490
	10	1639.46						490
	20	1639.90						490
	100	1640.94	97.68399 – 158.6237	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	3 - 4		490
	50	1641.09						490
	100	1641.56	96.30631 – 157.3032	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3F^o - f^3F$	2 - 1		490
	10	1641.83						490
	100	1642.16						490
	70	1643.07						490
	100	1643.20						490
	80	1643.34						490
	50	1643.86						490
	150	1644.652	87.77068 – 148.57381	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	$^1F - ^1D^o$	3 - 2		893
	90	1644.882	71.32306 – 132.11750	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - ^3D^o$	3 - 3		893
	50	1645.16						490
	70	1646.15	71.32306 – 132.07071	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - ^3D^o$	3 - 2		490
	20	1646.56						490
	5	1647.71						790
	50	1648.36						490
	10	1648.58						490
	50	1649.13						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	150	1649.51	97.61908 – 158.2418	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5F^\circ - f^5F$	5 – 5		490
	40	1649.93	96.69397 – 157.3852	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	0 – 1		490
	10	1651.32						490
	100	1651.56	97.35901 – 157.9080	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5F^\circ - f^5F$	4 – 4		490
	20	1651.92						490
	50	1652.08	96.77433 – 157.3852	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	1 – 1		490
	150	1652.46	97.12342 – 157.6373	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5F^\circ - f^5F$	3 – 3		490
	10	1654.23	113.11521 – 173.5699	$3d^3(a^2G)4p - 3d^3(a^2H)4d$	$^3G^\circ - g^3H$	4 – 5		490
	10	1654.79						490
	70	1655.08						490
	20	1657.45						490
	20	1658.30	37.00516 – 97.30659	$3d^4 - 3d^3(a^4F)4p$	$a^3F - ^3D^\circ$	3 – 2		490
	20	1658.63						490
	100	1659.26						490
	30	1659.82						490
	80	1660.26						490
	10	1660.46	97.68399 – 157.9080	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	3 – 4		490
	150	1660.70						490
	20	1661.58						490
	40	1661.93						490
	25	1663.051	56.65137 – 116.70205	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3F - ^3D^\circ$	2 – 2		893
	40	1663.75						490
	90	1663.926	74.70008 – 134.80754	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - ^3F^\circ$	2 – 3		893
	1	1664.049	49.62825 – 109.72279	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	2 – 3		893
	150	1664.35	113.11521 – 173.2005	$3d^3(a^2G)4p - 3d^3(a^2H)4d$	$^3G^\circ - f^3I$	4 – 5		490
	4	1664.491	49.49246 – 109.57089	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	1 – 2		893
	10	1664.90	50.09117 – 110.15409	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	4 – 4		490
	20	1665.18	94.80170 – 154.8546	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^\circ - e^5G$	5 – 6		490
	70	1665.53						490
	90	1665.62						490
	40	1667.337	56.99308 – 116.96909	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3F^\circ$	3 – 3		893
	30	1667.44						490
	250	1667.621	49.49246 – 109.45811	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^\circ$	1 – 0		893
	20	1667.92	97.68399 – 157.6373	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	3 – 3		490
	100	1668.24	49.62825 – 109.57089	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	2 – 2		490
	80	1668.33						490
	70	1668.96	37.00516 – 96.92202	$3d^4 - 3d^3(a^4F)4p$	$a^3F - ^3D^\circ$	3 – 2		490
	40	1669.619	49.82891 – 109.72279	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	3 – 3		893
	150	1669.97	56.65137 – 116.53295	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3F - ^3D^\circ$	2 – 3		490
	50	1670.27						490
	150	1670.45	94.02999 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^\circ - e^5F$	3 – 2		490
	20	1670.80						490
	10	1671.40						490
	30	1671.85						490
	10	1672.03						490
	20	1673.00	71.67719 – 131.45016	$3d^3(a^2H)4s - 3d^3(a^4F)4p$	$^3H - ^3G^\circ$	4 – 5		490
	50	1673.58	97.68399 – 157.4351	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5D^\circ - f^5F$	3 – 2		490
	150	1673.784	50.41006 – 110.15409	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	5 – 4		893
	90	1673.867	49.82891 – 109.57089	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^\circ$	3 – 2		893
	1	1674.439	56.65137 – 116.37292	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^1F^\circ$	2 – 1		893
	15C	1674.73	94.37629 – 154.0857	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^\circ - e^5F$	4 – 3		490
	4	1674.896	49.82891 – 109.53425	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^5F - ^3H^\circ$	3 – 4		893
	200	1675.72						490
	150	1676.20						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	150	1676.955	50.09117 - 109.72279	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^o$	4 - 3		893
	10	1677.54						490
	10	1677.68						490
	150	1678.414	71.87017 - 131.45046	$3d^3(a^2H)4s - 3d^3(a^4F)4p$	$^3H - ^3G^o$	6 - 5		893
	300	1679.25						490
	150	1679.375	57.42340 - 116.96909	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3F^o$	4 - 3		893
	200	1679.537	56.99308 - 116.53295	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3F - ^3D^o$	3 - 3		893
	1	1679.691	50.41806 - 109.94498	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^5F - ^3H^o$	5 - 5		893
	100	1679.83	71.73756 - 131.26566	$3d^3(a^2H)4s - 3d^3(a^4F)4p$	$^3H - ^3G^o$	5 - 4		490
	150	1682.383	71.67719 - 131.11636	$3d^3(a^2H)4s - 3d^3(a^4F)4p$	$^3H - ^3G^o$	4 - 3		893
	90	1683.540	56.99308 - 116.39166	$3d^3(a^4F)4s - 3d^3(a^2D)4p$	$^3F - ^3F^o$	3 - 2		893
	150	1684.02	100.42301 - 159.8833	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5G^o - f^5F$	5 - 4		490
	100	1684.14						490
	4	1684.277	49.49246 - 108.86498	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^o$	1 - 1		893
	4	1685.072	49.62825 - 108.97290	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^o$	2 - 2		893
	10	1685.38						490
	150	1685.85						490
	40	1686.44						490
	150	1687.03	100.10066 - 159.3756	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5G^o - f^5F$	4 - 3		490
	70	1687.56						490
	40	1688.134	49.62825 - 108.86498	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^o$	2 - 1		893
	40	1688.39						490
	1	1689.038	49.49246 - 108.69763	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5D^o$	1 - 0		893
	10	1689.14	87.77068 - 146.97333	$3d^3(a^2F)4s - 3d^3(b^2D)4p$	$^3F - ^3D^o$	3 - 2		490
	200	1689.457	99.84167 - 159.0318	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^5G^o - f^5F$	3 - 2		893
	80	1689.77						490
	30	1690.00						490
71	300	1690.28	93.76621 - 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^o - e^5H$	2 - 3		490
	20	1690.52						490
	10	1690.72						490
	50	1691.09						490
	50	1691.64						490
	120	1691.774	57.42340 - 116.53295	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^3F - ^3D^o$	4 - 3		893
	30	1692.31						490
	20	1692.63						490
	600	1692.89	94.02999 - 153.0991	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^o - e^5H$	3 - 4		490
	30	1693.43						490
	20	1693.72						490
	70	1694.53						490
	70	1694.92						490
	70	1695.77	49.49246 - 108.46140	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^o$	1 - 2		490
	600	1696.64	94.37629 - 153.3146	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^o - e^5H$	4 - 5		490
	20	1696.85						490
	60	1697.43						490
71	40	1697.84	94.02999 - 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5G^o - e^5H$	3 - 3		490
	40	1698.03						490
	200	1698.75						490
	10	1699.35						490
	20	1699.84						490
	20	1700.12						490
34	250	1700.269	43.28671 - 102.10076	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^o$	4 - 4		893
	30	1701.05						490
34	60	1701.297	43.32217 - 102.10076	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^o$	3 - 4		893
	600	1701.48						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
71	80	1702.89	94.37629 – 153.0991	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3H$	4 – 4		490
	40	1703.73						490
	10	1704.79						490
	10	1705.36	109.94498 – 168.5823	$3d^3(a^2G)4p - 3d^3(a^2G)4d$	$^3H^\circ - f^3H$	5 – 6		490
	10	1705.76						490
	250	1705.961	75.35163 – 133.96957	$3d^3(a^2H)4s - 3d^3(a^2F)4p$	$^3H - ^3G^\circ$	5 – 4		893
	50	1706.15						490
	30	1706.65						490
	30	1707.27						490
	800	1707.43						490
	40	1707.608	56.99308 – 115.55428	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	$^3F - ^3D^\circ$	3 – 3		893
	400	1707.78						490
	25	1708.498	56.65137 – 115.18215	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	$^3F - ^3D^\circ$	2 – 2		893
71	60	1708.98	94.80170 – 153.3146	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3H$	5 – 5		490
	30	1710.10						490
34	60	1710.366	43.28671 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^\circ$	4 – 3		893
	200	1711.02						490
34	5	1711.25						490
34	200	1711.63	43.32217 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^\circ$	3 – 3		490
	20	1712.24						490
	10	1712.52						490
	50	1713.43	100.10066 – 158.4636	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3F$	4 – 3		490
	150	1714.01	100.10066 – 158.4429	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3G$	4 – 4		490
	10	1714.26						490
	40	1714.63						490
	30	1715.17	43.44199 – 101.74621	$3d^4 - 3d^3(a^4F)4p$	$b^3P - ^3F^\circ$	2 – 3		490
	20	1715.65						490
	40	1716.21						490
	40	1716.33						490
	40	1716.50						490
	200	1717.43	99.84167 – 158.0667	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3G$	3 – 3		490
	40	1717.65						490
	40	1717.92						490
	40	1718.16	100.42301 – 158.6237	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3F$	5 – 4		490
	120	1718.530	56.99308 – 115.18215	$3d^3(a^4F)4s - 3d^3(a^2P)4p$	$^3F - ^3D^\circ$	3 – 2		893
	40	1719.735	57.42340 – 115.57196	$3d^3(a^4F)4s - 3d^3(a^2H)4p$	$^3F - ^3H^\circ$	4 – 4		893
34	80	1720.00	43.30453 – 101.44457	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^\circ$	2 – 2		490
34	80	1720.00	100.10066 – 158.2418	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3G^\circ - f^3F$	4 – 5		490
	200	1720.249	57.42340 – 115.55428	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	$^3F - ^3D^\circ$	4 – 3		893
34	40	1720.512	43.32217 – 101.44457	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3F^\circ$	3 – 2		893
	150	1721.18						490
	10	1721.43						490
	200	1721.67	115.84458 – 173.9266	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3H^\circ - g^3H$	6 – 6		490
	70	1721.84						490
	150	1722.191	56.65137 – 114.71679	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	$^3F - ^3D^\circ$	2 – 1		893
	100	1723.16	115.84458 – 173.8763	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3H^\circ - f^3I$	6 – 7		490
	100	1723.50	100.42301 – 158.4429	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3G$	5 – 4		490
	10	1723.83						490
	120	1724.32	115.57196 – 173.5659	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3H^\circ - g^3H$	4 – 5		490
	100	1725.12	100.10066 – 158.0667	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3G$	4 – 3		490
	150	1725.29						490
	40	1725.60						490
	20	1726.61						490
	10	1727.51						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1727.97						490
	20	1728.24						490
	80	1728.34						490
	10	1730.34						490
	5	1730.92	70.98126 – 128.75462	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - {}^3F°$	1 – 2		490
	20	1731.53	97.09828 – 154.8496	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	4 – 5		490
	90	1731.76	96.14925 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	1 – 2		490
	50	1732.85						490
	200	1733.00	97.35981 – 155.0640	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5D$	4 – 4		490
	150	1733.13	96.38631 – 154.0857	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	2 – 3		490
	70	1734.83						490
	70	1735.20	101.74621 – 159.3756	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3F° - f^3F$	3 – 3		490
	10	1735.61						490
	10	1735.76						490
	30	1736.49	101.44457 – 159.0318	$3d^3(a^4F)4p - 3d^3(a^4F)5s$	$^3F° - f^3F$	2 – 2		490
	30	1737.47						490
	120	1738.23	115.67074 – 173.2005	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3H° - f^3I$	5 – 5		490
	4	1738.300	71.32306 – 128.85049	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - {}^3F°$	3 – 4		893
	10	1738.90	96.38631 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	2 – 2		490
	10	1740.06						490
	20	1740.31	71.32327 – 128.78413	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^3D - {}^3F°$	2 – 3		490
	60	1740.78	97.61948 – 155.0640	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5D$	5 – 4		490
	150	1742.19						490
	20	1742.52						490
	70	1742.96						490
	100	1743.44	97.09828 – 154.4571	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	4 – 4		490
	30	1743.65						490
	30	1743.87	65.76321 – 123.10584	$3d^4 - 3d^3(a^2D)4p$	$b^3D - {}^3D°$	2 – 2		490
	20	1744.07	97.12142 – 154.4571	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	3 – 4		490
	30	1744.81						490
	40	1745.04						490
	80	1745.55						490
	120	1745.751	74.78888 – 132.07071	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	$^1D - {}^1D°$	2 – 2		893
	10	1746.48						490
	200	1746.77	56.65137 – 113.89943	$3d^3(a^4F)4s - 3d^3(a^2F)4p$	$^3F - {}^3F°$	2 – 1		490
	70	174r.30	97.61948 – 154.8496	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	5 – 5		490
	80	1748.74						490
	40	1748.87	96.71404 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	3 – 2		490
	70	1749.67						490
	10	1749.88						490
	20	1750.27						490
	10	1750.98						490
	100	1751.34						490
	80	1752.47						490
	30	1753.23						490
	30	1753.60	37.00516 – 94.02999	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G°$	3 – 3		490
	300	1754.76	97.09828 – 154.0857	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	4 – 3		490
	20	1754.94						490
	150	1755.24	96.92202 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	2 – 2		490
	200	1755.46	97.12142 – 154.0857	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5F° - e^5F$	3 – 3		490
	100	1755.78	96.77438 – 153.7298	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^5D° - e^5F$	1 – 1		490
	30	1756.29						490
	10	1756.58						490
	10	1756.97						490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1757.45						490
	10	1757.95	101.44457 – 158.3283	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3F$	2 – 2		490
	50	1758.20	101.74621 – 158.6237	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3F$	3 – 4		490
	30	1759.19						490
	20	1759.34						490
	50	1759.50						490
	10	1760.31	96.92202 – 153.7298	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	2 – 1		490
	40	1761.38	97.12142 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3F$	3 – 2		490
	20	1761.73	37.00516 – 93.76621	$3d^4 - 3d^3(a^4F)4p$	$a^3F - {}^3G^o$	3 – 2		490
	30	1762.52						490
	70	1763.13	101.74621 – 158.4636	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3F$	3 – 3		490
	150	1763.77	101.74621 – 158.4429	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3G$	3 – 4		490
	10	1764.16						490
	120	1765.06						490
	10	1765.53						490
	60	1765.739	65.76321 – 122.39649	$3d^4 - 3d^3(a^2F)4p$	$b^3D - {}^3F^o$	2 – 1		893
	10	1765.93						490
	10	1766.08	101.44457 – 158.0667	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3G$	2 – 3		490
	60	1766.58						490
	300	1766.92						490
	10	1767.18	97.30659 – 153.8935	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3F$	2 – 2		490
	40	1768.32						490
	40	1768.50						490
	50	1768.78	43.30453 – 95.84167	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3G^o$	2 – 3		490
	100	1769.03						490
	300	1769.17	102.10076 – 158.6237	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3F$	4 – 4		490
	30	1770.10						490
	20	1770.35						490
	20	1770.66						490
	30	1770.96						490
	40	1772.46	117.14585 – 173.5659	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3I^o - g^3H$	5 – 5		490
	50	1772.60						490
	20	1773.32						490
	10	1773.70						490
	20	1774.51						490
	10	1774.89	102.10076 – 158.4429	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3G$	4 – 4		490
	30	1775.06	56.99308 – 113.32880	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - {}^1F^o$	3 – 3		490
	40	1777.27						490
	10	1777.49						490
	200	1778.93	96.71404 – 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	[illegible] $- e^3H$	3 – 3		490
	40	1779.91						490
	40	1779.99						490
	50	1780.14	117.48895 – 173.6628	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3I^o - f^3I$	6 – 6		490
	20	1781.45						490
	10	1781.73						490
	100	1782.07						490
	250	1782.99						490
	200	1783.95	117.14585 – 173.2005	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	$^3I^o - f^3I$	5 – 5		490
	150	1784.43						490
	50	1784.72						490
	10	1785.53	96.92202 – 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^o - e^3H$	2 – 3		490
	30	1786.16						490
	120	1787.18	97.35981 – 153.3146	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3F^o - e^3H$	4 – 5		490
	1	1788.464	75.35163 – 131.26566	$3d^3(a^2H)4s - 3d^3(a^2F)4p$	$^1H - {}^3G^o$	5 – 4		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	40	1789.77						490
	40	1790.48						490
	10	1790.71						490
	30	1791.48						490
	80	1792.73						490
	10	1793.60						490
	50	1793.75	56.65137 – 112.39984	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	2 – 2		490
	80	1793.95						490
	30	1795.58	57.42340 – 113.11521	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3G^\circ$	4 – 4		490
	10	1796.37						490
	10	1796.89						490
	20	1797.92	97.30639 – 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^\circ - e^3H$	2 – 3		490
	50	1798.33						490
	20	1798.97						490
	10	1799.40						490
	10	1800.84						490
	10	1801.46						490
	120	1802.60	56.99308 – 112.46701	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	3 – 3		490
	10	1803.47						490
	10	1804.85	56.99308 – 112.39984	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	3 – 2		490
	10	1807.45						490
	10	1809.58						490
	30	1810.14	97.68399 – 152.9273	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3D^\circ - e^3H$	3 – 3		490
	30	1810.77						490
	40	1810.92						490
	40	1812.24						490
	10	1812.98						490
	20	1813.60						490
	80	1815.49						490
	10	1816.09						490
	100	1817.16						490
	20	1817.79						490
	40	1818.28						490
	60	1819.853	57.42340 – 112.37288	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3F^\circ$	4 – 4		893
	20	1821.08						490
	60	1822.333	65.89238 – 120.76726	$3d^3(a^2G)4s - 3d^3(a^2H)4p$	$^3G - ^3G^\circ$	3 – 3		893
	10	1825.28						490
	10	1825.66						490
	300	1827.26						490
	20	1829.39						490
46	200	1829.761	56.99308 – 111.64476	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3G^\circ$	3 – 4		893
	40	1830.54						490
	100	1831.15						490
	10	1831.60	102.33349 – 156.92993	$3d^3(b^2D)4s - 3d^3(b^2D)4p$	$^3D - ^1P^\circ$	2 – 1		490
	10	1832.34						490
	40	1832.87						490
	10	1833.00						490
	1	1833.915	102.40180 – 156.92993	$3d^3(b^2D)4s - 3d^3(b^2D)4p$	$^3D - ^1P^\circ$	1 – 1		893
	10	1834.68						490
	90	1835.693	66.22509 – 120.70027	$3d^3(a^2G)4s - 3d^3(a^2H)4p$	$^3G - ^3G^\circ$	5 – 5		893
46	250	1837.099	57.42340 – 111.85697	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	$^3F - ^3G^\circ$	4 – 5		893
	30	1838.34	43.28671 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3D^\circ$	4 – 3		490
	25	1838.933	43.30453 – 97.68399	$3d^4 - 3d^3(a^4F)4p$	$b^3F - ^3D^\circ$	2 – 3		893
	10	1839.72	100.10066 – 154.4571	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	$^3G^\circ - e^3F$	4 – 4		490

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1840.48	43.28671 – 97.61948	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3F^\circ$	4 – 5		490
	10	1842.09						490
	100	1843.40						490
	100	1844.99						490
	80	1846.45						490
	10	1846.71						490
	100	1848.56						490
	120	1848.995	65.76321 – 119.84647	$3d^4 - 3d^3(a^2D)4p$	$b^3D - {}^3F^\circ$	2 – 3		893
	10	1849.76						490
	30	1849.99						490
	10	1850.45						490
	25	1853.021	74.78888 – 128.75462	$3d^3(a^2D)4s - 3d^3(a^2F)4p$	${}^3D - {}^3F^\circ$	2 – 2		893
	10	1853.36						490
	20	1854.63						490
	10	1856.20						490
	20	1857.59						490
	10	1858.03						490
	10	1866.12	119.61280 – 173.2805	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	${}^3H^\circ - i^3I$	5 – 5		490
	20	1866.63						490
	10	1867.52	63.42192 – 116.96909	$3d^3(a^4P)4s - 3d^3(a^2D)4p$	${}^3P - {}^3F^\circ$	3 – 3		490
	20	1871.00						490
	10	1875.18	63.04574 – 116.37292	$3d^3(a^4P)4s - 3d^3(a^2D)4p$	${}^3P - {}^3P^\circ$	1 – 1		490
	10	1875.52	101.74621 – 155.0640	$3d^3(a^4F)4p - 3d^3(a^4F)4d$	${}^5F^\circ - e^5D$	3 – 4		490
	10	1877.93						490
	20	1878.77	120.70027 – 173.9266	$3d^3(a^2H)4p - 3d^3(a^2H)4d$	${}^3G^\circ - g^3H$	5 – 6		490
	20	1878.99						490
	20	1881.02	56.99308 – 110.15489	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	${}^5F - {}^5D^\circ$	3 – 4		490
	20	1881.33						490
	20	1881.73						490
	45	1883.32						490
	5	1884.30	56.65137 – 109.72279	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	${}^5F - {}^5D^\circ$	2 – 3		490
	5	1884.49	43.32217 – 96.30631	$3d^4 - 3d^3(a^4F)4p$	$b^3F - {}^3F^\circ$	3 – 2		490
	10	1888.83						490
	10	1893.30						490
	20	1894.05						490
	30	1896.09						490
	90	1896.406	57.42340 – 110.15489	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	${}^5F - {}^5D^\circ$	4 – 4		893
	10	1899.15						490
	20	1899.56						490
	20	1900.02						490
	20	1902.19						490
	20	1902.59						490
	5	1903.29	56.99308 – 109.53425	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	${}^5F - {}^3H^\circ$	3 – 4		490
	10	1903.979	57.42340 – 109.94498	$3d^3(a^4F)4s - 3d^3(a^2G)4p$	${}^5F - {}^3H^\circ$	4 – 5		893
	30	1904.84						490
	40	1906.12						490
	50	1910.33						490
	10	1911.263	56.65137 – 108.97290	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	${}^5F - {}^5F^\circ$	2 – 2		893
	80	1911.66						490
	40	1912.50						490
	20	1913.85						490
	30	1914.87						490
	10	1917.52	63.42192 – 115.57196	$3d^3(a^4P)4s - 3d^3(a^2H)4p$	${}^3P - {}^3H^\circ$	3 – 4		490
	1	1918.409	70.98126 – 123.10584	$3d^3(a^2D)4s - 3d^3(a^2D)4p$	${}^3D - {}^3D^\circ$	1 – 2		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	40	1918.61						490
	30	1919.05						490
	20	1922.72	50.09117 - 102.10076	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^o$	: 4		490
	4	1922.790	63.17430 - 115.18215	$3d^3(a^4P)4s - 3d^3(a^2P)4p$	$^3P - ^3D^o$	2 - 2		893
	10	1923.41						490
	10	1925.26						490
	40	1926.64						490
	250	1928.814	69.60150 - 121.44677	$3d^3(a^4P)4s - 3d^3(a^4P)4p$	$^5P - ^5S^o$	0 - 1		893
	20	1930.39	56.99308 - 108.79584	$3d^3(a^4F)4s - 3d^3(a^4P)4p$	$^3F - ^3P^o$	3 - 3		490
	10	1934.581	50.41006 - 102.10076	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^o$	5 - 4		893
	200	1935.550	69.78189 - 121.44677	$3d^3(a^4P)4s - 3d^3(a^4P)4p$	$^5P - ^5S^o$	1 - 1		893
	4	1935.918	50.09117 - 101.74621	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5F^o$	4 - 3		893
	30	1937.84						490
	20	1939.44						490
	50	1942.30						490
	10	1942.73						490
	5	1944.94	70.98126 - 122.39649	$3d^3(a^2D)4s - 3d^3(a^2P)4p$	$^3D - ^3P^o$	1 - 1		490
	10	1945.47						490
	150	1949.198	105.62609 - 156.92993	$3d^3(b^2D)4s - 3d^3(b^2D)4p$	$^3D - ^3P^o$	2 - 1		893
	60	1950.997	70.19101 - 121.44677	$3d^3(a^2P)4s - 3d^3(a^4P)4p$	$^3P - ^5S^o$	2 - 1		893
	50	1953.26						490
	250	1954.874	70.29206 - 121.44677	$3d^3(a^4P)4s - 3d^3(a^4P)4p$	$^5P - ^5S^o$	2 - 1		893
	40	1956.36	66.03001 - 117.14585	$3d^3(a^2G)4s - 3d^3(a^2H)4p$	$^3G - ^3I^o$	4 - 5		490
	120	1956.899	70.34556 - 121.44677	$3d^3(a^2P)4s - 3d^3(a^4P)4p$	$^3P - ^5S^o$	1 - 1		893
	4	1957.839	65.89238 - 116.96909	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^o$	3 - 3		893
	1	1958.038	66.03001 - 117.10158	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^o$	4 - 4		893
	10	1959.224	69.65974 - 120.70027	$3d^3(a^2G)4s - 3d^3(a^2H)4p$	$^1G - ^1G^o$	4 - 5		893
	10	1960.18						490
	10	1960.69						490
	5	1962.16						490
	10	1962.334	70.48701 - 121.44677	$3d^3(a^2P)4s - 3d^3(a^4P)4p$	$^3P - ^5S^o$	0 - 1		893
	120	1963.119	66.03001 - 116.96909	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^o$	4 - 3		893
	90	1965.031	65.89238 - 116.78205	$3d^3(a^2G)4s - 3d^3(a^4P)4p$	$^3G - ^3D^o$	3 - 2		893
	200	1965.541	66.22509 - 117.10158	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^o$	5 - 4		893
	10	1966.57						490
	20	1971.11						490
	100	1972.45						490
	70	1973.20						490
	50	1974.03	117.92389 - 168.5823	$3d^3(a^2H)4p - 3d^3(a^2G)4d$	$^3I^o - f^3H$	7 - 6		490
	60	1974.43						490
	10	1974.70	65.89238 - 116.53295	$3d^3(a^2G)4s - 3d^3(a^4P)4p$	$^3G - ^3D^o$	3 - 3		490
	100	1975.56						490
	4	1975.902	65.76321 - 116.37292	$3d^4 - 3d^3(a^2D)4p$	$b^1D - ^1P^o$	2 - 1		893
	30	1976.07						490
	40	1978.91						490
	120	1980.083	66.03001 - 116.53295	$3d^3(a^2G)4s - 3d^3(a^4P)4p$	$^3G - ^3D^o$	4 - 3		893
	90	1980.225	65.89238 - 116.39166	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^o$	3 - 2		893
	1	1981.558	70.98126 - 121.44677	$3d^3(a^2D)4s - 3d^3(a^4P)4p$	$^3D - ^5S^o$	1 - 1		893
	20	1981.82						490
	50	1985.72						490
	50	1986.54						490
	10	1986.82	50.09117 - 100.42301	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5G^o$	4 - 5		490
	10	1987.00						490
49	200	1987.620	63.04574 - 113.35704	$3d^3(a^4P)4s - 3d^3(a^4P)4p$	$^5P - ^5S^o$	1 - 2		893

CR III — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	1989.64						490
	40	1991.17						490
	90	1992.556	69.69974 - 119.80647	$3d^3(a^2G)4s - 3d^3(a^2D)4p$	$^3G - ^3F^{\circ}$	4 - 3		893
49	25P	1992.716	63.17430 - 113.35704	$3d^3(a^4P)4s - 3d^3(a^4P)4p$	$^5P - ^5S^{\circ}$	2 - 2		893
	10	1995.066	71.32327 - 121.44677	$3d^3(a^2D)4s - 3d^3(a^4P)4p$	$^3D - ^5S^{\circ}$	2 - 1		893
	10	1996.03						490
	20	1996.70						490
	20	1999.12						490
	90	1999.484	50.41006 - 100.42301	$3d^3(a^4F)4s - 3d^3(a^4F)4p$	$^5F - ^5G^{\circ}$	5 - 5		893

CHROMIUM IV (Cr^{3+}), Z = 24
Ground State $1s^22s^22p^63s^23p^63d^3(^4F_{3/2})$ (21 electrons)
Ionization Potential [396 000] cm^{-1}; [49.1] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	1	523.808	20.6643 - 211.5740	$3d^3 - 3d^2(a^1S)4p$	$a^2D - x^2F^{\circ}$	5/2 - 5/2		219
	5	573.356	0.5556 - 174.9674	$3d^3 - 3d^2(a^1D)4p$	$gs^4F - y^2D^{\circ}$	7/2 - 5/2		219
	20	573.758	0.5556 - 174.8449	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	7/2 - 7/2		219
	160	575.048	0.9456 - 174.8449	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	9/2 - 7/2		219
	20	575.175	0.2358 - 174.0948	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	5/2 - 5/2		219
	20	575.850	0.0 - 173.6579	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	3/2 - 3/2		219
	110	576.241	0.5556 - 174.0948	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	7/2 - 5/2		219
	110	576.623	0.2358 - 173.6579	$3d^3 - 3d^2(a^3P)4p$	$gs^4F - y^4D^{\circ}$	5/2 - 3/2		219
	40	579.831	15.0518 - 187.5167	$3d^3 - 3d^2(a^1G)4p$	$a^2G - x^2F^{\circ}$	7/2 - 5/2		219
	40	582.824	15.4016 - 186.9788	$3d^3 - 3d^2(a^1G)4p$	$a^2G - x^2F^{\circ}$	9/2 - 7/2		219
	70	595.093	15.4016 - 183.4426	$3d^3 - 3d^2(a^1G)4p$	$a^2G - z^2H^{\circ}$	9/2 - 11/2		219
	40	596.569	15.0518 - 182.6777	$3d^3 - 3d^2(a^1G)4p$	$a^2G - z^2H^{\circ}$	7/2 - 9/2		219
	1	601.273	20.6643 - 186.9788	$3d^3 - 3d^2(a^1G)4p$	$a^2D - x^2F^{\circ}$	5/2 - 7/2		219
	5	608.138	19.4306 - 183.8739	$3d^3 - 3d^2(a^3P)4p$	$a^2P - y^2P^{\circ}$	1/2 - 3/2		219
	20	608.713	19.4306 - 183.7187	$3d^3 - 3d^2(a^3P)4p$	$a^2P - y^2P^{\circ}$	1/2 - 1/2		219
	5	609.013	19.5192 - 183.7187	$3d^3 - 3d^2(a^3P)4p$	$a^2P - y^2P^{\circ}$	3/2 - 1/2		219
	110	612.643	20.6499 - 183.8739	$3d^3 - 3d^2(a^3P)4p$	$a^2D - y^2P^{\circ}$	3/2 - 3/2		219
	110	612.643	14.1771 - 177.4050	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	3/2 - 5/2		219
	70	613.746	14.4713 - 177.4050	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	5/2 - 5/2		219
	70	614.028	14.0590 - 176.9153	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	1/2 - 3/2		219
	5	614.480	14.1771 - 176.9153	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	3/2 - 3/2		219
	70	614.903	15.4016 - 178.0281	$3d^3 - 3d^2(a^1G)4p$	$a^2G - y^2G^{\circ}$	9/2 - 9/2		219
	40	615.335	14.1771 - 176.6091	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	3/2 - 1/2		219
	40	615.598	14.4713 - 176.9153	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4P^{\circ}$	5/2 - 3/2		219
	285	616.819	21.3207 - 183.4426	$3d^3 - 3d^2(a^1G)4p$	$a^2H - z^2H^{\circ}$	11/2 - 11/2		219
4	40	617.047	0.2358 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^2D^{\circ}$	5/2 - 5/2		219
3	20	617.94	0.2358 - 162.0633	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	5/2 - 7/2	P	791
3	70	618.230	0.0 - 161.7548	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	3/2 - 5/2		219
4	70	618.262	0.5556 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^2D^{\circ}$	7/2 - 5/2		219
	160	618.766	21.0659 - 182.6777	$3d^3 - 3d^2(a^1G)4p$	$a^2H - z^2H^{\circ}$	9/2 - 9/2		219
3	110	619.133	0.2358 - 161.7548	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	5/2 - 5/2		219
3	110	619.758	0.0 - 161.3534	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	3/2 - 1/2		219
3	5	620.125	0.2358 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	5/2 - 3/2		219
3	360	620.665	0.9456 - 162.0633	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	9/2 - 7/2		219
3	285	621.358	0.5556 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^4D^{\circ}$	7/2 - 5/2		219
4	220	622.089	0.2358 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$gs^4F - z^2D^{\circ}$	5/2 - 3/2		219

CR IV — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	70	623.541	14.4713 - 174.8449	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4D°$	[illegible]		219
	160	625.037	0.9456 - 160.9358	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
	20	625.323	14.1771 - 174.0948	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4D°$	[illegible]		219
	20	625.986	0.5556 - 160.3039	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
	1	626.564	14.0590 - 173.6579	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4D°$	[illegible]		219
	1	627.037	14.1771 - 173.6579	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4D°$	[illegible]		219
	40	627.185	15.4016 - 174.8449	$3d^3 - 3d^2(a^3P)4p$	$a^2G - y^4D°$	[illegible]		219
	1	627.471	14.0590 - 173.4306	$3d^3 - 3d^2(a^3P)4p$	$a^4P - y^4D°$	[illegible]		219
2	40	627.719	0.5556 - 159.8621	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	110	628.482	0.2358 - 159.3505	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	450	629.264	0.9456 - 159.8621	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	110	629.355	0.0 - 158.8912	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	360	629.743	0.5556 - 159.3505	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	285	630.301	0.2358 - 158.8912	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
	40	630.522	52.9753 - 211.5740	$3d^3 - 3d^2(a^1S)4p$	$b^2D - z^2P°$	[illegible]		219
2	220	630.812	0.0 - 158.5259	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
1	285	630.902	0.9456 - 159.4480	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4G°$	9/2 - 11/2		219
2	40	631.289	0.9456 - 159.3505	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
2	70	631.567	0.5556 - 158.8912	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
	70	631.666	15.0518 - 173.3644	$3d^3 - 3d^2(a^1D)4p$	$a^2G - y^2F°$	[illegible]		219
2	70	631.748	0.2358 - 158.5259	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4F°$	[illegible]		219
1	220	632.623	0.5556 - 158.6275	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4G°$	[illegible]		219
	285	633.059	15.4016 - 173.3644	$3d^3 - 3d^2(a^1D)4p$	$a^2G - y^2F°$	[illegible]		219
1	220	634.133	0.2358 - 157.9311	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4G°$	[illegible]		219
	285	634.582	15.0518 - 172.6347	$3d^3 - 3d^2(a^1D)4p$	$a^2G - y^2F°$	[illegible]		219
	5	635.265	53.1420 - 210.5567	$3d^3 - 3d^2(a^1S)4p$	$b^2D - z^2P°$	[illegible]		219
1	220	635.485	0.0 - 157.3595	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4G°$	[illegible]		219
1	1	636.44	0.2358 - 157.3595	$3d^3 - 3d^2(a^3F)4p$	$a^4F - z^4G°$	[illegible]	P	791
	110	636.859	14.0590 - 171.0797	$3d^3 - 3d^2(a^3P)4p$	$a^4P - z^4S°$	[illegible]		219
10	1	637.096	21.0659 - 178.0281	$3d^3 - 3d^2(a^1G)4p$	$a^2H - y^2G°$	[illegible]		219
	160	637.338	14.1771 - 171.0797	$3d^3 - 3d^2(a^3P)4p$	$a^4P - z^4S°$	[illegible]		219
10	220	637.553	21.0659 - 177.9144	$3d^3 - 3d^2(a^1G)4p$	$a^2H - y^2G°$	[illegible]		219
	285	638.127	21.3207 - 178.0281	$3d^3 - 3d^2(a^1G)4p$	$a^2H - y^2G°$	11/2 - 9/2		219
	285	638.535	14.4713 - 171.0797	$3d^3 - 3d^2(a^3P)4p$	$a^4P - z^4S°$	[illegible]		219
	40	642.970	19.4386 - 174.9674	$3d^3 - 3d^2(a^1D)4p$	$a^2P - y^2D°$	[illegible]		219
	5	644.756	19.4386 - 174.5384	$3d^3 - 3d^2(a^1D)4p$	$a^2P - y^2D°$	[illegible]		219
	220	648.077	20.6643 - 174.9674	$3d^3 - 3d^2(a^1D)4p$	$a^2D - y^2D°$	[illegible]		219
	160	649.821	20.6499 - 174.5384	$3d^3 - 3d^2(a^1D)4p$	$a^2D - y^2D°$	[illegible]		219
	20	649.874	20.6643 - 174.5384	$3d^3 - 3d^2(a^1D)4p$	$a^2D - y^2D°$	[illegible]		219
	1	651.766	20.6643 - 174.0948	$3d^3 - 3d^2(a^3P)4p$	$a^2D - y^2D°$	[illegible]		219
	40	652.305	19.5192 - 172.8216	$3d^3 - 3d^2(a^1D)4p$	$a^2P - z^2P°$	[illegible]		219
	160	653.762	34.5557 - 187.5167	$3d^3 - 3d^2(a^1G)4p$	$a^2F - x^2F°$	[illegible]		219
	160	654.688	19.4386 - 172.1821	$3d^3 - 3d^2(a^1D)4p$	$a^2P - z^2P°$	[illegible]		219
	5	655.039	19.5192 - 172.1821	$3d^3 - 3d^2(a^1D)4p$	$a^2P - z^2P°$	[illegible]		219
	160	655.237	34.3628 - 186.9788	$3d^3 - 3d^2(a^1G)4p$	$a^2F - x^2F°$	[illegible]		219
	1	656.065	34.5557 - 186.9788	$3d^3 - 3d^2(a^1G)4p$	$a^2F - x^2F°$	[illegible]		219
	110	657.152	20.6499 - 172.8216	$3d^3 - 3d^2(a^1D)4p$	$a^2D - z^2P°$	[illegible]		219
	110	659.986	20.6643 - 172.1821	$3d^3 - 3d^2(a^1D)4p$	$a^2D - z^2P°$	[illegible]		219
	1	664.828	20.6643 - 171.0797	$3d^3 - 3d^2(a^3P)4p$	$a^2D - z^4S°$	[illegible]		219
7	30	665.00	15.0518 - 165.4289	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^2G°$	[illegible]	P	791
7	220	666.546	15.4016 - 165.4289	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^2G°$	[illegible]		219
7	160	667.297	15.0518 - 164.9086	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^2G°$	[illegible]		219
7	20	668.867	15.4016 - 164.9086	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^2G°$	[illegible]		219
	40	673.596	19.4386 - 167.8951	$3d^3 - 3d^2(a^3P)4p$	$a^2P - z^2S°$	[illegible]		219

CR IV — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	20	673.964	19.5192 - 167.8951	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^2S^o$	[illegible]		219
	5	675.110	14.1771 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
	1	676.457	14.4713 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
5	20	677.070	14.0590 - 161.7548	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
5	160	677.552	14.4713 - 162.0633	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
5	110	678.808	14.1771 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
5	40	678.904	14.0590 - 161.3534	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
	5	679.141	20.6499 - 167.8951	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^2S^o$	[illegible]		219
5	1	679.455	14.1771 - 161.3534	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
5	40	680.170	14.4713 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4D^o$	[illegible]		219
	5	680.619	14.0590 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^2D^o$	[illegible]		219
	160	680.833	34.3628 - 181.2415	$3d^3 - 3d^2(a^3F)4p$	$a^2F - x^2D^o$	[illegible]		219
	20	681.166	14.1771 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^2D^o$	[illegible]		219
	110	681.568	34.5557 - 181.2763	$3d^3 - 3d^2(a^3F)4p$	$a^2F - x^2D^o$	[illegible]		219
	20	681.841	15.4016 - 162.0633	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^4D^o$	[illegible]		219
	40	682.760	14.4713 - 160.9358	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4F^o$	[illegible]		219
	20	684.338	14.1771 - 160.3039	$3d^3 - 3d^2(a^3F)4p$	$a^4P - z^4F^o$	[illegible]		219
6	285	687.125	15.4016 - 160.9358	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^4F^o$	[illegible]		219
6	220	688.463	15.0518 - 160.3039	$3d^3 - 3d^2(a^3F)4p$	$a^2G - z^4F^o$	[illegible]		219
9	5	692.705	21.0659 - 165.4289	$3d^3 - 3d^2(a^3F)4p$	$a^2H - z^2G^o$	[illegible]		219
9	360	693.924	21.3207 - 165.4289	$3d^3 - 3d^2(a^3F)4p$	$a^2H - z^2G^o$	[illegible]		219
9	285	695.208	21.0659 - 164.9086	$3d^3 - 3d^2(a^3F)4p$	$a^2H - z^2G^o$	[illegible]		219
	110	696.063	34.3628 - 178.0281	$3d^3 - 3d^2(a^1G)4p$	$a^2F - y^2G^o$	[illegible]		219
	110	697.554	34.5557 - 177.9144	$3d^3 - 3d^2(a^1G)4p$	$a^2F - y^2G^o$	[illegible]		219
	110	699.981	19.4306 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^4D^o$	[illegible]		219
	40	702.667	19.4306 - 161.7548	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^2D^o$	[illegible]		219
	40	703.060	19.5192 - 161.7548	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^2D^o$	[illegible]		219
5	160	705.975	20.6499 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4D^o$	[illegible]		219
8	20	706.062	20.6643 - 162.2996	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4D^o$	[illegible]		219
	70	706.481	19.4306 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^2D^o$	[illegible]		219
	70	706.885	19.5192 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^2D^o$	[illegible]		219
	40	709.900	19.4306 - 160.3039	$3d^3 - 3d^2(a^3F)4p$	$a^2P - z^4F^o$	[illegible]		219
	5	709.992	20.6499 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4D^o$	[illegible]		219
	5	710.077	20.6643 - 161.4939	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4D^o$	[illegible]		219
	5	712.576	20.6499 - 160.9850	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^2D^o$	[illegible]		219
	220	712.901	20.6643 - 160.9358	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4F^o$	[illegible]		219
	40	716.128	20.6643 - 160.3039	$3d^3 - 3d^2(a^3F)4p$	$a^2D - z^4F^o$	[illegible]		219
	1	719.420	34.3628 - 173.3644	$3d^3 - 3d^2(a^1D)4p$	$a^2F - y^2F^o$	[illegible]		219
	1	724.218	34.5557 - 172.6347	$3d^3 - 3d^2(a^1D)4p$	$a^2F - y^2F^o$	[illegible]		219
	0	743.271	52.9753 - 187.5167	$3d^3 - 3d^2(a^1G)4p$	$b^2D - z^2F^o$	[illegible]		219
	70	744.190	53.1420 - 187.5167	$3d^3 - 3d^2(a^1G)4p$	$b^2D - z^2F^o$	[illegible]		219
	110	745.248	52.9753 - 186.9788	$3d^3 - 3d^2(a^1G)4p$	$b^2D - x^2F^o$	[illegible]		219
	110	763.947	52.9753 - 183.8739	$3d^3 - 3d^2(a^3P)4p$	$b^2D - y^2F^o$	[illegible]		219
	1	764.923	53.1420 - 183.8739	$3d^3 - 3d^2(a^3P)4p$	$b^2D - y^2F^o$	[illegible]		219
	70	765.833	53.1420 - 183.7187	$3d^3 - 3d^2(a^3P)4p$	$b^2D - y^2F^o$	[illegible]		219
	40	779.627	52.9753 - 181.2415	$3d^3 - 3d^2(a^3P)4p$	$b^2D - x^2D^o$	[illegible]		219
	5	780.428	53.1420 - 181.2763	$3d^3 - 3d^2(a^3P)4p$	$b^2D - x^2D^o$	[illegible]		219
	20	790.058	34.3628 - 160.9358	$3d^3 - 3d^2(a^3P)4p$	$a^2F - z^4F^o$	[illegible]		219
	40	795.241	34.5557 - 160.3039	$3d^3 - 3d^2(a^3P)4p$	$a^2F - z^4F^o$	[illegible]		219
	10	816.92						490
	1	819.732	52.9753 - 174.9674	$3d^3 - 3d^2(a^1D)4p$	$b^2D - y^2D^o$	[illegible]		219
	10	820.88	53.1420 - 174.9674	$3d^3 - 3d^2(a^1D)4p$	$b^2D - y^2D^o$	[illegible]		490
	1	914.714	52.9753 - 162.2996	$3d^3 - 3d^2(a^3P)4p$	$b^2D - z^4D^o$	[illegible]		219
	1	926.261	52.9753 - 160.9358	$3d^3 - 3d^2(a^3P)4p$	$b^2D - z^4F^o$	[illegible]		219

CR IV — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	0	933.172	53.1420 – 160.3039	$3d^3$ - $3d^2(a^3F)4p$	b^2D - z^2F°	5/2 - 5/2		219
	30	1002.39						490
	30	1090.97						490
	10	1092.23						490
	10	1098.06						490
	10	1111.17						490
	10	1227.43						490
	100	1315.00						490
	125	1315.69	157.3595 – 233.365	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	5/2 - 7/2	P	791
	150	1319.49	157.9311 – 233.718	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	7/2 - 9/2	P	791
	200	1324.85	158.6275 – 234.108	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	9/2 - 11/2	P	791
	50	1325.66	157.9311 – 233.365	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	7/2 - 7/2	P	791
	50	1331.73	158.6275 – 233.718	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	9/2 - 9/2	P	791
	250	1332.27	159.4480 – 234.508	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	11/2 - 13/2	P	791
	10	1338.02	158.6275 – 233.365	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	9/2 - 7/2	P	791
	50	1339.41	159.4480 – 234.108	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	11/2 - 11/2	P	791
	10	1346.44	159.4480 – 233.718	$3d^2(a^3F)4p$ - $3d^2(a^3F)4d$	z^4G° - e^4H	11/2 - 9/2	P	791
	20	1348.44						490
	40	1351.63						490
	10	1359.93						490
	10	1364.49	104.6286 – 177.9144	$3d^2(a^3F)4s$ - $3d^2(a^1G)4p$	b^4F - y^2G°	7/2 - 7/2		490
	150	1367.39						490
	20	1369.58						490
	20	1373.46	105.1041 – 177.9144	$3d^2(a^3F)4s$ - $3d^2(a^1G)4p$	b^4F - y^2G°	9/2 - 7/2		490
	200	1375.56						490
	10	1383.24						490
	20	1388.49						490
	30	1395.83						490
	10	1399.50						490
	220	1401.822	109.9402 – 181.2763	$3d^2(a^3F)4s$ - $3d^2(a^3P)4p$	b^2F - x^2D°	5/2 - 3/2		219
	20	1410.37						490
	30	1412.24						490
	450	1417.418	110.6904 – 181.2415	$3d^2(a^3F)4s$ - $3d^2(a^3P)4p$	b^2F - x^2D°	7/2 - 5/2		219
	100	1423.16						490
	100	1424.62						490
	10	1426.58						490
	10	1429.41						490
	10	1447.03	104.2571 – 173.3644	$3d^2(a^3F)4s$ - $3d^2(a^1D)4p$	b^4F - y^2F°	5/2 - 7/2		490
	20	1461.06						490
	30	1465.00	105.1041 – 173.3644	$3d^2(a^3F)4s$ - $3d^2(a^1D)4p$	b^4F - y^2F°	9/2 - 7/2	Q	490
	20	1466.14						490
	70	1471.151	109.9402 – 177.9144	$3d^2(a^3F)4s$ - $3d^2(a^1G)4p$	b^2F - y^2G°	5/2 - 7/2		219
	10	1475.10						490
	20	1482.07						490
	20	1482.36						490
	220	1485.052	110.6904 – 178.0281	$3d^2(a^3F)4s$ - $3d^2(a^1G)4p$	b^2F - y^2G°	7/2 - 9/2		219
	10	1500.46						490
	120	1508.89						490
	10	1509.85						490
	20	1533.42						490
	10	1551.20						490
	10	1553.09						490
	5	1558.745	110.6904 – 174.8449	$3d^2(a^3F)4s$ - $3d^2(a^3P)4p$	b^2F - y^2D°	7/2 - 5/2		219
	5	1576.691	109.9402 – 173.3644	$3d^2(a^3F)4s$ - $3d^2(a^1D)4p$	b^2F - y^2F°	5/2 - 7/2		219

CR IV — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	5	1594.739	118.5780 - 181.2763	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - z^2D^o$	5/2-3/2		219
	285	1595.039	109.9462 - 172.6347	$3d^2(a^3F)4s - 3d^2(a^1D)4p$	$b^2F - y^2F^o$	9/2-9/2		219
	380	1595.558	110.6904 - 173.3644	$3d^2(a^3F)4s - 3d^2(a^1D)4p$	$b^2F - y^2F^o$	7/2-7/2	P	219
	60	1595.622	118.5780 - 181.2415	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - z^2D^o$	3/2-3/2	P	219
	40	1598.723	118.7265 - 181.2763	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - z^2D^o$	5/2-5/2		219
	5	1599.619	118.7265 - 181.2415	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - z^2D^o$	3/2-5/2		219
	20	1613.14	119.2506 - 181.2415	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - z^2D^o$	1/2-3/2		490
	40	1657.71	105.1041 - 165.4289	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^2F - z^2G^o$	9/2-9/2		490
	450	1658.083	127.2063 - 187.5167	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - x^2F^o$	7/2-5/2		219
	120	1658.93	104.6286 - 164.9086	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^2F - z^2G^o$	7/2-7/2		490
	100	1666.66	173.3644 - 233.365	$3d^2(a^1D)4p - 3d^2(a^3F)4d$	$y^2F^o - e^2H$	7/2-9/2		490
	550	1672.660	127.1939 - 186.9788	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - x^2F^o$	9/2-7/2		219
	160	1673.021	127.2063 - 186.9788	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - x^2F^o$	7/2-7/2		219
	110	1681.673	124.4092 - 183.8739	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - y^2P^o$	1/2-3/2		219
	40	1685.02						490
	360	1686.072	124.4092 - 183.7187	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - y^2P^o$	5/2-5/2		219
	450	1690.881	124.7329 - 183.8739	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - y^2P^o$	3/2-3/2		219
	160	1695.328	124.7329 - 183.7187	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - y^2P^o$	3/2-5/2		219
	30	1698.55	174.8449 - 233.718	$3d^2(a^3P)4p - 3d^2(a^3F)4d$	$y^4D^o - e^4H$	7/2-9/2		490
	110	1699.677	118.5780 - 177.4050	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4P^o$	5/2-5/2		219
	20	1704.203	118.7265 - 177.4050	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4P^o$	3/2-5/2		219
	10	1704.48						490
	50	1709.89						490
	50	1713.69						490
	30	1715.04						490
	110	1718.533	118.7265 - 176.9153	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4P^o$	3/2-3/2		219
	450	1719.560	119.2506 - 177.4050	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	3/2-3/2	P	219
	70	1722.38	174.8449 - 232.905	$3d^2(a^3P)4p - 3d^2(a^3F)4d$	$y^4D^o - e^4G$	7/2-7/2		490
14	160	1722.857	104.2571 - 162.2996	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	5/2-5/2		219
	285	1725.257	118.7265 - 176.6091	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4P^o$	3/2-1/2		219
	20	1726.00	174.9674 - 232.905	$3d^2(a^1D)4p - 3d^2(a^3F)4d$	$y^2D^o - e^4G$	5/2-7/2		490
	360	1727.067	119.0133 - 176.9153	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	1/2-3/2		219
13	70	1729.919	104.2571 - 162.0633	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	5/2-7/2		219
13	220	1731.280	103.9947 - 161.7548	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	3/2-3/2		219
	450	1732.043	119.6700 - 177.4050	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	3/2-3/2		219
	220	1733.832	119.0133 - 176.6091	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	1/2-1/2		219
14	450	1733.979	104.6286 - 162.2996	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	7/2-5/2		219
	285	1734.156	119.2506 - 176.9153	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	3/2-1/2		219
	60	1734.68						490
13	450	1739.193	104.2571 - 161.7548	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	5/2-3/2		219
	160	1740.988	119.2506 - 176.6091	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	3/2-1/2		219
13	160	1741.100	104.6286 - 162.0633	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	7/2-7/2		219
	30	1741.93						490
13	220	1743.421	103.9947 - 161.3534	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	3/2-1/2		219
	220	1746.875	119.6700 - 176.9153	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4P^o$	5/2-3/2		219
13	285	1747.132	104.2571 - 161.4939	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	5/2-5/2		219
	20	1754.52						490
14	110	1754.685	103.9947 - 160.9850	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2D^o$	3/2-3/2	P	219
13	550	1755.643	105.1041 - 162.0633	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	9/2-7/2		219
	50	1758.37						490
	250	1758.486	124.4092 - 181.2763	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - x^2D^o$	1/2-3/2	P	219
13	400	1758.542	104.6286 - 161.4939	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4D^o$	7/2-5/2	P	219
	30	1762.52						490
14	285	1762.804	104.2571 - 160.9850	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2D^o$	5/2-3/2		219

CR IV – Continued

Multiplet	Rel. Int.	λ (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	360	1764.324	104.2571 - 160.9358	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]		219
	110	1768.549	124.7329 - 181.2763	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - x^2D^o$	[illegible]		219
	450	1769.635	124.7329 - 181.2415	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^2P - x^2D^o$	[illegible]		219
	360	1773.131	118.5700 - 174.9674	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2D^o$	[illegible]		219
	30	1775.909	103.9947 - 160.3039	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]	P	219
	10	1775.972	104.6286 - 160.9358	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]	P	219
	20	1776.992	118.5700 - 174.8449	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4D^o$	[illegible]		219
	450	1777.821	127.1939 - 183.4426	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - z^2H^o$	[illegible]		219
	110	1778.053	118.7265 - 174.9674	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2D^o$	[illegible]		219
	40	1784.223	104.2571 - 160.3039	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]	P	219
	220	1791.094	105.1041 - 160.9358	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]		219
	285	1791.729	118.7265 - 174.5384	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2D^o$	[illegible]		219
	40	1794.796	119.2506 - 174.9674	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - y^2D^o$	[illegible]		219
	70	1796.129	104.6286 - 160.3039	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^2F^o$	[illegible]		219
	220	1800.991	119.0133 - 174.5384	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - y^2D^o$	[illegible]		219
	20	1802.340	127.1939 - 182.6777	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - z^2H^o$	[illegible]		219
	870	1802.723	127.2063 - 182.6777	$3d^2(a^1G)4s - 3d^2(a^1G)4p$	$b^2G - z^2H^o$	[illegible]		219
	110	1808.410	119.6700 - 174.9674	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - y^2D^o$	[illegible]		219
	110	1808.723	119.2506 - 174.5384	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - y^2D^o$	[illegible]		219
12	360	1810.499	104.6286 - 159.8621	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	750	1812.413	119.6700 - 174.8449	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
12	360	1815.100	104.2571 - 159.3505	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	10	1818.90						490
16	870	1819.231	109.9402 - 164.9086	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^2F - z^2G^o$	[illegible]		219
	70	1820.454	118.7265 - 173.6579	$3d^2(a^1D)4s - 3d^2(a^3P)4p$	$c^2D - y^4D^o$	[illegible]		219
12	220	1821.621	103.9947 - 158.8912	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	20	1822.49						490
	450	1823.341	119.2506 - 174.0948	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
	450	1824.995	118.5700 - 173.3644	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2F^o$	[illegible]		219
12	750	1826.211	105.1041 - 159.8621	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
16	650	1826.863	110.6904 - 165.4289	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^2F - z^2G^o$	[illegible]		219
12	650	1827.408	104.6286 - 159.3505	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	220	1830.010	119.0133 - 173.6579	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
12	450	1830.350	104.2571 - 158.8912	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	10	1833.66						490
12	450	1833.812	103.9947 - 158.5259	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	1000	1837.400	119.6700 - 174.0948	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]	P	219
	450	1837.642	119.0133 - 173.4306	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
	220	1837.991	119.2506 - 173.6579	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
11	1000	1840.139	105.1041 - 159.4480	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4G^o$	[illegible]		219
12	220	1842.686	104.2571 - 158.5259	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
12	220	1842.897	104.6286 - 158.8912	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
12	220	1843.448	105.1041 - 159.3505	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4F^o$	[illegible]		219
	40	1844.407	110.6904 - 164.9086	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^2F - z^2G^o$	[illegible]		219
	70	1845.705	119.2506 - 173.4306	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
	285	1848.593	118.7265 - 172.8216	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - z^2P^o$	[illegible]		219
	160	1849.632	118.5700 - 172.6347	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2F^o$	[illegible]		219
11	1000	1851.890	104.6286 - 158.6275	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4G^o$	[illegible]		219
	220	1852.277	119.6700 - 173.6579	$3d^2(a^3P)4s - 3d^2(a^3P)4p$	$b^4P - y^4D^o$	[illegible]		219
	285	1855.012	118.7265 - 172.6347	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - y^2F^o$	[illegible]		219
	20	1858.449	119.0133 - 172.8216	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - z^2P^o$	[illegible]		219
11	870	1863.108	104.2571 - 157.9311	$3d^2(a^3F)4s - 3d^2(a^3F)4p$	$b^4F - z^4G^o$	[illegible]		219
	360	1865.255	118.5700 - 172.1821	$3d^2(a^1D)4s - 3d^2(a^1D)4p$	$c^2D - z^2P^o$	[illegible]		219
	20	1866.685	119.2506 - 172.8216	$3d^2(a^3P)4s - 3d^2(a^1D)4p$	$b^4P - z^2P^o$	[illegible]		219

CR IV – Continued

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
11	750	1868 344	105 1041 - 158 6275	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
11	870	1873 892	103 9947 - 157 3595	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
11	750	1876 083	104 6286 - 157 9311	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
	1	1880 811	119 0133 - 172 1821	$3d^2(a\,^3P)4s$ - $3d^2(a\,^1D)4p$	b^4P - z^2P°	[illegible]		219
11	650	1883 156	104 2571 - 157 3595	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
11	40	1892 960	105 1041 - 157 9311	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
11	20	1896 419	104 6286 - 157 3595	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^4F - z^4G°	[illegible]		219
	400	1904 323	119 6700 - 172 1821	$3d^2(a\,^3P)4s$ - $3d^2(a\,^1D)4p$	b^4P - z^2P°	[illegible]	P	219
	350	1904 410	118 5700 - 171 0797	$3d^2(a\,^1D)4s$ - $3d^2(a\,^3P)4p$	c^2D - z^4S°	[illegible]	P	219
	50	1909 88	109 9402 - 162 2996	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2D°	[illegible]	P	47
	70	1910 107	118 7265 - 171 0797	$3d^2(a\,^1D)4s$ - $3d^2(a\,^3P)4p$	c^2D - z^4S°	[illegible]		219
	5	1918 542	109 9402 - 162 0633	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^4D°	[illegible]		219
	160	1920 620	119 0133 - 171 0797	$3d^2(a\,^3P)4s$ - $3d^2(a\,^3P)4p$	b^4P - z^4S°	[illegible]		219
	220	1929 422	119 2506 - 171 0797	$3d^2(a\,^3P)4s$ - $3d^2(a\,^3P)4p$	b^4P - z^4S°	[illegible]		219
	285	1929 953	109 9402 - 161 7548	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^4D°	[illegible]		219
	20	1934 13						490
	750	1937 630	110 6904 - 162 2996	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2D°	[illegible]		219
	110	1939 723	109 9402 - 161 4939	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^4D°	[illegible]		219
	220	1945 160	119 6700 - 171 0797	$3d^2(a\,^3P)4s$ - $3d^2(a\,^3P)4p$	b^4P - z^4S°	[illegible]		219
	360	1946 549	110 6904 - 162 0633	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^4D°	[illegible]		219
	20	1948 28						490
	550	1959 060	109 9402 - 160 9850	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2D°	[illegible]		219
15	650	1960 950	109 9402 - 160 9358	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2F°	[illegible]		219
	870	1967 181	127 1939 - 178 0281	$3d^2(a\,^1G)4s$ - $3d^2(a\,^1G)4p$	b^2G - y^2G°	[illegible]		219
	360	1968 364	110 6904 - 161 4939	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^4D°	[illegible]		219
	70	1971 583	127 1939 - 177 9144	$3d^2(a\,^1G)4s$ - $3d^2(a\,^1G)4p$	b^2G - y^2G°	[illegible]		219
	650	1972 075	127 2063 - 177 9144	$3d^2(a\,^1G)4s$ - $3d^2(a\,^1G)4p$	b^2G - y^2G°	[illegible]		219
15	450	1985 552	109 9402 - 160 3039	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2F°	[illegible]		219
15	650	1990 247	110 6904 - 160 9358	$3d^2(a\,^3F)4s$ - $3d^2(a\,^3F)4p$	b^2F - z^2F°	[illegible]		219
	450	1990 664	124 7329 - 174 9674	$3d^2(a\,^3P)4s$ - $3d^2(a\,^1D)4p$	b^2P - y^2D°	[illegible]	P	219
	20	1997 35						490

CHROMIUM V (Cr^{4+}), Z = 24
Ground State $1s^22s^22p^63s^23p^63d^2(^3F_2)$ (20 electrons)
Ionization Potential 560 200 cm^{-1}; 69.46 eV

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	20	433 119	5082 - 231 3929	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	3 - 4		218
	5	434 180	0 - 230 3163	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	2 - 3		218
	220	434 306	1 1417 - 231 3929	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	4 - 4		218
	110	435 143	5082 - 230 3163	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	3 - 3		218
	110	435 636	0 - 229 5517	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	2 - 2		218
	70	436 351	1 1417 - 230 3163	$3d^2$ - $3d4p$	a^3F - $^3F^\circ$	4 - 3		218
	70	437 420	5082 - 229 1208	$3d^2$ - $3d4p$	a^3F - $^3D^\circ$	3 - 3		218
	40	437 655	0 - 228 4891	$3d^2$ - $3d4p$	a^3F - $^3D^\circ$	2 - 2		218
	100	438 593	0 - 228 0018	$3d^2$ - $3d4p$	a^3F - $^3D^\circ$	2 - 1	P	218
	130	438 633	5082 - 228 4891	$3d^2$ - $3d4p$	a^3F - $^3D^\circ$	3 - 2	P	218
	220	438 637	1 1417 - 229 1208	$3d^2$ - $3d4p$	a^3F - $^3D^\circ$	4 - 3	P	218
	110	441 056	13 1880 - 239 9175	$3d^2$ - $3d4p$	^1D - $^1P^\circ$	2 - 1		218

CR V — Continued

Multiplet	Rel. Int.	λ (in Å)	Levels (in 10³ cm⁻¹)	Configurations	Terms	J - J	Notes	References
	20	442.243	0. - 226.1198	$3d^2$ - 3d4p	g'F - D°	2 - 2		218
	20	445.751	13.1880 - 237.5295	$3d^2$ - 3d4p	'D - 'F°	2 - 3		218
	5	446.672	16.0410 - 239.9175	$3d^2$ - 3d4p	'P - 'P°	2 - 1		218
	5	451.141	13.1880 - 234.8464	$3d^2$ - 3d4p	'D - 'P°	2 - 2		218
	5	451.607	13.1880 - 234.6184	$3d^2$ - 3d4p	'D - 'P°	2 - 1		218
	110	456.272	15.6766 - 234.8464	$3d^2$ - 3d4p	'P - 'P°	1 - 2		218
	70	456.357	15.4918 - 234.6184	$3d^2$ - 3d4p	'P - 'P°	0 - 1		218
	70	456.637	15.6766 - 234.6685	$3d^2$ - 3d4p	'P - P°	1 - 0		218
	40	456.743	15.6766 - 234.6184	$3d^2$ - 3d4p	'P - 'P°	1 - 1		218
	160	457.028	16.0410 - 234.8464	$3d^2$ - 3d4p	'P - 'P°	2 - 2		218
	70	457.504	16.0410 - 234.6184	$3d^2$ - 3d4p	'P - 'P°	2 - 1		218
	450	464.015	22.0192 - 237.5295	$3d^2$ - 3d4p	G - 'F°	4 - 3		218
	110	469.311	16.0410 - 229.1208	$3d^2$ - 3d4p	'P - 'D°	2 - 3		218
	220	469.634	13.1880 - 226.1198	$3d^2$ - 3d4p	'D - 'D°	2 - 2		218
	70	469.893	15.6766 - 228.4891	$3d^2$ - 3d4p	'P - 'D°	1 - 2		218
	40	470.567	15.4918 - 228.0018	$3d^2$ - 3d4p	'P - 'D°	0 - 1		218
	20	470.697	16.0410 - 228.4891	$3d^2$ - 3d4p	'P - 'D°	2 - 2		218
	5	470.976	15.6766 - 228.0018	$3d^2$ - 3d4p	'P - 'D°	1 - 1		218
	160	529.742	51.1464 - 239.9175	$3d^2$ - 3d4p	'S - 'P°	0 - 1		218
	110	754.521	226.1198 - 358.6538	3d4p - 3d5s	'D° - 'D	2 - 2		218
	1	764.151	226.1198 - 356.9813	3d4p - 3d5s	'D° - 'D	2 - 2		218
	1	768.251	228.4891 - 358.6538	3d4p - 3d5s	'D° - 'D	2 - 2		218
	1	774.079	228.4891 - 357.6759	3d4p - 3d5s	'D° - 'D	2 - 3		218
	1	775.308	228.0018 - 356.9813	3d4p - 3d5s	'D° - 'D	1 - 2		218
	5	776.743	228.0018 - 356.7448	3d4p - 3d5s	'D° - 'D	1 - 1		218
	160	777.873	229.1208 - 357.6759	3d4p - 3d5s	'D° - 'D	3 - 3		218
	40	778.253	228.4891 - 356.9813	3d4p - 3d5s	'D° - 'D	2 - 2		218
	1	779.209	230.3163 - 358.6538	3d4p - 3d5s	'F° - 'D	3 - 2		218
	40	786.210	229.5517 - 356.7448	3d4p - 3d5s	'F° - 'D	2 - 1		218
	110	789.492	230.3163 - 356.9813	3d4p - 3d5s	'F° - 'D	3 - 2		218
	160	791.872	231.3929 - 357.6759	3d4p - 3d5s	'F° - 'D	4 - 3		218
	40	814.148	234.8464 - 357.6759	3d4p - 3d5s	'P° - 'D	2 - 3		218
	5	817.246	234.6184 - 356.9813	3d4p - 3d5s	'P° - 'D	1 - 2		218
	1	818.803	234.6184 - 356.7448	3d4p - 3d5s	'P° - 'D	1 - 1		218
	1	819.153	234.6685 - 356.7448	3d4p - 3d5s	'P° - 'D	0 - 1		218
	220	825.600	237.5295 - 358.6538	3d4p - 3d5s	'F° - 'D	3 - 2		218
	1	832.309	237.5295 - 357.6759	3d4p - 3d5s	'F° - 'D	3 - 3		218
	1	837.157	237.5295 - 356.9813	3d4p - 3d5s	'F° - 'D	3 - 2		218
	20	842.195	239.9175 - 358.6538	3d4p - 3d5s	'P° - 'D	1 - 2		218
	220	968.703	226.1198 - 329.3503	3d4p - 3d4d	'D° - 'D	2 - 2		218
	1	978.064	228.0018 - 330.2451	3d4p - 3d4d	'D° - 'P	1 - 1		218
	1	979.590	228.0018 - 330.0848	3d4p - 3d4d	'D° - 'P	1 - 0		218
	1	979.934	228.4891 - 330.5368	3d4p - 3d4d	'D° - 'P	2 - 2		218
	70	982.736	228.4891 - 330.2451	3d4p - 3d4d	'D° - 'P	2 - 1		218
	110	986.035	229.1208 - 330.5368	3d4p - 3d4d	'D° - 'P	3 - 2		218
	1	997.709	229.1208 - 329.3503	3d4p - 3d4d	'D° - 'D	3 - 2		218
	1	1002.024	229.5517 - 329.3503	3d4p - 3d4d	'F° - 'D	2 - 2		218
	70	1029.842	228.0018 - 325.1041	3d4p - 3d4d	'D° - 'F	1 - 2		218
	110	1031.105	228.4891 - 325.4725	3d4p - 3d4d	'D° - 'F	2 - 3		218
	110	1033.452	229.1208 - 325.8842	3d4p - 3d4d	'D° - 'F	3 - 4		218
	5	1035.037	228.4891 - 325.1041	3d4p - 3d4d	'D° - 'F	2 - 2		218
	40	1042.544	234.6184 - 330.5368	3d4p - 3d4d	'P° - 'P	1 - 2		218
	220	1045.044	234.8464 - 330.5368	3d4p - 3d4d	'P° - 'P	2 - 2		218
	5	1045.733	234.6184 - 330.2451	3d4p - 3d4d	'P° - 'P	1 - 1		218

CR V — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	20	1046.294	234.6685 - 330.2451	3d4p - 3d4d	$^3P^o$ - ^3P	0 - 1		218
	40	1046.364	230.3163 - 325.8842	3d4p - 3d4d	$^3F^o$ - ^3F	3 - 4		218
	20	1046.542	229.5517 - 325.1041	3d4p - 3d4d	$^3F^o$ - ^3F	2 - 2		218
	5	1047.494	234.6184 - 330.0848	3d4p - 3d4d	$^3P^o$ - ^3P	1 - 0		218
	20	1048.236	234.8464 - 330.2451	3d4p - 3d4d	$^3P^o$ - ^3P	2 - 1		218
	70	1050.901	230.3163 - 325.4725	3d4p - 3d4d	$^3F^o$ - ^3F	3 - 3		218
	1	1054.991	230.3163 - 325.1041	3d4p - 3d4d	$^3F^o$ - ^3F	3 - 2		218
	110	1058.298	231.3929 - 325.8842	3d4p - 3d4d	$^3F^o$ - ^3F	4 - 4		218
	285	1060.651	237.5295 - 331.8112	3d4p - 3d4d	$^1F^o$ - ^1G	3 - 4		218
	1	1062.933	231.3929 - 325.4725	3d4p 3d4d	$^3F^o$ - ^3F	4 - 3		218
	20	1073.367	226.1198 - 319.2840	3d4p - 3d4d	$^1D^o$ - ^1P	2 - 1		218
	5	1089.079	237.5295 - 329.3503	3d4p - 3d4d	$^1F^o$ - ^1D	3 - 2		218
	40	1103.390	228.4891 - 319.1191	3d4p - 3d4d	$^3D^o$ - ^3G	2 - 3		218
	160	1104.296	226.1198 - 316.6749	3d4p - 3d4d	$^1D^o$ - ^1F	2 - 3		218
	20	1105.250	229.1208 - 319.5168	3d4p - 3d4d	$^3D^o$ - ^3G	3 - 4		218
	5	1108.322	228.0018 - 318.2276	3d4p - 3d4d	$^3D^o$ - ^3D	1 - 2		218
	5	1109.731	228.4891 - 318.6017	3d4p - 3d4d	$^3D^o$ - ^3D	2 - 3		218
	220	1112.452	228.0018 - 317.8938	3d4p - 3d4d	$^3D^o$ - ^3D	1 - 1		218
	285	1114.350	228.4891 - 318.2276	3d4p - 3d4d	$^3D^o$ - ^3D	2 - 2		218
	450	1116.478	229.5517 - 319.1191	3d4p - 3d4d	$^3F^o$ - ^3G	2 - 3		218
	360	1117.559	229.1208 - 318.6017	3d4p - 3d4d	$^3D^o$ - ^3D	3 - 3		218
	220	1118.157	239.9175 - 329.3503	3d4p - 3d4d	$^1P^o$ - ^1D	1 - 2		218
	5	1118.518	228.4891 - 317.8938	3d4p - 3d4d	$^3D^o$ - ^3D	2 - 1		218
	650	1121.066	230.3163 - 319.5168	3d4p - 3d4d	$^3F^o$ - ^3G	3 - 4		218
	5	1122.255	229.1208 - 318.2276	3d4p - 3d4d	$^3D^o$ - ^3D	3 - 2		218
	20	1126.090	230.3163 - 319.1191	3d4p - 3d4d	$^3F^o$ - ^3G	3 - 3		218
	650	1127.631	231.3929 - 320.0744	3d4p - 3d4d	$^3F^o$ - ^3G	4 - 5		218
	40	1134.768	231.3929 - 319.5168	3d4p - 3d4d	$^3F^o$ - ^3G	4 - 4		218
	160	1137.529	234.6184 - 322.5281	3d4p - 3d4d	$^3P^o$ - ^3S	1 - 1		218
	20	1138.177	234.6685 - 322.5281	3d4p - 3d4d	$^3P^o$ - ^3S	0 - 1		218
	160	1140.489	234.8464 - 322.5281	3d4p - 3d4d	$^3P^o$ - ^3S	2 - 1		218
	40	1146.668	231.3929 - 318.6017	3d4p - 3d4d	$^3F^o$ - ^3D	4 - 3		218
	450	1193.950	234.8464 - 318.6017	3d4p - 3d4d	$^3P^o$ - ^3D	2 - 3		218
	360	1196.042	234.6184 - 318.2276	3d4p - 3d4d	$^3P^o$ - ^3D	1 - 2		218
	70	1200.834	234.6184 - 317.8938	3d4p - 3d4d	$^3P^o$ - ^3D	1 - 1		218
	110	1201.556	234.6685 - 317.8938	3d4p - 3d4d	$^3P^o$ - ^3D	0 - 1		218
	70	1204.126	234.8464 - 317.8938	3d4p - 3d4d	$^3P^o$ - ^3D	2 - 1		218
	220	1210.499	239.9175 - 322.5281	3d4p - 3d4d	$^1P^o$ - ^3S	1 - 1		218
	220	1259.986	239.9175 - 319.2840	3d4p - 3d4d	$^1P^o$ - ^1P	1 - 1		218
	450	1263.501	237.5295 - 316.6749	3d4p - 3d4d	$^1F^o$ - ^1F	3 - 3		218
	650	1465.861	171.6981 - 239.9175	3d4s - 3d4p	^1D - $^1P^o$	2 - 1		218
	5	1477.769	167.1764 - 234.8464	3d4s - 3d4p	^3D - $^3P^o$	1 - 2		218
	220	1481.651	167.1764 - 234.6685	3d4s - 3d4p	^3D - $^3P^o$	1 - 0		218
	220	1482.757	167.1764 - 234.6184	3d4s - 3d4p	^3D - $^3P^o$	1 - 1		218
	220	1484.666	167.4910 - 234.8464	3d4s - 3d4p	^3D - $^3P^o$	2 - 2		218
	450	1489.711	167.4910 - 234.6184	3d4s - 3d4p	^3D - $^3P^o$	2 - 1		218
	650	1497.966	168.0895 - 234.8464	3d4s - 3d4p	^3D - $^3P^o$	3 - 2		218
	750	1519.030	171.6981 - 237.5295	3d4s - 3d4p	^1D - $^1F^o$	2 - 3		218
	1000	1579.696	168.0895 - 231.3929	3d4s - 3d4p	^3D - $^3F^o$	3 - 4		218
	750	1591.721	167.4910 - 230.3163	3d4s - 3d4p	^3D - $^3F^o$	2 - 3		218
	650	1603.191	167.1764 - 229.5517	3d4s - 3d4p	^3D - $^3F^o$	1 - 2		218
	40	1607.035	168.0895 - 230.3163	3d4s - 3d4p	^3D - $^3F^o$	3 - 3		218
	40	1611.330	167.4910 - 229.5517	3d4s - 3d4p	^3D - $^3F^o$	2 - 2		218
	40	1622.607	167.4910 - 229.12[illegible]8	3d4s - 3d4p	^3D - $^3D^o$	2 - 3		218

CR V — Continued

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
110	1630.989	167.1764 - 228.4891	3d4s - 3d4p	$^3D - ^3D^\circ$	1 - 2		218
285	1638.495	168.0895 - 229.1208	3d4s - 3d4p	$^3D - ^3D^\circ$	3 - 3		218
220	1639.403	167.4910 - 228.4891	3d4s - 3d4p	$^3D - ^3D^\circ$	2 - 2		218
160	1644.053	167.1764 - 228.0018	3d4s - 3d4p	$^3D - ^3D^\circ$	1 - 1		218
70	1652.595	167.4910 - 228.0018	3d4s - 3d4p	$^3D - ^3D^\circ$	2 - 1		218
70	1655.639	168.0895 - 228.4891	3d4s - 3d4p	$^3D - ^3D^\circ$	3 - 2		218
70	1705.629	167.4910 - 226.1198	3d4s - 3d4p	$^3D - ^1D^\circ$	2 - 2		218
20	1705.968	171.6981 - 230.3163	3d4s - 3d4p	$^1D - ^3F^\circ$	2 - 3		218
110	1728.497	171.6981 - 229.5517	3d4s - 3d4p	$^1D - ^3F^\circ$	2 - 2		218
1000	1837.502	171.6981 - 226.1198	3d4s - 3d4p	$^1D - ^1D^\circ$	2 - 2	P	218

CHROMIUM VI (Cr^{5+}), Z = 24
Ground State $1s^22s^22p^63s^23p^63d(^2D_{3/2})$ (19 electrons)
Ionization Potential 731 020 cm^{-1}; 90.636 eV

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
1	144.76	0. - 690.781	$3p^63d - 3p^610f$	$g^2D - ^2F^\circ$	3/2 - 5/2	P	009
1	144.961	.940 - 690.781	$3p^63d - 3p^610f$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
1	146.776	0. - 681.307	$3p^63d - 3p^69f$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
4	146.980	.940 - 681.307	$3p^63d - 3p^69f$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
4	149.706	0. - 667.973	$3p^63d - 3p^68f$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
12	149.918	.940 - 667.973	$3p^63d - 3p^68f$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
30	154.197	0. - 648.521	$3p^63d - 3p^67f$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
50	154.418	.940 - 648.533	$3p^63d - 3p^67f$	$g^2D - ^2F^\circ$	5/2 - 7/2		222
80	161.659	0. - 618.583	$3p^63d - 3p^66f$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
80	161.687	.940 - 619.419	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^2D^\circ$	5/2 - 3/2		222
80	161.836	.940 - 618.849	$3p^63d - 3p^66f$	$g^2D - ^2F^\circ$	5/2 - 7/2		222
12	161.908	.940 - 618.583	$3p^63d - 3p^66f$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
1	161.930	.940 - 618.491	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^2D^\circ$	5/2 - 5/2		222
110	162.565	.940 - 616.079	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^2F^\circ$	5/2 - 7/2		222
12	162.764	0. - 614.385	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
50	163.014	.940 - 614.385	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
12	163.514	0. - 611.568	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^2D^\circ$	3/2 - 3/2		222
12	163.801	0. - 610.497	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^2D^\circ$	3/2 - 5/2		222
4	164.159	0. - 609.166	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^4D^\circ$	3/2 - 1/2		222
1	164.301	0. - 608.631	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^4D^\circ$	3/2 - 5/2		222
12	164.564	.940 - 608.631	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^4D^\circ$	5/2 - 5/2		222
12	164.833	.940 - 607.615	$3p^63d - 3p^53d(^3D^\circ)4s$	$g^2D - ^4D^\circ$	5/2 - 7/2		222
11	168.088	0 - 594.926	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
4	168.355	.940 - 594.926	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^2F^\circ$	5/2 - 5/2		222
150	169.435	.940 - 591.137	$3p^63d - 3p^53d(^1F^\circ)4s$	$g^2D - ^2F^\circ$	5/2 - 7/2		222
12	170.569	0. - 586.273	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^4F^\circ$	3/2 - 5/2		222
30	171.400	.940 - 584.371	$3p^63d - 3p^53d(^3F^\circ)4s$	$g^2D - ^4F^\circ$	5/2 - 7/2		222
4	172.204	0. - 580.697	$3p^63d - 3p^53d(^3P^\circ)4s$	$g^2D - ^2P^\circ$	3/2 - 3/2		222
80	172.487	.940 - 580.697	$3p^63d - 3p^53d(^3P^\circ)4s$	$g^2D - ^2P^\circ$	5/2 - 3/2		222
50	172.841	0 - 578.566	$3p^63d - 3p^53d(^3P^\circ)4s$	$g^2D - ^2P^\circ$	3/2 - 1/2		222
4	173.973	.940 - 575.742	$3p^63d - 3p^66p$	$g^2D - ^2P^\circ$	5/2 - 3/2		222
12	174.175	0 - 574.135	$3p^63d - 3p^66p$	$g^2D - ^2P^\circ$	3/2 - 1/2		222
150	175.756	0 - 568.9574	$3p^63d - 3p^65f$	$g^2D - ^2F^\circ$	3/2 - 5/2		222
200	176.037	.940 - 568.9930	$3p^63d - 3p^65f$	$g^2D - ^2F^\circ$	5/2 - 7/2		222
375	201.007	0 - 497.495	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - ^2D^\circ$	3/2 - 3/2		222
250	201.224	0 - 496.958	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - ^2D^\circ$	3/2 - 5/2		222

CR VI — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	200	201.388	.940 - 497.495	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - {}^2D^\circ$	5/2 - 3/2		222
	450	201.606	.940 - 496.958	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - {}^2D^\circ$	5/2 - 5/2		222
	110	202.057	0. - 494.9112	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3P))$	$g^2D - {}^2P^\circ$	3/2 - 3/2		222
	375	202.442	.940 - 494.9112	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3P))$	$g^2D - {}^2P^\circ$	5/2 - 3/2		222
	300	202.739	0. - 493.2471	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3P))$	$g^2D - {}^2P^\circ$	3/2 - 1/2		222
	110	204.682	0. - 488.5619	$3p^63d - 3p^65p$	$g^2D - {}^2P^\circ$	3/2 - 3/2		222
	450	205.084	.940 - 488.5619	$3p^63d - 3p^65p$	$g^2D - {}^2P^\circ$	5/2 - 3/2		222
	375	207.489	0. - 481.9560	$3p^63d - 3p^64f$	$g^2D - {}^2F^\circ$	3/2 - 5/2		222
	450	207.651	.940 - 482.5171	$3p^63d - 3p^64f$	$g^2D - {}^2F^\circ$	5/2 - 7/2		222
	110	207.892	.940 - 481.9560	$3p^63d - 3p^64f$	$g^2D - {}^2F^\circ$	5/2 - 5/2		222
	450	226.241	.940 - 442.9454	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - {}^2F^\circ$	5/2 - 7/2		222
	375	227.202	0. - 440.1352	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - {}^2F^\circ$	3/2 - 5/2		222
	80	227.689	.940 - 440.1352	$3p^63d - 3p^5(^2P^\circ)(3d^2(^3F))$	$g^2D - {}^2F^\circ$	5/2 - 5/2		222
	250	264.078	0. - 378.677	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1D))$	$g^2D - {}^2F^\circ$	3/2 - 5/2		222
	12	264.732	.940 - 378.677	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1D))$	$g^2D - {}^2F^\circ$	5/2 - 5/2		222
	300	269.776	.940 - 371.618	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1D))$	$g^2D - {}^2F^\circ$	5/2 - 7/2		222
	80	279.154	.940 - 359.165	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1G))$	$g^2D - {}^2F^\circ$	5/2 - 7/2		222
	50	280.143	0. - 356.962	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1G))$	$g^2D - {}^2F^\circ$	3/2 - 5/2		222
	12	280.879	.940 - 356.962	$3p^63d - 3p^5(^2P^\circ)(3d^2(^1G))$	$g^2D - {}^2F^\circ$	5/2 - 5/2		222
	150	335.123	0. - 298.3967	$3p^63d - 3p^64p$	$g^2D - {}^2P^\circ$	3/2 - 3/2		222
	600	336.184	.940 - 298.3967	$3p^63d - 3p^64p$	$g^2D - {}^2P^\circ$	5/2 - 3/2		222
	450	337.185	0. - 296.5732	$3p^63d - 3p^64p$	$g^2D - {}^2P^\circ$	3/2 - 1/2		222
	1	383.575	227.8579 - 488.5619	$3p^64s - 3p^65p$	$^2S - {}^2P^\circ$	1/2 - 3/2		222
	1	385.015	227.8579 - 487.5895	$3p^64s - 3p^65p$	$^2S - {}^2P^\circ$	1/2 - 1/2		222
	0	420.499	296.5732 - 534.3817	$3p^64p - 3p^65d$	$^2P^\circ - {}^2D$	1/2 - 3/2		222
	0	423.559	298.3967 - 534.4897	$3p^64p - 3p^65d$	$^2P^\circ - {}^2D$	3/2 - 5/2		222
	1	562.572	442.9454 - 620.7005	$3p^5(^2P^\circ)(3d^2(^3F)) - 3p^66g$	$^2F^\circ - {}^2G$	7/2 - 9/2		222
	1	602.011	402.8886 - 568.9930	$3p^64d - 3p^65f$	$^2D - {}^2F^\circ$	5/2 - 7/2		222
	30	607.239	296.5732 - 461.2530	$3p^64p - 3p^65s$	$^2P^\circ - {}^2S$	1/2 - 1/2		222
	50	614.028	298.3967 - 461.2530	$3p^64p - 3p^65s$	$^2P^\circ - {}^2S$	3/2 - 1/2		222
	4	720.771	481.9560 - 620.6963	$3p^64f - 3p^66g$	$^2F^\circ - {}^2G$	5/2 - 7/2		222
	4	723.675	482.5171 - 620.7005	$3p^64f - 3p^66g$	$^2F^\circ - {}^2G$	7/2 - 9/2		222
	12	756.786	440.1352 - 572.2723	$3p^5(^2P^\circ)(3d^2(^3F)) - 3p^65g$	$^2F^\circ - {}^2G$	5/2 - 7/2		222
	30	773.223	442.9454 - 572.2744	$3p^5(^2P^\circ)(3d^2(^3F)) - 3p^65g$	$^2F^\circ - {}^2G$	7/2 - 9/2		222
	520	942.610	296.5732 - 402.6617	$3p^64p - 3p^64d$	$^2P^\circ - {}^2D$	1/2 - 3/2		222
	600	957.009	298.3967 - 402.8886	$3p^64p - 3p^64d$	$^2P^\circ - {}^2D$	3/2 - 5/2		222
	300	959.093	298.3967 - 402.6617	$3p^64p - 3p^64d$	$^2P^\circ - {}^2D$	3/2 - 3/2		222
	12	1086.681	402.8886 - 494.9112	$3p^64d - 3p^5(^2P^\circ)(3d^2(^3P))$	$^2D - {}^2P^\circ$	5/2 - 3/2		222
	12	1103.926	402.6617 - 493.2471	$3p^64d - 3p^5(^2P^\circ)(3d^2(^3P))$	$^2D - {}^2P^\circ$	3/2 - 1/2		222
	150	1107.225	481.9560 - 572.2723	$3p^64f - 3p^65g$	$^2F^\circ - {}^2G$	5/2 - 7/2		222
	200	1114.114	482.5171 - 572.2744	$3p^64f - 3p^65g$	$^2F^\circ - {}^2G$	7/2 - 9/2		222
	12	1164.146	402.6617 - 488.5619	$3p^64d - 3p^65p$	$^2D - {}^2P^\circ$	3/2 - 3/2		222
	110	1167.222	402.8886 - 488.5619	$3p^64d - 3p^65p$	$^2D - {}^2P^\circ$	5/2 - 3/2		222
	80	1177.469	402.6617 - 487.5895	$3p^64d - 3p^65p$	$^2D - {}^2P^\circ$	3/2 - 1/2		222
	200	1255.832	402.8886 - 482.5171	$3p^64d - 3p^64f$	$^2D - {}^2F^\circ$	5/2 - 7/2		222
	150	1261.128	402.6617 - 481.9560	$3p^64d - 3p^64f$	$^2D - {}^2F^\circ$	3/2 - 5/2		222
	50	1264.746	402.8886 - 481.9560	$3p^64d - 3p^64f$	$^2D - {}^2F^\circ$	5/2 - 5/2		222
	80	1281.439	572.2744 - 650.3108	$3p^65g - 3p^67h$	$^2G - {}^2H^\circ$	9/2 - 11/2		222
	50	1342.741	487.5895 - 562.0641	$3p^65p - 3p^66s$	$^2P^\circ - {}^2S$	1/2 - 1/2		222
	80	1360.504	488.5619 - 562.0641	$3p^65p - 3p^66s$	$^2P^\circ - {}^2S$	3/2 - 1/2		222
	800	1417.659	227.8579 - 298.3967	$3p^64s - 3p^64p$	$^2S - {}^2P^\circ$	1/2 - 3/2		222
	700	1455.282	227.8579 - 296.5732	$3p^64s - 3p^64p$	$^2S - {}^2P^\circ$	1/2 - 1/2		222
	50	1907.462	481.9560 - 534.3817	$3p^64f - 3p^65d$	$^2F^\circ - {}^2D$	5/2 - 3/2		222
	80	1924.089	482.5171 - 534.4897	$3p^64f - 3p^65d$	$^2F^\circ - {}^2D$	7/2 - 5/2		222

CR VI — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	12	1932.783	568.9574 - 620.6963	$3p^55f$ - $3p^56g$	$^3F^\circ$ - ^3G	[illegible]		222
	30	1933.955	568.9930 - 620.7005	$3p^55f$ - $3p^56g$	$^3F^\circ$ - ^3G	[illegible]		222

CHROMIUM VII (Cr^{6+}), Z = 24
Ground State $1s^22s^22p^63s^23p^6(^1S_0)$ (18 electrons)
Ionization Potential 1 291 900 cm^{-1}; 160.18 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		71.744	0. - 1393.84	$3s^23p^6$ - $3s3p^67p$	g^1S - $^1P^\circ$	0 - 1	A	440
	1	74.875	0. - 1335.56	$3s^23p^6$ - $3s3p^66p$	g^1S - $^1P^\circ$	0 - 1	A	440
	4	81.491	0. - 1227.13	$3s^23p^6$ - $3s3p^65p$	g^1S - $^1P^\circ$	0 - 1	A	440
	1	81.980	0. - 1219.81	$3s^23p^6$ - $3s3p^65p$	g^1S - $^3P^\circ$	0 - 1	A	440
	1	92.128	0. - 1085.446	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{1/2})6s$	g^1S - [illegible]	0 - 1		907
	5	92.969	0. - 1075.627	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})6s$	g^1S - [illegible]	0 - 1		907
	5	95.917	0. - 1042.568	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{1/2})5d$	g^1S - [illegible]	0 - 1		907
	20	96.760	0. - 1033.485	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})5d$	g^1S - [illegible]	0 - 1		907
	20	100.593	0. - 994.105	$3s^23p^6$ - $3s3p^64p$	g^1S - $^1P^\circ$	0 - 1		907
	1	101.565	0. - 984.59	$3s^23p^6$ - $3s3p^64p$	g^1S - $^3P^\circ$	0 - 1	A	440
	40	104.127	0. - 960.366	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{1/2})5s$	g^1S - [illegible]	0 - 1		907
	40	105.139	0. - 951.122	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})5s$	g^1S - [illegible]	0 - 1		907
	285	114.235	0. - 875.3805	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{1/2})4d$	g^1S - [illegible]	0 - 1		907
	285	115.407	0. - 866.5028	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})4d$	g^1S - [illegible]	0 - 1		907
	5	116.654	0. - 857.2345	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})4d$	g^1S - [illegible]	0 - 1		907
	650	146.497	0. - 682.6102	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{1/2})4s$	g^1S - [illegible]	0 - 1		907
	450	148.714	0. - 672.4277	$3s^23p^6$ - $3s^23p^5(^2P^\circ_{3/2})4s$	g^1S - [illegible]	0 - 1		907
	20	166.488	341.1793 - 941.811	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3P^\circ$ - [illegible]	0 - 1		907
	70	166.560	342.7735 - 943.1491	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3P^\circ$ - [illegible]	1 - 2		907
	40	166.936	342.7735 - 941.811	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3P^\circ$ - [illegible]	1 - 1		907
	220	167.020	346.1371 - 944.8667	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3P^\circ$ - [illegible]	2 - 3		907
	110	167.496	346.1371 - 943.1491	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3P^\circ$ - [illegible]	2 - 2		907
	40	168.523	363.0609 - 956.454	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{1/2})4f$	$^3F^\circ$ - [illegible]	2 - 3		907
	5	169.084	357.5437 - 948.9439	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	4 - 4		907
	5	169.842	360.1719 - 948.9439	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	3 - 4		907
	5	170.086	357.5437 - 945.4757	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	4 - 4		907
	20	170.139	360.1719 - 947.9174	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	3 - 3		907
	450	170.393	357.5437 - 944.4168	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	4 - 5		907
	285	170.850	360.1719 - 945.4757	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	3 - 4		907
	160	170.982	363.0609 - 947.9174	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3F^\circ$ - [illegible]	2 - 3		907
	5	174.070	382.7374 - 957.2051	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{1/2})4f$	$^3D^\circ$ - [illegible]	3 - 4		907
	160	174.286	382.6823 - 956.454	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{1/2})4f$	$^1D^\circ$ - [illegible]	2 - 3		907
	220	175.315	386.6166 - 957.0046	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{1/2})4f$	$^3D^\circ$ - [illegible]	2 - 3		907
	70	175.812	385.8283 - 954.623	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	1 - 2		907
	110	176.053	386.6166 - 954.623	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	2 - 2		907
	5	176.295	389.2262 - 956.454	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{1/2})4f$	$^1F^\circ$ - [illegible]	3 - 3		907
	285	176.613	382.7374 - 948.9439	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	3 - 4		907
	40	176.916	382.6823 - 947.9174	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^1D^\circ$ - [illegible]	2 - 3		907
	70	177.694	382.7374 - 945.4757	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	3 - 4		907
	70	177.895	382.7374 - 944.8667	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	3 - 3		907
	1	178.851	382.6823 - 941.811	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^1D^\circ$ - [illegible]	2 - 1		907
	5	179.682	386.6166 - 943.1491	$3s^23p^53d$ - $3s^23p^5(^2P^\circ_{3/2})4f$	$^3D^\circ$ - [illegible]	2 - 2		907

CR VII — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	40	179.776	389.2262 - 945.4757	$3s^23p^53d - 3s^23p^5(^2P^o_{1/2})4f$	$^1F^o$ - H	3 - 4		907
	870	202.828	0. - 493.0354	$3s^23p^6 - 3s^23p^53d$	g^1S - $^1P^o$	0 - 1		907
	20	241.393	342.7735 - 757.0358	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3P	1 - 0		907
	5	242.461	346.1371 - 758.5721	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^1P	2 - 1		907
	70	242.579	346.1371 - 758.3744	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^1D	2 - 2		907
	20	242.953	342.7735 - 754.3789	$3s^23p^53d - 3s^23p^54p$	$^2P^o$ - ^1P	1 - 1		907
	5	244.565	342.7735 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3P	1 - 2		907
	20	245.431	341.1793 - 748.6293	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3D	0 - 1		907
	70	246.599	346.1371 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3P	2 - 2		907
	40	250.311	346.1371 - 745.6311	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3D	2 - 3		907
	20	251.124	360.1719 - 758.3744	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^1D	3 - 2		907
	1	252.837	363.0609 - 758.5721	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3P	2 - 1		907
	20	254.177	341.1793 - 734.6053	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3S	0 - 1		907
	70	255.210	342.7735 - 734.6053	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3S	1 - 1		907
	1	255.447	360.1719 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3P	3 - 2		907
	40	255.545	363.0609 - 754.3789	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^1P	2 - 1		907
	70	257.422	346.1371 - 734.6053	$3s^23p^53d - 3s^23p^54p$	$^3P^o$ - ^3S	2 - 1		907
	450	257.676	357.5437 - 745.6311	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3D	4 - 3		907
	285	259.181	0. - 385.8283	$3s^23p^6 - 3s^23p^53d$	g^1S - $^3D^o$	0 - 1		907
	110	259.360	363.0609 - 748.6293	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3D	2 - 1		907
	40	259.432	360.1719 - 745.6311	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3D	3 - 3		907
	360	259.636	360.1719 - 745.3289	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^3D	3 - 2		907
	20	261.598	363.0609 - 745.3289	$3s^23p^53d - 3s^23p^54p$	$^3F^o$ - ^1D	2 - 2		907
	1	266.172	382.6823 - 758.3744	$3s^23p^53d - 3s^23p^54p$	$^1D^o$ - ^1D	2 - 2		907
	70	268.852	386.6166 - 758.5721	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3P	2 - 1		907
	70	269.038	382.6823 - 754.3789	$3s^23p^53d - 3s^23p^54p$	$^1D^o$ - ^1P	2 - 1		907
	20	269.397	385.8283 - 757.0358	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3P	1 - 0		907
	160	270.897	389.2262 - 758.3744	$3s^23p^53d - 3s^23p^54p$	$^1F^o$ - ^1D	3 - 2		907
	160	271.070	382.7374 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3P	3 - 2		907
	5	273.269	382.6823 - 748.6293	$3s^23p^53d - 3s^23p^54p$	$^1D^o$ - ^3D	2 - 1		907
	1	273.952	386.6166 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3P	2 - 2		907
	1	275.563	382.7374 - 745.6311	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3D	3 - 3		907
	5	275.635	385.8283 - 748.6293	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3D	1 - 1		907
	1	275.756	382.6823 - 745.3289	$3s^23p^53d - 3s^23p^54p$	$^1D^o$ - ^3D	2 - 2		907
	1	275.792	382.7374 - 745.3289	$3s^23p^53d - 3s^23p^54p$	$^3D^o$ - ^3D	3 - 2		907
	5	275.926	389.2262 - 751.6493	$3s^23p^53d - 3s^23p^54p$	$^1F^o$ - ^3P	3 - 2		907
	1	280.571	389.2262 - 745.6311	$3s^23p^53d - 3s^23p^54p$	$^1F^o$ - ^3D	3 - 3		907
	20	280.823	389.2262 - 745.3289	$3s^23p^53d - 3s^23p^54p$	$^1F^o$ - ^3D	3 - 2		907
	20	291.738	0. - 342.7735	$3s^23p^6 - 3s^23p^53d$	g^1S - $^3P^o$	0 - 1		907
	1	355.012	346.1371 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^1D	2 - 2		907
	220	375.425	342.7735 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^3D	1 - 2		907
	70	376.073	342.7735 - 608.6796	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^3D	1 - 1		907
	5	377.687	363.0609 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^1F^o$ - ^1D	2 - 2		907
	360	379.153	346.1371 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^3D	2 - 3		907
	110	380.219	346.1371 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^3D	2 - 2		907
	1	380.897	346.1371 - 608.6796	$3s^23p^53d - 3s3p^63d$	$^3P^o$ - ^3D	2 - 1		907
	450	396.288	357.5437 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^3F^o$ - ^3D	4 - 3		907
	40	400.452	360.1719 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^3F^o$ - ^3D	3 - 3		907
	360	401.658	360.1719 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3F^o$ - ^3D	3 - 2		907
	70	406.369	363.0609 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3F^o$ - ^3D	2 - 2		907
	285	407.138	363.0609 - 608.6796	$3s^23p^53d - 3s3p^63d$	$^3F^o$ - ^3D	2 - 1		907
	220	407.918	382.6823 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^1D^o$ - ^1D	2 - 2		907
	160	408.019	382.7374 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^3D^o$ - ^1D	3 - 2		907
	160	414.582	386.6166 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^3D^o$ - ^1D	2 - 2		907

CR VII — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	110	419.104	389.2262 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^1F^\circ - {}^3D$	3 - 2		907
	1	440.121	382.6823 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^1D^\circ - {}^3D$	2 - 3		907
	285	440.244	382.7374 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	3 - 3		907
	70	441.584	382.6823 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^1D^\circ - {}^3D$	2 - 2		907
	20	441.680	382.7374 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	3 - 2		907
	40	447.792	385.8283 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	1 - 2		907
	40	447.882	386.6166 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	2 - 3		907
	110	448.729	385.8283 - 608.6796	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	1 - 1		907
	110	449.386	386.6166 - 609.1427	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	2 - 2		907
	20	450.314	386.6166 - 608.6796	$3s^23p^53d - 3s3p^63d$	$^3D^\circ - {}^3D$	2 - 1		907
	110	453.183	389.2262 - 609.8878	$3s^23p^53d - 3s3p^63d$	$^1F^\circ - {}^3D$	3 - 3		907
	20	741.889	493.0354 - 627.8267	$3s^23p^53d - 3s3p^63d$	$^1P^\circ - {}^1D$	1 - 2		907
	40	801.277	734.6053 - 859.4071	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3S - [illegible]	1 - 2		907
	20	815.474	734.6053 - 857.2345	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3S - [illegible]	1 - 1		907
	5	820.239	751.6493 - 873.5655	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3P - [illegible]	2 - 2		907
	5	821.788	734.6053 - 856.2922	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3S - [illegible]	1 - 0		907
	20	836.644	745.6311 - 865.1558	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3D - [illegible]	3 - 3		907
	20	841.747	745.3289 - 864.1295	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3D - [illegible]	2 - 2		907
	5	844.989	757.0358 - 875.3805	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3P - [illegible]	0 - 1		907
	40	848.517	754.3789 - 872.2316	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^1P - [illegible]	1 - 2		907
	160	862.043	745.3289 - 861.1984	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3D - [illegible]	2 - 3		907
	70	865.800	748.6293 - 864.1295	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3D - [illegible]	1 - 2		907
	20	869.615	758.5721 - 873.5655	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3P - [illegible]	1 - 2		907
	220	870.980	745.6311 - 860.4443	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3D - [illegible]	3 - 4		907
	110	871.296	758.3744 - 873.1461	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^1D - [illegible]	2 - 3		907
	70	881.012	751.6493 - 865.1558	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3P - [illegible]	2 - 3		907
	20	926.520	758.5721 - 866.5028	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^3P - [illegible]	1 - 1		907
	1	936.492	758.3744 - 865.1558	$3s^23p^54p - 3s^23p^5(^2P^\circ)4d$	^1D - [illegible]	2 - 3		907
	5	1163.516	672.4277 - 758.3744	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^1D	1 - 2		907
	1	1163.947	857.2345 - 943.1491	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	1 - 2		907
	5	1170.143	859.4071 - 944.8667	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	2 - 3		907
	40	1181.920	672.4277 - 757.0358	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3P	1 - 0		907
	5	1186.561	861.1984 - 945.4757	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	3 - 4		907
	5	1189.640	873.1461 - 957.2051	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	3 - 4		907
	20	1190.867	860.4443 - 944.4168	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	4 - 5		907
	70	1193.492	865.1558 - 948.9439	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	3 - 4		907
	20	1198.481	873.5655 - 957.0046	$3s^23p^5(^2P^\circ)4d - 3s^23p^5(^2P^\circ)4f$	[illegible] - [illegible]	2 - 3		907
	220	1207.866	668.8586 - 751.6493	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3P	2 - 2		907
	360	1302.551	668.8586 - 745.6311	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3D	2 - 3		907
	160	1307.696	668.8586 - 745.3289	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3D	2 - 2		907
	220	1312.307	672.4277 - 748.6293	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3D	1 - 1		907
	220	1319.885	682.6102 - 758.3744	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^1D	1 - 2		907
	110	1393.366	682.6102 - 754.3789	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^1P	1 - 1		907
	220	1426.644	678.5347 - 748.6293	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3D	0 - 1		907
	40	1448.457	682.6102 - 751.6493	$3s^23p^5(^2P^\circ)4s - 3s^23p^54p$	[illegible] - ^3P	1 - 2		907

CHROMIUM VIII (Cr^{7+}), Z = 24
Ground State $1s^2 2s^2 2p^6 3s^2 3p^5 (^2P^o_{3/2})$ (17 electrons)
Ionization Potential [1 490 000] cm^{-1}; [184.7] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		102.45	0.0 - 976.08	$3s^23p^5 - 3s^23p^4(^1D)4d$	$g^2P^o - ^2D$	3/2 - 5/2		854
		103.03	0.0 - 970.59	$3s^23p^5 - 3s^23p^4(^1D)4d$	$g^2P^o - ^2P$	3/2 - 3/2		854
		103.36	9.8919 - 977.38	$3s^23p^5 - 3s^23p^4(^1D)4d$	$g^2P^o - ^2D$	1/2 - 3/2		854
		103.48	0.0 - 966.37	$3s^23p^5 - 3s^23p^4(^3P)4d$	$g^2P^o - ^2S$	3/2 - 1/2		854
		103.92	9.8919 - 972.17	$3s^23p^5 - 3s^23p^4(^1D)4d$	$g^2P^o - ^2F$	1/2 - 1/2		854
		105.69	0.0 - 946.16	$3s^23p^5 - 3s^23p^4(^3P)4d$	$g^2P^o - ^2D$	3/2 - 5/2		854
		106.68	9.8919 - 947.27	$3s^23p^5 - 3s^23p^4(^3P)4d$	$g^2P^o - ^2D$	1/2 - 3/2		854
	200	124.184	0.0 - 805.26	$3s^23p^5 - 3s^23p^4(^1S)4s$	$g^2P^o - ^2S$	3/2 - 1/2		182
	100	125.728	9.8919 - 805.26	$3s^23p^5 - 3s^23p^4(^1S)4s$	$g^2P^o - ^2S$	1/2 - 1/2		182
	700	129.998	0.0 - 769.24	$3s^23p^5 - 3s^23p^4(^1D)4s$	$g^2P^o - ^2D$	3/2 - 5/2		182
	600	131.638	9.8919 - 769.55	$3s^23p^5 - 3s^23p^4(^1D)4s$	$g^2P^o - ^2D$	1/2 - 3/2		182
	200	132.321	0.0 - 755.74	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^2P$	3/2 - 1/2		182
	600	133.395	0.0 - 749.64	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^2P$	3/2 - 3/2		182
	300	134.076	9.8919 - 755.74	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^2P$	1/2 - 1/2		182
	400	134.942	0.0 - 741.06	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^4P$	3/2 - 3/2		182
	100	135.185	9.8919 - 749.64	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^2P$	1/2 - 3/2		182
	50	135.892	0.0 - 735.88	$3s^23p^5 - 3s^23p^4(^3P)4s$	$g^2P^o - ^4P$	3/2 - 5/2		182
		143.17	135. + D - 833.47 + D	$3s^23p^4(^3P)3d - 3s^23p^4(^3P)4f$	$^4D - ^4F^o$	7/2 - 9/2		854
		146.37	146.335 + S - 829.535 + S	$3s^23p^4(^3P)3d - 3s^23p^4(^3P)4f$	$^4F - ^4G^o$	7/2 - 9/2		854
		146.63	142.359 + S - 824.347 + S	$3s^23p^4(^3P)3d - 3s^23p^4(^3P)4f$	$^4F - ^4G^o$	5/2 - 7/2		854
		147.20	145 + S - 824.347 + S	$3s^23p^4(^3P)3d - 3s^23p^4(^3P)4f$	$^4F - ^4G^o$	9/2 - 11/2		854
		147.30	164. + L - 842.886 + L	$3s^23p^4(^1D)3d - 3s^23p^4(^1D)4f$	$^2G - ^2H^o$	9/2 - 11/2		854
		147.49	146.335 + S - 824.347 + S	$3s^23p^4(^3P)3d - 3s^23p^4(^3P)4f$	$^4F - ^4G^o$	7/2 - 9/2		854
		201.54	0.0 - 496.17	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2D$	3/2 - 3/2		260
	700	205.01	0.0 - 487.78	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2D$	3/2 - 5/2		260,256
	400	205.65	9.8919 - 496.17	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2D$	1/2 - 3/2		260,256
	300	207.07	0.0 - 482.91	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2P$	3/2 - 1/2		260,256
	200	208.63	0.0 - 479.31	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2P$	3/2 - 3/2		260,256
	200	211.42	9.8919 - 482.91	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2P$	1/2 - 1/2		260,256
	200	213.03	9.8919 - 479.31	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2P$	1/2 - 3/2		260,256
	400	216.67	0.0 - 461.54	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2S$	3/2 - 1/2		260,256
	200	221.41	9.8919 - 461.54	$3s^23p^5 - 3s^23p^4(^1D)3d$	$g^2P^o - ^2S$	1/2 - 1/2		260,256
	650	413.112	0.0 - 242.065	$3s^23p^5 - 3s3p^6$	$g^2P^o - ^2S$	3/2 - 1/2		726
	450	430.713	9.8919 - 242.065	$3s^23p^5 - 3s3p^6$	$g^2P^o - ^2S$	1/2 - 1/2		726

CHROMIUM IX (Cr^{8+}), Z = 24
Ground State $1s^2 2s^2 2p^6 3s^2 3p^4 (^3P_2)$ (16 electrons)
Ionization Potential [1 688 000] cm^{-1}; [209.3] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		94.33	7.821 - 1067.9	$3s^23p^4 - 3s^23p^3(^2D^o)4d$	$g^3P - ^3D^o$	1 - 2		851
		96.17	30.284 - 1070.112	$3s^23p^4 - 3s^23p^3(^2D^o)4d$	$^1D - ^1F^o$	2 - 3		854
		96.48	30.284 - 1066.771	$3s^23p^4 - 3s^23p^3(^2D^o)4d$	$^1D - ^1D^o$	2 - 2		854
		96.55	66.855 - 1102.576	$3s^23p^4 - 3s^23p^34d$	$^1S - ^1P^o$	0 - 1		854
		97.19	0. - 1028.91	$3s^23p^4 - 3s^23p^3(^4S^o)4d$	$g^3P - ^3D^o$	2 - 3		854
		97.97	7.821 - 1028.54	$3s^23p^4 - 3s^23p^3(^4S^o)4d$	$g^3P - ^3D^o$	1 - 2		854

CR IX — Continued

Multiplet	Rel. Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		98.08	9.549 - 1029.14	$3s^23p^4 - 3s^23p^3(^4S^\circ)4d$	g^{3}P - ^{3}D°	0 - 1		854
	200	117.435	30.284 - 881.72	$3s^23p^4 - 3s^23p^3(^2P^\circ)4s$	^{1}D - ^{1}P°	2 - 1		181
	600	117.942	0. - 847.87	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	g^{3}P - ^{3}D°	2 - 3		181
	200	118.165	0 - 846.26	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	g^{3}P - ^{3}D°	2 - 2		181
	400	119.269	7.821 - 846.26	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	g^{3}P - ^{3}D°	1 - 2		181
	200	119.320	7.821 - 845.90	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	g^{3}P - ^{3}D°	1 - 1		181
	100	119.569	9.549 - 845.90	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	g^{3}P - ^{3}D°	0 - 1		181
	600	121.293	30.284 - 854.73	$3s^23p^4 - 3s^23p^3(^2D^\circ)4s$	^{1}D - ^{1}D°	2 - 2		181
	400	121.781	0 - 821.07	$3s^23p^4 - 3s^23p^3(^4S^\circ)4s$	g^{3}P - ^{3}S°	2 - 1		181
	200	122.720	66.855 - 881.72	$3s^23p^4 - 3s^23p^3(^2P^\circ)4s$	^{1}S - ^{1}P°	0 - 1		181
	200	122.964	7.821 - 821.07	$3s^23p^4 - 3s^23p^3(^4S^\circ)4s$	g^{3}P - ^{3}S°	1 - 1		181
	50	123.226	9.549 - 821.07	$3s^23p^4 - 3s^23p^3(^4S^\circ)4s$	g^{3}P - ^{3}S°	0 - 1		181
		127.31	1028.645 + S - 1814.129 + S	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4f$	^{3}F° - ^{3}G	2 - 3		854
		127.42	1029.323 + S - 1814.129 + S	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4f$	^{3}F° - ^{3}G	3 - 4		854
		127.53	1030 + S - 1814.129 + S	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4f$	^{3}F° - ^{3}G	4 - 5		854
		127.88	879.572 + D - 1661.555 + D	$3s^23p^3(^4S^\circ)3d - 3s^23p^3(^4S^\circ)4f$	^{5}D° - ^{5}F	3 - 4		854
		127.95	880 + D - 1661.555 + D	$3s^23p^3(^4S^\circ)3d - 3s^23p^3(^4S^\circ)4f$	^{5}D° - ^{5}F	4 - 5		854
		129.77	1030. + L - 1800.594 + L	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4f$	^{3}G° - ^{3}H	5 - 6		854
		129.99	1170 + R - 1939.289 + R	$3s^23p^3(^2P^\circ)3d - 3s^23p^3(^2P^\circ)4f$	^{3}F° - ^{3}G	4 - 5		854
		131.08	500.00 + K - 1262.89 + K	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4f$	^{3}G° - ^{3}H	4 - 5		851
		176.86	400.00 + X - 965.42 + X	$3s^23p^3(^4S^\circ)3d - 3s^23p^3(^4S^\circ)4p$	^{5}D° - ^{5}P	4 - 3		851
		180.57	460.00 + Y - 1013.80 + Y	$3s^23p^3(^2D^\circ)3d - 3s^23p^3(^2D^\circ)4p$	^{3}G° - ^{3}F	5 - 4		851
		208.53	0. - 479.57	$3s^23p^4 - 3s^23p^3(^4S^\circ)3d$	g^{3}P - ^{3}D°	2 - 2		239
	200	209.44	30.284 - 507.75	$3s^23p^4 - 3s^23p^3(^2D^\circ)3d$	^{1}D - ^{1}F°	2 - 3		239,256
		210.62	0. - 474.79	$3s^23p^4 - 3s^23p^3(^4S^\circ)3d$	g^{3}P - ^{3}D°	2 - 3		239
		211.32	9.549 - 482.76	$3s^23p^4 - 3s^23p^3(^4S^\circ)3d$	g^{3}P - ^{3}D°	0 - 1		239
		211.97	7.821 - 479.57	$3s^23p^4 - 3s^23p^3(^4S^\circ)3d$	g^{3}P - ^{3}D°	1 - 2		239
		215.04	66.855 - 531.88	$3s^23p^4 - 3s^23p^3(^2D^\circ)3d$	^{1}S - ^{1}P°	0 - 1		239
		215.97	30.284 - 493.31	$3s^23p^4 - 3s^23p^3(^2D^\circ)3d$	^{1}D - ^{1}D°	2 - 2		239
		220.02	0. - 454.51	$3s^23p^4 - 3s^23p^3(^2D^\circ)3d$	g^{3}P - ^{3}P°	2 - 2		239
		223.87	7.821 - 454.51	$3s^23p^4 - 3s^23p^3(^2D^\circ)3d$	g^{3}P - ^{3}P°	1 - 2		239
	1	327.267	0. - 305.561	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{1}P°	2 - 1		726
	110	363.271	30.284 - 305.561	$3s^23p^4 - 3s3p^5$	^{1}D - ^{1}P°	2 - 1		726
	110	407.637	0. - 245.317	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	2 - 1		726
	110	414.602	7.821 - 249.016	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	1 - 0		726
	160	418.290	0 - 239.068	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	2 - 2		726
	70	418.925	66.855 - 305.561	$3s^23p^4 - 3s3p^5$	^{1}S - ^{1}P°	0 - 1		726
	110	421.057	7.821 - 245.317	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	1 - 1		726
	70	424.146	9.549 - 245.317	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	0 - 1		726
	70	432.440	7.821 - 239.068	$3s^23p^4 - 3s3p^5$	g^{3}P - ^{3}P°	1 - 2		726
		1496.	0 - 66.849	$3s^23p^4 - 3s^23p^4$	g^{3}P - ^{1}S	2 - 0	F,P	375,726
	185	1694.11	7.821 - 66.849	$3s^23p^4 - 3s^23p^4$	g^{3}P - ^{1}S	1 - 0	F	726

CHROMIUM X (Cr^{9+}), Z = 24
Ground State $1s^2 2s^2 2p^6 3s^2 3p^3 (^4S^{\circ}_{3/2})$ (15 electrons)
Ionization Potential [1 971 000] cm^{-1}; [244.4] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		106.49	0. - 939.055	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$g^4S^{\circ} - ^4P$	3/2 - 5/2		854
		107.14	0. - 933.358	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$g^4S^{\circ} - ^4P$	3/2 - 3/2		854
		107.45	37.106 - 967.84	$3s^2 3p^3 - 3s^2 3p^2(^1D)4s$	$^2D^{\circ} - ^2D$	3/2 - 3/2		854
		107.70	0. - 928.505	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$g^4S^{\circ} - ^4P$	3/2 - 1/2		854
		107.80	39.454 - 966.93	$3s^2 3p^3 - 3s^2 3p^2(^1D)4s$	$^2D^{\circ} - ^2D$	5/2 - 5/2		854
		109.84	39.454 - 949.78	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$^2D^{\circ} - ^2P$	5/2 - 3/2		854
		110.37	37.106 - 943.30	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$^2D^{\circ} - ^2P$	3/2 - 1/2		854
		111.02	67.163 - 967.84	$3s^2 3p^3 - 3s^2 3p^2(^1D)4s$	$^2P^{\circ} - ^2D$	3/2 - 3/2		854
		111.16	67.163 - 966.93	$3s^2 3p^3 - 3s^2 3p^2(^1D)4s$	$^2P^{\circ} - ^2D$	3/2 - 5/2		854
		113.31	67.163 - 949.78	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$^2P^{\circ} - ^2P$	3/2 - 3/2		854
		113.70	63.936 - 943.30	$3s^2 3p^3 - 3s^2 3p^2(^3P)4s$	$^2P^{\circ} - ^2P$	1/2 - 1/2		854
		115.29	750 + D - 1617.377 + D	$3s^2 3p^2(^3P)3d - 3s^2 3p^2(^3P)4f$	$^4F - ^4G^{\circ}$	9/2 - 11/2		854
		116.75	950 + S - 1806.531 + S	$3s^2 3p^2(^1D)3d - 3s^2 3p^2(^1D)4f$	$^2G - ^2H^{\circ}$	7/2 - 9/2		854
		117.09	950. + S - 1804.043 + S	$3s^2 3p^2(^1D)3d - 3s^2 3p^2(^1D)4f$	$^2G - ^2H^{\circ}$	9/2 - 11/2		854
		216.72	39.454 - 500.88	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2D^{\circ} - ^2F$	5/2 - 7/2		239
		218.88	63.936 - 520.62	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2P^{\circ} - ^2D$	1/2 - 3/2		239
		220.42	67.163 - 520.82	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2P^{\circ} - ^2D$	3/2 - 5/2		239
		221.18	67.163 - 519.28	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2P^{\circ} - ^2D$	3/2 - 3/2		239
		223.86	0. - 446.71	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$g^4S^{\circ} - ^4P$	3/2 - 5/2		239
		224.74	0. - 444.96	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$g^4S^{\circ} - ^4P$	3/2 - 3/2		239
		226.24	0. - 442.01	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$g^4S^{\circ} - ^4P$	3/2 - 1/2		239
		227.42	37.106 - 476.82	$3s^2 3p^3 - 3s^2 3p^2(^1D)3d$	$^2D^{\circ} - ^2D$	3/2 - 3/2		239
		228.71	39.454 - 476.68	$3s^2 3p^3 - 3s^2 3p^2(^1D)3d$	$^2D^{\circ} - ^2D$	5/2 - 5/2		239
		231.21	63.936 - 496.43	$3s^2 3p^3 - 3s^2 3p^2(^1D)3d$	$^2P^{\circ} - ^2P$	1/2 - 3/2		239
		232.96	67.163 - 496.43	$3s^2 3p^3 - 3s^2 3p^2(^1D)3d$	$^2P^{\circ} - ^2P$	3/2 - 3/2		239
		233.80	63.936 - 491.65	$3s^2 3p^3 - 3s^2 3p^2(^1D)3d$	$^2P^{\circ} - ^2P$	1/2 - 1/2		239
		247.67	37.106 - 440.87	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2D^{\circ} - ^2P$	3/2 - 1/2		239
		252.64	37.106 - 432.92	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2D^{\circ} - ^2P$	3/2 - 3/2	P	239
		254.15	39.454 - 432.92	$3s^2 3p^3 - 3s^2 3p^2(^3P)3d$	$^2D^{\circ} - ^2P$	5/2 - 3/2		239
	70	333.035	37.106 - 337.373	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2P$	3/2 - 1/2		726
	5	337.490	37.106 - 333.414	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2P$	3/2 - 3/2		726
	220	340.181	39.454 - 333.414	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2P$	5/2 - 3/2		726
	1	351.092	63.936 - 348.763	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2S$	1/2 - 1/2		726
	40	355.112	67.163 - 348.763	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2S$	3/2 - 1/2		726
	20	365.718	63.936 - 337.373	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2P$	1/2 - 1/2		726
	1	371.086	63.936 - 333.414	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2P$	1/2 - 3/2		726
	1	375.584	67.163 - 333.414	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2P$	3/2 - 3/2		726
	360	395.984	37.106 - 289.639	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2D$	3/2 - 3/2		726
	450	398.150	39.454 - 290.614	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2D$	5/2 - 5/2		726
	40	399.707	39.454 - 289.639	$3s^2 3p^3 - 3s3p^4$	$^2D^{\circ} - ^2D$	5/2 - 3/2		726
	70	411.655	0 - 242.922	$3s^2 3p^3 - 3s3p^4$	$g^4S^{\circ} - ^4P$	3/2 - 1/2		726
	110	416.690	0 - 239.987	$3s^2 3p^3 - 3s3p^4$	$g^4S^{\circ} - ^4P$	3/2 - 3/2		726
	220	427.551	0 - 233.890	$3s^2 3p^3 - 3s3p^4$	$g^4S^{\circ} - ^4P$	3/2 - 5/2		726
	1	443.062	63.936 - 289.639	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2D$	1/2 - 3/2		726
	20	447.529	67.163 - 290.614	$3s^2 3p^3 - 3s3p^4$	$^2P^{\circ} - ^2D$	3/2 - 5/2		726
	0	1489.04	0 - 67.1574	$3s^2 3p^3 - 3s^2 3p^3$	$g^4S^{\circ} - ^2P^{\circ}$	3/2 - 3/2	F	940
		1564.10	0 - 63.9345	$3s^2 3p^3 - 3s^2 3p^3$	$g^4S^{\circ} - ^2P^{\circ}$	3/2 - 1/2	F	940

CHROMIUM XI (Cr^{10+}), Z = 24
Ground State $1s^22s^22p^63s^23p^2(^3P_0)$ (14 electrons)
Ionization Potential [2 184 000] cm^{-1}; [270.8] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		81.02	0. - 1234.3	$3s^23p^2$ - $3s^23p4d$	g^3P - $^3D^o$	0 - 1		970
		81.18	11.980 - 1243.8	$3s^23p^2$ - $3s^23p4d$	g^3P - $^3F^o$	2 - 3		970
		81.23	5.536 - 1236.6	$3s^23p^2$ - $3s^23p4d$	g^3P - $^3D^o$	1 - 2		970
		81.39	5.536 - 1234.3	$3s^23p^2$ - $3s^23p4d$	g^3P - $^3D^o$	1 - 1		970
		81.55	11.980 - 1238.2	$3s^23p^2$ - $3s^23p4d$	g^3P - $^3D^o$	2 - 3		970
		82.05	36.994 - 1255.8	$3s^23p^2$ - $3s^23p4d$	^1D - $^1F^o$	2 - 3		970
		83.31	74.9863 - 1275.3	$3s^23p^2$ - $3s^23p4d$	^1S - $^1P^o$	0 - 1		970
		98.47	5.536 - 1021.058	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	1 - 2		854
		98.94	0 - 1010.713	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	0 - 1		854
		99.10	11.980 - 1021.058	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	2 - 2		854
		99.13	306.570 - 1315.4	$3s3p^3$ - $3s^23p4f$	$^3D^o$ - ^3F	2 - 3		970
		99.48	5.536 - 1010.713	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	1 - 1		854
		99.67	5.536 - 1008.796	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	1 - 0		854
		100.09	306.570 - 1305.7	$3s3p^3$ - $3s^23p4f$	$^3D^o$ - ^3G	2 - 3		970
		100.13	11.980 - 1010.713	$3s^23p^2$ - $3s^23p4s$	g^3P - $^3P^o$	2 - 1		854
		100.90	36.994 - 1028.067	$3s^23p^2$ - $3s^23p4s$	^1D - $^1P^o$	2 - 1		854
		105.26	384.0+D - 1334.03+D	$3s^23p3d$ - $3s^23p4f$	$^5F^o$ - ^5G	4 - 5		970
		105.65	378.5+D - 1325.02+D	$3s^23p3d$ - $3s^23p4f$	$^5F^o$ - ^5G	3 - 4		970
		115.13	478.59 - 1347.2	$3s^23p3d$ - $3s^23p4f$	$^1F^o$ - ^1G	3 - 4		970
		117.13	490.35 - 1344.1	$3s^23p3d$ - $3s^23p4f$	$^1P^o$ - ^1D	1 - 2		970
		226.45	36.994 - 478.59	$3s^23p^2$ - $3s^23p3d$	^1D - $^1F^o$	2 - 3		239
		230.29	0. - 434.24	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	0 - 1		239
		232.18	5.536 - 436.21	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	1 - 2		239
		233.26	5.536 - 434.24	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	1 - 1		239
		235.03	0. - 425.48	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3P^o$	0 - 1		239
		235.53	11.980 - 436.55	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	2 - 3		239
		235.74	11.980 - 436.21	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	2 - 2		239
		237.24	5.536 - 427.09	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3D^o$	1 - 2		239
		240.76	74.9863 - 490.35	$3s^23p^2$ - $3s^23p3d$	^1S - $^1P^o$	0 - 1		239
		241.87	5.536 - 418.98	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3P^o$	1 - 2		239
		245.70	11.980 - 418.98	$3s^23p^2$ - $3s^23p3d$	g^3P - $^3P^o$	2 - 2		239
		256.32	36.994 - 427.09	$3s^23p^2$ - $3s^23p3d$	^1D - $^1D^o$	2 - 2		239
	1	280.572	0. - 356.424	$3s^23p^2$ - $3s3p^3$	g^3P - $^3S^o$	0 - 1		726
	20	284.988	5.536 - 356.424	$3s^23p^2$ - $3s3p^3$	g^3P - $^3S^o$	1 - 1		726
	40	290.323	11.980 - 356.424	$3s^23p^2$ - $3s3p^3$	g^3P - $^3S^o$	2 - 1		726
	40	298.059	36.994 - 372.498	$3s^23p^2$ - $3s3p^3$	^1D - $^1P^o$	2 - 1		726
		336.121	74.9863 - 372.498	$3s^23p^2$ - $3s3p^3$	^1S - $^1P^o$	0 - 1		726
	5	339.446	11.980 - 306.570	$3s^23p^2$ - $3s3p^3$	g^3P - $^3D^o$	2 - 2		726
		359.203	0. - 278.394	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	0 - 1		726
	40	366.085	5.536 - 278.698	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	1 - 2		726
	5	366.491	5.536 - 278.394	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	1 - 1		726
	5	366.942	5.536 - 278.059	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	1 - 0		726
	40	370.959	36.994 - 306.570	$3s^23p^2$ - $3s3p^3$	^1D - $^1D^o$	2 - 2		726
	70	374.927	11.980 - 278.698	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	2 - 2		726
		375.362	11.980 - 278.394	$3s^23p^2$ - $3s3p^3$	g^3P - $^3P^o$	2 - 1		726
	5	412.629	0. - 242.346	$3s^23p^2$ - $3s3p^3$	g^3P - $^3D^o$	0 - 1		726
	20	422.083	5.536 - 242.456	$3s^23p^2$ - $3s3p^3$	g^3P - $^3D^o$	1 - 2		726
	5	422.282	5.536 - 242.346	$3s^23p^2$ - $3s3p^3$	g^3P - $^3D^o$	1 - 1		726
	20	431.154	11.980 - 243.916	$3s^23p^2$ - $3s3p^3$	g^3P - $^3D^o$	2 - 3		726
	0	1439.85	5.536 - 74.9863	$3s^23p^2$ - $3s^23p^2$	g^3P - ^1S	1 - 0	F	726,442
		1587.1	11.980 - 74.9863	$3s^23p^2$ - $3s^23p^2$	g^3P - ^1S	2 - 0	F,P	375,726

CHROMIUM XII (Cr^{11+}), Z = 24
Ground State $1s^22s^22p^63s^23p(^2P^\circ_{1/2})$ (13 electrons)
Ionization Potential [2 404 000] cm^{-1}; [298.0] eV

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
200	75.815	0. - 1319.00	$3s^23p - 3s^24d$	$g\,^2P^\circ - ^2D$	1/2 - 3/2		180
300	76.488	12.261 - 1319.65	$3s^23p - 3s^24d$	$g\,^2P^\circ - ^2D$	3/2 - 5/2		180
	90.86	200.00 + W - 1300.6 + W	$3s3p^2 - 3s3p4s$	$^4P - ^4P^\circ$	5/2 - 5/2		241
	96.11	1200.0 + X - 2240.5 + X	3s3p3d - 3s3p4f	$^4F^\circ - ^4G$	9/2 - 11/2		241
	96.35	1170.0 + Z - 2207.9 + Z	3s3p3d - 3s3p4f	$^4F^\circ - ^4G$	5/2 - 7/2		241
	96.50	1180.0 + Y - 2216.3 + Y	3s3p3d - 3s3p4f	$^4F^\circ - ^4G$	7/2 - 9/2		241
	101.39	408.66 - 1394.95	$3s^23d - 3s^24f$	$^2D - ^2F^\circ$	3/2 - 5/2		241
	101.46	405.84 - 1395.45	$3s^23d - 3s^24f$	$^2D - ^2F^\circ$	5/2 - 7/2		241
	244.70	0. - 408.66	$3s^23p - 3s^23d$	$g\,^2P^\circ - ^2D$	1/2 - 3/2		239
	251.52	12.261 - 409.84	$3s^23p - 3s^23d$	$g\,^2P^\circ - ^2D$	3/2 - 5/2		239
	252.27	12.261 - 408.66	$3s^23p - 3s^23d$	$g\,^2P^\circ - ^2D$	3/2 - 3/2	P	267
	294.77	0. - 339.25	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2P$	1/2 - 3/2		239
	300.08	0. - 333.24	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2P$	1/2 - 1/2	P	251
	305.81	12.261 - 339.25	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2P$	3/2 - 3/2		239
	311.55	12.261 - 333.24	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2P$	3/2 - 1/2		239
	318.89	0. - 313.58	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2S$	1/2 - 1/2	P	239
	320.20	188.84 + W - 501.15 + W	$3s3p^2 - 3p^3$	$^4P - ^4S^\circ$	1/2 - 3/2		239
	325.13	193.58 + W - 501.15 + W	$3s3p^2 - 3p^3$	$^4P - ^4S^\circ$	3/2 - 3/2		239
	331.87	12.261 - 313.58	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2S$	3/2 - 1/2	P	239
	332.06	200.00 + W - 501.15 + W	$3s3p^2 - 3p^3$	$^4P - ^4S^\circ$	5/2 - 3/2		239
	393.00	0. - 254.45	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2D$	1/2 - 3/2		239
	410.91	12.261 - 255.62	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2D$	3/2 - 5/2		239
	412.90	12.261 - 254.45	$3s^23p - 3s3p^2$	$g\,^2P^\circ - ^2D$	3/2 - 3/2	P	239

CHROMIUM XIII (Cr^{12+}), Z = 24
Ground State $1s^22s^22p^63s^2(^1S_0)$ (12 electrons)
Ionization Potential [2 862 000] cm^{-1}; [354.8] eV

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	40.92	0.0 - 2443.80	$3s^2 - 3s7p$	$g\,^1S - ^1P^\circ$	0 - 1		851
	43.75	0.0 - 2285.70	$3s^2 - 3s6p$	$g\,^1S - ^1P^\circ$	0 - 1		851
	47.26	203.45 - 2319.45	3s3p - 3s6d	$^3P^\circ - ^3D$	0 - 1		851
	47.34	207.38 - 2319.78	3s3p - 3s6d	$^3P^\circ - ^3D$	1 - 2		851
	47.55	216.57 - 2319.57	3s3p - 3s6d	$^3P^\circ - ^3D$	2 - 3		851
	49.03	216.57 - 2256.17	3s3p - 3s6s	$^3P^\circ - ^3S$	2 - 1		851
	49.59	0.0 - 2016.50	$3s^2 - 3s5p$	$g\,^1S - ^1P^\circ$	0 - 1		851
	53.02	590.08 - 2476.18	3s3d - 3s7f	$^3D - ^3F^\circ$	3 - 4		851
	53.39	203.45 - 2076.45	3s3p - 3s5d	$^3P^\circ - ^3D$	0 - 1		851
50	53.506	207.38 - 2076.33	3s3p - 3s5d	$^3P^\circ - ^3D$	1 - 2		180
100	53.765	216.57 - 2076.52	3s3p - 3s5d	$^3P^\circ - ^3D$	2 - 3		180
	56.37	304.61 - 2078.61	3s3p - 3s5d	$^1P^\circ - ^1D$	1 - 2		851
	56.96	207.38 - 1963.00	3s3p - 3s5s	$^3P^\circ - ^3S$	1 - 1		851
	57.24	590.08 - 2337.08	3s3d - 3s6f	$^3D - ^3F^\circ$	3 - 4		851
	65.04	216.57 - 1754.07	3s3p - 3p4p	$^3P^\circ - ^3S$	2 - 1		851
	65.13	216.57 - 1751.97	3s3p - 3p4p	$^3P^\circ - ^3P$	2 - 2		851
	65.39	216.57 - 1745.87	3s3p - 3p4p	$^3P^\circ - ^3D$	2 - 3		851
50	65.968	590.08 - 2105.97	3s3d - 3s5f	$^3D - ^3F^\circ$	3 - 4		180

CR XIII — Continued

Multiplet Rel Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
200	66.983	0.0 - 1492.92	$3s^2$ - 3s4p	g^1S - $^1P^o$	0 - 1		180
100	70.792	203.45 - 1616.04	3s3p - 3s4d	$^3P^o$ - ^3D	0 - 1		180
300	70.973	207.38 - 1616.37	3s3p - 3s4d	$^3P^o$ - ^3D	1 - 2		180
300	71.398	216.57 - 1617.17	3s3p - 3s4d	$^3P^o$ - ^3D	2 - 3		180
50	71.435	216.57 - 1616.37	3s3p - 3s4d	$^3P^o$ - ^3D	2 - 2		180
	71.86	499.21 - 1890.81	$3p^2$ - 3p4d	^3P - $^3P^o$	2 - 2		851
	72.13	483.15 - 1869.55	$3p^2$ - 3p4d	^1D - $^1F^o$	2 - 3		851
	72.27	482.14 - 1865.84	$3p^2$ - 3p4d	^3P - $^3D^o$	0 - 1		851
	72.57	488.22 - 1866.22	$3p^2$ - 3p4d	^3P - $^3D^o$	1 - 2		851
	72.88	499.21 - 1871.31	$3p^2$ - 3p4d	^3P - $^3D^o$	2 - 3		851
	73.31	483.15 - 1847.25	$3p^2$ - 3p4d	^1D - $^1F^o$	2 - 3		851
	76.17	304.61 - 1617.46	3s3p - 3s4d	$^1P^o$ - ^1D	1 - 2		854
	82.79	483.15 - 1690.71	$3p^2$ - 3s4f	^1D - $^1F^o$	2 - 3		854
50	84.616	203.45 - 1385.26	3s3p - 3s4s	$^3P^o$ - ^3S	0 - 1		180
200	84.898	207.38 - 1385.26	3s3p - 3s4s	$^3P^o$ - ^3S	1 - 1		180
300	85.566	216.57 - 1385.26	3s3p - 3s4s	$^3P^o$ - ^3S	2 - 1		180
	86.78	499.21 - 1651.51	$3p^2$ - 3p4s	^3P - $^3P^o$	2 - 2		851
	89.99	818.89 - 1930.09	3p3d - 3p4f	$^3F^o$ - ^3G	4 - 5		241
	90.02	805.20 - 1916.06	3p3d - 3p4f	$^3F^o$ - ^3G	2 - 3		241
	90.17	811.53 - 1920.53	3p3d - 3p4f	$^3F^o$ - ^3G	3 - 4		241
	90.85	824.54 + K - 1925.24 + K	3p3d - 3p4f	$^1D^o$ - ^1F	2 - 3		241
	91.30	304.61 - 1399.91	3s3p - 3s4s	$^1P^o$ - ^1S	1 - 0		851
200	91.749	588.56 - 1678.49	3s3d - 3s4f	^3D - $^3F^o$	1 - 2		180
300	91.792	589.19 - 1678.61	3s3d - 3s4f	^3D - $^3F^o$	2 - 3		180
400	91.855	590.08 - 1678.75	3s3d - 3s4f	^3D - $^3F^o$	3 - 4		180
	92.01	852.11 + R - 1938.91 + R	3p3d - 3p4f	$^3P^o$ - ^3D	0 - 1		241
	92.16	853.81 + R - 1938.91 + R	3p3d - 3p4f	$^3P^o$ - ^3D	1 - 1		241
	92.37	857.34 + R - 1939.94 + R	3p3d - 3p4f	$^3D^o$ - ^3D	2 - 2		241
	92.61	860.99 - 1940.79	3p3d - 3p4f	$^3D^o$ - ^3D	3 - 3		241
	93.42	860.99 - 1931.42	3p3d - 3p4f	$^3D^o$ - ^3F	3 - 4		241
	96.86	820.00 + L - 1852.40 + L	3p3d - 3p4f	$^3F^o$ - ^3G	3 - 4		241
	97.25	662.24 - 1690.71	3s3d - 3s4f	^1D - $^1F^o$	2 - 3		854
	248.66	483.15 - 885.30	$3p^2$ - 3p3d	^1D - $^1P^o$	2 - 1	P	375
	259.68	203.45 - 588.56	3s3p - 3s3d	$^3P^o$ - ^3D	0 - 1		854
	261.91	207.38 - 589.19	3s3p - 3s3d	$^3P^o$ - ^3D	1 - 2		854
	262.33	207.38 - 588.56	3s3p - 3s3d	$^3P^o$ - ^3D	1 - 1		854
	267.73	216.57 - 590.08	3s3p - 3s3d	$^3P^o$ - ^3D	2 - 3		854
	276.41	499.21 - 860.99	$3p^2$ - 3p3d	^3P - $^3D^o$	2 - 3	P	251
	279.32	499.21 - 857.21	$3p^2$ - 3p3d	^3P - $^3P^o$	2 - 2		854
	279.62	304.61 - 662.24	3s3p - 3s3d	$^1P^o$ - ^1D	1 - 2	P	854
	316.60	569.44 - 885.30	$3p^2$ - 3p3d	^1S - $^1P^o$	0 - 1	P	251
150	328.29	0.0 - 304.61	$3s^2$ - 3s3p	g^1S - $^1P^o$	0 - 1		270,437
	342.69	207.38 - 499.21	3s3p - $3p^2$	$^3P^o$ - ^3P	1 - 2		270
	351.16	203.45 - 488.22	3s3p - $3p^2$	$^3P^o$ - ^3P	0 - 1	P	270
	353.81	216.57 - 499.21	3s3p - $3p^2$	$^3P^o$ - ^3P	2 - 2		270
	356.07	207.38 - 488.22	3s3p - $3p^2$	$^3P^o$ - ^3P	1 - 1	P	270
	363.96	207.38 - 482.14	3s3p - $3p^2$	$^3P^o$ - ^3P	1 - 0		270
	368.12	216.57 - 488.22	3s3p - $3p^2$	$^3P^o$ - ^3P	2 - 1	P	270
	369.13	590.08 - 860.99	3s3d - 3p3d	^3D - $^3D^o$	3 - 3		251
	377.60	304.61 - 569.44	3s3p - $3p^2$	$^1P^o$ - ^1S	1 - 0		242
	437.05	590.08 - 818.89	3s3d - 3p3d	^3D - $^3F^o$	3 - 4		251
	448.31	662.24 - 885.30	3s3d - 3p3d	^1D - $^1P^o$	2 - 1	P	375
	449.76	589.19 - 811.53	3s3d - 3p3d	^3D - $^3F^o$	2 - 3		242
	461.60	588.56 - 805.20	3s3d - 3p3d	^3D - $^3F^o$	1 - 2		251

CR XIII — Continued

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		482.2	0.0 - 207.38	$3s^2$ - 3s3p	g^{1}S - ^{1}P°	0 - 1		1131
		560.11	304.61 - 483.15	3s3p - $3p^2$	^{1}P° - ^{1}D	1 - 2	P	854

CHROMIUM XIV (Cr^{13+}), Z = 24
Ground State $1s^22s^22p^63s(^2S_{1/2})$ (11 electrons)
Ionization Potential 3 098 500 cm^{-1}; 384.17 eV

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		21.467	0 - 4658.3	$2p^63s$ - $2p^53s^2$	g^{2}S - ^{2}P°	½ - ½		265
		21.770	0 - 4593.5	$2p^63s$ - $2p^53s^2$	g^{2}S - ^{2}P°	½ - 3/2		265
	0	35.450	0 - 2820.87	$2p^63s$ - $2p^69p$	g^{2}S - ^{2}P°	½ - 3/2		118
	2	36.466	0 - 2742.280	$2p^63s$ - $2p^68p$	g^{2}S - ^{2}P°	½ - 3/2		118
	8	38.036	0 - 2629.088	$2p^63s$ - $2p^67p$	g^{2}S - ^{2}P°	½ - 3/2		118
	0	38.679	242.724 - 2828.105	$2p^63p$ - $2p^69d$	^{2}P° - ^{2}D	½ - 3/2		118
	0	38.899	256.535 - 2827.295	$2p^63p$ - $2p^69d$	^{2}P° - ^{2}D	3/2 - 5/2		118
	1	39.796	242.724 - 2755.539	$2p^63p$ - $2p^68d$	^{2}P° - ^{2}D	½ - 3/2		118
	2	40.018	256.535 - 2755.410	$2p^63p$ - $2p^68d$	^{2}P° - ^{2}D	3/2 - 5/2		118
	7	40.782	0 - 2452.062	$2p^63s$ - $2p^66p$	g^{2}S - ^{2}P°	½ - 3/2		118
	10	40.800	0 - 2450.980	$2p^63s$ - $2p^66p$	g^{2}S - ^{2}P°	½ - ½		118
	2	41.556	242.724 - 2649.115	$2p^63p$ - $2p^67d$	^{2}P° - ^{2}D	½ - 3/2		118
	2	41.788	256.535 - 2649.566	$2p^63p$ - $2p^67d$	^{2}P° - ^{2}D	3/2 - 5/2		118
		42.453	256.535 - 2612.081	$2p^63p$ - $2p^67s$	^{2}P° - ^{2}S	3/2 - ½		118
	3	44.597	242.724 - 2485.027	$2p^63p$ - $2p^66d$	^{2}P° - ^{2}D	½ - 3/2		118
	4	44.869	256.535 - 2485.245	$2p^63p$ - $2p^66d$	^{2}P° - ^{2}D	3/2 - 5/2		118
	15	45.835	242.724 - 2424.510	$2p^63p$ - $2p^66s$	^{2}P° - ^{2}S	½ - ½		118
	1	46.039	589.568 - 2761.639	$2p^63d$ - $2p^68f$	^{2}D - ^{2}F°	5/2 - 7/2		118
	5	46.125	256.535 - 2424.510	$2p^63p$ - $2p^66s$	^{2}P° - ^{2}S	3/2 - ½		118
	55	46.468	0 - 2152.018	$2p^63s$ - $2p^65p$	g^{2}S - ^{2}P°	½ - 3/2		118
	12	46.527	0 - 2149.289	$2p^63s$ - $2p^65p$	g^{2}S - ^{2}P°	½ - ½		118
	2	48.300	587.867 - 2658.260	$2p^63d$ - $2p^67f$	^{2}D - ^{2}F°	3/2 - 5/2		118
	3	48.338	589.568 - 2658.333	$2p^63d$ - $2p^67f$	^{2}D - ^{2}F°	5/2 - 7/2		118
	3	50.821	242.724 - 2210.414	$2p^63p$ - $2p^65d$	^{2}P° - ^{2}D	½ - 3/2		118
	4	51.172	256.535 - 2210.728	$2p^63p$ - $2p^65d$	^{2}P° - ^{2}D	3/2 - 5/2		118
	2	52.321	587.867 - 2499.145	$2p^63d$ - $2p^66f$	^{2}D - ^{2}F°	3/2 - 5/2		118
	3	52.363	589.568 - 2499.313	$2p^63d$ - $2p^66f$	^{2}D - ^{2}F°	5/2 - 7/2		118
	25	53.760	242.724 - 2102.811	$2p^63p$ - $2p^65s$	^{2}P° - ^{2}S	½ - ½		118
	20	54.164	256.535 - 2102.811	$2p^63p$ - $2p^65s$	^{2}P° - ^{2}S	3/2 - ½		118
	8	60.699	587.867 - 2235.25	$2p^63d$ - $2p^65f$	^{2}D - ^{2}F°	3/2 - 5/2		118
	10	60.756	589.568 - 2235.28	$2p^63d$ - $2p^65f$	^{2}D - ^{2}F°	5/2 - 7/2		118
	70	63.324	0 - 1579.180	$2p^63s$ - $2p^64p$	g^{2}S - ^{2}P°	½ - 3/2		118
	60	63.539	0 - 1573.836	$2p^63s$ - $2p^64p$	g^{2}S - ^{2}P°	½ - ½		118
	4	64.005	589.568 - 2152.018	$2p^63d$ - $2p^65p$	^{2}D - ^{2}P°	5/2 - 3/2		118
	10	68.594	242.724 - 1700.577	$2p^63p$ - $2p^64d$	^{2}P° - ^{2}D	½ - 3/2		118
	20	69.213	256.535 - 1701.350	$2p^63p$ - $2p^64d$	^{2}P° - ^{2}D	3/2 - 5/2		118
	10	69.247	256.535 - 1700.577	$2p^63p$ - $2p^64d$	^{2}P° - ^{2}D	3/2 - 3/2		118
	25	80.916	242.724 - 1478.517	$2p^63p$ - $2p^64s$	^{2}P° - ^{2}S	½ - ½		118
	30	81.838	256.535 - 1478.517	$2p^63p$ - $2p^64s$	^{2}P° - ^{2}S	3/2 - ½		118
	27	86.057	587.867 - 1749.887	$2p^63d$ - $2p^64f$	^{2}D - ^{2}F°	3/2 - 5/2		118
	28	86.164	589.568 - 1750.145	$2p^63d$ - $2p^64f$	^{2}D - ^{2}F°	5/2 - 7/2		118
	10	101.05	589.568 - 1579.180	$2p^63d$ - $2p^64p$	^{2}D - ^{2}P°	5/2 - 3/2		118

CR XIV — Continued

Multiplet	Rel. Int.	λ$_{vac}$ (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	12	101.42	587.867 - 1573.836	$2p^63d - 2p^64p$	$^2D - ^2P^\circ$	[illegible]		118
	10	187.02	1700.577 - 2235.25	$2p^64d - 2p^65f$	$^2D - ^2F^\circ$	[illegible]		1091
	10	187.30	1701.350 - 2235.28	$2p^64d - 2p^65f$	$^2D - ^2F^\circ$	[illegible]		1091
	30	204.91	1749.887 - 2237.91	$2p^64f - 2p^65g$	$^2F^\circ - ^2G$	[illegible]		1091
	30	205.01	1750.145 - 2237.92	$2p^64f - 2p^65g$	$^2F^\circ - ^2G$	[illegible]		1091
	50	289.735	242.724 - 587.867	$2p^63p - 2p^63d$	$^2P^\circ - ^2D$	[illegible]		118,437
		300.271	256.535 - 589.568	$2p^63p - 2p^63d$	$^2P^\circ - ^2D$	[illegible]		118
		301.814	256.535 - 587.867	$2p^63p - 2p^63d$	$^2P^\circ - ^2D$	[illegible]		118
	250	389.81	0 - 256.535	$2p^63s - 2p^63p$	$g^2S - ^2P^\circ$	[illegible]		270,437
	200	411.99	0 - 242.724	$2p^63s - 2p^63p$	$g^2S - ^2P^\circ$	[illegible]		270,437

CHROMIUM XV (Cr^{14+}), Z = 24
Ground State $1s^22s^22p^6(^1S_0)$ (10 electrons)
Ionization Potential 8 151 000 cm^{-1}; 1010.6 eV

Multiplet	Rel. Int.	λ$_{vac}$ (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	13.294	0.0 - 7522.2	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})6d$	g^1S - [illegible]	0 - 1		716
	10	13.416	0.0 - 7453.8	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})6d$	g^1S - [illegible]	0 - 1		716
	20	13.862	0.0 - 7214.0	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})5d$	g^1S - [illegible]	0 - 1		716
	20	13.991	0.0 - 7147.4	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})5d$	g^1S - [illegible]	0 - 1		716
	10	15.509	0.0 - 6447.9	$2s^22p^6 - 2s^22p^5(^2P^\circ)4s$	$g^1S - ^1P^\circ$	0 - 1		716
	20	15.788	0.0 - 6333.9	$2s^22p^6 - 2s^22p^5(^2P^\circ)4s$	$g^1S - ^1P^\circ$	0 - 1		716
	100	16.889	0.0 - 5921.0	$2s^22p^6 - 2s2p^6(^2S)3p$	$g^1S - ^1P^\circ$	0 - 1		716
	50	16.971	0.0 - 5894.5	$2s^22p^6 - 2s2p^6(^2S)3p$	$g^1S - ^1P^\circ$	0 - 1		716
	400	18.497	0.0 - 5406.3	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3d$	g^1S - [illegible]	0 - 1		766
	200	18.782	0.0 - 5324.2	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3d$	g^1S - [illegible]	0 - 1		766
	50	19.015	0.0 - 5259.0	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3d$	g^1S - [illegible]	0 - 1		766
	400	20.863	0.0 - 4793.2	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3s$	g^1S - [illegible]	0 - 1		766
	300	21.153	0.0 - 4727.5	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3s$	g^1S - [illegible]	0 - 1		766
		21.213	0.0 - 4714.1	$2s^22p^6 - 2s^22p^5(^2P^\circ_{[illegible]})3s$	g^1S - [illegible]	0 - 2	F	1112
		52.88	5269.0 + C - 7160.1 + F	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})5f$	$^3F^\circ$ - [illegible]	4 - 5	P	1055
		58.02	4714.1 - 6437.6	$2s^22p^5(^2P^\circ_{[illegible]})3s - 2s^22p^5(^2P^\circ)4p$	[illegible] - ^3D	2 - 3		1055
		58.20	4793.2 - 6511.4	$2s^22p^5(^2P^\circ_{[illegible]})3s - 2s^22p^5(^2P^\circ)4p$	[illegible] - ^1P	1 - 1		1055
		62.375	4963.0 + C - 6566.2 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3P - ^3D^\circ$	1 - 2		395
		62.481	4946.1 + C - 6546.6 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3D - ^3D^\circ$	2 - 3		395
		62.837	4954.1 + C - 6545.5 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3D - ^3F^\circ$	3 - 4		395
		62.951	5040.9 + C - 6629.4 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3P - ^3F^\circ$	1 - 2		395
		63.055	5042.9 + C - 6628.8 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3D - ^3F^\circ$	2 - 3		395
		63.31	4974.6 + C - 6554.1 + C	$2s^22p^5(^2P^\circ_{[illegible]})3p - 2s^22p^5(^2P^\circ)4d$	$^3P - ^3F^\circ$	2 - 3	P	395
		74.70	5255.0 + C - 6593.7 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^3P^\circ$ - [illegible]	2 - 2		1055
		74.97	5269.0 + C - 6602.9 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^3F^\circ$ - [illegible]	4 - 5		1055
		75.25	5312.1 + C - 6641.0 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^3F^\circ$ - [illegible]	2 - 3		1055
		75.29	5274.3 + C - 6602.5 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^3F^\circ$ - [illegible]	3 - 4		1055
		75.44	5360.5 + C - 6686.1 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^1F^\circ$ - [illegible]	3 - 3		1055
		75.73	5360.5 + C - 6681.0 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^1F^\circ$ - [illegible]	3 - 4		1055
		76.14	5292.4 + C - 6605.8 + C	$2s^22p^5(^2P^\circ)3d - 2s^22p^5(^2P^\circ_{[illegible]})4f$	$^3D^\circ$ - [illegible]	3 - 4		1055

CHROMIUM XVI (Cr^{15+}), Z = 24
Ground State $1s^22s^22p^5(^2P^o_{3/2})$ (9 electrons)
Ionization Potential [8 850 000] cm^{-1}; [1097] eV

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
3	13.528	0.0 - 7392.1	$2s^22p^5 - 2s^22p^4(^1D)4d$	$g^2P^o - ^2S$	3/2 - 1/2		1089
10	13.556	0.0 - 7376.8	$2s^22p^5 - 2s^22p^4(^1S)4d$	$g^2P^o - ^2D$	3/2 - 5/2		716
10	13.953	0.0 - 7166.9	$2s^22p^5 - 2s^22p^4(^3P)4d$	$g^2P^o - ^2P$	3/2 - 3/2		716
10	14.039	0.0 - 7123.0	$2s^22p^5 - 2s^22p^4(^3P)4d$	$g^2P^o - ^2D$	3/2 - 5/2	Q	716
	14.29	0.0 - 6997.9	$2s^22p^5 - 2s^22p^4(^3P)4d$	$g^2P^o - ^4P$	3/2 - 5/2	P	716
	14.47	0.0 - 6910.8	$2s^22p^5 - 2s^22p^4(^1S)4s$	$g^2P^o - ^2S$	3/2 - 1/2		716
30	17.073	0.0 - 5857.2	$2s^22p^5 - 2s^22p^4(^1S)3d$	$g^2P^o - ^2D$	3/2 - 5/2		850
50	17.242	70.890 - 5870.7	$2s^22p^5 - 2s^22p^4(^1S)3d$	$g^2P^o - ^2D$	1/2 - 3/2		850
80	17.370	0.0 - 5757.1	$2s^22p^5 - 2s^22p^4(^1D)3d$	$g^2P^o - ^2D$	3/2 - 5/2		850
60	17.438	0.0 - 5734.6	$2s^22p^5 - 2s^22p^4(^1D)3d$	$g^2P^o - ^2S$	3/2 - 1/2		850
30	17.514	70.890 - 5780.6	$2s^22p^5 - 2s^22p^4(^1D)3d$	$g^2P^o - ^2D$	1/2 - 3/2		850
20	17.589	70.890 - 5756.2	$2s^22p^5 - 2s^22p^4(^1D)3d$	$g^2P^o - ^2P$	1/2 - 3/2		850
50	17.603	0.0 - 5680.8	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2D$	3/2 - 5/2		850
20	17.633	0.0 - 5671.2	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2P$	3/2 - 3/2		850
40	17.671	0.0 - 5659.0	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2F$	3/2 - 5/2		850
20	17.704	0.0 - 5648.5	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2D$	3/2 - 3/2		850
30	17.730	0.0 - 5640.2	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^4P$	3/2 - 5/2		850
50	17.785	0.0 - 5622.7	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^4F$	3/2 - 5/2		850
20	17.793	0.0 - 5620.3	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^4P$	3/2 - 3/2		850
20	17.833	0.0 - 5607.7	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^4P$	3/2 - 1/2		850
20	17.856	70.890 - 5671.2	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2P$	1/2 - 1/2		850
20	17.931	70.890 - 5648.5	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2D$	1/2 - 3/2		850
30	17.993	70.890 - 5628.6	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^2P$	1/2 - 3/2		850
20	18.017	70.890 - 5620.3	$2s^22p^5 - 2s^22p^4(^3P)3d$	$g^2P^o - ^4P$	1/2 - 1/2		850
300	18.775	0.0 - 5325.3	$2s^22p^5 - 2s^22p^4(^1S)3s$	$g^2P^o - ^2S$	3/2 - 1/2		850
80	19.038	70.890 - 5325.3	$2s^22p^5 - 2s^22p^4(^1S)3s$	$g^2P^o - ^2S$	1/2 - 1/2		850
150	19.255	0.0 - 5193.5	$2s^22p^5 - 2s^22p^4(^1D)3s$	$g^2P^o - ^2D$	3/2 - 5/2		850
60	19.442	0.0 - 5143.5	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^2P$	3/2 - 3/2		850
100	19.511	70.890 - 5196.2	$2s^22p^5 - 2s^22p^4(^1D)3s$	$g^2P^o - ^2D$	1/2 - 3/2		850
100	19.538	0.0 - 5118.2	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^2P$	3/2 - 1/2		850
200	19.714	70.890 - 5143.5	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^2P$	1/2 - 3/2		850
100	19.807	0.0 - 5048.7	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^4P$	3/2 - 5/2		850
10	19.847	70.890 - 5109.4	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^4P$	1/2 - 1/2		850
60	19.951	937.829 - 5950.3	$2s2p^6 - 2s2p^6(^2P^o)3s$	$^2S - ^2P^o$	1/2 - 3/2		850
20	19.995	70.890 - 5072.4	$2s^22p^5 - 2s^22p^4(^3P)3s$	$g^2P^o - ^4P$	1/2 - 3/2		850
300	106.629	0.0 - 937.829	$2s^22p^5 - 2s2p^6$	$g^2P^o - ^2S$	3/2 - 1/2	P	1104,1091
250	115.348	70.890 - 937.829	$2s^22p^5 - 2s2p^6$	$g^2P^o - ^2S$	1/2 - 1/2	P	1104,1091
	1410.6	0.0 - 70.890	$2s^22p^5 - 2s^22p^5$	$g^2P^o - g^2P^o$	3/2 - 1/2	F,P	1137

CHROMIUM XVII (Cr^{16+}), Z = 24
Ground State $1s^22s^22p^4(^3P_2)$ (8 electrons)
Ionization Potential [9 560 000] cm^{-1}; [1185] eV

Multiplet Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
30	16.221	0.0 - 6164.8	$2s^22p^4 - 2s^22p^3(^2P^o)3d$	$g^3P - ^3D^o$	2 - 3		877
30	16.249	60.378 - 6214.6	$2s^22p^4 - 2s^22p^3(^2P^o)3d$	$g^3P - ^3D^o$	1 - 2		877
30	16.31	58.146 - 6189.4	$2s^22p^4 - 2s^22p^3(^2P^o)3d$	$g^3P - ^3D^o$	0 - 1		877
90	16.455	0.0 - 6075.3	$2s^22p^4 - 2s^22p^3(^2D^o)3d$	$g^3P - ^3D^o$	2 - 3		716
10	16.64	60.378 - 6070.0	$2s^22p^4 - 2s^22p^3(^2D^o)3d$	$g^3P - ^3D^o$	1 - 2		877
40	16.675	263.00 - 6260.3	$2s^22p^4 - 2s^22p^3(^2P^o)3d$	$^1S - ^1P^o$	0 - 1	P	947

CR XVII — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	16.696	135.10 - 6124.6	$2s^22p^4 - 2s^22p^3(^2D^o)3d$	$^1D - ^1F^o$	2 - 3		877
		16.773	135.10 - 6096.0	$2s^22p^4 - 2s^22p^3(^2D^o)3d$	$^1D - ^1D^o$	2 - 2	P	877
	10	16.811	0.0 - 5948.5	$2s^22p^4 - 2s^22p^3(^4S^o)3d$	$g^3P - ^3D^o$	2 - 3		877
	150	17.957	0.0 - 5568.9	$2s^22p^4 - 2s^22p^3(^2D^o)3s$	$g^3P - ^3D^o$	2 - 3		865
	50	17.968	135.10 - 5701.0	$2s^22p^4 - 2s^22p^3(^2P^o)3s$	$^1D - ^1P^o$	2 - 1		865
	150	18.020	0.0 - 5549.3	$2s^22p^4 - 2s^22p^3(^2D^o)3s$	$g^3P - ^3D^o$	2 - 2		865
	50	18.219	60.378 - 5549.3	$2s^22p^4 - 2s^22p^3(^2D^o)3s$	$g^3P - ^3D^o$	1 - 2		865
	200	18.336	0.0 - 5453.9	$2s^22p^4 - 2s^22p^3(^4S^o)3s$	$g^3P - ^3S^o$	2 - 1		865
	50	18.389	263.00 - 5701.0	$2s^22p^4 - 2s^22p^3(^2P^o)3s$	$^1S - ^1P^o$	0 - 1		865
		18.52	0.0 - 5399.4+K	$2s^22p^4 - 2s^22p^3(^4S^o)3s$	$g^3P - ^5S^o$	2 - 2	P	680
	150	18.531	60.378 - 5453.9	$2s^22p^4 - 2s^22p^3(^4S^o)3s$	$g^3P - ^3S^o$	1 - 1		865
		18.73	60.378 - 5399.4+K	$2s^22p^4 - 2s^22p^3(^4S^o)3s$	$g^3P - ^5S^o$	1 - 2	P	680
	150	89.57	0.0 - 1116.42	$2s^22p^4 - 2s2p^5$	$g^3P - ^1P^o$	2 - 1		1091
	10	94.49	58.146 - 1116.42	$2s^22p^4 - 2s2p^5$	$g^3P - ^1P^o$	0 - 1		1091
	4	94.69	60.378 - 1116.42	$2s^22p^4 - 2s2p^5$	$g^3P - ^1P^o$	1 - 1		1091
	30	97.20	858.15 - 1886.95	$2s2p^5 - 2p^6$	$^1P^o - ^1S$	1 - 0		1091
	250	101.91	135.10 - 1116.42	$2s^22p^4 - 2s2p^5$	$^1D - ^1P^o$	2 - 1		1091
	250	116.53	0.0 - 858.15	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	2 - 1		1091
	110	117.20	263.00 - 1116.42	$2s^22p^4 - 2s2p^5$	$^1S - ^1P^o$	0 - 1		1091
	200	120.84	60.378 - 887.92	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	1 - 0		1091
	375	122.91	0.0 - 813.60	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	2 - 2		1091
	150	125.00	58.146 - 858.15	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	0 - 1		1091
	200	125.35	60.378 - 858.15	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	1 - 1		1091
	200	129.78	1116.42 - 1886.95	$2s2p^5 - 2p^6$	$^1P^o - ^1S$	1 - 0		1091
	250	132.76	60.378 - 813.60	$2s^22p^4 - 2s2p^5$	$g^3P - ^3P^o$	1 - 2		1091
	10	147.40	135.10 - 813.60	$2s^22p^4 - 2s2p^5$	$^1D - ^3P^o$	2 - 2		1091
		380.2	0.0 - 263.00	$2s^22p^4 - 2s^22p^4$	$g^3P - ^1S$	2 - 0	F,P	375,1091
		493.8	60.378 - 263.00	$2s^22p^4 - 2s^22p^4$	$g^3P - ^1S$	1 - 0	F	1120
		740.8	0.0 - 135.10	$2s^22p^4 - 2s^22p^4$	$g^3P - ^1D$	2 - 2	F	1120
		781.9	135.10 - 263.00	$2s^22p^4 - 2s^22p^4$	$^1D - ^1S$	2 - 0	F,P	375,1091
		1299.	58.146 - 135.10	$2s^22p^4 - 2s^22p^4$	$g^3P - ^1D$	0 - 2	F,P	375,1091
		1338	60.378 - 135.10	$2s^22p^4 - 2s^22p^4$	$g^3P - ^1D$	1 - 2	F,P	375,1091
		1656.3	0.0 - 60.378	$2s^22p^4 - 2s^22p^4$	$g^3P - g^3P$	2 - 1	F	1120
		1720.	0.0 - 58.146	$2s^22p^4 - 2s^22p^4$	$g^3P - g^3P$	2 - 0	F,P	375,1091

CHROMIUM XVIII (Cr^{17+}), Z = 24
Ground State $1s^22s^22p^3(^4S^o_{3/2})$ (7 electrons)
Ionization Potential [10 480 000] cm^{-1}; [1299] eV

Multiplet	Rel. Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		15.501	126.040 - 6577.2+F	$2s^22p^3 - 2s^22p^2(^1D)3d$	$^2D^o - ^2F$	[illegible]	P	877
		15.512	0.0 - 6446.6+F	$2s^22p^3 - 2s^22p^2(^3P)3d$	$g^4S^o - ^4P$	[illegible]	P	877
	10	15.52	0.0 - 6443.3	$2s^22p^3 - 2s^22p^2(^3P)3d$	$g^4S^o - ^4P$	[illegible]		877
		15.550	150.776 - 6581.7+F	$2s^22p^3 - 2s^22p^2(^1D)3d$	$^2D^o - ^2P$	[illegible]	P	877
	20	15.587	150.776 - 6564.7	$2s^22p^3 - 2s^22p^2(^1D)3d$	$^2D^o - ^2F$	[illegible]	Q	716,877
		15.835	150.776 - 6466.0+F	$2s^22p^3 - 2s^22p^2(^3P)3d$	$^2D^o - ^2F$	[illegible]	P	877
		16.292	264.482 - 6402.5+F	$2s^22p^3 - 2s^22p^2(^3P)3d$	$^2P^o - ^2P$	[illegible]	P	877
	50	90.63	0.0 - 1103.35	$2s^22p^3 - 2s2p^4$	$g^4S^o - ^4P$	[illegible]		1091
	10	93.36	667.56 - 1738.69	$2s2p^4 - 2p^5$	$^4P - ^2P^o$	[illegible]		1091
	4	94.16	0.0 - 1062.04	$2s^22p^3 - 2s2p^4$	$g^4S^o - ^2S$	[illegible]		1091
	150	95.77	126.040 - 1170.20	$2s^22p^3 - 2s2p^4$	$^2D^o - ^2P$	[illegible]		1091
	150	102.32	126.040 - 1103.35	$2s^22p^3 - 2s2p^4$	$^2D^o - ^2P$	[illegible]		1091

CR XVIII — Continued

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	300	104.98	150.776 - 1103.35	$2s^22p^3$ - $2s2p^4$	$^2D^o$ - ^2P	[illegible]		1091
	10	105.92	226.068 - 1170.20	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2P	[illegible]		1091
	150	106.84	126.040 - 1062.04	$2s^22p^3$ - $2s2p^4$	$^2D^o$ - ^2S	[illegible]		1091
	10	108.37	0.0 - 922.77	$2s^22p^3$ - $2s2p^4$	g$^4S^o$ - ^2D	[illegible]		1091
	375	110.41	264.482 - 1170.20	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2P	[illegible]		1091
	110	112.27	922.77 - 1813.47	$2s2p^4$ - $2p^5$	^2D - $^2P^o$	[illegible]		1091
	300	113.99	226.068 - 1103.35	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2P	[illegible]		1091
	110	119.21	264.482 - 1103.35	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2P	[illegible]		1091
	200	119.62	226.068 - 1062.04	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2S	[illegible]		1091
	80	122.56	922.77 - 1738.69	$2s2p^4$ - $2p^5$	^2D - $^2P^o$	[illegible]		1091
	250	123.87	931.41 - 1738.69	$2s2p^4$ - $2p^5$	^2D - $^2P^o$	[illegible]		1091
	200	125.38	264.482 - 1062.04	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2S	[illegible]		1091
	300	125.51	126.040 - 922.77	$2s^22p^3$ - $2s2p^4$	$^2D^o$ - ^2D	[illegible]		1091
	375	128.10	150.776 - 931.41	$2s^22p^3$ - $2s2p^4$	$^2D^o$ - ^2D	[illegible]		1091
	150	136.52	0.0 - 732.49	$2s^22p^3$ - $2s2p^4$	g$^4S^o$ - ^4P	[illegible]		1091
	375	139.87	0.0 - 714.95	$2s^22p^3$ - $2s2p^4$	g$^4S^o$ - ^4P	[illegible]		1091
	110	140.82	1103.35 - 1813.47	$2s2p^4$ - $2p^5$	^2P - $^2P^o$	[illegible]		1091
	50	143.53	226.068 - 922.77	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2D	[illegible]		1091
	30	147.79	1062.04 - 1738.69	$2s2p^4$ - $2p^5$	^2S - $^2P^o$	[illegible]		1091
	300	149.80	0.0 - 667.56	$2s^22p^3$ - $2s2p^4$	g$^4S^o$ - ^4P	[illegible]		1091
	200	149.94	264.482 - 931.41	$2s^22p^3$ - $2s2p^4$	$^2P^o$ - ^2D	[illegible]		1091
	80	155.46	1170.20 - 1813.47	$2s2p^4$ - $2p^5$	^2P - $^2P^o$	[illegible]		1091
	200	157.40	1103.35 - 1738.69	$2s2p^4$ - $2p^5$	^2P - $^2P^o$	[illegible]		1091
		378.10	0.0 - 264.482	$2s^22p^3$ - $2s^22p^3$	g$^4S^o$ - $^2P^o$	[illegible]	F,P	375,1091
		442.34	0.0 - 226.068	$2s^22p^3$ - $2s^22p^3$	g$^4S^o$ - $^2P^o$	[illegible]	F,P	375,1091
		663.24	0.0 - 150.776	$2s^22p^3$ - $2s^22p^3$	g$^4S^o$ - $^2D^o$	[illegible]	F,P	375,1091
		722.32	126.040 - 264.482	$2s^22p^3$ - $2s^22p^3$	$^2D^o$ - $^2P^o$	[illegible]	F,P	375,1091
		793.3	0.0 - 126.040	$2s^22p^3$ - $2s^22p^3$	g$^4S^o$ - $^2D^o$	[illegible]	F	1120
		879.46	150.776 - 264.482	$2s^22p^3$ - $2s^22p$	$^2D^o$ - $^2P^o$	[illegible]	F,P	375,1091
		999.72	126.040 - 226.068	$2s^22p^3$ - $2s^22p^3$	$^2D^o$ - $^2P^o$	[illegible]	F,P	375,1091
		1328	150.776 - 226.068	$2s^22p^3$ - $2s^22p^3$	$^2D^o$ - $^2P^o$	[illegible]	F,P	375,1091

CHROMIUM XIX (Cr^{18+}), Z = 24
Ground State $1s^22s^22p^4(^3P_2)$ (6 electrons)
Ionization Potential [11 260 000] cm^{-1}; [1396] eV

Multiplet	Rel Int	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		14.802	47.806 - 6803.5 + B	$2s^22p^4$ - $2s^22p^33d$	g^3P - $^3D^o$	1 - 2	P	949
		14.809	82.453 - 6835.0 + B	$2s^22p^4$ - $2s^22p^33d$	g^3P - $^3P^o$	2 - 2	P	949
	10	14.836	82.453 - 6822.5 + B	$2s^22p^4$ - $2s^22p^33d$	g^3P - $^3D^o$	2 - 3	P	949,716
	0	14.925	184.596 - 6885.7 + B	$2s^22p^4$ - $2s^22p^33d$	^1D - $^1P^o$	2 - 1	Q	716,949
		15.027	82.453 - 6737.1 + B	$2s^22p^4$ - $2s^22p^33d$	g^3P - $^3F^o$	2 - 3	P	949
		15.180	298.87 - 6885.7 + B	$2s^22p^4$ - $2s^22p^33d$	^1S - $^1P^o$	0 - 1	P	949
		15.251	184.596 - 6742.2 + B	$2s^22p^4$ - $2s^22p^33d$	^1D - $^1D^o$	2 - 2	P	949
		15.301	686.83 - 7222.3 + F	$2s2p^5$ - $2s2p^4(^4P)3d$	$^3D^o$ - ^3F	3 - 4	P	877
		15.91	82.453 - 6367.6	$2s^22p^4$ - $2s^22p^33s$	g^3P - $^3P^o$	2 - 2	P	375
	10	95.62	404.41 - 1450.23	$2s2p^5$ - $2p^6$	$^1S^o$ - ^1P	2 - 2		1091
	30	95.88	47.806 - 1090.68	$2s^22p^4$ - $2s2p^5$	g^3P - $^3P^o$	1 - 1		1091
	110	104.18	0.0 - 959.88	$2s^22p^4$ - $2s2p^5$	g^3P - $^3S^o$	0 - 1		1091

CR XIX — Continued

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	200	109.64	47.806 - 959.88	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3S°$	1 - 1		1091
	250	110.37	184.596 - 1090.68	$2s^22p^2 - 2s2p^3$	$^1D - ^1P°$	2 - 1		1091
	50	111.18	686.83 - 1586.24	$2s2p^3 - 2p^4$	$^3D° - ^1D$	3 - 2		1091
	80	111.88	82.453 - 976.22	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^1D°$	2 - 2		1091
	300	113.97	82.453 - 959.88	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3S°$	2 - 1		1091
	110	118.31	672.77 - 1517.98	$2s2p^3 - 2p^4$	$^3D° - ^3P$	1 - 0		1091
	150	118.67	671.63 - 1514.32	$2s2p^3 - 2p^4$	$^3D° - ^3P$	2 - 1		1091
	110	118.83	672.77 - 1514.32	$2s2p^3 - 2p^4$	$^3D° - ^3P$	1 - 1		1091
	50	125.93	0.0 - 794.12	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	0 - 1		1091
	175	126.30	298.87 - 1090.68	$2s^22p^2 - 2s2p^3$	$^1S - ^1P°$	0 - 1		1091
	200	126.33	184.596 - 976.22	$2s^22p^2 - 2s2p^3$	$^1D - ^1D°$	2 - 2		1091
	4	127.95	804.74 - 1586.24	$2s2p^3 - 2p^4$	$^3P° - ^1D$	2 - 2		1091
	375	128.43	671.63 - 1450.23	$2s2p^3 - 2p^4$	$^3D° - ^3P$	2 - 2		1091
	30	128.63	672.77 - 1450.23	$2s2p^3 - 2p^4$	$^3D° - ^3P$	1 - 2		1091
	250	130.99	686.83 - 1450.23	$2s2p^3 - 2p^4$	$^3D° - ^3P$	3 - 2		1091
	10	132.11	47.806 - 804.74	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	1 - 2		1091
	250	133.99	47.806 - 794.12	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	1 - 1		1091
	80	134.89	47.806 - 789.15	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	1 - 0		1091
	10	137.89	789.15 - 1514.32	$2s2p^3 - 2p^4$	$^3P° - ^3P$	0 - 1		1091
	50	138.15	794.12 - 1517.98	$2s2p^3 - 2p^4$	$^3P° - ^3P$	1 - 0		1091
	300	138.45	82.453 - 804.74	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	2 - 2		1091
	4	138.86	794.12 - 1514.32	$2s2p^3 - 2p^4$	$^3P° - ^3P$	1 - 1		1091
	30	140.51	82.453 - 794.12	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3P°$	2 - 1		1091
	110	140.92	804.74 - 1514.32	$2s2p^3 - 2p^4$	$^3P° - ^3P$	2 - 1		1091
	110	143.57	1090.68 - 1787.21	$2s2p^3 - 2p^4$	$^1P° - ^1S$	1 - 0		1091
	110	148.64	0.0 - 672.77	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3D°$	0 - 1		1091
	30	152.42	794.12 - 1450.23	$2s2p^3 - 2p^4$	$^3P° - ^3P$	1 - 2		1091
	30	154.92	804.74 - 1450.23	$2s2p^3 - 2p^4$	$^3P° - ^3P$	2 - 2		1091
	10	160.01	47.806 - 672.77	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3D°$	1 - 1		1091
	150	160.30	47.806 - 671.63	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3D°$	1 - 2		1091
	250	163.94	976.22 - 1586.24	$2s2p^3 - 2p^4$	$^1D° - ^1D$	2 - 2		1091
	150	165.46	82.453 - 686.83	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3D°$	2 - 3		1091
	4	169.73	82.453 - 671.63	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^3D°$	2 - 2		1091
	50	179.18	959.88 - 1517.98	$2s2p^3 - 2p^4$	$^3S° - ^3P$	1 - 0		1091
	30	180.37	959.88 - 1514.32	$2s2p^3 - 2p^4$	$^3S° - ^3P$	1 - 1		1091
	10	201.82	1090.68 - 1586.24	$2s2p^3 - 2p^4$	$^1P° - ^1D$	1 - 2		1091
	300	203.94	959.88 - 1450.23	$2s2p^3 - 2p^4$	$^3S° - ^3P$	1 - 2		1091
		310.6	82.453 - 404.41	$2s^22p^2 - 2s2p^3$	$g\,^3P - ^5S°$	2 - 2	P	375,1091
		398.4	47.806 - 298.87	$2s^22p^2 - 2s^22p^2$	$g\,^3P - ^1S$	1 - 0	F	1120
		462.07	82.453 - 298.87	$2s^22p^2 - 2s^22p^2$	$g\,^3P - ^1S$	2 - 0	F,P	375,1120
		541.72	0.0 - 184.596	$2s^22p^2 - 2s^22p^2$	$g\,^3P - ^1D$	0 - 2	F,P	375,1120
		731.1	47.806 - 184.596	$2s^22p^2 - 2s^22p^2$	$g\,^3P - ^1D$	1 - 2	F	1120
		875.09	184.596 - 298.87	$2s^22p^2 - 2s^22p^2$	$^1D - ^1S$	2 - 0	F,P	375,1120
		979.0	82.453 - 184.596	$2s^22p^2 - 2s^22p^2$	$g\,^3P - ^1D$	2 - 2	F	1120
		1213	0.0 - 82.453	$2s^22p^2 - 2s^22p^2$	$g\,^3P - g\,^3P$	0 - 2	F,P	375,1120

CHROMIUM XX (Cr^{19+}), Z = 24
Ground State $1s^22s^22p(^2P^o_{1/2})$ (5 electrons)
Ionization Potential [12 070 000] cm^{-1}; [1496] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	3	10.712	0.0 - 9335.3	$2s^22p - 2s^24d$	$g\,^2P^o - {}^2D$	[illegible]		1089
	2	10.840	82.950 - 9308.1	$2s^22p - 2s^24d$	$g\,^2P^o - {}^2D$	[illegible]		1089
	3	10.940	0.0 - 9145.0	$2s^22p - 2s^24s$	$g\,^2P^o - {}^2S$	[illegible]		1089
	5	11.030	82.950 - 9145.0	$2s^22p - 2s^24s$	$g\,^2P^o - {}^2S$	[illegible]		1089
		13.631	0.0 - 7336.2+F	$2s^22p - 2s2p(^3P)3p$	$g\,^2P^o - {}^2D$	[illegible]	P	877
		13.683	82.950 - 7391.2+F	$2s^22p - 2s2p(^3P)3p$	$g\,^2P^o - {}^2D$	[illegible]	P	877
		13.910	0.0 - 7189.1+F	$2s^22p - 2s2p(^3P)3p$	$g\,^2P^o - {}^2P$	[illegible]	P	877
		13.946	82.950 - 7253.4+F	$2s^22p - 2s2p(^3P)3p$	$g\,^2P^o - {}^2P$	[illegible]	P	877
	2	14.065	861.671 - 7971.6	$2s2p^2 - 2s2p(^3P^o)3d$	$^2P - {}^2D^o$	[illegible]		1089
	1	14.093	653.010 - 7748.8	$2s2p^2 - 2s2p(^3P^o)3d$	$^2D - {}^2F^o$	[illegible]		1089
		14.129	0.0 - 7077.6+F	$2s^22p - 2s^23d$	$g\,^2P^o - {}^2D$	[illegible]	P	877
	10	14.205	428.13 - 7466.4+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^4P - {}^4P^o$	[illegible]	Q	716,877
		14.214	428.13 - 7463.4+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^4P - {}^4D^o$	[illegible]	P	877
	2	14.261	428.13 - 7440.3	$2s2p^2 - 2s2p(^3P^o)3d$	$^4P - {}^4F^o$	[illegible]		1089
		14.447	653.010 - 7574.9+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^2D - {}^2F^o$	[illegible]	P	877
		14.524	640.990 - 7526.2+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^2D - {}^2F^o$	[illegible]	P	877
	0	14.641	640.990 - 7470.1+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^2D - {}^2D^o$	[illegible]	Q	716,877
		14.669	653.010 - 7470.1+F	$2s2p^2 - 2s2p(^3P^o)3d$	$^2D - {}^2D^o$	[illegible]	P	877
	30	15.061	82.950 - 6724.5	$2s^22p - 2s^23s$	$g\,^2P^o - {}^2S$	[illegible]	Q	716,375
	80	116.05	0.0 - 861.671	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2P$	[illegible]		1091
	30	117.95	0.0 - 847.763	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2P$	[illegible]		1091
	10	122.29						1091
	375	128.42	82.950 - 861.671	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2P$	[illegible]		1091
	50	129.26	640.990 - 1414.60	$2s2p^2 - 2p^3$	$^2D - {}^2P^o$	[illegible]		1091
	250	130.76	82.950 - 847.763	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2P$	[illegible]		1091
	150	131.31	653.010 - 1414.60	$2s2p^2 - 2p^3$	$^2D - {}^2P^o$	[illegible]		1091
	250	131.50	0.0 - 760.410	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2S$	[illegible]		1091
	150	133.82	352.33 - 1099.51	$2s2p^2 - 2p^3$	$^4P - {}^4S^o$	[illegible]		1091
	110	135.26	640.990 - 1380.28	$2s2p^2 - 2p^3$	$^2D - {}^2P^o$	[illegible]		1091
	250	140.75	389.12 - 1099.51	$2s2p^2 - 2p^3$	$^4P - {}^4S^o$	[illegible]		1091
	4	147.62	82.950 - 760.410	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2S$	[illegible]		1091
	250	148.99	428.13 - 1099.51	$2s2p^2 - 2p^3$	$^4P - {}^4S^o$	[illegible]		1091
	30	152.86	760.410 - 1414.60	$2s2p^2 - 2p^3$	$^2S - {}^2P^o$	[illegible]		1091
	200	156.00	0.0 - 640.990	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2D$	[illegible]		1091
	10	161.33	760.410 - 1380.28	$2s2p^2 - 2p^3$	$^2S - {}^2P^o$	[illegible]		1091
	50	164.63	640.990 - 1248.39	$2s2p^2 - 2p^3$	$^2D - {}^2D^o$	[illegible]		1091
	200	167.97	653.010 - 1248.39	$2s2p^2 - 2p^3$	$^2D - {}^2D^o$	[illegible]		1091
	80	169.87	640.990 - 1229.67	$2s2p^2 - 2p^3$	$^2D - {}^2D^o$	[illegible]		1091
	50	173.42	653.010 - 1229.67	$2s2p^2 - 2p^3$	$^2D - {}^2D^o$	[illegible]		1091
	150	175.42	82.950 - 653.010	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2D$	[illegible]		1091
	4	176.42	847.763 - 1414.60	$2s2p^2 - 2p^3$	$^2P - {}^2P^o$	[illegible]		1091
	50	179.21	82.950 - 640.990	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^2D$	[illegible]		1091
	80	180.85	861.671 - 1414.60	$2s2p^2 - 2p^3$	$^2P - {}^2P^o$	[illegible]		1091
	30	187.79	847.763 - 1380.28	$2s2p^2 - 2p^3$	$^2P - {}^2P^o$	[illegible]		1091
	4	192.82	861.671 - 1380.28	$2s2p^2 - 2p^3$	$^2P - {}^2P^o$	[illegible]		1091
	50	213.10	760.410 - 1229.67	$2s2p^2 - 2p^3$	$^2S - {}^2D^o$	[illegible]		1091
		257.0	0.0 - 389.12	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^4P$	[illegible]		1058
	50	258.57	861.671 - 1248.39	$2s2p^2 - 2p^3$	$^2P - {}^2D^o$	[illegible]		1091
	10	271.72	861.671 - 1229.67	$2s2p^2 - 2p^3$	$^2P - {}^2D^o$	[illegible]		1091
		283.8	0.0 - 352.33	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^4P$	[illegible]	P	1058
		289.7	82.950 - 428.13	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^4P$	[illegible]		1058
		326.6	82.950 - 389.12	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^4P$	[illegible]		1058
		371.2	82.950 - 352.33	$2s^22p - 2s2p^2$	$g\,^2P^o - {}^4P$	[illegible]	P	1058
		1205.9	0.0 - 82.950	$2s^22p - 2s^22p$	$g\,^2P^o - g\,^2P^o$	[illegible]	F	1120

CHROMIUM XXI (Cr^{20+}), Z = 24
Ground State $1s^22s^2(^1S_0)$ (4 electrons)
Ionization Potential [13 180 000] cm^{-1}; [1634] eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
	10	12.909	341.12 - 8087.1+B	$1s^22s2p - 1s^22p3p$	$^3P^o - ^3P$	1 - 1	Q	716,619
	10	12.981	405.03 - 8108.7	$1s^22s2p - 1s^22p3p$	$^3P^o - ^3S$	2 - 1		643
	0	13.018	405.03 - 8086.8	$1s^22s2p - 1s^22p3p$	$^3P^o - ^3D$	2 - 3		643
	0	13.060	318.04 - 7975.1	$1s^22s2p - 1s^22p3p$	$^3P^o - ^3D$	0 - 1		643
		13.081	0.0 - 7644.7+B	$1s^22s^2 - 1s^22s3p$	$g^1S - ^1P^o$	0 - 1	P	619
	0	13.123	0.0 - 7620.2	$1s^22s^2 - 1s^22s3p$	$g^1S - ^3P^o$	0 - 1		643
	0	13.205	667.23 - 8241.3	$1s^22s2p - 1s^22s3s$	$^1P^o - ^1S$	1 - 0		643
		13.316	667.23 - 8177.0+B	$1s^22s2p - 1s^22p3p$	$^1P^o - ^1D$	1 - 2	P	619
		13.514	318.04 - 7718.0+B	$1s^22s2p - 1s^22s3d$	$^3P^o - ^3D$	0 - 1	P	619
	10	13.55	341.12 - 7721.2	$1s^22s2p - 1s^22s3d$	$^3P^o - ^3D$	1 - 2		877
	0	13.647	405.03 - 7732.7	$1s^22s2p - 1s^22s3d$	$^3P^o - ^3D$	2 - 3		643
	0	13.684	911.09 - 8218.8	$1s^22p^2 - 1s^22p3d$	$^3P - ^3P^o$	1 - 1		643
	0	13.752	947.08 - 8218.8	$1s^22p^2 - 1s^22p3d$	$^3P - ^3P^o$	2 - 1		643
	10	13.760	864.74 - 8134.4	$1s^22p^2 - 1s^22s2p$	$^3P - ^3D^o$	0 - 1	Q	877
	10	13.779	947.08 - 8204.5	$1s^22p^2 - 1s^22p3d$	$^3P - ^3D^o$	2 - 3		643
	10	13.844	1051.89 - 8275.4	$1s^22p^2 - 1s^22p3d$	$^1D - ^1P^o$	2 - 1		643
	0	13.870	911.09 - 8121.0	$1s^22p^2 - 1s^22p3d$	$^3P - ^3D^o$	1 - 2		643
	0	13.950	1051.89 - 8220.4	$1s^22p^2 - 1s^22p3d$	$^1D - ^3P^o$	2 - 2		643
	10	14.029	667.23 - 7795.3	$1s^22s2p - 1s^22s3d$	$^1P^o - ^1D$	1 - 2	P	619,716
	0	14.041	341.12 - 7463.2	$1s^22s2p - 1s^22s3s$	$^3P^o - ^3S$	1 - 1		643
	2	14.172	405.03 - 7463.2	$1s^22s2p - 1s^22s3s$	$^3P^o - ^3S$	2 - 1	Q	1089
	2	14.217	911.09 - 7946.8	$1s^22p^2 - 1s^22p3s$	$^3P - ^3P^o$	1 - 2	Q	1089
		14.244	1254.91 - 8275.4	$1s^22p^2 - 1s^22p3d$	$^1S - ^1P^o$	0 - 1	P	619
		14.457	1051.89 - 7969.0	$1s^22p^2 - 1s^22p3s$	$^1D - ^1P^o$	2 - 1	P	619
		14.896	1254.91 - 7969.0	$1s^22p^2 - 1s^22p3s$	$^1S - ^1P^o$	0 - 1	P	619
	300	149.87	0.0 - 667.23	$1s^22s^2 - 1s^22s2p$	$g^1S - ^1P^o$	0 - 1		1091
	50	154.61	405.03 - 1051.89	$1s^22s2p - 1s^22p^2$	$^3P^o - ^1D$	2 - 2		1091
	80	165.03	341.12 - 947.08	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	1 - 2		1091
	50	168.62	318.04 - 911.09	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	0 - 1		1091
	50	170.16	667.23 - 1254.91	$1s^22s2p - 1s^22p^2$	$^1P^o - ^1S$	1 - 0		1091
	150	175.45	341.12 - 911.09	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	1 - 1		1091
	110	184.48	405.03 - 947.08	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	2 - 2		1091
	50	190.98	341.12 - 864.74	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	1 - 0		1091
	10	197.61	405.03 - 911.09	$1s^22s2p - 1s^22p^2$	$^3P^o - ^3P$	2 - 1		1091
	10	259.97	667.23 - 1051.89	$1s^22s2p - 1s^22p^2$	$^1P^o - ^1D$	1 - 2		1091
	50	293.15	0.0 - 341.12	$1s^22s^2 - 1s^22s2p$	$g^1S - ^3P^o$	0 - 1		437,730

CHROMIUM XXII (Cr^{21+}), Z = 24
Ground State $1s^22s(^2S_{1/2})$ (3 electrons)
Ionization Potential 13 882 000 cm^{-1}; 1721.6 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		2.190	0.0 - 45662.	$1s^22s - 1s2s2p$	$g^2S - ^2P^o$	$\frac{1}{2} - \frac{3}{2}$	P	631
		7.562	0.0 - 13224.1	$1s^22s - 1s^29p$	$g^2S - ^2P^o$	$\frac{1}{2} - \frac{3}{2}$	P	643
		7.664	0.0 - 13048.4	$1s^22s - 1s^28p$	$g^2S - ^2P^o$	$\frac{1}{2} - \frac{3}{2}$	P	643
		7.774	357.49 - 13220.9	$1s^22p - 1s^29d$	$^2P^o - ^2D$	$\frac{1}{2} - \frac{3}{2}$	P	643
		7.817	0.0 - 12793.6	$1s^22s - 1s^27p$	$g^2S - ^2P^o$	$\frac{1}{2} - \frac{3}{2}$	P	643
		7.828	448.40 - 13223.0	$1s^22p - 1s^29d$	$^2P^o - ^2D$	$\frac{3}{2} - \frac{5}{2}$	P	643

Cr XXII — Continued

Multiplet	Rel Int	λ (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		7 881	357 49 - 13046 2	$1s^22p$ - $1s^28d$	$^2P^o$ - ^2D	[illegible]	P	643
		7 936	448 40 - 13049 2	$1s^22p$ - $1s^28d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 042	357 49 - 12792 2	$1s^22p$ - $1s^27d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 066	0 0 - 12398 0	$1s^22s$ - $1s^26p$	g ^2S - $^2P^o$	[illegible]	P	643
		8 100	448 40 - 12794 1	$1s^22p$ - $1s^27d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 304	357 49 - 12400 0	$1s^22p$ - $1s^26d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 365	448 40 - 12403 0	$1s^22p$ - $1s^26d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 516	0 0 - 11743 0	$1s^22s$ - $1s^25p$	g ^2S - $^2P^o$	[illegible]	P	643
		8 778	357 49 - 11749 6	$1s^22p$ - $1s^25d$	$^2P^o$ - ^2D	[illegible]	P	643
		8 847	448 40 - 11751 7	$1s^22p$ - $1s^25d$	$^2P^o$ - ^2D	[illegible]	P	643
		9 488	0 0 - 10539 7	$1s^22s$ - $1s^24p$	g ^2S - $^2P^o$	[illegible]	P	977
		9 498	0 0 - 10528 3	$1s^22s$ - $1s^24p$	g ^2S - $^2P^o$	[illegible]	P	977
		9 806	357 49 - 10555 3	$1s^22p$ - $1s^24d$	$^2P^o$ - ^2D	[illegible]	P	977
		9 870	357 49 - 10489 0	$1s^22p$ - $1s^24s$	$^2P^o$ - ^2S	[illegible]	P	977
		9 891	448 40 - 10558 6	$1s^22p$ - $1s^24d$	$^2P^o$ - ^2D	[illegible]	P	977
		9 966	448 40 - 10489 0	$1s^22p$ - $1s^24s$	$^2P^o$ - ^2S	[illegible]	P	977
	100	12 613	0 0 - 7928 32	$1s^22s$ - $1s^23p$	g ^2S - $^2P^o$	[illegible]	P	977,273
	200	12 656	0 0 - 7901 26	$1s^22s$ - $1s^23p$	g ^2S - $^2P^o$	[illegible]	P	977,273
	200	13 142	357 49 - 7966 68	$1s^22p$ - $1s^23d$	$^2P^o$ - ^2D	[illegible]	P	977,273
	200	13 286	448 40 - 7975 12	$1s^22p$ - $1s^23d$	$^2P^o$ - ^2D	[illegible]	P	977,273
	20	13 428	357 49 - 7804 86	$1s^22p$ - $1s^23s$	$^2P^o$ - ^2S	[illegible]	P	977,273
	200	13 594	448 40 - 7804 86	$1s^22p$ - $1s^23s$	$^2P^o$ - ^2S	[illegible]	P	977,273
	150	223 015	0 0 - 448 40	$1s^22s$ - $1s^22p$	g ^2S - $^2P^o$	[illegible]	P	977,730
	120	279 731	0 0 - 357 49	$1s^22s$ - $1s^22p$	g ^2S - $^2P^o$	[illegible]	P	977,730

CHROMIUM XXIII (Cr^{22+}), Z = 24
Ground State $1s^2(^1S_0)$ (2 electrons)
Ionization Potential 60 349 000 cm^{-1}; 7482.4 eV

Multiplet	Rel Int	λ (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		1 724	0 0 - 58023 1	$1s^2$ - 1s5p	g ^1S - $^1P^o$	0 - 1	P	728
		1 763	0 0 - 56714 4	$1s^2$ - 1s4p	g ^1S - $^1P^o$	0 - 1	P	728
		1 856	0 0 - 53888 2	$1s^2$ - 1s3p	g ^1S - $^1P^o$	0 - 1	P	728
		2 182	0 0 - 45832 0	$1s^2$ - 1s2p	g ^1S - $^1P^o$	0 - 1	P	956
	1	2 192	0 0 - 45614 9	$1s^2$ - 1s2p	g ^1S - $^3P^o$	0 - 1	P	856
		2 203	0 0 - 45389 1	$1s^2$ - 1s2s	g ^1S - ^3S	0 - 1	F,P	375,918
		11 82	45389 1 - 53850 9	1s2s - 1s3p	^3S - $^3P^o$	1 - 2	P	375
		12 09	45619 0 - 53888 2	1s2s - 1s3p	^1S - $^1P^o$	0 - 1	P	375
		326 26	45389 1 - 45695 6	1s2s - 1s2p	^3S - $^3P^o$	1 - 2	P	375
		469 48	45619 0 - 45832 0	1s2s - 1s2p	^1S - $^1P^o$	0 - 1	P	375
		1154 73	53764 3 - 53850 9	1s3s - 1s3p	^3S - $^3P^o$	1 - 2	P	375
		1582 28	53825 0 - 53888 2	1s3s - 1s3p	^1S - $^1P^o$	0 - 1	P	375

CHROMIUM XXIV (Cr^{23+}), Z = 24
Ground State $1s(^2S_{1/2})$ (1 electron)
Ionization Potential 63 675 300 cm^{-1}; 7894.79 eV

Multiplet	Rel. Int.	λ_{vac} (in Å)	Levels (in 10^3 cm^{-1})	Configurations	Terms	J - J	Notes	References
		1.603	0.0 - 62385.1385	1s - 7p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		1.615	0.0 - 61919.1477	1s - 6p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		1.636	0.0 - 61141.5413	1s - 5p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		1.675	0.0 - 59715.3160	1s - 4p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		1.766	0.0 - 56634.2120	1s - 3p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		1.767	0.0 - 56597.5100	1s - 3p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		2.090	0.0 - 47843.0420	1s - 2p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		2.096	0.0 - 47719.2500	1s - 2p	$g\,{}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		6.820	47722.8200 - 62385.1385	2s - 7p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		6.877	47843.0420 - 62385.1385	2p - 7d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		7.044	47722.8200 - 61919.1477	2s - 6p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		7.104	47843.0420 - 61919.1477	2p - 6d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		7.452	47722.8200 - 61141.5413	2s - 5p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		7.518	47843.0420 - 61144.1334	2p - 5d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		8.339	47722.8200 - 59715.3160	2s - 4p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		8.419	47843.0420 - 59720.3786	2p - 4d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		11.222	47722.8200 - 56634.2120	2s - 3p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		11.360	47843.0420 - 56646.2052	2p - 3d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		17.281	56598.5810 - 62385.1385	3s - 7p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		17.388	56634.2120 - 62385.1385	3p - 7d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		17.425	56646.2052 - 62385.1385	3d - 7f	${}^2D - {}^2F^{\circ}$	[illegible]	P	1042
		18.795	56598.5810 - 61919.1477	3s - 6p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		18.922	56634.2120 - 61919.1477	3p - 6d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		18.965	56646.2052 - 61919.1477	3d - 6f	${}^2D - {}^2F^{\circ}$	[illegible]	P	1042
		22.012	56598.5810 - 61141.5413	3s - 5p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		22.173	56634.2120 - 61144.1334	3p - 5d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		22.226	56646.2052 - 61145.4279	3d - 5f	${}^2D - {}^2F^{\circ}$	[illegible]	P	1042
		32.085	56598.5810 - 59715.3160	3s - 4p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042
		32.403	56634.2120 - 59720.3786	3p - 4d	${}^2P^{\circ} - {}^2D$	[illegible]	P	1042
		32.502	56646.2052 - 59722.9060	3d - 4f	${}^2D - {}^2F^{\circ}$	[illegible]	P	1042
		831.794	47722.8200 - 47843.0420	2s - 2p	${}^2S - {}^2P^{\circ}$	[illegible]	P	1042

D. Magnetic Dipole Lines for Chromium Ions
(Wavelengths, Classifications, and Transition Probabilities)

D. Magnetic Dipole Lines for Chromium Ions

[Excerpted from: V. Kaufman and J. Sugar, J. Phys. Chem. Ref. Data 15, 321 (1986)]

1. Introduction

The following tables, including the introductory comments, are excerpted from the above cited compilation of observed and predicted wavelengths of magnetic dipole lines arising within ground configurations of the type ns^2np^k ($n=2$ and 3, $k=1$ to 5). The compilation work was done by V. Kaufman and J. Sugar of the National Institute of Standards and Technology (formerly the National Bureau of Standards).

All measured lines that are correctly identified are included. Some are only tentatively classified by the authors, but appear to be reasonable on the basis of predictions along isoelectronic sequences.

Also included is a selected group of electric quadrupole lines (E2) that are frequently observed in ns^2np^2 and ns^2np^4 configurations; these are the $^1D_2-^1S_0$ transitions.

It will probably be difficult to observe the $nsnp$ ($^3P_{0,1,2}-^1P_1$) transitions in the Be and Mg isoelectronic sequences because the very large electric-dipole transition probability of the $ns^2\,^1S_0-nsnp\,^1P_1$ resonant transition will tend to rapidly deplete the $nsnp\,^1P_1$ level. Similarly, but to a lesser extent, the $^3P_0-^3P_1$ transition can be expected to be weak because of the $ns^2\,^1S_0-nsnp\,^3P_1$ transition. However, these magnetic-dipole transitions have been included for the sake of completeness.

Calculations of line strengths and transition probabilities have been made for all of these lines by both relativistic and non-relativistic methods. Preference has been given to the relativistic results. Calculations by both methods for the $n=3$ shell differ on the average by only 5%.[1]

2. Predicted Wavelengths

For the chromium ions, predicted values for the wavelengths of the M1 and E2 lines were obtained from the known energy levels by the Ritz principle of deriving wavelengths from energy differences. Their uncertainties are derived from the reported level uncertainties. The source of data is given in Sec. 7 below.

3. Observed Wavelengths

The most common laboratory source generating copious forbidden lines is the tokamak, which contains a magnetically-confined, high-temperature plasma with an ion density similar to that of the solar corona. By injecting any impurity element, magnetic dipole lines of that element may be seen in stages of ionization determined by the plasma temperature. Most of the chromium data are from tokamak observations. The other wavelength data are from astronomical sources, including gaseous nebulae, stars and the solar corona.

The sources of observed data that have been credited are those providing the best measurements.

4. Predicted Transition Probabilities

In most cases multiconfiguration Dirac-Fock calculations of line strengths are available. These calculations do not generally converge for neutral and singly ionized atoms, but non-relativistic calculations have been made in every such case. Line strengths for the magnetic dipole lines of the isoelectronic sequences of B I, C I, N I, and F I were taken from Cheng *et al.*[2] Those for the Al I, Si I, P I, and Cl I sequences were taken from Huang[3-5] and Huang *et al.*[6] The relativistic calculations are not available for the Be, Mg, and S isoelectronic sequences. The transition probabilities for all magnetic-dipole lines of the Be-like, Mg-like, and S-like ions were therefore calculated in the manner described by Sugar and Kaufman.[1] These are non-relativistic calculations in intermediate coupling. They agree within a few percent with relativistic calculations in the $n=3$ sequences for which both are available.

Line strengths for the electric-quadrupole lines of $2s^22p^k$ ($^1D_2-^1S_0$) [$k=2$] and [$k=4$] are for the carbon and oxygen sequences from Cheng *et al.*[2] The transition probabilities for these lines in the sulfur sequence, $3s^23p^4$, are from Mendoza and Zeippen.[7]

Relations between transition probabilities $A(s^{-1})$ and line strengths S are given explicitly as

$$A = \frac{2.697 \times 10^{13}}{\lambda^3 g} S(\mathrm{M1}),$$

$$A = \frac{1.680 \times 10^{18}}{\lambda^5 g} S(\mathrm{E2}),$$

where λ is the transition wavelength in Å and g is the $2J+1$ degeneracy of the upper level. S(M1) in Bohr magneton units (μ_B) and S(E2) in atomic units (ea_0^2) are the magnetic-dipole and electric-quadrupole line strengths, respectively.

The magnetic-dipole transition rate in almost all cases is a few orders of magnitude greater than the electric-quadrupole transition rate. The E2 rate has been added to the M1 rate in those cases for which the former is greater than 1% of the latter. This is true only for some of the N I ($2p^3$) and P I ($3p^3$) sequence transitions. An asterisk following the transition rate in the tables shows where this occurs.

5. Data Table Information

The tables contain the predicted and observed wavelengths and predicted transition probabilities for magnetic-dipole transitions within ns^2np^k ($k = 1-5$) and $nsnp$ configurations for $n = 2, 3$. The electric quadrupole transition $^1D_2$–$^1S_0$ for $k = 2, 4$ is included because it is frequently observed. The data are presented in order of increasing wavelength. The columns from left to right in order of appearance contain the following information:

Column No.	Description
1	Wavelengths (observed and predicted) in Å below 20 000 Å, and in micrometers (μm) between 2 and 1000 μm. Wavelengths given without units are in Å. Wavelengths in vacuum are given below 2000 Å, in air between 2000 Å and 5 μm, and in vacuum above 5 μm. Each wavelength is followed by its uncertainty in parentheses. Tentative identifications are preceded by "T". E2 transitions are denoted by "Q".
2	Transition probabilities (A) are written as a factor times 10 to a power. The power of ten follows the decimal factor. For example, 2.20 + 4 means 2.20×10^4. An asterisk following the transition probability indicates that the E2 rate for the transition is greater than 1% of the M1 rate and has been added to that value.
3	Spectrum.
4	Electronic configuration.
5	Line classification. Lower level is given first.
6	Ionization energy in thousands of electron volts (keV).[8-10]
7	References for observed wavelengths. Definitions of symbols are given in Sec. 8, "References for Observed Wavelengths".

6. References to Text

[1] J. Sugar and V. Kaufman, J. Opt. Soc. Am. B 1, 218 (1984).
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[9] J. Sugar and C. Corliss, J. Phys. Chem. Ref. Data 14, Suppl. 2, for K through Ni (1985).
[10] T. A. Carlson, C. W. Nestor, N. Wasserman and J. D. McDowell, At. Data 2, 63, for Cu through Mo (1970).

7. Reference for Energy Levels

Sugar, J., and Corliss, C. (1985), J. Phys. Chem. Ref. Data 14, Suppl. 2.

8. References for Observed Wavelengths

DH	Denne, B., and Hinnov, E. (1984), J. Opt. Soc. Am. B 1, 699.
FBM	Finkenthal, M., Bell, R. E., Moos, H. W., and TFR Group [1984], J. Appl. Phys. 56, 2012.
HSCS	Hinnov, E., Suckewer, S., Cohen, S., and Sato, K. (1982), Phys. Rev. A 25, 2293.
J	Jefferies, J. T. (1969), Mem. Soc. R. Sci. Liege 17, 213.
M	Magnant-Crifo, F. (1973), Sol. Phys. 31, 91.
PSS	Peacock, N. J., Stamp, M. F., and Silver, J. D. (1984), Phys. Scr. T8, 10.
SBT	Sandlin, G. D., Brueckner, G. E., and Tousey, R. (1977), Astrophys. J. 214, 898.
Su	Suckewer, S. (Oct. 1985), private communication.

Magnetic Dipole Lines for Chromium

Wavelength Observed	Wavelength Calculated	A (s^{-1})	Spectrum	Config.	Classification	I.E. (keV)	Ref. (obs. H)
	286.51(17)	1.24 +4	Cr XXI	2s 2p	${}^3P_0$ - ${}^1P_1$	1.63	
	306.80(5)	7.42 +3	Cr XXI	2s 2p	${}^3P_1$ - ${}^1P_1$	1.63	
378.0(3)	378.1(3)	1.61 +4	Cr XVIII	$2s^2$ $2p^3$	${}^4S_{3/2}$ - ${}^2P_{3/2}$	1.30	DH
	381.6(3)	6.56 +3	Cr XXI	2s 2p	${}^3P_2$ - ${}^1P_1$	1.63	
398.4(3)	398.42(16)	6.38 +4	Cr XIX	$2s^2$ $2p^2$	${}^3P_1$ - ${}^1S_0$	1.40	HSCS
442.1(3)	442.3(4)	1.31 +4	Cr XVIII	$2s^2$ $2p^3$	${}^4S_{3/2}$ - ${}^2P_{1/2}$	1.30	DH
493.8(3)	493.79(24)	6.42 +4	Cr XVII	$2s^2$ $2p^4$	${}^3P_1$ - ${}^1S_0$	1.19	HSCS
663.1(3)	663.1(9)	3.22 +2	Cr XVIII	$2s^2$ $2p^3$	${}^4S_{3/2}$ - ${}^2D_{5/2}$	1.30	DH
722.1(3)	722.56(16)	1.56 +4	Cr XVIII	$2s^2$ $2p^3$	${}^2D_{3/2}$ - ${}^2P_{3/2}$	1.30	DH
731.1(3)	731.07(8)	5.62 +3	Cr XIX	$2s^2$ $2p^2$	${}^3P_1$ - ${}^1D_2$	1.40	HSCS
740.75(3)	740.75(3)	6.67 +3	Cr XVII	$2s^2$ $2p^4$	${}^3P_2$ - ${}^1D_2$	1.19	PSS
	Q 781.9(6)	4.19 +1	Cr XVII	$2s^2$ $2p^4$	${}^1D_2$ - ${}^1S_0$	1.19	
793.3(3)	793.3(1.3)	6.12 +3	Cr XVIII	$2s^2$ $2p^3$	${}^4S_{3/2}$ - ${}^2D_{3/2}$	1.30	HSCS
	Q 875.6(8)	2.03 +1	Cr XIX	$2s^2$ $2p^2$	${}^1D_2$ - ${}^1S_0$	1.40	
	879.96(23)	5.14 +3	Cr XVIII	$2s^2$ $2p^3$	${}^2D_{5/2}$ - ${}^2P_{3/2}$	1.30	
979.0(3)	979.06(14)	5.93 +3	Cr XIX	$2s^2$ $2p^2$	${}^3P_2$ - ${}^1D_2$	1.40	HSCS
	988.5(1.0)	7.59 +1	Cr XIII	3s 3p	${}^3P_0$ - ${}^1P_1$	0.35	
	999.6(3)	3.33 +3	Cr XVIII	$2s^2$ $2p^3$	${}^2D_{3/2}$ - ${}^2P_{1/2}$	1.30	
	1028.49(10)	5.03 +1	Cr XIII	3s 3p	${}^3P_1$ - ${}^1P_1$	0.35	
	1135.8(1.3)	6.25 +1	Cr XIII	3s 3p	${}^3P_2$ - ${}^1P_1$	0.35	
1205.9(3)	1205.9(3)	5.11 +3	Cr XX	$2s^2$ 2p	${}^2P_{1/2}$ - ${}^2P_{3/2}$	1.50	HSCS
1340.7(4)	1340.09(20)	4.09 +2	Cr XVII	$2s^2$ $2p^4$	${}^3P_1$ - ${}^1D_2$	1.19	FBM
1410.60(2)	1410.62(4)	6.39 +3	Cr XVI	$2s^2$ $2p^5$	${}^2P_{3/2}$ - ${}^2P_{1/2}$	1.10	PSS
1440.01(2)	1440.8(2.1)	3.68 +2	Cr XI	$3s^2$ $3p^2$	${}^3P_1$ - ${}^1S_0$	0.27	SBT
1489.04(3)	1489.05(16)	1.21 +2	Cr X	$3s^2$ $3p^3$	${}^4S_{3/2}$ - ${}^2P_{3/2}$	0.24	SBT
1564.30(2)	1564.09(17)	5.89 +1	Cr X	$3s^2$ $3p^3$	${}^4S_{3/2}$ - ${}^2P_{1/2}$	0.24	SBT
1566.4(1)	1565 (5)	3.38 +3	Cr XXI	2s 2p	${}^3P_1$ - ${}^3P_2$	1.63	Su
1656.3(3)	1656.29(27)	4.58 +3	Cr XVII	$2s^2$ $2p^4$	${}^3P_2$ - ${}^3P_1$	1.19	HSCS
	1693.9(6)	[illegible].40 +2	Cr IX	$3s^2$ $3p^4$	${}^3P_1$ - ${}^1S_0$	0.21	
2090.9(3)	2090.9(4)	1.81 +3	Cr XIX	$2s^2$ $2p^2$	${}^3P_0$ - ${}^3P_1$	1.40	HSCS
	2534.1(5)	3.67 -1*	Cr X	$3s^2$ $3p^3$	${}^4S_{3/2}$ - ${}^2D_{5/2}$	0.24	
2606.4(3)	2606.4(3)	3.80 +2	Cr XVIII	$2s^2$ $2p^3$	${}^2P_{1/2}$ - ${}^2P_{3/2}$	1.30	DH
	Q 2634.(7)	1.03 +1	Cr XI	$3s^2$ $3p^2$	${}^1D_2$ - ${}^1S_0$	0.27	
	2694.4(5)	1.14 +1	Cr X	$3s^2$ $3p^3$	${}^4S_{3/2}$ - ${}^2D_{3/2}$	0.24	
	Q 2733.6(1.5)	6.41 +0	Cr IX	$3s^2$ $3p^4$	${}^1D_2$ - ${}^1S_0$	0.21	
2885.4(3)	2885.4(1.2)	4.69 +2	Cr XIX	$2s^2$ $2p^2$	${}^3P_1$ - ${}^3P_2$	1.40	HSCS
3178	3177.9(7)	1.77 +1	Cr XI	$3s^2$ $3p^2$	${}^3P_1$ - ${}^1D_2$	0.27	M
	3301.1(5)	2.99 +1	Cr IX	$3s^2$ $3p^4$	${}^3P_2$ - ${}^1D_2$	0.21	
	3326.4(8)	6.22 +1	Cr X	$3s^2$ $3p^3$	${}^2D_{3/2}$ - ${}^2P_{3/2}$	0.24	
	3608.2(9)	2.86 +1*	Cr X	$3s^2$ $3p^3$	${}^2D_{5/2}$ - ${}^2P_{3/2}$	0.24	
	3725.8(1.0)	2.82 +1*	Cr X	$3s^2$ $3p^3$	${}^2D_{3/2}$ - ${}^2P_{1/2}$	0.24	

Magnetic Dipole Lines for Chromium – Continued

Wavelength Observed	Wavelength Calculated	A (s^{-1})	Spectrum	Config.	Classification	I E (keV)	Ref (obs H)
3996.8(4)	3996.6(1.1)	2.60 +1	Cr XI	$3s^2\ 3p^2$	$^3P_2 - {}^1D_2$	0.27	[illegible]
4038.6(3)	4039.(7)	1.27 +2	Cr XVIII	$2s^2\ 2p^3$	$^2D_{3/2} - {}^2D_{5/2}$	1.30	DH
	4330.(40)	2.38 +2	Cr XXI	$2s\ 2p$	$^3P_0 - {}^3P_1$	1.63	
	4450.5(1.4)	4.19 +0	Cr IX	$3s^2\ 3p^4$	$^3P_1 - {}^1D_2$	0.21	
8153.8(4)	8153.7(7)	1.66 +1	Cr XII	$3s^2\ 3p$	$^2P_{1/2} - {}^2P_{3/2}$	0.30	[illegible]
	10106.4(2.0)	1.74 +1	Cr VIII	$3s^2\ 3p^5$	$^2P_{3/2} - {}^2P_{1/2}$	0.18	
	10878.(120)	1.03 +1	Cr XIII	$3s\ 3p$	$^3P_1 - {}^3P_2$	0.35	
	12783.(8)	1.04 +1	Cr IX	$3s^2\ 3p^4$	$^3P_2 - {}^3P_1$	0.21	
	15514.(17)	3.46 +0	Cr XI	$3s^2\ 3p^2$	$^3P_1 - {}^3P_2$	0.27	
	18059.(16)	2.98 +0	Cr XI	$3s^2\ 3p^2$	$^3P_0 - {}^3P_1$	0.27	
	2.54(6) μm	1.13 +0	Cr XIII	$3s\ 3p$	$^3P_0 - {}^3P_1$	0.35	
	3.103(7) μm	2.74 -1	Cr X	$3s^2\ 3p^3$	$^2P_{1/2} - {}^2P_{3/2}$	0.24	
	4.260(13) μm	1.28 -1	Cr X	$3s^2\ 3p^3$	$^2D_{3/2} - {}^2D_{5/2}$	0.24	
	4.3(4) μm	1.93 -1	Cr XVII	$2s^2\ 2p^4$	$^3P_0 - {}^3P_1$	1.19	
	5.787(24) μm	2.73 -1	Cr IX	$3s^2\ 3p^4$	$^3P_1 - {}^3P_0$	0.21	

E. Atomic Energy Levels of Chromium, Cr I through Cr XXIV

E. Atomic Energy Levels of Chromium, Cr I through Cr XXIV

[Excerpted from: J. Sugar and C. Corliss, J. Phys. Chem. Ref. Data 14, Suppl. 2 (1985)].

1. Introduction

The following tables, including the introductory comments, are excerpted from the iron-period compilation of atomic energy levels by J. Sugar and C. Corliss (1985) of the Atomic Energy Levels Data Center at the National Institute of Standards and Technology (formerly the National Bureau of Standards).

Generally, only published papers have been used as sources of data. Unpublished data are included when they constitute a substantial improvement over material in the literature. For many of the higher ions the original papers do not give energy level values, but only classifications of observed lines. In these cases the level values have been derived from the given data.

All energy levels are given in units of cm^{-1}, beginning with a value of zero for the ground level. Ionization energies found in the literature are usually given in eV or cm^{-1}. The conversion factor, 8065.479(21) cm^{-1}/eV, given by Cohen and Taylor (1973), is used here. In a few cases where adequate data were available but the ionization energy had not been derived, this calculation was carried out. For a number of the ions, no suitable series are known. In these cases values obtained by Lotz (1967), by a method of successive differences along isoelectronic sequences, have been quoted. Although uncertainties are not provided with these extrapolated values, it is estimated that they are accurate to 0.2% by comparing them with recently determined values.

Nearly all of the data are based on observations of various types of laboratory light sources. However, the laboratory data are sometimes supplemented by data obtained from solar observations. This is particularly true where spin-forbidden lines are needed to establish the absolute energy of a system of excited levels and where parity-forbidden transitions between levels of a ground configuration are used to obtain accurate relative energies for the low levels. Whenever both solar data and equivalent laboratory data are available preference is generally given to the laboratory measurements.

When no observations are available to connect independent systems of levels, an estimate of the connecting energy is adopted. Those level values affected by the estimate are denoted by $+x$ following the value. The value of x is the systematic error of the estimate.

Included under the heading "Leading Percentages" are the results of calculations that express the eigenvector percentage composition of levels (rounded to the nearest %) in terms of the basis states of a single configuration, or more than one configuration where configuration interaction has been included. First the percentage of the basis state corresponding to the level's name is given; next the second largest percentage together with the related basis state. Sometimes the leading percentage in an alternative coupling scheme is given. Generally, when the leading percentage is less than 40%, no name is given. When the first and second resultant terms are the same and sum to ≥40% the first name is given. When the first and second resultant terms are the same but have different parentages, and their share of the eigenvector composition sums to 40% or more, the level will be named as the higher percentage term. In cases where these percentages differ by one or two units (an insignificant difference), either term may be selected for the level name, and the lower percentage may appear first. For the unnamed level, the term symbol follows the percentage. The user should of course bear in mind that the percentages are model dependent, so that the results of different calculations can yield notably different percentages. In the case of Cr, the 1969 results by Roth are adopted. It was intended to use his new 1980 calculations as well, but it was found that the sum of percentages for a number of states exceeded 100 by significant amounts.

For configurations of equivalent d-electrons, several terms of the same LS type may occur. These are theoretically distinguished by their seniority number. In the present compilations they are designated in the notation of Nielson and Koster (1963). For example, in the $3d^5$ configuration there are three ^2D terms with seniorities of 1, 3, and 5. These terms are denoted as $^2D1$, $^2D2$, and $^2D3$, respectively, by Nielson and Koster. Martin, Zalubas, and Hagan (1978) give a complete summary of the coupling notations used here, tables of the allowed terms for equivalent electrons, etc.

The text for each ion does not include a complete review of the literature but is intended to credit the major contributions. In assembling the data for each spectrum the following bibliographies were used:

i. Papers cited by Moore (1949, 1952)

ii. C. E. Moore (1968, 1969)

iii. L. Hagan and W. C. Martin (1972)

iv. L. Hagan (1977)

v. R. Zalubas and A. Albright (1980)

vi. Card file of publications since June 1979 maintained by the NBS Atomic Energy Levels Data Center

He I Isoelectronic Sequence

Spectra of K, Ca, Ti, and V were obtained by Aglitskii *et al.* (1974) with a laser-heated plasma in third and fifth orders of a crystal spectrograph. Reference lines of Mg XI and Al XII published by Flemberg (1942) were used, and an uncertainty of ±0.0005 Å was reported for the lines of the He I isoelectronic sequence, which fall in the range of 2.3 – 3.6 Å. Flemberg's reference wavelengths were in *x*-units. The equivalence to Å that he used must be increased by 8 parts in 10^5, according to the more recent conversion determined by Deslattes and Henins (1973). With this correction, the data of Aglitskii *et al.* deviate randomly from the calculated wavelengths of Safronova (1981) by ±0.0008 Å.

In a beam-foil experiment the He-like argon spectrum was observed by Briand et al. (1983a). Their wavelengths for the $1s^2\,{}^1S_0 - 1s2p\,{}^3P_1^\circ$ and ${}^1P_1^\circ$ transitions were 3.9693(3) Å and 3.9491(3) Å, in agreement with the calculated values by Safronova.

The $1s2s\,{}^3S_1 - 1s2p\,{}^3P_2^\circ$ transition has been measured in Ca XIX by Livingston (1983) and in Fe XXV by Buchet *et al.* (1982). The measured wavelengths are 466.78(8) Å for Ca and 271.04(10) Å for Fe. The corresponding energy differences are greater than those predicted by Safronova by 142(37) and 123(136) cm^{-1}, respectively, or 0.07% and 0.03% of the energy difference. A new calculation of these energies by Hata and Grant (1983) predicted values that were 60 cm^{-1} lower in Ca and 154 cm^{-1} lower in Fe than the observed values.

Because of the excellent agreement of Safronova's calculations with the best experimental data available and the paucity of these data, the compilation of this sequence was based on her results. Her calculated energies were quoted for the $1s2s$ and $1s2p$ levels of the He I isoelectronic sequence and for the principal ionization energies (with correction to the Rydberg for finite atomic mass). The observed $1s2s\,{}^3S_1 - 1s2p\,{}^3P_2^\circ$ intervals in Ca XIX mentioned above are incorporated in the respective level lists. For $n = 3 - 5$ the calculated binding energies reported by Ermolaev and Jones (1974) are subtracted from the binding energy of the ground state by Safronova to arrive at energy level values. The uncertainty in the calculated energy levels and the ionization energies is assumed conservatively to be 2 parts in 10^4, corresponding to the deviations from the Aglitskii *et al.* (corrected) observations. (The deviation from the measurements in Ar is 1 part in 10^4.) The uncertainties in energy differences for levels of the same *n*-value are estimated to be 2 parts in 10^3. The deviation of the $1s2p$ ${}^3P_1^\circ - {}^1P_1^\circ$ intervals measured by Aglitskii *et al.* with resonance lines differ randomly from the calculated values of Safronova by 3%.

The singlet-triplet mixing coefficients for the $1snp\,{}^{1,3}P^\circ$ states are quoted from Ermolaev and Jones.

H I Isoelectronic Sequence

No observations of $1s - np$ transitions have been sufficiently accurate to test the theoretical values. The best measurement available is for the $1s - 2p$ energies for Fe XXVI with an uncertainty of ±5000 cm^{-1}, or 1 part in 10^4, by Briand, Tavernier, and Indelicato (1983b). Erickson (1977) has calculated the absolute binding energies for each of the levels through $n = 5$ and for the ns and np states through $n = 13$. An improved calculation of the Lamb-shift effects was reported by Mohr (1983), who gave the energy separations among the $n = 1$ and 2 levels. Gould and Marrus (1983) have measured the Lamb-shift of the $2s\,{}^2S_{1/2}$ state of Ar XVIII, obtaining the value 1264(13) cm^{-1}. Their results agrees with the value 1275.8(0.8) cm^{-1} calculated by Mohr and is three standard deviations lower than Erickson's value of 1301(2) cm^{-1}.

Mohr's results for the energy separations of $n = 1$ and 2 levels have been compiled, and Erickson's for $n = 3 - 5$ relative to the $2p\,{}^2P_{3/2}^\circ$ level. This increases Erickson's values for the levels, or, equivalently, increases the binding energy of the ground state (the ionization energy). Assuming that the uncertainty in these compiled values is mainly due to the error in the Lamb shift, the fractional error is taken as equal to the experimental fractional error in the Ar measurement. This contribution to the level values relative to the ground state is about 4 parts in 10^6 for the iron period. This is about 10 times the error estimated by Mohr for his calculated $1s - 2p$ intervals. The corresponding intervals calculated by Erickson are lower than those of Mohr by about the same fractional amount.

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Cr I

$Z = 24$

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s\ {}^7S_3$

Ionization energy = 54575.6 ± 0.3 cm^{-1} (6.76669 ± 0.00004 eV)

The early contributions to the analysis of this spectrum are summarized by Catalán and Sancho (1931), who give a list of over 700 classified lines. Kiess (1953) remeasured the spectrum in the range of 11 610–1890 Å with a wavelength accuracy varying from ±0.005 Å to ±0.05 Å. About 4400 lines are given, 80% of which are classified, including Zeeman patterns for 10% of them. This constituted a significant extension of the analysis and provided improved values for all the known levels with an estimated uncertainty of ±0.05 cm^{-1}. Kiess obtained a value for the ionization energy of 54 570 cm^{-1}.

An absorption spectrum below 2000 Å was observed by Huber, Sandeman, and Tubbs (1975) with an accuracy of ±0.004 Å. They identified the $3d^5({}^6S)np\ {}^7P^\circ$ Rydberg series for $n = 8$ and for $n = 12$–38 with an uncertainty of ±0.1 cm^{-1}, from which they derived a value for the ionization energy of 54 575.6±0.3 cm^{-1}. Improved wavelengths are given for the multiplets $a\ {}^5D - q\ {}^5D^\circ$, $a\ {}^5D - o\ {}^5F^\circ$, and $a\ {}^5D - r\ {}^5P^\circ$ reported by Kiess.

Further observations of the absorption spectrum at lower wavelengths were reported by Connerade, Baig, and Newsom (1981) with an accuracy of ±0.05 Å. They identified five $3d^5({}^6S)4s\ {}^7S - 3d^4({}^5D)4s\ ({}^6D)np$ series for $n = 6$ to $n = 28$. For $n = 6$ the term structure is identified by means of a diagonalization of the energy matrices of the $3d^4 4s6p$ configuration, as well as by quantum defects. Their results contradict the assignment by Kiess of terms to $3d^4 4s6p$, which we have therefore dropped. The levels identified by Connerade, Baig, and Newsom with this configuration and their percentage compositions are given. They have also observed the principal series $3d^5({}^6S)np\ {}^7P^\circ$ reported by Huber et al. and have identified the missing $7p$, $9p$, $10p$, and $11p$ terms.

Mansfield (1977) reported the observation in absorption of the $3p^5({}^2P)3d^5({}^6S)4s^2\ {}^7P^\circ$ term.

Most of the g-factors for the levels are obtained from Catalán and Sancho, supplemented by Kiess' three-decimal-place values. The more accurate values for the $3d^5({}^6S)4p\ {}^7P^\circ_3$ and ${}^7P^\circ_4$ levels were measured in an atomic beam by Budick, Goshen, and Marcus (1964), and those for $3d^5({}^6S)4s\ {}^7S$ and $3d^4 4s^2\ {}^5D$ were obtained by Childs and Goodman (1965).

The alphabetic prefixing of terms with lower case letters for distinguishing repeating terms of the same type has been retained from Kiess except where the levels were reinterpreted by Roth (1970) on the basis of his theoretical treatment.

Roth has calculated the odd-parity configurations $3d^5 4p$, $3d^4 4s4p$, and $3d^3 4s^2 4p$ with configuration interaction. His percentage compositions and designation changes for the experimental levels are adopted here. Roth distinguished repeating terms of the $3d^n$ core by the letters, a, b, ... rather than by seniority. The percentages include the sum of seniority states contributing to the term.

Fischer, Hansen, and Barwell (1976) pointed out that an error in Roth's calculation arising from insufficient precision in his diagonalization routine resulted in an incorrect mixture of the $z\ {}^5D^\circ$ and $y\ {}^5P^\circ$ terms. Revised percentages were provided for these terms and for $z\ {}^7P^\circ$ by Hansen.

Percentages for the configuration $3d^5 4s$ were taken from an ab initio calculation by Vizbaraite, Kupliauskis, and Tutlys (1968).

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Cr I

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^5(^6S)4s$	$a\ ^7S$	3	0.00	2.00183	100		
$3d^5(^6S)4s$	$a\ ^5S$	2	7 593.16	2.006	100		
$3d^4 4s^2$	$a\ ^5D$	0	7 750.78				
		1	7 810.82	1.50060			
		2	7 927.47	1.50060			
		3	8 095.21	1.50060			
		4	8 307.57	1.50060			
$3d^5(^4G)4s$	$a\ ^5G$	2	20 517.40	0.37	100		
		6	20 519.60	1.33	100		
		3	20 520.92	0.93	100		
		4	20 523.69	1.13	100		
		5	20 523.94	1.25	100		
$3d^5(^4P)4s$	$a\ ^5P$	3	21 840.84	1.6	98		
		2	21 847.88	1.847	98		
		1	21 856.94	2.500	100		
$3d^4 4s^2$	$a\ ^3P$	0	23 163.27				
		1	23 512.00				
		2	24 093.16				
$3d^5(^6S)4p$	$z\ ^7P^\circ$	2	*23 305.01*	2.334	67	33	$3d^4(^5D)4s4p(^3P^\circ)\ ^7P^\circ$
		3	*23 386.35*	1.9176	67	33	
		4	*23 498.84*	1.7510	67	31	
$3d^4 4s^2$	$a\ ^3H$	4	23 933.90				
		5	24 056.11				
		6	24 200.23				
$3d^5(^4D)4s$	$b\ ^5D$	0	24 277.06		100		
		4	24 282.34	1.51	100		
		1	24 286.54	1.48	100		
		2	24 299.89	1.51	98		
		3	24 303.94	1.55	98		
$3d^5(^4G)4s$	$a\ ^3G$	3	24 833.86		100		
		4	24 897.55		100		
		5	25 038.61		100		
$3d^4 4s^2$	$a\ ^3F$	2	24 940.61				
		3	25 106.34				
		4	25 177.39				
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^7F^\circ$	0	*24 971.21*		100		
		1	*25 010.64*	1.52	100		
		2	*25 089.20*	1.50	100		
		3	*25 206.02*	1.49	100		
		4	*25 359.82*	1.51	100		
		5	*25 548.64*	1.51	100		
		6	*25 771.40*	1.53	100		
$3d^5(^6S)4p$	$z\ ^5P^\circ$	3	*26 787.50*	1.670	92		
		2	*26 796.28*	1.830	91		
		1	*26 801.93*	2.512	92		

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^5(^4P)4s$	$b\ ^3P$	0	27 163.20		100		
		1	27 176.22		100		
		2	27 223.05		98		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^7D^\circ$	1	*27 300.19*	3.01	99		
		2	*27 382.18*	1.99	99		
		3	*27 500.37*	1.76	99		
		4	*27 649.71*	1.66	99		
		5	*27 825.45*	1.61	100		
$3d^4\ 4s^2$	$b\ ^3G$	3	27 597.22				
		4	27 703.54				
		5	27 816.88				
$3d^4(^5D)4s4p(^3P^\circ)$	$y\ ^7P^\circ$	2	*27 728.87*	2.341	66	33	$3d^5(^6S)4p\ ^7P^\circ$
		3	*27 820.23*	1.929	66	33	
		4	*27 935.26*	1.761	67	32	
$3d^5(^4D)4s$	$a\ ^3D$	3	28 637.00		100		
		1	28 679.43		100		
		2	28 682.18		98		
$3d^4(^5D)4s4p(^3P^\circ)$	$y\ ^5P^\circ$	1	*29 420.90*	2.513	95		
		2	*29 584.62*	1.836	95		
		3	*29 824.75*	1.669	96		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^5F^\circ$	1	*30 787.30*	0.002	96		
		2	*30 858.82*	0.997	96		
		3	*30 965.46*	1.245	96		
		4	*31 106.37*	1.345	95		
		5	*31 280.35*	1.396	96		
$3d^5(^2D3)4s$	$b\ ^3D$	3	31 009.00		56	18	$(^2D1)\ ^3D$
		2	31 028.33		50	24	$(^4F)\ ^5F$
		1	31 048.85		45	41	$(^4F)\ ^5F$
$3d^5(^2I)4s$	$a\ ^3I$	7	31 048.00		100		
		6	31 049.33		100		
		5	31 055.35		100		
$3d^5(^4F)4s$	$a\ ^5F$	1	31 352.42		50	31	$(^2D3)\ ^3D$
		2	31 355.21		74	12	
		3	31 364.33		88	6	
		4	31 377.96		100		
		5	31 393.40		100		
$3d^4\ 4s^2$	$a\ ^1G$	4	31 987.06				
$3d^4\ 4s^2$	$a\ ^1I$	6	32 097.36				
$3d^5(^2F1)4s$	$b\ ^3F$	2	33 040.10		79	14	$(^2D3)\ ^3D$
		3	33 060.74		83	13	
		4	33 113.27		100		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^5D^\circ$	0	*33 338.20*		80	8	$^3P^\circ$
		1	*33 423.79*	1.499	93		
		2	*33 542.11*	1.497	96		
		3	*33 671.55*	1.497	97		
		4	*33 816.06*	1.499	97		

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^3P^\circ$	0	*33 762.56*		88	8	$^5D^\circ$
		1	*33 897.26*	1.49	92		
		2	*34 190.49*	1.55	95		
$3d^5(^2I)4s$	$b\ ^1I$	6	33 762.74		100		
$3d^4\ 4s^2$	$c\ ^3D$	1	33 906.65				
		3	33 934.88				
		2	33 935.65				
$3d^6$	$c\ ^5D$	4	35 398.02				
		3	35 501.26				
		2	35 572.94				
		1	35 618.51				
		0	35 640.69				
$3d^5(^4F)4s$	$c\ ^3F$	2	35 807.90		100		
		3	35 813.73		100		
		4	35 862.82		98		
$3d^5(^2H)4s$	$b\ ^3H$	4	35 870.53		98		
		5	35 884.40		98		
		6	35 934.02		100		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^3F^\circ$	2	*35 897.87*		95		
		3	*36 034.22*		95		
		4	*36 212.15*		96		
$3d^5(^2F2)4s$	$d\ ^3F$	3	36 552.13		100		
		2	36 558.55		100		
		4	36 577.73		100		
$3d^5(^6S)5s$	$e\ ^7S$	3	36 895.73				
$3d^5(^2G2)4s$	$c\ ^3G$	3	37 205.88		98		
		5	37 233.50		96		
		4	37 244.17		98		
$3d^5(^6S)5s$	$e\ ^5S$	2	37 883.34				
$3d^5(^2H)4s$	$a\ ^1H$	5	38 537.68		98		
$3d^4(^5D)4s4p(^3P^\circ)$	$z\ ^3D^\circ$	1	*38 597.06*		96		
		2	*38 730.67*		96		
		3	*38 911.33*		96		
$3d^5(^2G2)4s$	$b\ ^1G$	4	39 158.63		98		
$3d^4(^5D)4s4p(^1P^\circ)$	$y\ ^5F^\circ$	1	*40 906.46*	0.004	84	12	$3d^5(^4G)4p\ ^5F^\circ$
		2	*40 971.29*	1.28	83	12	
		3	*41 086.26*	1.246	83	12	
		4	*41 224.78*	1.360	82	13	
		5	*41 393.47*		82	14	
$3d^4(^5D)4s4p(^1P^\circ)$	$x\ ^5P^\circ$	1	*40 930.31*	2.455	68	7	$3d^5(^4P)4p\ ^5P^\circ$
		2	*40 982.97*	1.76	56	7	
		3	*41 043.35*	1.640	56	8	

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^4(^5D)4s4p(^1P^\circ)$	$y\,^5D^\circ$	0	*41 224.80*		52		14	$3d^5(^4P)4p\,^5D^\circ$
		1	*41 289.17*	1.503	54		14	
		2	*41 409.03*	1.504	56		13	
		3	*41 575.10*	1.503	58		13	
		4	*41 782.19*	1.500	62		14	
$3d^4(^3H)4s4p(^3P^\circ)$	$z\,^5H^\circ$	3	*42 025.60*		61		20	$3d^5(^4G)4p\,^5H^\circ$
		4	*42 079.81*		55		19	$3d^5(^4G)4p\,^5H^\circ$
		5	*42 153.74*		48		17	$3d^5(^4G)4p\,^5H^\circ$
		7	*42 387.32*		65		24	$3d^5(^4G)4p\,^5H^\circ$
$3d^4(a\,^3P)4s4p(^3P^\circ)$	$x\,^5D^\circ$	0	*42 218.37*		49		26	$3d^4(^5D)4s4p(^1P^\circ)\,^5D^\circ$
		1	*42 292.96*	1.501	47		26	
		2	*42 438.82*	1.494	43		21	
		3	*42 643.26*	1.498	40		22	
		4	*42 908.57*	1.497	45		20	
$3d^5(^6S)5p$	$x\,^7P^\circ$	2	*42 238.04*					
		3	*42 254.11*					
		4	*42 275.20*					
$3d^4(^3H)4s4p(^3P^\circ)$		6	*42 252.17*		30	$^5H^\circ$	25	$3d^5(^4G)4p\,^5G^\circ$
$3d^5(^6S)4d$	$e\,^7D$	1	42 253.42					
		2	42 254.52					
		3	42 256.26					
		4	42 258.37					
		5	42 261.06	1.55				
$3d^5(^4G)4p$	$z\,^5G^\circ$	2	*42 515.35*	0.35	61		30	$3d^4(^3H)4s4p(^3P^\circ)\,^5G^\circ$
		3	*42 538.81*		57		19	$3d^4(^3H)4s4p(^3P^\circ)\,^5G^\circ$
		4	*42 564.85*		53		18	$3d^4(^3H)4s4p(^3P^\circ)\,^5G^\circ$
		5	*42 589.25*	1.23	47		16	$3d^4(^3H)4s4p(^3P^\circ)\,^5G^\circ$
		6	*42 605.81*	1.32	57		27	$3d^4(^3H)4s4p(^3P^\circ)\,^5H^\circ$
$3d^5(^4P)4p$	$z\,^5S^\circ$	2	*43 124.88*	1.93	46		46	$3d^4(a\,^3P)4s4p(^3P^\circ)\,^5S^\circ$
$3d^5(^6S)4d$	$e\,^5D$	4	44 060.87					
		3	44 068.72					
		2	44 080.90					
		1	44 088.92					
		0	44 092.80					
$3d^5(^6S)5p$	$w\,^5P^\circ$	1	*44 125.90*	2.74				
		2	*44 186.92*	1.79				
		3	*44 259.96*	1.68				
$3d^4(^3H)4s4p(^3P^\circ)$	$z\,^5I^\circ$	4	*44 246.70*		90			
		5	*44 307.96*		90			
		6	*44 393.10*		90			
		7	*44 514.44*		90			
		8	*44 666.55*		100			
$3d^4(a\,^3F)4s4p(^3P^\circ)$	$y\,^5G^\circ$	2	*44 299.98*	0.35	86			
		3	*44 373.34*	0.93	80			
		4	*44 534.46*		60		18	$^5F^\circ$
		5	*44 591.46*	1.25	46		20	$^5F^\circ$
		6	*44 746.96*	1.34	86		5	$3d^4(^3G)4s4p(^3P^\circ)\,^5G^\circ$

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^4(a\ ^3P)4s4p(^3P^\circ)$	$t\ ^5P^\circ$	1	*44 666.74*	2.47	78		8	$3d^5(^4D)4p\ ^5P^\circ$
		2	*44 875.19*		76		9	
		3	*45 113.22*	1.65	70		13	
$3d^4(a\ ^3F)4s4p(^3P^\circ)$	$x\ ^5F^\circ$	1	*45 201.84*		66		28	$3d^5(^4G)4p\ ^5F^\circ$
		2	*45 225.20*		63		27	$3d^5(^4G)4p\ ^5F^\circ$
		3	*45 255.51*		58		26	$3d^5(^4G)4p\ ^5F^\circ$
		4	*45 286.08*		50		23	$3d^5(^4G)4p\ ^5F^\circ$
$3d^4(a\ ^3F)4s4p(^3P^\circ)$		5	*45 306.45*	1.41	37	$^5G^\circ$	34	$^5F^\circ$
$3d^5(^4G)4p$	$z\ ^3H^\circ$	6	*45 348.73*		68		16	$^5H^\circ$
		5	*45 354.16*		40		32	
		4	*45 358.63*		50		25	
$3d^5(^4G)4p$	$y\ ^5H^\circ$	3	*45 566.02*	0.52	76		22	$3d^4(^3H)4s4p(^3P^\circ)\ ^5H^\circ$
		4	*45 614.88*		51		28	$3d^5(^4G)4p\ ^3H^\circ$
		5	*45 663.28*		43		38	$3d^5(^4G)4p\ ^3H^\circ$
		6	*45 707.96*		58		30	$3d^5(^4G)4p\ ^3H^\circ$
		7	*45 741.49*	1.29	74		25	$3d^4(^3H)4s4p(^3P^\circ)\ ^5H^\circ$
$3d^5(^4S)6s$	$f\ ^7S$	3	45 643.38	2.05				
$3d^5(^4P)4p$	$y\ ^3P^\circ$	1	*45 719.20*		45		24	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^3P^\circ$
		0	*45 722.59*		30		31	
		2	*45 734.82*		40		20	
$3d^5(^4G)4p$	$y\ ^3F^\circ$	2	*45 966.45*		75		8	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^3F^\circ$
		3	*46 000.96*		80		8	
		4	*46 058.20*		83		7	
$3d^5(^4S)6s$	$f\ ^5S$	2	45 967.81					
$3d^5(^4P)4p$		1	*46 077.09*		22	$^3D^\circ$	19	$3d^5(^4D)4p\ ^5F^\circ$
$3d^4(a\ ^3F)4s4p(^3P^\circ)$	$w\ ^5D^\circ$	0	*46 081.27*		40		25	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^5D^\circ$
		1	*46 298.32*		42		20	
		2	*46 349.50*		40		22	
		3	*46 368.35*		36		27	
		4	*46 422.46*		30		34	
$3d^5(^4P)4p$		2	*46 109.26*	1.24	23	$^3D^\circ$	14	$3d^5(^4D)4p\ ^5F^\circ$
$3d^5(^4P)4p$		3	*46 174.40*	1.33	37	$^3D^\circ$	15	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^5D^\circ$
$3d^4\ 4s5s$	$f\ ^7D$	1	46 448.60	2.99				
		2	46 524.84	1.99				
		3	46 637.21	1.77				
		4	46 783.06	1.63				
		5	46 958.98	1.61				
$3d^4(^3G)4s4p(^3P^\circ)$	$u\ ^5F^\circ$	2	*46 677.06*		20		18	$3d^5(^4D)4p\ ^5F^\circ$
		1	*46 678.35*		21		18	
		3	*46 688.24*	1.25	23		22	
		5	*46 704.98*	1.37	33		30	
		4	*46 720.54*		23		24	

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4(^3H)4s4p(^3P^\circ)$	$z\ ^3G^\circ$	3	46 846.77		42	20	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^3G^\circ$
		4	46 905.03		40	21	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^3G^\circ$
		5	46 985.87		34	20	$3d^5(^4G)4p\ ^3G^\circ$
$3d^5(^4P)4p$	$u\ ^5P^\circ$	3	46 878.61	1.68	47	20	$3d^5(^4D)4p\ ^5P^\circ$
		2	46 967.70	1.84	51	20	
		1	47 021.75	2.42	55	20	
$3d^4(^3H)4s4p(^3P^\circ)$	$x\ ^3G^\circ$	2	47 047.47	0.45	67	15	$3d^5(^4G)4p\ ^5G^\circ$
		3	47 125.70	0.96	62	14	
		4	47 189.87		60	15	
		6	47 222.27	1.44	70	19	
		5	47 223.80	1.27	63	16	
$3d^5(^4G)4p$	$y\ ^3G^\circ$	3	47 048.48		73	12	$3d^4(^3H)4s4p(^3P^\circ)\ ^3G^\circ$
		4	47 054.91		60	16	
		5	47 055.31		62	24	
$3d^4(a\ ^3P)4s4p(^3P^\circ)$	$z\ ^3S^\circ$	1	47 083.40		72	8	$3d^5(^4P)4p\ ^3S^\circ$
$3d^4(^3H)4s4p(^3P^\circ)$	$z\ ^3I^\circ$	5	47 586.06		61	28	$3d^4(^3G)4s4p(^3P^\circ)\ ^5H^\circ$
		6	47 630.43		57	34	
		7	47 692.63		52	40	
$3d^4(^3G)4s4p(^3P^\circ)$	$x\ ^5H^\circ$	3	47 621.31		79	12	$3d^4(^3H)4s4p(^3P^\circ)\ ^5H^\circ$
		4	47 688.51		82	11	$3d^4(^3H)4s4p(^3P^\circ)\ ^5H^\circ$
		5	47 793.82		56	30	$3d^4(^3H)4s4p(^3P^\circ)\ ^3I^\circ$
		6	47 863.29		53	35	$3d^4(^3H)4s4p(^3P^\circ)\ ^3I^\circ$
		7	48 140.18		40	42	$3d^4(^3H)4s4p(^3P^\circ)\ ^3I^\circ$
$3d^4(^5D)4s5p(^3P^\circ)$	$v\ ^5P^\circ$	1	47 629.66				
		2	47 631.51				
		3	47 636.25				
		4	47 639.84	1.34			
		5	47 644.76				
$3d^5(^6S)6p$	$w\ ^7P^\circ$	2	47 697.44				
		3	47 708.59				
		4	47 719.08				
$3d^5(^6S)5d$	$g\ ^7D$	1	47 700.18				
		2	47 700.96				
		3	47 702.30				
		4	47 704.66				
		5	47 709.80				
$3d^5(^4P)4p$	$v\ ^5D^\circ$	1	47 772.90	1.37	40	26	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^5D^\circ$
		2	47 786.10	1.30	40	26	
		0	47 788.08		46	27	
		3	47 814.40	1.53	40	25	
		4	47 866.48	1.50	52	23	
$3d^5(^4G)4p$		1	47 877.55	0.00	15 $^5F^\circ$	15	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^3P^\circ$
$3d^5(^4G)4p$	$u\ ^5F^\circ$	2	47 917.93	1.04	25	19	$3d^4(a\ ^3F)4s4p(^3P^\circ)\ ^5F^\circ$
		3	47 974.53	1.26	26	20	
		5	47 985.76	1.28	30	25	
		4	48 014.40		20	23	
		4	48 042.90				

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^4(a\,^3F)4s4p(^3P^\circ)$	$^3D^\circ$	1	*48 210.04*		59		7	$3d^5(^4G)4p\ ^5F^\circ$
		2	*48 217.83*		61		6	
		3	*48 251.91*		64		5	
$3d^4(a\,^3P)4s4p(^3P^\circ)$	$x\ ^3P^\circ$	0	*48 226.36*		29		24	$3d^5(^4P)4p\ ^3P^\circ$
		1	*48 331.30*		28		15	
		2	*48 458.67*		42		19	
$3d^4(^3H)4s4p(^3P^\circ)$	$y\ ^3H^\circ$	4	*48 288.37*		76			
		5	*48 310.39*		80			
		6	*48 445.35*		83			
$3d^4\,4s5s$	$f\ ^5D$	0	48 488.23					
		1	48 507.56					
		2	48 558.57					
		3	48 661.59	1.46				
		4	48 824.50	1.46				
	$x\ ^3G^\circ$	3	*48 515.08*					
		4	*48 562.16*					
		5	*48 786.39*					
$3d^4(a\,^3F)4s4p(^3P^\circ)$	$^1F^\circ$	3	*48 636.14*		60		15	$3d^4(^3G)4s4p(^3P^\circ)\ ^3F^\circ$
$3d^4(a\,^3P)4s4p(^3P^\circ)$	$x\ ^3D^\circ$	1	*48 839.90*		38		20	$3d^5(^4P)4p\ ^3D^\circ$
		2	*49 027.58*		46		14	
		3	*49 310.86*		61		7	
$3d^5(^6S)7s$	$g\ ^7S$	3	49 177.83					
$3d^5(^6S)7s$	$g\ ^5S$	2	49 321.51					
$3d^4(a\,^3F)4s4p(^1P^\circ)$	$w\ ^3G^\circ$	3	*49 370.70*		40		9	$3d^4(^3H)4s4p(^3P^\circ)\ ^3G^\circ$
		4	*49 453.94*		40		13	
		5	*49 538.06*		51		17	
$3d^4(^3G)4s4p(^3P^\circ)$	$w\ ^5G^\circ$	2	*49 466.77*		66		18	$3d^5(^4G)4p\ ^5G^\circ$
		3	*49 519.72*	1.04	58		14	
		4	*49 573.03*		63		19	
		5	*49 617.61*		70		17	
		6	*49 635.16*	1.35	73		17	
$3d^5(^4P)4p$	$y\ ^3S^\circ$	1	*49 477.04*		73		17	$3d^4(a\,^3P)4s4p(^3P^\circ)\ ^3S^\circ$
	$e\ ^3F$	2	49 586.38					
		3	49 717.88					
		4	49 863.50					
$3d^5(^4D)4p$	$t\ ^5P^\circ$	1	*49 588.97*	2.48	46		30	$3d^5(^4P)4p\ ^5P^\circ$
		3	*49 812.46*	1.77	31		26	
$3d^4(a\,^3F)4s4p(^3P^\circ)$		2	*49 598.08*	1.88	30	$^1D^\circ$	14	$3d^5(^4D)4p\ ^5P^\circ$
$3d^5(^4D)4p$	$z\ ^3F^\circ$	4	*49 620.69*		66		15	$3d^4(^3G)4s4p(^3P^\circ)\ ^3F^\circ$
		3	*49 650.22*		43		18	
		2	*49 652.76*		37		18	
$3d^4(a\,^5P)4s4p(^3P^\circ)$	$y\ ^5S^\circ$	2	*49 822.59*	2.00	31		30	$3d^5(^4P)4p\ ^5S^\circ$

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^5(^4D)4p$	$s\ ^5F^\circ$	1	*50 018.80*		44	29	$3d^4(^3G)4s4p(^3P^\circ)\ ^5F^\circ$
		2	*50 057.61*		43	29	
		3	*50 102.04*	1.27	44	29	
		4	*50 210.87*	1.25	30	21	
		5	*50 253.27*	1.39	46	33	
$3d^5(^4D)4p$	$w\ ^3D^\circ$	1	*50 105.54*		66	11	$3d^5(^4P)4p\ ^3D^\circ$
		2	*50 184.10*		57	14	
		3	*50 264.48*		51	18	
$3d^5(^6S)7p$	$^7P^\circ$	3	*50 185*				
		4	*50 197*				
$3d^5(^4D)4p$	$u\ ^5D^\circ$	4	*50 557.56*	1.54	44	15	$3d^5(^4D)4p\ ^5F^\circ$
		3	*50 628.11*	1.54	60	7	$3d^5(^4P)4p\ ^5D^\circ$
		2	*50 654.76*	1.51	68	8	$3d^5(^4P)4p\ ^5D^\circ$
		0	*50 661.20*		60	10	$3d^5(^4P)4p\ ^5D^\circ$
		1	*50 662.77*	1.46	71	9	$3d^5(^4P)4p\ ^5D^\circ$
$3d^4(^3G)4s4p(^3P^\circ)$	$w\ ^3F^\circ$	2	*50 890.15*		41	27	$3d^5(^4D)4p\ ^3F^\circ$
		3	*50 950.42*		42	26	
		4	*51 059.79*		46	23	
$3d^5(^6S)8s$	$h\ ^5S$	2	51 035.68				
$3d^5(^4D)4p$	$w\ ^3P^\circ$	0	*51 176.88*		71	11	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^3P^\circ$
		1	*51 246.87*		68	8	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^3P^\circ$
		2	*51 286.52*		45	32	$3d^4(a\ ^3P)4s4p(^3P^\circ)\ ^1D^\circ$
$3d^4(^3H)4s4p(^3P^\circ)$	$z\ ^1H^\circ$	5	*51 401.24*		60	11	$3d^5(^2I)4p\ ^1H^\circ$
$3d^5(^6S)8p$	$^7P^\circ$	2	*51 529.4*				
		3	*51 531.5*				
		4	*51 534.4*				
$3d^4(^3D)4s4p(^3P^\circ)$	$t\ ^5D^\circ$	0	*51 999.62*		94		
		1	*52 003.06*		94		
		2	*52 012.44*		98		
		3	*52 031.72*		92		
		4	*52 064.27*		92		
$3d^5(^6S)9p$	$^7P^\circ$		*52 341*				
$3d^4(^1I)4s4p(^3P^\circ)$	$y\ ^3I^\circ$	5	*52 591.94*		48	38	$3d^5(^2I)4p\ ^3I^\circ$
		6	*52 600.61*		58	30	
		7	*52 677.88*		59	30	
$3d^4(^3G)4s4p(^3P^\circ)$	$^3G^\circ$	4	*52 720.07*		72	14	$3d^4(^3H)4s4p(^3P^\circ)\ ^3G^\circ$
$3d^5(^6S)10p$	$^7P^\circ$		*52 857.3*				
$3d^4(a\ ^1G)4s4p(^3P^\circ)$	$x\ ^3H^\circ$	5	*52 885.39*		57	27	$3d^5(^2I)4p\ ^3H^\circ$
		6	*52 914.94*		68	26	
		4	*52 963.44*		47	26	
$3d^4(^3D)4s4p(^3P^\circ)$	$r\ ^5F^\circ$	1	*53 011.65*		86	6	$3d^5(^4D)4p\ ^5F^\circ$
		2	*53 037.52*		84	6	
		3	*53 073.90*		89	6	
		4	*53 117.54*		81	6	
		5	*53 172.33*	1.42	86	7	

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4\,4s4d$	$e\,^7$G	1	53 148.35				
		2	53 177.87				
		3	53 226.49				
		4	53 298.90				
		5	53 393.50				
		6	53 517.85				
		7	53 662.64				
$3d^4\,4s4d$	$h\,^7$D	2	53 195.03				
		3	53 284.34				
		4	53 375.46				
		5	53 627.75				
$3d^4\,4s4d$	$e\,^7$F	1	53 215.40				
		2	53 279.80				
		3	53 384.72				
		4	53 526.22				
		5	53 706.06				
		6	53 927.47				
$3d^5(^6S)11p$	^{7}P°		*53 217.0*				
$3d^5(^6S)12p$	^{7}P°		*53 484.5*				
$3d^4\,4s5p$	$s\,^5$D°	2	*53 541.25*				
		3	*53 640.74*				
		4	*53 782.77*				
$3d^5(^6S)13p$	^{7}P°		*53 671.4*				
$3d^3(^4F)4s^2\,4p$	$v\,^3$G°	3	*53 804.84*		28	22	$3d^5(^4F)4p\,^3$G°
		4	*53 927.59*		26	22	
		5	*54 078.13*		25	22	
$3d^5(^6S)14p$	^{7}P°		*53 815.8*				
$3d^5(^6S)15p$	^{7}P°		*53 928.0*				
$3d^4\,4s5p$	$s\,^5$P°	1	*53 963.05*				
		2	*54 032.63*				
		3	*54 132.88*				
$3d^5(^6S)16p$	^{7}P°		*54 017.1*				
$3d^5(^6S)17p$	^{7}P°		*54 089.0*				
$3d^5(^6S)18p$	^{7}P°		*54 147.7*				
$3d^5(^6S)19p$	^{7}P°		*54 196.6*				
$3d^4\,4s5p$	$q\,^5$P°	1	*54 198.23*				
		2	*54 252.19*				
		3	*54 328.95*				
		4	*54 425.29*				
		5	*54 536.53*				
$3d^5(^6S)20p$	^{7}P°		*54 237.7*				
$3d^5(^6S)21p$	^{7}P°		*54 272.4*				

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
	$e\ ^5F$	1	54 296.76				
		2	54 383.36				
		3	54 476.29				
		4	54 572.84				
		5	54 680.31				
$3d^5(^6S)22p$	$^7P^\circ$		*54 302.4*				
$3d^5(^2I)4p$	$z\ ^3K^\circ$	6	*54 316.83*		58	42	$3d^4(^1I)4s4p(^3P^\circ)\ ^3K^\circ$
		7	*54 404.94*		54	46	
		8	*54 498.27*		59	41	
$3d^5(^6S)23p$	$^7P^\circ$		*54 337.2*				
$3d^5(^6S)24p$	$^7P^\circ$		*54 349.5*				
$3d^5(^6S)25p$	$^7P^\circ$		*54 368.6*				
$3d^5(^6S)26p$	$^7P^\circ$		*54 385.5*				
$3d^5(^6S)27p$	$^7P^\circ$		*54 400.5*				
$3d^5(^6S)28p$	$^7P^\circ$		*54 413.5*				
$3d^5(^6S)29p$	$^7P^\circ$		*54 425.4*				
$3d^5(^6S)30p$	$^7P^\circ$		*54 436.1*				
$3d^5(^6S)31p$	$^7P^\circ$		*54 445.0*				
$3d^5(^6S)32p$	$^7P^\circ$		*54 453.4*				
$3d^5(^6S)33p$	$^7P^\circ$		*54 461.7*				
$3d^5(^6S)34p$	$^7P^\circ$		*54 468.5*				
$3d^5(^6S)35p$	$^7P^\circ$		*54 474.8*				
$3d^5(^6S)36p$	$^7P^\circ$		*54 480.6*				
$3d^5(^6S)37p$	$^7P^\circ$		*54 485.4*				
$3d^5(^6S)38p$	$^7P^\circ$		*54 491.2*				
Cr II ($^6S_{5/2}$)	*Limit*		54 575.6				
$3d^4\ 4s5s$	$g\ ^5D$	0	54 646.20				
		1	54 671.90				
		2	54 818.55				
		3	54 986.82				
		4	55 209.01				
$3d^4(^3H)4s4p(^1P^\circ)$	$w\ ^3H^\circ$	4	*54 736.55*		42	20	$3d^5(^2I)4p\ ^3H^\circ$
		5	*54 799.18*		41	21	
		6	*54 886.82*		42	24	
$3d^4(^1I)4s4p(^3P^\circ)$	$^3K^\circ$	6	*54 800.26*		56	40	$3d^5(^2I)4p\ ^3K^\circ$
$3d^4\ 4s5s$	$e\ ^3D$	1	54 804.69				
		2	54 974.64				
		3	55 204.79				
$3d^5(^4G)5p$	$v\ ^3H^\circ$	4	*54 810.94*				
		6	*54 866.57*				
		5	*54 929.72*				
$3d^4(^3D)4s4p(^3P^\circ)$	$v\ ^3D^\circ$	1	*54 956.59*		33	23	$3d^5(a\ ^2D)4p\ ^3D^\circ$
		2	*55 152.63*		30	26	
		3	*55 451.64*		30	19	
$3d^5(^2I)4p$	$z\ ^1K^\circ$	7	*54 970.23*		79	10	$^3K^\circ$

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^5(a\,^2D)4p$	$v\,^3F^\circ$	2	*54 992.93*		30		20	$3d^5(a\,^2F)4p\ ^3F^\circ$
		3	*55 101.87*		22		15	
		4	*55 207.40*		30		18	
$3d^5(^4G)5p$	$u\,^3F^\circ$	4	*55 120.77*					
		3	*55 352.72*					
		2	*55 473.67*					
$3d^5(^2I)4p$		6	*55 516.69*		35	$^1I^\circ$	28	$3d^4(^1I)4s4p(^3P^\circ)\ ^3H^\circ$
$3d^5(^2I)4p$	$x\,^3I^\circ$	5	*55 686.46*		29		30	$3d^4(^1I)4s4p(^3P^\circ)\ ^3I^\circ$
		6	*55 741.11*		34		30	
		7	*55 799.10*		30		32	
$3d^4(^1I)4s4p(^3P^\circ)$	$u\,^3H^\circ$	5	*55 874.98*		61		12	$3d^5(^2H)4p\ ^3H^\circ$
		4	*55 915.50*		67		[illegible]	$3d^5(^2H)4p\ ^3H^\circ$
$3d^4(^1I)4s4p(^3P^\circ)$		6	*55 908.12*		37	$^3H^\circ$	37	$3d^5(^2I)4p\ ^1I^\circ$
$3d^5(^2I)4p$	$y\,^1H^\circ$	5	*55 945.08*		43		12	$3d^4(^3G)4s4p(^3P^\circ)\ ^1H^\circ$
$3d^5(^4F)4p$	$v\,^5G^\circ$	2	*56 155.12*		46		44	$3d^3(^4F)4s^24p\ ^5G^\circ$
		3	*56 209.81*		49		38	
		4	*56 279.56*		51		40	
		5	*56 361.86*		55		28	
		6	*56 449.10*		50		34	
$3d^4(^3D)4s4p(^3P^\circ)$	$v\,^3P^\circ$	2	*56 591.88*		42		18	$3d^5(a\,^2D)4p\ ^3P^\circ$
		1	*56 722.60*		40		10	$3d^4(^3D)4s4p(^3P^\circ)\ ^1P^\circ$
		0	*56 802.50*		56		19	$3d^5(a\,^2D)4p\ ^3P^\circ$
$3d^4(a\,^3F)4s4p(^1P^\circ)$		3	*56 985.67*		21	$^3G^\circ$	16	$3d^4(^3D)4s4p(^3P^\circ)\ ^3F^\circ$
$3d^4(a\,^3F)4s4p(^1P^\circ)$	$u\,^3G^\circ$	4	*57 033.60*		24		15	$3d^4(^3H)4s4p(^3P^\circ)\ ^3G^\circ$
		5	*57 088.25*		25		23	$3d^4(^3H)4s4p(^3P^\circ)\ ^3G^\circ$
$3d^4(a\,^1S)4s4p(^3P^\circ)$	$u\,^3P^\circ$	2	*57 087.70*		43		22	$3d^5(a\,^2D)4p\ ^3P^\circ$
		1	*57 132.59*		40		21	
		0	*57 154.59*		40		22	
	$p\,^5F^\circ$	1	*57 096.62*					
		2	*57 100.66*					
		3	*57 186.60*					
		4	*57 237.50*					
		5	*57 327.66*					
		3	*57 141.85*					
$3d^4(^3D)4s4p(^3P^\circ)$		2	*57 220.67*		24	$^3F^\circ$	14	$3d^3(^4F)4s^24p\ ^3F^\circ$
$3d^5(^4F)4p$		3	*57 276.42*		10	$^3F^\circ$	10	$3d^3(^4F)4s^24p\ ^3F^\circ$
$3d^5(^4F)4p$		4	*57 335.47*		16	$^3F^\circ$	13	$3d^3(^4F)4s^24p\ ^3F^\circ$
$3d^5(^4G)5s$	$e\,^5G$	2	57 350.65					
		3	57 361.24					
		4	57 372.78					
		5	57 382.93					
		6	57 389.32					

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^5(a\,^2F)4p$	$t\,^3G^{\circ}$	3	57 557.65		40		14	$3d^5(^4F)4p\ ^5F^{\circ}$
		5	57 702.36		58		20	$3d^4(a\,^3F)4s4p(^3P^{\circ})\ ^3G^{\circ}$
$3d^5(a\,^2F)4p$		4	57 587.36		21	$^3G^{\circ}$	18	$3d^5(^4F)4p\ ^5F^{\circ}$
$3d^4\,4s5p$	$r\,^5D^{\circ}$	0	57 958.42					
		1	57 995.04					
		2	58 063.80					
		3	58 147.76					
		4	58 292.62					
	$e\,^3G$	3	57 984.94					
		5	57 990.23					
		4	57 992.15					
$3d^5(a\,^2F)4p$	$s\,^3F^{\circ}$	2	58 162.84		26		15	$3d^5(a\,^2D)4p\ ^3F^{\circ}$
		4	58 167.89		25		20	
		3	58 202.65		25		23	
$3d^5(^4F)4p$		1	58 725.28		33	$^5D^{\circ}$	18	$3d^5(^4F)4p\ ^3D^{\circ}$
$3d^5(^2H)4p$	$t\,^3H^{\circ}$	4	58 728.29		22		16	$3d^5(^2I)4p\ ^3H^{\circ}$
		5	58 754.58		24		17	
		6	58 775.36		26		17	
$3d^5(^4P)5p$	$t\,^3D^{\circ}$	2	58 772.03					
		1	58 870.20					
		3	58 924.12					
$3d^5(^4F)4p$	$u\,^3D^{\circ}$	2	58 880.23		39		28	$3d^4(^3D)4s4p(^3P^{\circ})\ ^3D^{\circ}$
		3	59 122.15		25		25	$3d^4(^3D)4s4p(^3P^{\circ})\ ^3D^{\circ}$
$3d^4\,4s(^6D)6p$	$^7F^{\circ}$	2	59 290					
		3	59 310					
		4	59 443					
$3d^4\,4s(^6D)6p$	$^7P^{\circ}$	2	59 280					
		3	59 442					
		4	59 659					
$3d^4(a\,^3F)4s4p(^1P^{\circ})$	$r\,^3F^{\circ}$	2	59 357.90		51		11	$3d^5(^4F)4p\ ^3F^{\circ}$
		3	59 417.01		46		9	
		4	59 487.71		50		9	
$3d^4\,4s(^6D)6p$	$^7D^{\circ}$	2	59 487					
		3	59 663					
		4	59 877					
$3d^4(^3H)4s4p(^1P^{\circ})$	$w\,^3I^{\circ}$	5	59 806.27		64		16	$3d^5(^2H)4p\ ^3I^{\circ}$
		6	59 884.27		74		13	
		7	59 957.46		77		13	
$3d^4\,4s(^6D)6p$	$^5P^{\circ}$	2	59 946					
		3	60 197					
$3d^5(a\,^2G)4p$		5	60 006.00		30	$^3G^{\circ}$	13	$3d^5(^2H)4p\ ^1H^{\circ}$
$3d^4(a\,^3P)4s4p(^1P^{\circ})$	$x\,^3S^{\circ}$	1	60 084.09		48		19	$^5P^{\circ}$

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
	$q\,^3D^\circ$	0	60 238.04					
		1	60 286.59					
		2	60 372.86					
		3	60 491.22					
		4	60 625.65					
	$q\,^3F^\circ$	2	60 253.00					
		3	60 326.04					
		4	60 367.38					
$3d^5(^2H)4p$	$v\,^3I^\circ$	5	60 427.63		50		16	$3d^5(a\,^2G)4p\ ^1H^\circ$
		6	60 527.55		74		11	$3d^5(a\,^2G)4p\ ^3H^\circ$
		7	60 656.97		85		6	$3d^5(^2I)4p\ ^3I^\circ$
$3d^5(^2H)4p$	$x\,^1I^\circ$	6	60 441.42		49		17	$3d^5(a\,^2G)4p\ ^3H^\circ$
$3d^5(a\,^2G)4p$		5	60 467.85		30	$^3G^\circ$	21	$3d^5(^2H)4p\ ^3I^\circ$
$3d^5(a\,^2G)4p$	$s\,^3G^\circ$	4	60 503.94		40		9	$3d^5(^2H)4p\ ^3G^\circ$
$3d^5(a\,^2G)4p$		3	60 518.16		32	$^3G^\circ$	16	$3d^5(a\,^2F)4p\ ^1F^\circ$
$3d^5(^4F)4p$		3	60 615.84		24	$^3D^\circ$	17	$3d^5(a\,^2D)4p\ ^3D^\circ$
$3d^5(a\,^2D)4p$	$s\,^3D^\circ$	2	60 629.87		25		24	$3d^4(a\,^1D)4s4p(^3P^\circ)\ ^3D^\circ$
		1	60 678.12		29		2	$3d^4(a\,^1D)4s4p(^3P^\circ)\ ^3D^\circ$
	$o\,^5F^\circ$	1	60 678.53					
		2	60 777.85					
		3	60 902.33					
		4	61 052.53					
		5	61 193.98					
$3d^5(b\,^2F)4p$	$p\,^3F^\circ$	3	60 819.50		40		21	$3d^4(^1F)4s4p(^3P^\circ)\ ^3F^\circ$
		4	60 960.58		30		24	
$3d^5(a\,^2G)4p$	$s\,^3H^\circ$	4	60 870.63		52		13	$3d^4(^3H)4s4p(^1P^\circ)\ ^3H^\circ$
		5	61 008.07		41		11	$3d^4(^3H)4s4p(^1P^\circ)\ ^3H^\circ$
	$r\,^5P^\circ$	1	61 065.96					
		2	61 107.95					
		3	61 198.68					
$3d^5(^2H)4p$	$r\,^3G^\circ$	3	61 078.28		24		19	$3d^5(b\,^2F)4p\ ^3G^\circ$
		4	61 123.20		19		15	$3d^5(b\,^2F)4p\ ^3G^\circ$
$3d^5(^2H)4p$		5	61 161.35		15	$^3G^\circ$	15	$3d^5(a\,^2G)4p\ ^3H^\circ$
$3d^5(a\,^2G)4p$		6	61 191.64		35	$^3H^\circ$	27	$3d^5(^2H)4p\ ^1I^\circ$
$3d^4(a\,^1D)4s4p(^3P^\circ)$	$t\,^3P^\circ$	0	61 387.86		77		7	$3d^5(a\,^2D)4p\ ^3P^\circ$
		1	61 527.34		66		8	$3d^5(a\,^2D)4p\ ^3P^\circ$
		2	61 675.72		58		8	$3d^4(^4F)4s^24p\ ^5F^\circ$
$3d^4\,4s5s$	$e\,^5P$	1	61 558.17					
		2	61 687.56					
		3	61 850.17					

Cr I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^5(^4F)4p$	$q\ ^3G°$	3	*61 330.05*		48 15 $3d^4(^3G)4s4p(^1P°)\ ^3G°$
$3d^5(^4F)4p$		4	*61 976.50*		32 $^3G°$ 20 $3d^3(^4F)4s^24p\ ^5F°$
$3d^4\ 4p^2$	$f\ ^7F$	3	62 034.44		
		4	62 188.83		
		5	62 472.80		
		6	62 658.38		
$3d^5(^4F)4p$		5	*63 037.60*		31 $^3G°$ 15 $3d^4(^3G)4s4p(^1P°)\ ^3H°$
$3d^5(^4G)4d$	$f\ ^5G$	2	62 646.60		
		3	62 661.96		
		4	62 671.00		
		6	62 673.92		
		5	62 690.96		
$3d^4\ 4s4p$	$r\ ^3H°$	4	*63 762.06*		
		5	*63 830.26*		
		6	*63 903.03*		
	$q\ ^3H°$	4	*63 116.80*		
		5	*63 144.36*		
		6	*63 182.94*		
$3d^5\ 4p$	$p\ ^3H°$	4	*63 841.81*		
		5	*63 927.27*		
		6	*63 997.86*		
$3d^4\ 4s5s$	$e\ ^5H$	3	64 712.04		
		4	64 751.42		
		5	64 802.08		
		6	64 896.30		
		7	64 940.28		
$3d^5\ 4p$	$p\ ^3G°$	3	*66 008.95*		
		4	*66 084.06*		
		5	*66 180.24*		
$3p^5\ 3d^5\ 4s^2$	$^7P°$	4	*311 280*		
		3	*314 290*		
		2	*316 880*		

Cr II

$Z = 24$

V I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5\ {}^6S_{5/2}$

Ionization energy = 132 966±10 cm^{-1} (16.4858±0.0010 eV)

Kiess (1951) carried out the principal analysis of this spectrum using his extensive measurements of wavelengths and Zeeman-effect data. Changes in several of his term designations for the $3d^4 4p$ configuration suggested by Roth (1969) on the basis of theoretical calculations have been adopted here.

Johansson (1983) has reobserved the spectrum, extending the observations into the infrared. All the previously known level values were redetermined, and the new configurations $3d^3 4s 4p$, $3d^4 4f$, $5p$, $5d$, $5f$, $5g$, $6s$, $6p$, $6d$, $6g$, and $7s$ as well as a few levels of $3d^4 8s$ and $9s$ were found. In addition, new levels of $3d^4 4s$, $4p$, and $5s$ were added. Altogether 450 new levels were reported. The level value determinations are still in a preliminary stage. The results are given here with an uncertainty of ±0.05 cm^{-1}.

From the 6-member $3d^4(^5D)ns\ {}^6D_{9/2}$ series, Johansson (1983) determined a new value for the ionization energy.

The percentage compositions for $3d^4 4p$ are by Roth. Repeating terms of the $3d^4$ core are labeled in alphabetical order rather than by seniority. Shadmi, Oreg, and Stein (1968) have calculated the $3d^5$, $3d^4 4s$, and $3d^3 4s^2$ configurations but give percentages only for $a\,^2H$ and $b\,^2H$, apparently the only highly mixed terms. No changes of designations were made except for the $e\,^2G$ and $e\,^2D$ terms. The percentages represent the sum of seniority states contributing the same core term.

References

Johansson, S. (1983), private communication.
Kiess, C. C. (1951), J. Res. Natl. Bur. Stand. (U.S.) 47, 385.
Roth, C. (1969), J. Res. Natl. Bur. Stand. (U.S.) 73A, 125.
Russell, H. N. (1950), J. Opt. Soc. Am. 40, 618.
Shadmi, Y., Oreg, J., and Stein, J. (1968), J. Opt. Soc. Am. 58, 909.

Cr II

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^5$	$a\,^6S$	5/2	0.00		
$3d^4(^5D)4s$	$a\,^6D$	1/2	11 961.81	3.323	
		3/2	12 032.58	1.867	
		5/2	12 147.82	1.669	
		7/2	12 303.86	1.578	
		9/2	12 496.44	1.554	
$3d^4(^5D)4s$	$a\,^4D$	1/2	19 528.25	0.000	
		3/2	19 631.17	1.192	
		5/2	19 797.88	1.370	
		7/2	20 024.01	1.427	
$3d^5$	$a\,^4G$	5/2	20 512.06	0.599	
		11/2	20 512.10	1.278	
		7/2	20 517.83	0.994	
		9/2	20 519.33	1.161	
$3d^5$	$a\,^4P$	5/2	21 822.52	1.590	
		1/2	21 823.84	2.693	
		3/2	21 824.11	1.717	
$3d^5$	$b\,^4D$	7/2	25 033.70	1.432	
		1/2	25 035.40	-0.045	
		3/2	25 042.81	1.207	
		5/2	25 046.76	1.381	
$3d^4(^3P)4s$	$b\,^4P$	1/2	29 951.88	2.686	
		3/2	30 307.44	1.756	
		5/2	30 864.46	1.572	

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^5$	$a\ ^2I$	$^{11}/_2$	30 142.30				
		$^{13}/_2$	30 149.83				
$3d^4(^3H)4s$	$a\ ^4H$	$^7/_2$	30 156.79	0.667			
		$^9/_2$	30 218.81	0.978			
		$^{11}/_2$	30 298.51	1.162			
		$^{13}/_2$	30 391.83	1.234			
$3d^4(^3F)4s$	$a\ ^4F$	$^3/_2$	31 082.94	0.418			
		$^5/_2$	31 117.39	1.032			
		$^7/_2$	31 168.58	1.246			
		$^9/_2$	31 219.35	1.340			
$3d^5$	$a\ ^2D$	$^5/_2$	31 350.90				
		$^3/_2$	31 531.24				
$3d^5$	$a\ ^2F$	$^7/_2$	32 355.68				
		$^5/_2$	32 603.40				
$3d^5$	$b\ ^4F$	$^7/_2$	32 836.68				
		$^3/_2$	32 844.76				
		$^9/_2$	32 854.31				
		$^5/_2$	32 854.95				
$3d^4(^3G)4s$	$b\ ^4G$	$^5/_2$	33 417.99	0.588			
		$^7/_2$	33 521.11	1.024			
		$^9/_2$	33 618.94	1.185			
		$^{11}/_2$	33 694.15	1.276			
$3d^4(^3H)4s$	$a\ ^2H$	$^9/_2$	34 630.95		62	35	$3d^5\ ^2H$
		$^{11}/_2$	34 812.95		57	41	
$3d^4(^3P)4s$	$a\ ^2P$	$^1/_2$	34 659.32	0.670			
		$^3/_2$	35 355.89	1.331			
$3d^4(^3F)4s$	$b\ ^2F$	$^5/_2$	35 569.20	0.876			
		$^7/_2$	35 607.50	1.144			
$3d^5$	$b\ ^2H$	$^9/_2$	35 610.85		61	37	$3d^4(^3H)4s\ ^2H$
		$^{11}/_2$	35 707.49		58	42	
$3d^5$	$a\ ^2G$	$^7/_2$	36 101.58				
		$^9/_2$	36 272.54				
$3d^4(^3D)4s$	$c\ ^4D$	$^7/_2$	38 269.59				
		$^5/_2$	38 314.86				
		$^3/_2$	38 362.43				
		$^1/_2$	38 396.23				
$3d^4(^3G)4s$	$b\ ^2G$	$^7/_2$	38 508.93	0.910			
		$^9/_2$	38 563.01	1.100			
$3d^4(a^1G)4s$	$c\ ^2G$	$^7/_2$	39 683.75				
		$^9/_2$	39 824.38				
$3d^5$	$c\ ^2F$	$^5/_2$	39 742.09				
		$^7/_2$	39 877.07				

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4(^1I)4s$	$b\ ^2I$	$^{13}/_2$	40 202.12				
		$^{11}/_2$	40 228.33				
$3d^4(^1S)4s$	$a\ ^2S$	$^1/_2$	40 415.09				
$3d^4(^3D)4s$	$b\ ^2D$	$^5/_2$	42 897.99				
		$^3/_2$	42 986.62				
$3d^5$	$b\ ^2S$	$^1/_2$	44 307.09				
$3d^4(^1D)4s$	$c\ ^2D$	$^3/_2$	45 669.37				
		$^5/_2$	45 730.58				
$3d^4(^5D)4p$	$z\ ^6F°$	$^1/_2$	*46 823.39*	−0.689	100		
		$^3/_2$	*46 905.17*	1.124	100		
		$^5/_2$	*47 040.35*	1.314	100		
		$^7/_2$	*47 227.24*	1.378	100		
		$^9/_2$	*47 464.55*	1.416	100		
		$^{11}/_2$	*47 751.62*		100		
$3d^5$	$d\ ^2D$	$^5/_2$	47 354.44				
		$^3/_2$	47 372.53				
$3d^4(^5D)4p$	$z\ ^6P°$	$^3/_2$	*48 398.95*	2.382	83		
		$^5/_2$	*48 491.10*	1.875	98		
		$^7/_2$	*48 632.12*	1.710	100		
$3d^4(^5D)4p$	$z\ ^4P°$	$^1/_2$	*48 749.36*	2.844	67	31	$(^5D)\ ^4D°$
		$^3/_2$	*49 005.93*	1.802	55	42	
		$^5/_2$	*49 706.33*	1.624	71	27	
$3d^4(^5D)4p$	$z\ ^4D°$	$^5/_2$	*49 351.80*	1.628	73	26	$(^5D)\ ^4P°$
		$^1/_2$	*49 492.77*	3.155	68	31	
		$^3/_2$	*49 564.60*	1.824	58	41	
		$^7/_2$	*49 645.77*	1.577	99		
		$^9/_2$	*49 838.38*	1.570	98		
$3d^4(^1F)4s$	$d\ ^2F$	$^7/_2$	50 667.24				
		$^5/_2$	50 687.62				
$3d^4(^5D)4p$	$z\ ^4F°$	$^3/_2$	*51 584.15*	0.406	97		
		$^5/_2$	*51 669.48*	1.025	97		
		$^7/_2$	*51 788.88*	1.248	96		
		$^9/_2$	*51 942.70*	1.338	96		
$3d^5$	$d\ ^2G$	$^7/_2$	52 297.81				
		$^9/_2$	52 321.01				
$3d^3\ 4s^2$	$c\ ^4F$	$^3/_2$	53 051.35				
		$^5/_2$	53 271.09				
		$^7/_2$	53 566.28				
		$^9/_2$	53 923.60				
$3d^4(^5D)4p$	$z\ ^4D°$	$^1/_2$	*54 418.02*	0.007	98		
		$^3/_2$	*54 499.52*	1.178	96		
		$^5/_2$	*54 625.62*	1.376	98		
		$^7/_2$	*54 784.48*	1.430	98		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4(^3F)4s$	$d\,^4F$	9/2	54 867.61				
		3/2	54 868.62				
		5/2	54 883.54				
		7/2	54 887.97				
$3d^4(^3P)4s$	$c\,^4P$	5/2	55 023.10				
		3/2	55 398.74				
		1/2	55 626.21				
$3d^4(^3P)4s$	$b\,^2P$	3/2	59 130.36				
		1/2	59 526.73				
$3d^4(^3F)4s$	$e\,^2F$	7/2	59 570.10				
		5/2	59 577.66				
$3d^4(^3G)4s$	$e\,^2G$	9/2	62 688.95				
		7/2	62 701.67				
$3d^4(^3H)4p$	$z\,^4H^\circ$	7/2	*63 600.91*	0.680	82	16	$(^3G)\,^4H^\circ$
		9/2	*63 706.30*	1.030	80	16	
		11/2	*63 848.74*	1.138	80	15	
		13/2	*64 030.53*	1.234	83	13	
$3d^4(a\,^3P)4p$	$y\,^4D^\circ$	1/2	*63 801.88*	0.000	87	7	$(a\,^3F)\,^4D^\circ$
		3/2	*64 061.73*	1.199	86	8	
		5/2	*64 448.81*	1.380	85	10	
		7/2	*64 924.52*	1.411	80	14	
$3d^4(a\,^3P)4p$	$z\,^2S^\circ$	1/2	*65 029.43*		73	7	$(a\,^3P)\,^4P^\circ$
$3d^4(a\,^3F)4p$	$z\,^4G^\circ$	5/2	*65 156.56*	0.593	79	14	$(^3G)\,^4G^\circ$
		7/2	*65 256.88*	0.920	70	12	
		9/2	*65 383.95*	1.120	50	10	
		11/2	*65 709.50*	1.265	73	13	
$3d^4(^3H)4p$	$z\,^4I^\circ$	9/2	*65 217.55*		96		
		11/2	*65 419.56*		96		
		13/2	*65 617.99*		96		
		15/2	*65 812.56*		100		
$3d^4(^3H)4p$	$z\,^2G^\circ$	7/2	*65 542.93*		40	23	$(a\,^3F)\,^2G^\circ$
		9/2	*65 670.08*		41	31	
$3d^3\,4s^2$	$d\,^4P$	1/2	65 882.58				
		3/2	66 010.39				
		5/2	66 256.75				
$3d^4(a\,^3P)4p$	$y\,^4P^\circ$	1/2	*66 256.47*	2.545	76	13	$(a\,^3P)\,^2S^\circ$
		3/2	*66 354.83*	1.671	90		
		5/2	*66 726.81*	1.502	92		
$3d^4(a\,^3P)4p$	$z\,^2P^\circ$	3/2	*66 649.38*		53	15	$(a\,^3F)\,^2D^\circ$
		1/2	*66 871.93*		79	14	$(a\,^3P)\,^2S^\circ$
$3d^4(a\,^3F)4p$	$y\,^4F^\circ$	5/2	*67 012.10*		71	13	$(a\,^3F)\,^2D^\circ$
		3/2	*67 070.45*		51	21	$(a\,^3P)\,^2P^\circ$
		7/2	*67 393.51*		76	10	$(^3H)\,^4G^\circ$
		9/2	*67 448.57*		63	18	$(^3H)\,^4G^\circ$

Cr II—Continued

Configuration	Term	*J*	Level (cm^{-1})	*g*	Leading percentages		
$3d^4(^3H)4p$	$y\,^4G^\circ$	7/2	*67 333.83*		60	18	$(a\,^3F)\,^4F^\circ$
		5/2	*67 344.03*		66	13	$(a\,^3F)\,^4G^\circ$
		9/2	*67 353.29*		51	32	$(a\,^3F)\,^4F^\circ$
		11/2	*67 369.14*		65	22	$(a\,^3F)\,^4G^\circ$
$3d^4(a\,^3F)4p$	$z\,^2D^\circ$	3/2	*67 379.47*		28	32	$(a\,^3F)\,^4F^\circ$
		5/2	*67 387.16*		50	18	
$3d^4(^3H)4p$	$z\,^2I^\circ$	11/2	*67 506.13*		93		
		13/2	*67 588.90*		95		
$3d^4(a\,^3F)4p$	$x\,^4D^\circ$	1/2	*67 859.61*		88	11	$(a\,^3P)\,^4D^\circ$
		5/2	*67 867.82*		77	13	
		3/2	*67 870.24*		84	12	
		7/2	*67 875.42*		60	19	
$3d^4(a\,^3P)4p$	$z\,^4S^\circ$	3/2	*68 305.64*	1.978	70	17	$(a\,^3P)\,^2P^\circ$
$3d^4(^3H)4p$	$z\,^2H^\circ$	9/2	*68 476.92*		81	12	$(a\,^1G)\,^2H^\circ$
		11/2	*68 737.82*		84	10	
$3d^4(a\,^3F)4p$	$z\,^2F^\circ$	5/2	*68 583.34*		50	21	$(^3G)\,^2F^\circ$
		7/2	*68 759.89*		50	18	
$3d^4(^3G)4p$	$y\,^4H^\circ$	7/2	*68 843.30*		83	16	$(^3H)\,^4H^\circ$
		9/2	*68 992.40*		82	14	
		11/2	*69 170.39*		82	13	
		13/2	*69 388.25*		86	13	
$3d^4(a\,^3P)4p$	$^2D^\circ$	3/2	*69 248.18*		65	28	$(a\,^3F)\,^2D^\circ$
		5/2	*69 354.09*		66	20	
$3d^4(^3G)4p$	$^4F^\circ$	5/2	*69 477.95*		71	11	$(^3D)\,^4F^\circ$
		9/2	*69 498.28*		60	13	$(a\,^3F)\,^2G^\circ$
		7/2	*69 506.08*		60	11	$(a\,^3F)\,^2G^\circ$
		3/2	*69 638.63*		81	13	$(^3D)\,^4F^\circ$
$3d^4(a\,^3F)4p$	$y\,^2G^\circ$	7/2	*69 903.55*		42	25	$(^3H)\,^2G^\circ$
		9/2	*70 107.67*		37	25	
$3d^4(^3G)4p$	$x\,^4G^\circ$	5/2	*70 316.90*		60	17	$(^3H)\,^4G^\circ$
		7/2	*70 427.05*		61	19	$(^3H)\,^4G^\circ$
		9/2	*70 679.15*		44	22	$(^3G)\,^2H^\circ$
		11/2	*70 879.80*		41	28	$(^3G)\,^2H^\circ$
$3d^4(^3G)4p$	$y\,^2H^\circ$	9/2	*70 394.90*		57	19	$(^3G)\,^4G^\circ$
		11/2	*70 398.87*		47	34	
$3d^4(^3G)4p$	$y\,^2F^\circ$	5/2	*70 584.47*		46	32	$(a\,^3P)\,^2P^\circ$
		7/2	*70 852.23*		50	20	
$3d^4(^3G)4p$	$x\,^2G^\circ$	7/2	*72 648.52*		79	11	$(^3H)\,^2G^\circ$
		9/2	*72 716.72*		75	13	
$3d^4(^3D)4p$	$w\,^4D^\circ$	1/2	*73 407.00*		96		
		3/2	*73 411.96*		91		
		5/2	*73 436.17*		87		
		7/2	*73 485.66*		80		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^4(a\,^3G)4p$	$x\,^2F°$	7/2	74 114.39		64	19	$(^3D)\,^4F°$
		5/2	74 496.15		77	7	$(^3D)\,^2F°$
$3d^4(^3D)4p$	$w\,^4F°$	3/2	74 273.31		82	13	$(^3G)\,^4F°$
		5/2	74 318.83		48	40	$(^3D)\,^4P°$
		7/2	74 423.67		80	6	$(^3D)\,^4F°$
		9/2	74 504.17		86	13	$(^3G)\,^4F°$
$3d^4(^1I)4p$	$^2I°$	11/2	74 421.80		85	12	$(a\,^1G)\,^2H°$
		13/2	74 743.28		64	35	$(^1I)\,^2K°$
$3d^4(^1I)4p$	$^2K°$	13/2	74 424.19		65	33	$(^1I)\,^2I°$
		15/2	74 958.80		100		
$3d^4(a\,^1G)4p$	$x\,^2H°$	9/2	74 455.82		82	11	$(^3H)\,^2H°$
		11/2	74 707.48		72	11	$(^1I)\,^2I°$
$3d^4(^3D)4p$	$x\,^4P°$	5/2	74 483.96		53	30	$(^3D)\,^4F°$
		3/2	74 717.59		93		
		1/2	74 920.44		96		
$3d^4(^3D)4p$	$y\,^2P°$	1/2	74 853.85		56	40	$(a\,^1S)\,^2P°$
		3/2	74 984.78		61	33	
$3d^4(a\,^1G)4p$	$w\,^2G°$	7/2	75 716.55		82	8	$(^3G)\,^2G°$
		9/2	75 810.04		80	12	
$3d^4(^3D)4p$	$w\,^2F°$	7/2	76 879.08		73	12	$(a\,^1G)\,^2F°$
		5/2	76 987.70		72	13	
$3d^4(^1I)4p$	$w\,^2H°$	11/2	77 078.92		88	8	$(^3G)\,^2H°$
		9/2	77 270.25		[illegible]	8	
$3d^4(a\,^1S)4p$	$x\,^2P°$	3/2	77 713.28		31	36	$(^3D)\,^2D°$
		1/2	77 777.33		48	32	$(^3D)\,^2P°$
$3d^4(^3D)4p$	$x\,^2D°$	5/2	77 935.25		66	36	$(a\,^1D)\,^2D°$
		3/2	78 100.56		48	22	$(a\,^1S)\,^2P°$
$3d^4(a\,^1D)4p$	$w\,^2D°$	3/2	80 288.06		74	13	$(^3D)\,^2D°$
		5/2	80 490.90		65	21	
$3d^4(a\,^1D)4p$	$v\,^2F°$	5/2	81 232.93		88		
		7/2	81 432.29		80		
$3d^5(^4F)4s4p(^3P°)$	$y\,^6D°$	1/2	81 649.19				
		3/2	81 737.87				
		5/2	81 816.29				
		7/2	81 978.08				
		9/2	82 192.59				
$3d^5(^4F)4s4p(^3P°)$	$y\,^6F°$	1/2	81 785.08				
		3/2	81 824.40				
		5/2	81 963.29				
		7/2	82 143.15				
		9/2	82 362.19				
		11/2	82 612.69				

Cr II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages		
$3d^4(^5D)5s$	$e\ ^6D$	1/2	82 692.86				
		3/2	82 763.75				
		5/2	82 881.17				
		7/2	83 041.38				
		9/2	83 240.41				
$3d^4(a\ ^1D)4p$	$w\ ^2P^\circ$	1/2	*82 852.85*		80	9	$(^3D)\ ^2P^\circ$
		3/2	*82 919.90*		78	11	
$3d^4(^5D)5s$	$e\ ^4D$	1/2	84 209.88				
		3/2	84 320.21				
		5/2	84 495.70				
		7/2	84 726.71				
$3d^4(^1F)4p$	$z\ ^2F^\circ$	5/2	*84 606.84*		80		
		7/2	*84 677.13*		87		
$3d^3(^4F)4s4p(^3P^\circ)$	$u\ ^4D^\circ$	1/2	*85 486.24*				
		3/2	*85 586.60*				
		5/2	*85 778.69*				
		7/2	*86 078.90*				
$3d^4(^1F)4p$	$v\ ^2G^\circ$	7/2	*85 573.17*		96		
		9/2	*85 938.96*		97		
$3d^4(^5D)4d$	$e\ ^4S$	3/2	86 165.30				
$3d^4(^1F)4p$	$c\ ^2D^\circ$	5/2	*86 507.31*		75	13	$(b\ ^3P)\ ^2D^\circ$
		3/2	*86 919.01*		79	12	
$3d^3(^4F)4s4p(^3P^\circ)$	$u\ ^4G^\circ$	5/2	*86 566.55*				
		7/2	*86 797.35*				
		9/2	*87 092.65*				
		11/2	*87 450.47*				
$3d^4(^5D)4d$	$e\ ^4G$	3/2	86 594.33				
		5/2	86 654.18				
		7/2	86 738.27				
		9/2	86 847.03				
		11/2	86 980.10				
		13/2	87 137.08				
$3d^4(^5D)4d$	$e\ ^4P$	3/2	86 667.73				
		5/2	86 691.55				
		7/2	86 782.04				
$3d^4(^5D)4d$	$f\ ^6D$	1/2	87 453.50				
		3/2	87 470.58				
		5/2	87 514.82				
		7/2	87 588.00				
		9/2	87 687.52				
$3d^4(^5D)4d$	$e\ ^4F$	1/2	87 594.58				
		3/2	87 666.28				
		5/2	87 759.02				
		7/2	87 858.56				
		9/2	87 946.55				
		11/2	88 001.36				

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^3(^4F)4s4p(^3P^\circ)$	$z\,^4F^\circ$	3/2	*87 628.74*				
		5/2	*87 768.61*				
		7/2	*87 916.67*				
		9/2	*88 073.49*				
$3d^3(^4F)4s4p(^3P^\circ)$	$z\,^2D^\circ$	3/2	*88 684.34*				
		5/2	*89 164.64*				
$3d^4(^5D)4d$	$e\,^4P$	1/2	89 254.56				
		3/2	89 277.95				
		5/2	89 336.89				
$3d^4(^5D)4d$	$e\,^4G$	5/2	89 056.02				
		7/2	89 174.08				
		9/2	89 325.32				
		11/2	89 508.55				
$3d^4(b\,^3P)4p$	$y\,^4P^\circ$	3/2	*89 422.36*		88	6	$(b\,^3P)\,^4D^\circ$
		5/2	*89 453.21*		82	7	
		1/2	*89 507.94*		96		
$3d^4(^5D)4d$	$f\,^4D$	1/2	89 651.66				
		3/2	89 724.27				
		5/2	89 812.42				
		7/2	89 885.08				
$3d^4(b\,^3P)4p$	$v\,^4D^\circ$	7/2	*90 218.49*		60	26	$(b\,^3F)\,^4D^\circ$
		5/2	*90 258.90*		51	20	
		3/2	*90 450.62*		61	24	
		1/2	*90 475.48*		70	26	
$3d^4(b\,^3F)4p$	$v\,^4F^\circ$	3/2	*90 262.13*		97		
		5/2	*90 441.78*		98		
		7/2	*90 489.86*		96		
		9/2	*90 588.59*		98		
$3d^4(^5D)4d$	$e\,^4F$	3/2	90 512.56				
		5/2	90 608.99				
		7/2	90 725.87				
		9/2	90 850.96				
$3d^4(b\,^3F)4p$	$t\,^2F^\circ$	5/2	*90 706.82*		86	5	$(b\,^3F)\,^4G^\circ$
		7/2	*90 830.79*		87	5	$(b\,^1G)\,^2F^\circ$
$3d^4(b\,^3F)4p$	$w\,^4G^\circ$	5/2	*91 073.72*				
		7/2	*91 122.82*		96		
		9/2	*91 189.51*		98		
		11/2	*91 292.16*				
$3d^4(b\,^3P)4p$	$t\,^2D^\circ$	5/2	*91 426.06*		60	10	$(^1F)\,^2D^\circ$
		3/2	*91 556.40*		58	21	$(b\,^3F)\,^2D^\circ$
$3d^3(^4F)4s4p(^3P^\circ)$	$t\,^2G^\circ$	7/2	*91 752.27*				
		9/2	*92 144.24*				
$3d^4(^5D)4d$	$e\,^6S$	5/2	91 966.29				
$3d^3(^4P)4s4p(^3P^\circ)$	$x\,^4P^\circ$	3/2	*92 235.35*				
		5/2	*92 417.93*				
		7/2	*92 653.23*				

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4(b\,^3P)4p$	$y\,^4S°$	3/2	92 612.28	97		
$3d^4(^5D)5p$	$^6F°$	1/2	92 988.83			
		3/2	93 047.31			
		5/2	93 143.88			
		7/2	93 276.86			
		9/2	93 444.17			
		11/2	93 643.40			
$3d^4(b\,^3F)4p$	$t\,^4D°$	7/2	93 531.69	73	27	$(b\,^3P)\,^4D°$
		5/2	93 671.00	72	72	
		3/2	93 770.10	72	27	
		1/2	93 800.39	72	27	
$3d^4(^5D)5p$	$^6D°$	3/2	93 574.44			
		5/2	93 776.15			
		7/2	93 966.45			
		9/2	94 177.18			
$3d^4(b\,^3F)4p$	$u\,^2G°$	9/2	93 641.50	98		
		7/2	93 801.46	98		
$3d^4(^5D)5p$	$^4P°$	3/2	93 740.40			
		5/2	93 974.05			
$3d^3(^4F)4s4p(^3P°)$	$s\,^2F°$	5/2	93 890.64			
		7/2	94 218.66			
$3d^3(^4P)4s4p(^3P°)$	$x\,^6D°$	1/2	93 968.70			
		3/2	94 098.13			
		5/2	94 265.99			
		7/2	94 452.57			
		9/2	94 656.24			
$3d^4(^5D)5p$	$^6P°$	3/2	94 002.56			
		5/2	94 144.43			
		7/2	94 363.51			
$3d^4(^5D)5p$	$^4F°$	3/2	94 256.07			
		5/2	94 365.19			
		7/2	94 522.31			
		9/2	94 749.20			
$3d^4(b\,^3P)4p$	$v\,^2P°$	3/2	94 383.20	94		
		1/2	94 624.73	92		
$3d^4(^5D)5p$	$^4D°$	1/2	94 839.27			
		3/2	94 932.95			
		5/2	95 076.72			
		7/2	95 250.69			
$3d^4(b\,^3P)4p$	$y\,^2S°$	1/2	96 245.32	98		
$3d^3(^2G)4s4p(^3P°)$	$t\,^4G°$	5/2	97 071.15			
		7/2	97 187.28			
		9/2	97 333.28			
		11/2	97 483.70			

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^3(^4P)4s4p(^3P^\circ)$	$w\ ^4P^\circ$	1/2	*97 168.48*				
		5/2	*97 182.54*				
		3/2	*97 294.06*				
$3d^4(b\ ^1G)4p$	$v\ ^2H^\circ$	9/2	*97 480.08*		86	12	$(b\ ^1G)\ ^2G^\circ$
		11/2	*97 899.41*		97		
$3d^4(b\ ^1G)4p$	$s\ ^2G^\circ$	7/2	*97 728.25*		97		
		9/2	*97 904.44*		86	12	$(b\ ^1G)\ ^2H^\circ$
$3d^3(^4P)4s4p(^3P^\circ)$	$z\ ^6S^\circ$	5/2	*97 875.00*				
$3d^4(b\ ^3P)4p$	$s\ ^2D^\circ$	5/2	*98 207.36*		71	29	$(b\ ^3P)\ ^2D^\circ$
		3/2	*98 314.99*		70	29	
$3d^3(^2G)4s4p(^3P^\circ)$	$t\ ^4F^\circ$	3/2	*98 578.50*				
		5/2	*98 641.88*				
		7/2	*98 719.40*				
		9/2	*98 812.67*				
$3d^4(b\ ^1G)4p$	$r\ ^2F^\circ$	7/2	*99 069.29*		87	8	$(b\ ^3F)\ ^2F^\circ$
		5/2	*99 243.99*		86	6	
$3d^4(a\ ^3P)5s$	$f\ ^4P$	1/2	99 677.93				
		3/2	100 040.22				
		5/2	100 650.52				
$3d^4(^3H)5s$	$e\ ^4H$	7/2	100 068.86				
		9/2	100 135.82				
		11/2	100 221.64				
		13/2	100 322.13				
$3d^3(^2P)4s4p(^3P^\circ)$	$r\ ^4D^\circ$	3/2	*100 691.80*				
		5/2	*101 074.56*				
		7/2	*101 514.29*				
$3d^4(a\ ^3P)5s$	$e\ ^2P$	1/2	100 792.80				
		3/2	101 492.84				
$3d^4(^3H)5s$	$e\ ^2H$	9/2	101 021.84				
		11/2	101 194.88				
$3d^3(^4P)4s4p(^3P^\circ)$	$u\ ^2P^\circ$	3/2	*101 157.49*				
$3d^3(^2H)4s4p(^3P^\circ)$	$w\ ^4H^\circ$	7/2	*101 170.38*				
		9/2	*101 296.00*				
		11/2	*101 783.20*				
		13/2	*101 900.82*				
$3d^4(a\ ^3F)5s$	$f\ ^4F$	3/2	101 245.00				
		5/2	101 276.60				
		7/2	101 321.83				
		9/2	101 382.97				
$3d^3(^2G)4s4p(^3P^\circ)$	$u\ ^2H^\circ$	9/2	*101 696.90*				
		11/2	*101 932.27*				
$3d^3(^2G)4s4p(^3P^\circ)$	$p\ ^2F^\circ$	7/2	*101 864.17*				
		5/2	*102 145.65*				

Cr II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages
$3d^3(^2G)4s4p(^3P^\circ)$	$r\ ^2G^\circ$	9/2	*101 938.04*		
		7/2	*102 121.92*		
$3d^3(^2D)4s4p(^3P^\circ)$	$s\ ^4F^\circ$	3/2	*101 987.[illegible]*		
		5/2	*102 297.15*		
		7/2	*102 492.60*		
		9/2	*102 725.66*		
$3d^4(a\ ^3F)5s$	$f\ ^2F$	5/2	102 148.81		
		7/2	102 243.22		
$3d^3(^4P)4s4p(^3P^\circ)$	$q\ ^4D^\circ$	3/2	*102 602.40*		
		1/2	*102 619.58*		
		5/2	*102 655.95*		
		7/2	*102 831.62*		
$3d^3(^4F)4s4p(^1P^\circ)$	$s\ ^4G^\circ$	5/2	*102 679.00*		
		7/2	*102 915.01*		
		9/2	*103 199.80*		
		11/2	*103 513.67*		
$3d^3(^2P)4s4p(^3P^\circ)$	$x\ ^4S^\circ$	3/2	*102 684.02*		
$3d^4(^3G)5s$	$f\ ^4G$	9/2	103 627.02		
		11/2	103 736.99		
$3d^4\ 4d$	$f\ ^4I$	9/2	103 755.48		
		11/2	103 843.33		
		13/2	103 948.26		
		15/2	104 069.62		
$3d^4\ 4d$	$f\ ^4H$	7/2	103 949.27		
		9/2	104 023.95		
		11/2	104 106.35		
		13/2	104 190.63		
$3d^3(^2D)4s4p(^3P^\circ)$	$o\ ^4D^\circ$	3/2	*104 274.62*		
		5/2	*104 467.83*		
		7/2	*104 680.78*		
$3d^3(^4F)4s4p(^1P^\circ)$	$p\ ^4D^\circ$	1/2	*104 439.77*		
		3/2	*104 616.27*		
		5/2	*104 869.13*		
		7/2	*105 206.69*		
$3d^3(^4F)4s4p(^1P^\circ)$	$r\ ^4F^\circ$	3/2	*104 446.50*		
		5/2	*104 630.01*		
		7/2	*104 875.34*		
		9/2	*105 203.46*		
$3d^4\ 4d$	$a\ ^4K$	11/2	104 460.28		
		13/2	104 539.92		
		15/2	104 633.04		
		17/2	104 734.37		
$3d^4\ 5s$	$g\ ^2G$	7/2	104 543.17		
		9/2	104 666.42		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D)6s$	^6D	1/2	105 098.94		
		3/2	105 168.82		
		5/2	105 285.37		
		7/2	105 447.05		
		9/2	105 650.58		
$3d^4(^5D)4f$	$^4P^\circ$	5/2	*105 122.26*		
		3/2	*105 283.47*		
		1/2	*105 392.48*		
$3d^4\,4d$	$a\,^2K$	13/2	105 124.90		
		15/2	105 285.33		
$3d^4\,4f$	$^6P^\circ$	7/2	*105 173.47*		
		5/2	*105 408.72*		
$3d^4(^5D)4f$	$^6H^\circ$	7/2	*105 197.38*		
		9/2	*105 263.52*		
		11/2	*105 367.93*		
		13/2	*105 508.05*		
		15/2	*105 681.82*		
$3d^4\,4d$	$g\,^4H$	7/2	105 198.98		
		9/2	105 256.34		
		11/2	105 337.97		
		13/2	105 434.42		
$3d^4(^5D)4f$	$^4H^\circ$	7/2	*105 282.58*		
		9/2	*105 406.99*		
		11/2	*105 559.58*		
		13/2	*105 742.62*		
$3d^4\,4d$	$g\,^4G$	9/2	105 365.50		
		11/2	105 423.32		
$3d^4(^5D)4f$	$^6D^\circ$	9/2	*105 398.27*		
		7/2	*105 420.09*		
		5/2	*105 595.35*		
$3d^4(^5D)4f$	$^6G^\circ$	5/2	*105 438.32*		
		7/2	*105 609.47*		
		9/2	*105 623.64*		
		7/2	*105 765.04*		
		13/2	*105 895.59*		
		11/2	*105 898.12*		
$3d^4(^5D)4f$	$^4D^\circ$	7/2	*105 507.52*		
		5/2	*105 582.18*		
$3d^4(^5D)4f$	$^6F^\circ$	3/2	*105 577.19*		
$3d^4(^5D)4f$	$^6F^\circ$	11/2	*105 638.84*		
		7/2	*105 823.86*		
		9/2	*105 870.43*		
$3d^4(^5D)4f$	$^4G^\circ$	5/2	*105 677.49*		
		7/2	*105 724.77*		
		11/2	*106 032.24*		
		9/2	*106 045.32*		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D)4f$	$^4F^\circ$	$^9/_2$	*105 790.06*		
		$^5/_2$	*105 903.05*		
		$^7/_2$	*105 985.63*		
$3d^4(^5D)6s$	^4D	$^1/_2$	105 923.4		
		$^3/_2$	106 030.93		
		$^5/_2$	106 095.64		
		$^7/_2$	106 275.24		
$3d^4\,4d$	$f\,^2I$	$^{11}/_2$	106 145.26		
		$^{13}/_2$	106 342.95		
$3d^3(^2H)4s4p(^3P^\circ)$	$t\,^2H^\circ$	$^{11}/_2$	*106 163.16*		
		$^9/_2$	*106 165.3*		
$3d^3(^2H)4s4p(^3P^\circ)$	$r\,^4G^\circ$	$^5/_2$	*106 719.38*		
		$^7/_2$	*106 779.14*		
		$^9/_2$	*106 791.84*		
		$^{11}/_2$	*106 827.42*		
$3d^3(^4P)4s4p(^3P^\circ)$	$w\,^4S^\circ$	$^3/_2$	*106 726.06*		
$3d^4(^5D)5d$	^6G	$^3/_2$	106 877.20		
		$^5/_2$	106 929.42		
		$^7/_2$	107 006.29		
		$^9/_2$	107 111.84		
		$^{11}/_2$	107 246.87		
		$^{13}/_2$	107 412.09		
$3d^4\,4d$	$i\,^2G$	$^9/_2$	106 923.98		
$3d^4(^5D)5d$	^4S	$^3/_2$	106 924.84		
$3d^3(^2D)4s4p(^3P^\circ)$	$o\,^2F^\circ$	$^5/_2$	*107 022.83*		
		$^7/_2$	*107 153.15*		
$3d^4(^5D)5d$	^6P	$^5/_2$	107 025.34		
		$^3/_2$	107 056.53		
		$^7/_2$	107 114.75		
$3d^3(^4P)4s4p(^3P^\circ)$	$q\,^2D^\circ$	$^3/_2$	*107 212.29*		
		$^5/_2$	*107 355.52*		
$3d^4(^5D)5d$	^6F	$^3/_2$	107 259.87		
		$^5/_2$	107 309.28		
		$^7/_2$	107 386.22		
		$^9/_2$	107 455.55		
		$^{11}/_2$	107 701.34		
$3d^4(^5D)5d$	^4G	$^5/_2$	107 400.84		
		$^7/_2$	107 500.37		
		$^9/_2$	107 632.26		
		$^{11}/_2$	107 794.15		
$3d^4(^5D)5d$	^6D	$^3/_2$	107 414.68		
		$^5/_2$	107 519.44		
		$^7/_2$	107 627.40		
		$^9/_2$	107 696.31		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D)5d$	^4F	3/2	107 516.77		
		5/2	107 726.82		
		7/2	107 850.60		
		9/2	107 948.05		
$3d^4(^5D)5d$	^4D	5/2	107 597.65		
		7/2	107 716.30		
$3d^4\,4d$	$g\ ^4I$	9/2	107 706.84		
		11/2	107 760.85		
		13/2	107 846.75		
		15/2	107 981.81		
$3d^3(^2H)4s4p(^3P^\circ)$	$q\ ^2G^\circ$	9/2	*107 739.20*		
		7/2	*107 918.49*		
$3d^4\,4d$	$h\ ^4H$	7/2	107 829.54		
		9/2	107 922.41		
		11/2	108 017.98		
		13/2	108 104.01		
$3d^3(^2H)4s4p(^3P^\circ)$	$x\ ^2I^\circ$	11/2	*107 850.50*		
		13/2	*108 031.16*		
$3d^4(^5D)5d$	^6S	5/2	109 394.47		
$3d^4(^5D)6p$	$^6F^\circ$	1/2	*109 564.97*		
		3/2	*109 611.24*		
		5/2	*109 694.38*		
		7/2	*109 812.06*		
		9/2	*109 965.71*		
		11/2	*110 154.04*		
$3d^4(^5D)6p$	$^4P^\circ$	3/2	*109 661.41*		
		5/2	*109 974.05*		
$3d^4(^5D)6p$	$^6P^\circ$	3/2	*109 772.35*		
		5/2	*109 864.95*		
		7/2	*110 097.11*		
$3d^3(^2D)4s4p(^3P^\circ)$	$p\ ^2D^\circ$	3/2	*109 914.68*		
		5/2	*109 943.57*		
$3d^4(^5D)6p$	$^6D^\circ$	1/2	*109 923.45*		
		3/2	*110 007.57*		
		5/2	*110 138.26*		
		7/2	*110 272.15*		
		9/2	*110 385.80*		
$3d^4(^5D)6p$	$^4F^\circ$	5/2	*110 315.08*		
		7/2	*110 471.38*		
		9/2	*110 665.54*		
$3d^4(^5D)6p$	$^4D^\circ$	3/2	*110 931.72*		
		5/2	*111 082.38*		
		7/2	*111 269.22*		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D)5f$	$^6H^\circ$	$^5/_2$	*115 208.37*		
		$^9/_2$	*115 288.81*		
		$^7/_2$	*115 309.16*		
		$^{11}/_2$	*115 396.86*		
		$^{13}/_2$	*115 546.61*		
		$^{15}/_2$	*115 734.85*		
$3d^4(^5D)7s$	^6D	$^1/_2$	115 234.53		
		$^3/_2$	115 301.92		
		$^5/_2$	115 417.88		
		$^7/_2$	115 581.62		
		$^9/_2$	115 788.38		
$3d^4(^5D)5f$	$^6P^\circ$	$^7/_2$	*115 249.31*		
		$^3/_2$	*115 747.63*		
		$^5/_2$	*115 767.13*		
$3d^4(^5D)5f$	$^4P^\circ$	$^3/_2$	*115 298.53*		
$3d^4(^5D)5f$	$^6D^\circ$	$^5/_2$	*115 309.64*		
		$^9/_2$	*115 393.47*		
		$^3/_2$	*115 430.93*		
		$^7/_2$	*115 591.20*		
$3d^4(^5D_0)5g$	$^2[4]$	$^9/_2$	115 371.26		
		$^7/_2$	115 371.39		
$3d^4(^5D)5f$	$^4H^\circ$	$^7/_2$	*115 398.46*		
		$^9/_2$	*115 430.45*		
		$^{11}/_2$	*115 598.97*		
		$^{13}/_2$	*115 782.87*		
$3d^4(^5D)5f$	$^4G^\circ$	$^5/_2$	*115 408.13*		
		$^7/_2$	*115 627.76*		
		$^{11}/_2$	*115 916.22*		
		$^9/_2$	*115 927.40*		
$3d^4(^5D_1)5g$	$^2[4]$	$^9/_2$	115 411.98		
		$^7/_2$	115 412.17		
$3d^4(^5D_1)5g$	$^2[5]$	$^{11}/_2$	115 444.00		
		$^9/_2$	115 444.02		
$3d^4(^5D)5f$	$^6G^\circ$	$^7/_2$	*115 447.64*		
		$^5/_2$	*115 461.80*		
		$^{11}/_2$	*115 585.21*		
		$^9/_2$	*115 592.43*		
		$^{13}/_2$	*115 836.61*		
$3d^4(^5D_2)5g$	$^2[5]$	$^{11}/_2$	115 554.95		
		$^9/_2$	115 555.05		
$3d^4(^5D_2)5g$	$^2[4]$	$^9/_2$	115 556.30		
		$^7/_2$	115 556.44		
$3d^4(^5D_2)5g$	$^2[6]$	$^{13}/_2$	115 560.97		
		$^{11}/_2$	115 561.07		

Cr II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages
$3d^4(^5D)5f$	$^6F^{\circ}$	5/2	*115 570.91*		
		3/2	*115 605.95*		
		7/2	*115 797.28*		
		9/2	*115 824.49*		
		11/2	*115 840.45*		
$3d^4(^5D)7s$	^4D	3/2	115 640.42		
		5/2	115 818.49		
		7/2	116 047.90		
$3d^4(^5D)5f$	$^4F^{\circ}$	5/2	*115 672.84*		
		7/2	*115 882.21*		
$3d^4(^5D_3)5g$	$^2[7]$	15/2	115 723.70		
		13/2	115 723.89		
$3d^4(^5D_3)5g$	$^2[3]$	7/2	115 732.06		
		5/2	115 732.23		
$3d^4(^5D_3)5g$	$^2[4]$	7/2	115 738.43		
$3d^4(^5D_3)5g$	$^2[6]$	13/2	115 741.12		
		11/2	115 741.30		
$3d^4(^5D_3)5g$	$^2[5]$	11/2	115 742.39		
		9/2	115 742.55		
$3d^4(^5D)5f$	$^4D^{\circ}$	5/2	*115 810.34*		
$3d^4(^5D_4)5g$	$^2[8]$	17/2	115 927.17		
		15/2	115 927.30		
$3d^4(^5D_4)5g$	$^2[2]$	5/2	115 926.73		
$3d^3(^4P)4s4p(^1P^{\circ})$	$^4P^{\circ}$	1/2	*115 943.7*		
		3/2	*115 966.7*		
		5/2	*116 041.7*		
$3d^4(^5D_4)5g$	$^2[3]$	7/2	115 945.47		
$3d^4(^5D_4)5g$	$^2[4]$	9/2	115 962.72		
		7/2	115 962.84		
$3d^4(^5D_4)5g$	$^2[7]$	15/2	115 968.86		
		13/2	115 969.19		
$3d^4(^5D_4)5g$	$^2[5]$	11/2	115 975.22		
		9/2	115 975.44		
$3d^4(^5D_4)5g$	$^2[6]$	13/2	115 979.31		
		11/2	115 979.59		
$3d^4(^5D)6d$	^6G	3/2	116 171.71		
		5/2	116 213.38		
		7/2	116 281.95		
		9/2	116 388.95		
		11/2	116 531.26		
		13/2	116 708.67		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D)6d$	^6P	$^3/_2$	116 253.35		
		$^5/_2$	116 295.06		
		$^7/_2$	116 385.67		
$3d^4(^5D)6d$	^4S	$^3/_2$	116 355.55		
$3d^4(^5D)6d$	^6F	$^1/_2$	116 360.98		
		$^3/_2$	116 429.23		
		$^5/_2$	116 477.51		
		$^7/_2$	116 572.42		
		$^9/_2$	116 601.65		
		$^{11}/_2$	116 829.01		
$3d^4(^5D)6d$	^6D	$^3/_2$	116 581.74		
		$^5/_2$	116 687.20		
		$^7/_2$	116 790.31		
		$^9/_2$	116 831.84		
$3d^4(^5D)6d$	^4G	$^5/_2$	116 877.15		
		$^7/_2$	116 985.30		
		$^9/_2$	117 141.58		
		$^{11}/_2$	117 342.41		
$3d^4(^5D)6d$	^4D	$^5/_2$	117 072.83		
		$^7/_2$	117 263.48		
$3d^4(^5D)6d$	^4F	$^5/_2$	117 228.51		
		$^9/_2$	117 488.50		
		$^7/_2$	117 520.75		
$3d^4(^5D)6d$	^4P	$^3/_2$	117 381.64		
		$^5/_2$	117 481.24		
$3d^4(^5D)6d$	^6S	$^5/_2$	117 672.56		
$3d^3(^4P)4s4p(^3P^\circ)$	$^4D^\circ$	$^3/_2$	*118 622.6*		
		$^5/_2$	*118 640.08*		
		$^1/_2$	*118 661.4*		
		$^7/_2$	*118 753.64*		
$3d^4(^5D)8s$	^6D	$^1/_2$	120 702.6		
		$^3/_2$	120 757.1		
		$^5/_2$	120 870.78		
		$^7/_2$	121 036.43		
		$^9/_2$	121 246.83		
$3d^4(^5D_1)6g$	$^2[5]$	$^{11}/_2$	120 820.04		
		$^9/_2$	120 820.09		
$3d^4(^5D_2)6g$	$^2[6]$	$^{13}/_2$	120 938.67		
$3d^4(^5D_3)6g$	$^2[7]$	$^{15}/_2$	121 105.81		
		$^{13}/_2$	121 106.04		
$3d^4(^5D_3)6g$	$^2[6]$	$^{13}/_2$	121 114.05		
		$^{11}/_2$	121 114.25		
$3d^4(^5D_3)6g$	$^2[5]$	$^{11}/_2$	121 115.31		
		$^9/_2$	121 115.45		

Cr II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^4(^5D_4)6g$	$^2[8]$	$^{17}/_2$	121 315.57		
		$^{15}/_2$	121 315.83		
$3d^4(^5D_4)6g$	$^2[4]$	$^9/_2$	121 335.13		
		$^7/_2$	121 335.25		
$3d^4(^5D_4)6g$	$^2[7]$	$^{15}/_2$	121 338.36		
		$^{13}/_2$	121 338.68		
$3d^4(^5D_4)6g$	$^2[6]$	$^{13}/_2$	121 344.81		
		$^{11}/_2$	121 345.09		
$3d^4(^5D)9s$	^6D	$^7/_2$	124 310.74		
		$^9/_2$	124 523.96		
Cr III ($^5D_0$)	*Limit*		132 966		

Cr III

$Z=24$

Ti I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4\ ^5D_0$

Ionization energy = 249 700±200 cm^{-1} (30.96±0.02 eV)

The analysis was begun by White (1929) who found systems of triplet and quintet terms, which were later unified by Bowen (1937). F. L. Moore considerably augmented this work and provided his unpublished results to C. E. Moore (1952) for inclusion in her compilation. Ekberg (1976) has remeasured the spectrum in the region of 750–2700 Å with an uncertainty of ±0.005 Å and established 76 new levels while rejecting 26 of those found by Moore.

We give the results of Ekberg for the $3d^4$, $3d^3 4s$, and $3d^3 4p$ configurations, including his calculated percentage compositions for the levels. The level uncertainty is ±0.1 cm^{-1}. The $3d^3(^4F)4d\ ^5H$ term is from White. The other terms of $3d^3 4d$ and those of $3d^3 5s$ are from the analysis by Moore. The uncertainty of these levels is ±0.5 cm^{-1}.

Johansson and Ekberg (1982) discovered three terms of the $3d^2 4s 4p$ configuration and gave their results in a preliminary report.

The ionization energy was derived by Catalán and Velasco (1952) from the 2-member $3d^3 ns$ series.

References

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Cr III

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4$	^{5}D	0	0.00	100		
		1	62.22	100		
		2	183.16	100		
		3	356.55	100		
		4	576.08	100		
$3d^4$	^{3}P2	0	16 771.36	58	41	^{3}P1
		1	17 168.56	59	41	
		2	17 851.18	59	41	
$3d^4$	^{3}H	4	17 273.70	99		
		5	17 396.92	99		
		6	17 530.65	100		
$3d^4$	^{3}F2	2	18 451.84	77	22	^{3}F1
		3	18 511.18	77	22	
		4	18 583.39	77	21	
$3d^4$	^{3}G	3	20 703.64	98		
		4	20 852.95	99		
		5	20 996.04	99		
$3d^4$	^{1}G2	4	25 138.87	64	35	^{1}G1
$3d^4$	^{3}D	3	25 726.44	100		
		2	25 780.94	100		
		1	25 848.31	100		
$3d^4$	^{1}I	6	26 014.89	100		
$3d^4$	^{1}S2	0	27 372.32	77	22	^{1}S1

Cr III—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages		
$3d^4$	^{1}D2	2	32 151.99	77	22	^{1}D1
$3d^4$	^{1}F	3	37 005.16	100		
$3d^4$	^{3}F1	4	43 286.71	79	21	^{3}F2
		2	43 304.53	77	22	
		3	43 322.17	78	22	
$3d^4$	^{3}P1	2	43 441.99	59	41	^{3}P2
		1	43 916.59	59	41	
		0	44 141.36	59	41	
$3d^3(^4F)4s$	^{5}F	1	49 492.46	100		
		2	49 628.25	100		
		3	49 828.91	100		
		4	50 091.17	100		
		5	50 410.06	100		
$3d^4$	^{1}G1	4	49 768.65	65	35	^{1}G2
$3d^3(^4F)4s$	^{3}F	2	56 651.37	100		
		3	56 993.08	100		
		4	57 423.40	100		
$3d^3(^4P)4s$	^{5}P	1	63 045.74	100		
		2	63 174.30	90		
		3	63 421.92	100		
$3d^4$	^{1}D1	2	65 763.21	78	22	^{1}D2
$3d^3(^2G)4s$	^{3}G	3	65 892.38	100		
		4	66 080.01	100		
		5	66 225.09	90		
$3d^3(^4P)4s$	^{3}P	0	69 601.50	50	41	(^{2}P) ^{3}P
		1	69 781.89	56	34	
		2	70 292.86	71	15	
$3d^3(^2G)4s$	^{1}G	4	69 659.74	97		
$3d^3(^2P)4s$	^{3}P	2	70 191.01	63	26	(^{4}P) ^{3}P
		1	70 345.56	53	41	
		0	70 487.01	50	41	
$3d^3(^2D2)4s$	^{3}D	1	70 981.26	65	19	(^{2}D1) ^{3}D
		3	71 323.06	79	21	(^{2}D1) ^{3}D
		2	71 323.27	50	21	(^{2}P) ^{3}P
$3d^3(^2H)4s$	^{3}H	4	71 677.19	97		
		5	71 737.56	99		
		6	71 870.17	100		
$3d^3(^2P)4s$	^{1}P	1	73 881.54	96		
$3d^3(^2D2)4s$	^{1}D	2	74 788.88	77	22	(^{2}D1) ^{3}D
$3d^3(^2H)4s$	^{1}H	5	75 351.63	100		

Cr III—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^3(^4F)4s$	^5F	4	84 374.12	100		
		3	84 484.76	100		
		2	84 572.53	100		
$3d^3(^4F)4s$	^3F	3	87 770.68	100		
$3d^3(^4F)4p$	$^5G°$	2	*93 766.21*	100		
		3	*94 029.99*	100		
		4	*94 376.29*	100		
		5	*94 801.70*	100		
		6	*95 306.09*	100		
$3d^3(^4F)4p$	$^5F°$	1	*96 149.25*	52	35	$(^4F)\ ^5D°$
		2	*96 386.31*	44	29	$(^4F)\ ^5D°$
		3	*97 121.42*	61	37	$(^4F)\ ^5D°$
		4	*97 359.81*	73	25	$(^4F)\ ^5D°$
		5	*97 619.48*	90		
$3d^3(^4F)4p$	$^5D°$	0	*96 693.97*	97		
		3	*96 714.04*	51	35	$(^4F)\ ^5F°$
		1	*96 774.38*	79	18	
		2	*96 922.02*	56	42	
		4	*97 098.28*	72	26	
$3d^3(^4F)4p$	$^3D°$	1	*97 077.96*	57	30	$(^4F)\ ^5F°$
		2	*97 306.59*	67	13	$(^4F)\ ^5F°$
		3	*97 683.99*	79	9	$(^4F)\ ^5D°$
$3d^3(^4F)4p$	$^3G°$	3	*99 841.67*	93	5	$(^2G)\ ^3G°$
		4	*100 100.66*	93		
		5	*100 423.01*	92		
$3d^3(^4F)4p$	$^3F°$	2	*101 444.57*	96		
		3	*101 746.21*	95		
		4	*102 100.76*	96		
$3d^3(^2D1)4s$	^3D	3	102 236.46	79	21	$(^2D2)\ ^3D$
		2	102 333.49	78	22	
		1	102 401.80	77	23	
$3d^3(^2D1)4s$	^1D	2	105 626.89	78	22	$(^2D2)\ ^1D$
$3d^3(^4P)4p$	$^5P°$	1	*108 250.89*	99		
		2	*108 461.40*	98		
		3	*108 795.84*	99		
$3d^3(^4P)4p$	$^5D°$	0	*108 697.63*	56	27	$(^4P)\ ^3P°$
		1	*108 864.98*	60	34	
		2	*109 570.89*	50	33	
		3	*109 722.79*	96		
		4	*110 154.89*	97		
$3d^3(^4P)4p$	$^3P°$	2	*108 972.90*	52	30	$(^4P)\ ^5D°$
		0	*109 458.11*	47	41	
		1	*109 570.62*	54	37	
$3d^3(^2G)4p$	$^3H°$	4	*109 534.25*	85	13	$(^2H)\ ^3H°$
		5	*109 944.98*	83	14	
		6	*110 507.18*	85	15	

Cr III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^3(^2G)4p$	$^3G^\circ$	3	*111 376.09*	86		5	$(^4F)\ ^3G^\circ$
		4	*111 644.76*	89		5	
		5	*111 856.97*	86		5	
$3d^3(^2G)4p$	$^3F^\circ$	4	*112 372.88*	52		37	$(^2G)\ ^1G^\circ$
		2	*112 399.84*	73		13	$(^2D2)\ ^3F^\circ$
		3	*112 467.01*	70		8	$(^2D2)\ ^3F^\circ$
$3d^3(^2G)4p$	$^1G^\circ$	4	*113 115.21*	59		30	$(^2G)\ ^3F^\circ$
$3d^3(^2G)4p$	$^1F^\circ$	3	*113 328.80*	72		12	$(^2D2)\ ^1F^\circ$
$3d^3(^4P)4p$	$^5S^\circ$	2	*113 357.04*	95			
$3d^3(^2G)4p$	$^1H^\circ$	5	*113 419.93*	77		18	$(^2H)\ ^1H^\circ$
$3d^3(^2P)4p$	$^1D^\circ$	2	*113 767.13*	43		22	$(^2D2)\ ^1D^\circ$
$3d^3(^2P)4p$	$^3P^\circ$	0	*113 861.47*	62		22	$(^2D2)\ ^3P^\circ$
		1	*113 899.43*	57		23	
		2	*114 599.14*	47		22	
$3d^3(^2P)4p$	$^3D^\circ$	1	*114 716.79*	70		22	$(^4P)\ ^3D^\circ$
		2	*115 182.15*	50		21	
		3	*115 554.28*	48		31	
$3d^3(^2H)4p$	$^3H^\circ$	4	*115 571.96*	83		13	$(^2G)\ ^3H^\circ$
		5	*115 670.74*	85		14	
		6	*115 844.58*	85		15	
$3d^3(^2D2)4p$		1	*116 372.92*	30	$^1P^\circ$	28	$(^4P)\ ^3D^\circ$
$3d^3(^2D2)4p$	$^3F^\circ$	2	*116 391.66*	40		25	$(^4P)\ ^3D^\circ$
		4	*117 101.58*	68		17	$(^2D1)\ ^3F^\circ$
$3d^3(^2P)4p$	$^3S^\circ$	1	*116 451.19*	60		13	$(^4P)\ ^3D^\circ$
$3d^3(^4P)4p$	$^3D^\circ$	3	*116 532.95*	44		21	$(^2D2)\ ^3F^\circ$
		2	*116 782.05*	34		31	$(^2P)\ ^3D^\circ$
$3d^3(^2P)4p$		1	*116 774.00*	32	$^3S^\circ$	21	$(^4P)\ ^3D^\circ$
$3d^3(^2D2)4p$		3	*116 969.09*	37	$^3F^\circ$	32	$(^2P)\ ^3D^\circ$
$3d^3(^2H)4p$	$^3I^\circ$	5	*117 145.85*	98			
		6	*117 488.95*	99			
		7	*117 923.89*	100			
$3d^3(^2D2)4p$	$^3D^\circ$	1	*118 165.15*	60		17	$(^2D2)\ ^3F^\circ$
		2	*118 422.99*	72		16	
		3	*118 599.11*	71		16	
$3d^3(^2H)4p$	$^1G^\circ$	4	*118 900.53*	81		16	$(^2F)\ ^1G^\circ$
$3d^3(^2D2)4p$	$^3P^\circ$	2	*119 421.42*	41		30	$(^2P)\ ^3P^\circ$
		1	*119 489.02*	42		28	
		0	*119 625.62*	46		26	
$3d^3(^2H)4p$	$^1H^\circ$	5	*119 612.80*	78		18	$(^2G)\ ^1H^\circ$

Cr III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^3(^2D2)4p$	$^1F^{\circ}$	3	*119 846.47*	61	18	$(^2D1)\ ^1F^{\circ}$
$3d^3(^2H)4p$	$^1I^{\circ}$	6	*120 432.99*	90		
$3d^3(^2H)4p$	$^3G^{\circ}$	5	*120 700.27*	80		
		4	*120 749.55*	88		
		3	*120 767.26*	90		
$3d^3(^4P)4p$	$^3S^{\circ}$	1	*121 446.77*	87		
$3d^3(^2P)4p$	$^1P^{\circ}$	1	*122 396.49*	71	17	$(^2D2)\ ^1F^{\circ}$
$3d^3(^2D2)4p$	$^1D^{\circ}$	2	*123 105.84*	46	41	$(^2P)\ ^1D^{\circ}$
$3d^3(^2F)4p$	$^3F^{\circ}$	2	*128 754.62*	95		
		3	*128 784.13*	94		
		4	*128 850.49*	94		
$3d^3(^2F)4p$	$^3G^{\circ}$	3	*131 116.36*	92	5	$(^2H)\ ^3G^{\circ}$
		4	*131 265.66*	92	5	$(^2H)\ ^3G^{\circ}$
		5	*131 450.16*	96		
$3d^3(^2F)4p$	$^1D^{\circ}$	2	*132 070.71*	79	18	$(^2D1)\ ^1D^{\circ}$
$3d^3(^2F)4p$	$^3D^{\circ}$	3	*132 117.50*	92	5	$(^2D1)\ ^3D^{\circ}$
		2	*132 499.78*	91	5	
		1	*132 734.22*	94	5	
$3d^3(^2F)4p$	$^1G^{\circ}$	4	*133 969.57*	83	15	$(^2H)\ ^1G^{\circ}$
$3d^3(^2F)4p$	$^1F^{\circ}$	3	*134 887.54*	94		
$3d^3(^2D1)4p$	$^3D^{\circ}$	1	*146 936.18*	77	19	$(^2D2)\ ^3D^{\circ}$
		2	*146 973.33*	77	18	
		3	*147 090.73*	77	17	
$3d^3(^2D1)4p$	$^1D^{\circ}$	2	*148 573.81*	53	20	$(^2D2)\ ^1D^{\circ}$
$3d^3(^2D1)4p$	$^3F^{\circ}$	2	*149 344.03*	62	20	$(^2D2)\ ^3F^{\circ}$
		3	*149 383.64*	73	23	
		4	*149 626.30*	75	23	
$3d^3(^2D1)4p$	$^3P^{\circ}$	2	*151 351.27*	75	23	$(^2D2)\ ^3P^{\circ}$
		1	*151 687.44*	75	24	
		0	*151 852.12*	76	24	
$3d^3(^2D1)4p$	$^1F^{\circ}$	3	*152 037.21*	77	20	$(^2D)\ ^1F^{\circ}$
$3d^3(^4F)4d$	^5H	3	152 927.3			
		4	153 099.1			
		5	153 314.6			
		6	153 571.7			
		7	153 871.7			
$3d^3(^2D1)4p$	$^1P^{\circ}$	1	*156 929.93*	75	24	$(^2D2)\ ^1P^{\circ}$

Cr III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3d^3(^4F)5s$	^5F	1	157 303.2	
		2	157 435.1	
		3	157 637.3	
		4	157 908.0	
		5	158 241.8	
$3d^3(^4F)4d$	^3G	3	158 066.7	
		4	158 442.9	
$3d^3(^4F)5s$	^3F	2	159 031.8	
		3	159 375.6	
		4	159 803.3	
$3d^3(^4F)4d$	^3F	3	158 463.6	
		4	158 623.7	
$3d^3(^2H)4d$	^3I	5	173 200.5	
		6	173 662.8	
$3d^2(^3F)4s4p(^3P^\circ)$	$^5G^\circ$	2	175 965.9	
		3	176 274.8	
		4	176 684.7	
		5	177 196.0	
		6	177 803.9	
$3d^2(^3F)4s4p(^3P^\circ)$	$^5F^\circ$	1	177 292.3	
		2	177 466.1	
		3	177 724.9	
		4	178 063.9	
		5	178 473.5	
$3d^2(^3F)4s4p(^3P^\circ)$	$^5D^\circ$	0	179 815.5	
		1	179 863.2	
		2	179 951.6	
		3	180 100.8	
		4	180 334.0	
Cr IV ($^4F_{3/2}$)	*Limit*		249 700	

Cr IV

$Z=24$

Sc I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3\ {}^4F_{3/2}$

Ionization energy = 396 500±400 cm^{-1} (49.16±0.05 eV)

The initial analysis was by White (1929) and was later extended by Bowen (1937). Ekberg (1973) reobserved the spectrum and extended the analysis but reported no levels above 211 574 cm^{-1}. With new observations Ekberg and Engström (1982) greatly increased the range of known energy levels by establishing 59 of the 67 possible $3d^2 4d$ levels and 15 of the 16 $3d^2 5s$ levels, as well as the $3d^2({}^1S)4s\ {}^2S_{1/2}$ level. The uncertainty of the energy level values is ±0.4 cm^{-1}. Percentage compositions for all the known levels were obtained by these authors.

From the $3d^2({}^3F)ns$ terms for $n=4,5$ and an extrapolated value for the change in effective quantum number between them, Ekberg and Engström determined the value for the ionization energy.

References

Bowen, I. S. (1937), Phys. Rev. 52, 1153.
Ekberg, J. O. (1973), Phys. Scr. 7, 55.
Ekberg, J. O., and Engström, L. (1982), Phys. Scr. 25, 6[illegible].
White, H. E. (1929), Phys. Rev. 33, 672.

Cr IV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^3$	^4F	3/2	0.0	100		
		5/2	237.4	100		
		7/2	556.4	100		
		9/2	945.5	100		
$3d^3$	^4P	1/2	14 059.9	100		
		3/2	14 177.5	99		
		5/2	14 472.2	100		
$3d^3$	^2G	7/2	15 053.6	100		
		9/2	15 402.4	100		
$3d^3$	^2P	3/2	19 439.4	93		
		1/2	19 520.8	100		
$3d^3$	$^2D2$	3/2	20 651.0	72	22	$^2D1$
		5/2	20 665.5	78	22	
$3d^3$	^2H	9/2	21 066.9	100		
		11/2	21 321.1	100		
$3d^3$	^2F	7/2	34 364.3	100		
		5/2	34 556.9	100		
$3d^3$	$^2D1$	5/2	52 976.4	78	22	$^2D2$
		3/2	53 143.8	77	23	
$3d^2({}^3F)4s$	^4F	3/2	103 996.5	100		
		5/2	104 258.6	100		
		7/2	104 630.2	100		
		9/2	105 105.7	100		
$3d^2({}^3F)4s$	^2F	5/2	109 941.5	100		
		7/2	110 691.8	100		
$3d^2({}^1D)4s$	^2D	5/2	118 571.5	65	35	$({}^3P)\ {}^4P^{\circ}$
		3/2	118 727.8	58	42	

Cr IV—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^2(^3P)4s$	^4P	1/2	119 014.6	100		
		3/2	119 252.0	58	42	$(^1D)\ ^2D$
		5/2	119 671.3	65	35	$(^1D)\ ^2D$
$3d^2(^3P)4s$	^2P	1/2	124 410.5	100		
		3/2	124 734.4	99		
$3d^2(^1G)4s$	^2G	9/2	127 195.7	100		
		7/2	127 208.3	100		
$3d^2(^1S)4s$	^2S	1/2	155 354.4	100		
$3d^2(^3F)4p$	$^4G^{\circ}$	5/2	*157 361.4*	96		
		7/2	*157 933.3*	97		
		9/2	*158 629.5*	98		
		11/2	*159 449.2*	100		
$3d^2(^3F)4p$	$^4F^{\circ}$	3/2	*158 527.7*	97		
		5/2	*158 892.7*	98		
		7/2	*159 352.0*	98		
		9/2	*159 863.6*	98		
$3d^2(^3F)4p$	$^2F^{\circ}$	5/2	*160 305.4*	78	5	$(^1D)\ ^2F^{\circ}$
		7/2	*160 937.4*	79	14	$(^3F)\ ^4D^{\circ}$
$3d^2(^3F)4p$	$^2D^{\circ}$	3/2	*160 986.5*	45	42	$(^3F)\ ^4D^{\circ}$
		5/2	*162 301.4*	60	22	
$3d^2(^3F)4p$	$^4D^{\circ}$	1/2	*161 354.8*	94	6	$(^3P)\ ^4P^{\circ}$
		5/2	*161 495.3*	67	15	$(^3F)\ ^2D^{\circ}$
		3/2	*161 756.3*	52	36	$(^3F)\ ^2D^{\circ}$
		7/2	*162 064.9*	81	13	$(^3F)\ ^2F^{\circ}$
$3d^2(^3F)4p$	$^2G^{\circ}$	7/2	*164 909.7*	96		
		9/2	*165 430.0*	96		
$3d^2(^3P)4p$	$^2S^{\circ}$	1/2	*167 896.5*	99		
$3d^2(^3P)4p$	$^4S^{\circ}$	3/2	*171 081.3*	91	9	$(^1D)\ ^2P^{\circ}$
$3d^2(^1D)4p$	$^2P^{\circ}$	3/2	*172 184.0*	84	9	$(^3P)\ ^4S^{\circ}$
		1/2	*172 823.2*	96		
$3d^2(^1D)4p$	$^2F^{\circ}$	5/2	*172 636.4*	87	7	$(^3F)\ ^2F^{\circ}$
		7/2	*173 366.0*	84	7	$(^3P)\ ^4D^{\circ}$
$3d^2(^3P)4p$	$^4D^{\circ}$	1/2	*173 431.9*	98	5	$(^3F)\ ^4D^{\circ}$
		3/2	*173 659.1*	92	5	$(^3F)\ ^4D^{\circ}$
		5/2	*174 096.2*	80		
		7/2	*174 846.2*	88	7	$(^1D)\ ^2F^{\circ}$
$3d^2(^1D)4p$	$^2D^{\circ}$	3/2	*174 539.7*	83	6	$(^3F)\ ^2D^{\circ}$
		5/2	*174 968.6*	82	6	
$3d^2(^3P)4p$	$^4P^{\circ}$	1/2	*176 690.9*	99		
		3/2	*176 916.7*	99		
		5/2	*177 408.5*	96		

Cr IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^2(^1G)4p$	$^2G^o$	$^7/_2$	*177 916.5*	95		
		$^9/_2$	*178 030.0*	95		
$3d^2(^3P)4p$	$^2D^o$	$^5/_2$	*181 243.1*	81	12	$(^3F)\ ^2D^o$
		$^3/_2$	*181 277.9*	79	10	
$3d^2(^1G)4p$	$^2H^o$	$^9/_2$	*182 679.2*	99		
		$^{11}/_2$	*183 444.2*	100		
$3d^2(^3P)4p$	$^2P^o$	$^1/_2$	*183 720.3*	99		
		$^3/_2$	*183 875.6*	97		
$3d^2(^1G)4p$	$^2F^o$	$^7/_2$	*186 980.8*	96		
		$^5/_2$	*187 519.0*	97		
$3d^2(^1S)4p$	$^2P^o$	$^1/_2$	*210 559.2*	98		
		$^3/_2$	*211 575.9*	98		
$3d^2(^3F)4d$	^4G	$^5/_2$	232 566.1	89	12	$(^3F)\ ^2F$
		$^7/_2$	232 896.6	87	11	$(^3F)\ ^4H$
		$^9/_2$	233 236.7	82	18	$(^3F)\ ^4H$
		$^{11}/_2$	233 647.0	80	19	$(^3F)\ ^4H$
$3d^2(^3F)4d$	^2F	$^5/_2$	233 117.3	82	12	$(^3F)\ ^4G$
		$^7/_2$	233 637.6	89		
$3d^2(^3F)4d$	^4H	$^7/_2$	233 358.8	89	11	$(^3F)\ ^4G$
		$^9/_2$	233 708.5	82	18	
		$^{11}/_2$	234 100.1	80	20	
		$^{13}/_2$	234 500.9	100		
$3d^2(^3F)4d$	^4D	$^1/_2$	233 618.4	97		
		$^3/_2$	233 798.9	98		
		$^5/_2$	234 085.2	98		
		$^7/_2$	234 502.1	95		
$3d^2(^3F)4d$	^2P	$^1/_2$	235 743.0	88	7	$(^1D)\ ^2P$
		$^3/_2$	236 491.4	89	6	
$3d^2(^3F)4d$	^4P	$^1/_2$	237 798.2	86	13	$(^3P)\ ^4P$
		$^3/_2$	238 100.4	85	13	
		$^5/_2$	238 447.1	84	14	
$3d^2(^3F)4d$	^2G	$^7/_2$	237 999.5	84	12	$(^1D)\ ^2G$
		$^9/_2$	238 561.3	84	12	
$3d^2(^3F)4d$	^2D	$^3/_2$	239 541.4	78	18	$(^1D)\ ^2D$
		$^5/_2$	239 822.2	75	19	
$3d^2(^3F)4d$	^2H	$^9/_2$	239 582.6	91	9	$(^1G)\ ^2H$
		$^{11}/_2$	240 268.8	90	9	
$3d^2(^3F)4d$	^4F	$^3/_2$	240 967.9	96		
		$^5/_2$	241 182.5	95		
		$^7/_2$	241 472.8	96		
		$^9/_2$	241 832.5	95		

Cr IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^2(^3P)4d$	^2P	$^3/_2$	247 099.1	60	40	$(^1D)\ ^2P$
		$^1/_2$	247 765.0	59	38	
$3d^2(^1D)4d$	^2F	$^5/_2$	247 239.3	84	15	$(^3P)\ ^2F$
		$^7/_2$	247 546.7	86	11	
$3d^2(^1D)4d$	^2G	$^9/_2$	249 932.5	75	8	$(^1G)\ ^2G$
		$^7/_2$	250 007.7	79	8	
$3d^2(^3P)4d$	^4F	$^5/_2$	250 535.2	91		
		$^7/_2$	250 752.7	86	6	$(^3P)\ ^4D$
		$^9/_2$	251 093.1	86	8	$(^1G)\ ^2G$
$3d^2(^3P)4d$	^4D	$^3/_2$	251 017.3	97		
		$^1/_2$	251 095.6	90		
		$^5/_2$	251 137.8	94		
		$^7/_2$	251 342.7	93	5	$(^3P)\ ^4F$
$3d^2(^3F)5s$	^4F	$^3/_2$	251 563.9	100		
		$^5/_2$	251 8[illegible]7.0	97		
		$^7/_2$	252 1[illegible]8.3	98		
		$^9/_2$	252 694.5	100		
$3d^2(^3P)4d$	^2F	$^5/_2$	252 464.8	54	37	$(^1G)\ ^2F$
		$^7/_2$	252 532.8	56	36	
$3d^2(^3F)5s$	^2F	$^5/_2$	253 476.1	97		
		$^7/_2$	254 212.1	98		
$3d^2(^3P)4d$	^4P	$^5/_2$	254 534.6	81	13	$(^3F)\ ^4P$
$3d^2(^3P)4d$	^2D	$^3/_2$	255 662.3	35	27	$(^1D)\ ^2D$
		$^5/_2$	255 836.9	38	35	
$3d^2(^1D)4d$	^2P	$^1/_2$	255 803.6	51	34	$(^3P)\ ^2P$
		$^3/_2$	256 306.2	43	31	$(^3P)\ ^2D$
$3d^2(^1G)4d$	^2I	$^{11}/_2$	256 853.2	100		
		$^{13}/_2$	256 885.4	100		
$3d^2(^1G)4d$	^2G	$^7/_2$	257 588.6	88	7	$(^3F)\ ^2G$
		$^9/_2$	257 714.4	87	7	
$3d^2(^1G)4d$	^2H	$^9/_2$	259 755.4	91	9	$(^3F)\ ^2H$
		$^{11}/_2$	259 799.6	91	9	
$3d^2(^1G)4d$	^2F	$^7/_2$	263 875.9	62	27	$(^3P)\ ^2F$
		$^5/_2$	263 971.0	61	27	
$3d^2(^1D)5s$	^2D	$^5/_2$	265 031.6	96		
		$^3/_2$	265 048.6	98		
$3d^2(^1G)4d$	^2D	$^3/_2$	266 878.0	64	32	$(^3P)\ ^2D$
		$^5/_2$	266 931.7	64	33	
$3d^2(^3P)5s$	^4P	$^1/_2$	266 946.6	100		
		$^3/_2$	267 130.4	99		
		$^5/_2$	267 469.0	96		

Cr IV—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
$3d^2(^3P)5s$	^2P	$\frac{1}{2}$	268 458.1	100
		$\frac{3}{2}$	268 813.4	98
$3d^2(^1G)5s$	^2G	$\frac{7}{2}$	273 865.3	100
		$\frac{9}{2}$	273 866.6	100
Cr V ($^3F_2$)	*Limit*		396 500	

Cr v

$Z=24$

Ca I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2\ {}^3F_2$

Ionization energy $= 560\,200 \pm 300$ cm^{-1} (69.46 ± 0.04 eV)

The initial analysis is due to White (1929) who reported levels of the $3d^2$, $3d4s$, $3d4p$, and $3d4d$ configurations. Additions and revisions were made by Cady and Edlén and were communicated to Moore for inclusion in her AEL compilation (1952). The spectrum was completely reobserved in the range of 400–1800 Å by Ekberg (1973) whose results are quoted here. The uncertainty in his level values is given as ± 0.5 cm^{-1}. He added the ${}^1S_0$ level of $3d^2$ and all the known levels of $3d4d$ and $3d5s$. The one term of $3d4d$ due to White was found to be false.

The ionization energy was derived by Ekberg from the series $3d4s$ and $3d5s$.

References

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White, H. E. (1929), Phys. Rev. 33, 538.

Cr v

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3d^2$	${}^3F$	2	0.0	$3d\,4d$	${}^1F$	3	316 674.9
		3	508.2				
		4	1 141.7	$3d\,4d$	${}^3D$	1	317 893.8
						2	318 227.6
$3d^2$	${}^1D$	2	13 188.0			3	318 601.7
$3d^2$	${}^3P$	0	15 491.8	$3d\,4d$	${}^3G$	3	319 119.1
		1	15 676.6			4	319 516.8
		2	16 041.0			5	320 074.4
$3d^2$	${}^1G$	4	22 019.2	$3d\,4d$	${}^1P$	1	319 284.0
$3d^2$	${}^1S$	0	51 146.4	$3d\,4d$	${}^3S$	1	322 528.1
$3d\,4s$	${}^3D$	1	167 176.4	$3d\,4d$	${}^3F$	2	325 104.1
		2	167 491.0			3	325 472.5
		3	168 089.5			4	325 884.2
$3d\,4s$	${}^1D$	2	171 698.1	$3d\,4d$	${}^1D$	2	329 350.3
$3d\,4p$	${}^1D^\circ$	2	*226 119.8*	$3d\,4d$	${}^3P$	0	330 084.8
						1	330 245.1
$3d\,4p$	${}^3D^\circ$	1	*228 001.8*			2	330 536.8
		2	*228 489.1*				
		3	*229 120.8*	$3d\,4d$	${}^1G$	4	331 811.2
$3d\,4p$	${}^3F^\circ$	2	*229 551.7*	$3d\,5s$	${}^3D$	1	356 744.8
		3	*230 316.3*			2	356 981.3
		4	*231 392.9*			3	357 675.9
$3d\,4p$	${}^3P^\circ$	1	*234 618.4*	$3d\,5s$	${}^1D$	2	358 653.8
		0	*234 668.5*				
		2	*234 846.4*				
$3d\,4p$	${}^1F^\circ$	3	*237 529.5*	Cr VI (${}^2D_{3/2}$)	*Limit*		560 200
$3d\,4p$	${}^1P^\circ$	1	*239 917.5*				

Cr VI

$Z=24$

K I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d\ ^2D_{3/2}$

Ionization energy = 731 020±6 cm^{-1} (90.6356±0.0007 eV)

The first known terms were found by Gibbs and White (1926, 1929) who reported the positions of the $3p^6 3d\ ^2D$, $4s\ ^2S$, and $4p\ ^2P^\circ$ terms. The $nf\ ^2F^\circ$ series for $n=5$–10 was identified by Alexander, Feldman, and Fraenkel (1965) and the missing $4f\ ^2F^\circ$ by Gabriel, Fawcett, and Jordan (1965) who replaced the false levels of this term given earlier by Kruger and Weissberg (1937). The $4p\ ^2P^\circ-4d\ ^2D$ multiplet was found by Fawcett (1970). Observations of open $3p^6$-core configurations were first reported by Feldman and Fraenkel (1966) who identified the $3p^6 3d-3p^5 3d4s$ transition array. Some of these lines were classified by Cowan (1967). Gabriel, Fawcett, and Jordan (1966) classified six lines of the $3p^6 3d-3p^5 3d^2$ group.

The spectrum was reobserved in the range of 400–2500 Å by Ekberg (1973). He interpreted a considerable number of new lines and verified the earlier work. His revisions of the values for the known levels and his additions to the analysis are quoted here. Levels obtained from transitions to the ground term from 350 000 to 700 000 cm^{-1} are given to the units place and have an uncertainty varying from ±5 to ±20 cm^{-1}. The rest have an uncertainty of ±1 cm^{-1}. The ionization energy is derived by Ekberg from the nh series with an estimated uncertainty of ±6 cm^{-1}.

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Cr VI

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3p^6(^1S)3d$	^2D	3/2 5/2	0 940	$3p^5(^2P^\circ)3d^2(^3P)$	$^2P^\circ$	1/2 3/2	*493 247.1* *494 911.2*
$3p^6(^1S)4s$	^2S	1/2	227 857.9	$3p^5(^2P^\circ)3d^2(^3F)$	$^2D^\circ$	5/2 3/2	*496 958* *497 495*
$3p^6(^1S)4p$	$^2P^\circ$	1/2 3/2	*296 573.2* *298 396.7*	$3p^6(^1S)5d$	^2D	3/2 5/2	534 381.7 534 489.7
$3p^5(^2P^\circ)3d^2(^1G)$	$^2F^\circ$	5/2 7/2	*356 962* *359 165*	$3p^6(^1S)6s$	^2S	1/2	562 064.1
$3p^5(^2P^\circ)3d^2(^1D)$	$^2F^\circ$	7/2 5/2	*371 618* *378 677*	$3p^6(^1S)5f$	$^2F^\circ$	5/2 7/2	*568 957.4* *568 993.0*
$3p^6(^1S)4d$	^2D	3/2 5/2	402 661.7 402 888.6	$3p^6(^1S)5g$	^2G	7/2 9/2	572 272.3 572 274.4
$3p^5(^2P^\circ)3d^2(^3F)$	$^2F^\circ$	5/2 7/2	*440 135.2* *442 945.4*	$3p^6(^1S)6p$	$^2P^\circ$	1/2 3/2	*574 135* *575 742*
$3p^6(^1S)5s$	^2S	1/2	461 253.0	$3p^5 3d(^3P^\circ)4s$	$^2P^\circ$	1/2 3/2	*578 566* *580 697*
$3p^6(^1S)4f$	$^2F^\circ$	5/2 7/2	*481 956.0* *482 517.1*	$3p^5 3d(^3F^\circ)4s$	$^4F^\circ$	7/2 5/2	*584 371* *586 273*
$3p^6(^1S)5p$	$^2P^\circ$	1/2 3/2	*487 589.5* *488 561.9*				

Cr VI—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^5 3d(^3F^\circ)4s$	$^2F^\circ$	7/2	*591 137*
		5/2	*594 926*
$3p^5 3d(^3D^\circ)4s$	$^4D^\circ$	7/2	*607 615*
		5/2	*608 631*
		3/2	*609 166*
$3p^5 3d(^1D^\circ)4s$	$^2D^\circ$	5/2	*610 497*
		3/2	*611 568*
$3p^5 3d(^1F^\circ)4s$	$^2F^\circ$	5/2	*614 385*
		7/2	*616 079*
$3p^5 3d(^3D^\circ)4s$	$^2D^\circ$	5/2	*618 491*
		3/2	*619 419*
$3p^6(^1S)6f$	$^2F^\circ$	5/2	*618 583*
		7/2	*618 849*
$3p^6(^1S)6g$	^2G	7/2	620 696.3
		9/2	620 700.5
$3p^6(^1S)6h$	$^2H^\circ$	9/2, 11/2	*631 162.9*
$3p^6(^1S)7f$	$^2F^\circ$	5/2	*648 521*
		7/2	*648 533*
$3p^6(^1S)7h$	$^2H^\circ$	9/2, 11/2	*650 310.8*
$3p^6(^1S)8f$	$^2F^\circ$	5/2, 7/2	*667 973*
$3p^6(^1S)9f$	$^2F^\circ$	5/2, 7/2	*681 307*
$3p^6(^1S)10f$	$^2F^\circ$	5/2, 7/2	*690 781*
Cr VII ($^1S_0$)	*Limit*		731 020

Cr VII

$Z = 24$

Ar I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6\ ^1S_0$

Ionization energy = 1 291 900±600 cm^{-1} (160.18±0.07 eV)

Most of the levels are taken from an extensive analysis by Ekberg (1976) who observed the spectrum in the range of 90–2000 Å with an accuracy of ±0.01 Å. The few earlier identifications are noted in his work. Relative to the ground state the level uncertainty is ±10 cm^{-1}. Among the excited levels the relative uncertainty is ±0.5 cm^{-1}. The designations and percentage compositions for the levels are from Ekberg. A value for the ionization energy of 1 291 900 (600) cm^{-1} was derived by him by extrapolation. The same value may be derived from the 3-member *ns* series.

The terms $3s3p^6 4p\ ^3P^\circ_1$, $5p\ ^1P^\circ_1$ and $^3P^\circ_1$, $6p\ ^1P^\circ_1$, and $7p\ ^1P^\circ_1$ were determined by Kastner, Crooker, Behring, and Cohen (1977) from observations of absorption in a spark between 70 and 100 Å. The level uncertainty obtained from these data is ±100 cm^{-1}.

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Cr VII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^2 3p^6$	^1S	0	0.0			
$3s^2 3p^5 3d$	$^3P^\circ$	0	*341 179.3*	100		
		1	*342 773.5*	100		
		2	*346 137.1*	99		
$3s^2 3p^5 3d$	$^3F^\circ$	4	*357 543.7*	100		
		3	*360 '71.9*	97		
		2	*363 060.9*	96		
$3s^2 3p^5 3d$	$^1D^\circ$	2	*382 682.3*	77	19	$^3D^\circ$
$3s^2 3p^5 3d$	$^3D^\circ$	3	*382 737.4*	74	26	$^1F^\circ$
		1	*385 828.3*	99		
		2	*386 616.6*	78	20	$^1D^\circ$
$3s^2 3p^5 3d$	$^1F^\circ$	3	*389 226.2*	72	25	$^3D^\circ$
$3s^2 3p^5 3d$	$^1P^\circ$	1	*493 035.4*	100		
$3s3p^6 3d$	^3D	1	608 679.6	100		
		2	609 142.7	100		
		3	609 887.8	100		
$3s3p^6 3d$	^1D	2	627 826.7	100		
$3s^2 3p^5(^2P^\circ_{3/2})4s$	$^2[3/2]^\circ$	2	*668 858.6*	100		
		1	*672 427.7*	86	15	$(^2P^\circ_{1/2})\ ^2[1/2]^\circ$
$3s^2 3p^5(^2P^\circ_{1/2})4s$	$^2[1/2]^\circ$	0	*678 534.7*	100		
		1	*682 610.2*	86	15	$(^2P^\circ_{3/2})\ ^2[3/2]^\circ$
$3s^2 3p^5 4p$	^3S	1	734 605.3			

Cr VII—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3s^2 3p^5 4p$	^3D	2	745 328.9			
		3	745 631.1			
		1	748 629.3			
$3s^2 3p^5 4p$	^3P	2	751 649.3			
		0	757 035.8			
		1	758 572.1			
$3s^2 3p^5 4p$	^1P	1	754 378.9			
$3s^2 3p^5 4p$	^1D	2	758 374.4			
$3s^2 3p^5(^2P^\circ_{3/2})4d$	$^2[1/2]^\circ$	0	*856 292.2*	100		
		1	*857 234.5*	75	20	$(^2P^\circ_{3/2})\ ^2[3/2]^\circ$
$3s^2 3p^5(^2P^\circ_{3/2})4d$	$^2[3/2]^\circ$	2	*859 407.1*	85	15	$(^2P^\circ_{1/2})\ ^2[3/2]^\circ$
		1	*866 502.8*	79	21	$(^2P^\circ_{3/2})\ ^2[1/2]^\circ$
$3s^2 3p^5(^2P^\circ_{3/2})4d$	$^2[7/2]^\circ$	4	*860 444.3*	100		
		3	*861 198.4*	93		
$3s^2 3p^5(^2P^\circ_{1/2})4d$	$^2[5/2]^\circ$	2	*864 129.5*	[illegible]	11	$(^2P^\circ_{3/2})\ ^2[5/2]^\circ$
		3	*865 155.8*	[illegible]	6	$(^2P^\circ_{3/2})\ ^2[7/2]$
$3s^2 3p^5(^2P^\circ_{1/2})4d$	$^2[5/2]^\circ$	2	*872 231.6*	[illegible]	12	$(^2P^\circ_{3/2})\ ^2[5/2]^\circ$
		3	*873 146.1*	92	7	$(^2P^\circ_{3/2})\ ^2[5/2]^\circ$
$3s^2 3p^5(^2P^\circ_{1/2})4d$	$^2[3/2]^\circ$	2	*873 565.5*	85	15	$(^2P^\circ_{3/2})\ ^2[3/2]^\circ$
		1	*875 380.5*	95		
$3s^2 3p^5(^2P^\circ_{3/2})4f$	$^2[3/2]$	1	941 811			
		2	943 149.1			
$3s^2 3p^5(^2P^\circ_{3/2})4f$	$^2[9/2]$	5	944 416.8			
		4	945 475.7			
$3s^2 3p^5(^2P^\circ_{3/2})4f$	$^2[5/2]$	3	944 866.7			
		2	954 623			
$3s^2 3p^5(^2P^\circ_{3/2})4f$	$^2[7/2]$	3	947 917.4			
		4	948 943.9			
$3s^2 3p^5(^2P^\circ_{3/2})5s$	$^2[3/2]^\circ$	1	*951 122*			
$3s^2 3p^5(^2P^\circ_{1/2})4f$	$^2[7/2]$	3	956 454			
		4	957 205.1			
$3s^2 3p^5(^2P^\circ_{1/2})4f$	$^2[5/2]$	3	957 004.6			
$3s^2 3p^5(^2P^\circ_{1/2})5s$	$^2[1/2]^\circ$	1	*960 366*			
$3s3p^6 4p$	$^3P^\circ$	1	*984 590*			
$3s3p^6 4p$	$^1P^\circ$	1	*994 105*			
$3s^2 3p^5(^2P^\circ_{3/2})5d$	$^2[3/2]^\circ$	1	*1 033 485*			
$3s^2 3p^5(^2P^\circ_{1/2})5d$	$^2[3/2]^\circ$	1	*1 042 568*			

Cr VII—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2 3p^5(^2P^\circ_{3/2})6s$	$^2[3/2]^\circ$	1	*1 075 627*	
$3s^2 3p^5(^2P^\circ_{1/2})6s$	$^2[1/2]^\circ$	1	*1 085 446*	
$3s3p^6 5p$	$^3P^\circ$	1	*1 219 810*	
$3s3p^6 5p$	$^1P^\circ$	1	*1 227 130*	
Cr VIII $(^2P^\circ_{3/2})$	*Limit*		1 291 900	
$3s3p^6 6p$	$^1P^\circ$	1	*1 335 560*	
$3s3p^6 7p$	$^1P^\circ$	1	*1 393 840*	

Cr VIII

$Z = 24$

Cl I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^5\ ^2P^\circ_{3/2}$

Ionization energy = 1 490 000 ± 3000 cm^{-1} (184.7 ± 0.4 eV)

All the known levels are derived from transitions to the $3s^2 3p^5\ ^2P^\circ$ ground term. Edlén (1937) identified lines originating from all levels of the $3s^2 3p^4 4s$ configuration except for the $^4P_{1/2}$. Earlier, Weissberg and Kruger (1936) had reported lines from the ^2P term of this configuration as well as from the ^2S term of $3s3p^6$. The transitions from $3s^2 3p^4 3d$ were identified by Gabriel, Fawcett, and Jordan (1966) and by Fawcett and Gabriel (1966). The parent states for the terms $3s^2 3p^4 3d\ ^2P$ and ^2D are changed to $3p^4\ (^3P)$ as indicated by the calculated states of Fe X by Bromage, Cowan, and Fawcett (1977). Transitions from $3s^2 3p^4 4d$ were given by Fawcett, Cowan, and Hayes (1972). Line identifications in the $3p^4 3d - 3p^4 4f$ transition array were also given in this paper but cannot be used to derive energy levels because they do not combine with known levels.

The recent measurements of the $3s^2 3p^5 - 3s3p^6$ doublet by Smitt, Svensson, and Outred (1976) are used to determine the ground term interval with an uncertainty of ±2 cm^{-1} and the $3s3p^6\ ^2S_{1/2}$ level with an uncertainty of ±10 cm^{-1}. The uncertainty in the values of the higher-lying levels is estimated to be ±100 cm^{-1}.

The ionization energy is an extrapolated value by Lotz (1967).

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Cr VIII

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^5$	$^2P^\circ$	3/2	*0*
		1/2	*9 892*
$3s3p^6$	^2S	1/2	242 065
$3s^2 3p^4(^1D)3d$	^2S	1/2	461 540
$3s^2 3p^4(^3P)3d$	^2P	3/2	479 310
		1/2	482 910
$3s^2 3p^4(^3P)3d$	^2D	5/2	487 780
		3/2	496 170
$3s^2 3p^4(^3P)4s$	^4P	5/2	735 880
		3/2	741 060
$3s^2 3p^4(^3P)4s$	^2P	3/2	749 640
		1/2	755 740
$3s^2 3p^4(^1D)4s$	^2D	5/2	769 240
		3/2	769 550
$3s^2 3p^4(^1S)4s$	^2S	1/2	805 260
$3s^2 3p^4(^3P)4d$	^2D	5/2	946 200
		3/2	947 300
$3s^2 3p^4(^1D)4d$	^2S	1/2	966 400
$3s^2 3p^4(^1D)4d$	^2P	3/2	970 600
		1/2	972 200
$3s^2 3p^4(^1D)4d$	^2D	5/2	976 100
		3/2	977 400
Cr IX ($^3P_2$)	*Limit*		**1 490 000**

Cr IX

$Z=24$

S I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^4\ ^3P_2$

Ionization energy = 1 688 000±3000 cm^{-1} (209.3±0.4 eV)

Edlén (1937) provided the initial spectral classifications by identifying the $3p^4-3p^3 4s$ transitions. Both singlet and triplet levels were detected but not the connection between them.

Classifications in the $3p^4-3p^3 3d$ transition array were made by Gabriel, Fawcett, and Jordan (1965) and by Fawcett and Gabriel (1966). Some new measurements were later provided by Fawcett (1971) as well as two newly classified lines of this group. The $3s3p^5$ configuration was found by Fawcett (1970). Classified lines of the $3p^4-3p^3 4d$ and $3p^3 3d-3p^3 4f$ arrays were reported by Fawcett, Cowan, and Hayes (1972). The latter array could not be used to derive $3p^3 4f$ levels because of the lack of transitions to known levels.

Smitt, Svensson, and Outred (1976) give improved measurements of the $3s^2 3p^4-3s3p^5$ transitions, obtaining an uncertainty of ±5 cm^{-1} for the levels, except for the $3s^2 3p^4\ ^1S_0$ determined from a blended line. They also found the intersystem line $^3P_2-{}^1P_1^\circ$ and identified the $^1S_0-{}^1P_1^\circ$ line. The uncertainty in the levels above the $3s3p^5$ configuration is ±100 cm^{-1}.

The ionization energy is an extrapolated value by Lotz (1976).

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Cr IX

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^4$	^3P	2	0	$3s^2 3p^3(^2P^\circ)3d$	$^1P^\circ$	1	*531 880*
		1	7 821				
		0	9 549	$3s^2 3p^3(^4S^\circ)4s$	$^3S^\circ$	1	*821 100*
$3s^2 3p^4$	^1D	2	30 284	$3s^2 3p^3(^2D^\circ)4s$	$^3D^\circ$	1	*845 900*
						2	*846 260*
$3s^2 3p^4$	^1S	0	66 855			3	*847 870*
$3s3p^5$	$^3P^\circ$	2	*239 068*	$3s^2 3p^3(^2D^\circ)4s$	$^1D^\circ$	2	*854 790*
		1	*245 317*				
		0	*249 016*	$3s^2 3p^3(^2P^\circ)4s$	$^1P^\circ$	1	*881 810*
$3s3p^5$	$^1P^\circ$	1	*305 561*	$3s^2 3p^3(^4S^\circ)4d$	$^3D^\circ$	2	*1 028 500*
						3	*1 028 900*
$3s^2 3p^3(^2D^\circ)3d$	$^3P^\circ$	2	*454 510*			1	*1 029 100*
$3s^2 3p^3(^2D^\circ)3d$	$^1D^\circ$	2	*493 310*	$3s^2 3p^3(^2D^\circ)4d$	$^1D^\circ$	2	*1 066 800*
$3s^2 3p^3(^4S^\circ)3d$	$^3D^\circ$	3	*474 790*	$3s^2 3p^3(^2D^\circ)4d$	$^1F^\circ$	3	*1 070 100*
		2	*479 570*				
		1	*482 760*	$3s^2 3p^3 4d$	$^1P^\circ$	1	*1 102 600*
$3s^2 3p^3(^2D^\circ)3d$	$^1F^\circ$	3	*507 750*	Cr X ($^4S^\circ_{3/2}$)	*Limit*		1 688 000

Cr X

$Z = 24$

P I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^3\ {}^4S^\circ_{3/2}$

Ionization energy = 1 971 000 ± 4000 cm^{-1} (244.4 ± 0.5 eV)

The levels of $3s3p^4$ are due to Smitt, Svensson, and Outred (1976) who gave improved measurements and additional classifications in the $3s^2 3p^3 - 3s3p^4$ array, previously interpreted by Fawcett and Peacock (1967) and by Fawcett (1970). The important ${}^4S^\circ - {}^2P^\circ$ forbidden lines of the $3s^2 3p^3$ configuration, which unify the term systems, were identified by Feldman and Doschek (1976) in solar coronal spectra. The uncertainty in these level values is ±5 cm^{-1}. Transitions from $3p^2 3d$ to the ground configuration were identified by Gabriel, Fawcett, and Jordan (1966), Fawcett, Gabriel, and Saunders (1967), and most completely by Fawcett (1970). The level value uncertainty is ±100 cm^{-1}. Lines of the $3s^2 3p^3 - 3s^2 3p^2 4s$ array were classified by Fawcett, Cowan, and Hayes (1972), giving a level uncertainty of ±300 cm^{-1}. These authors also identified lines arising from the $3p^2 4f$ configuration but the lower levels have not been determined.

The ionization energy was obtained by Lotz (1967) by extrapolation.

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Cr X

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^3$	${}^4S^\circ$	3/2	0	$3s^2 3p^2({}^1D)3d$	${}^2D$	5/2	476 680
						3/2	476 820
$3s^2 3p^3$	${}^2D^\circ$	3/2	37 108				
		5/2	39 450	$3s^2 3p^2({}^1D)3d$	${}^2P$	1/2	491 650
						3/2	496 430
$3s^2 3p^3$	${}^2P^\circ$	1/2	63 935				
		3/2	67 157	$3s^2 3p^2({}^3P)3d$	${}^2F$	7/2	500 880
$3s3p^4$	${}^4P$	5/2	233 890	$3s^2 3p^2({}^3P)3d$	${}^2D$	5/2	519 280
		3/2	239 987			3/2	520 820
		1/2	242 922				
				$3s^2 3p^2({}^3P)4s$	${}^4P$	1/2	928 500
$3s3p^4$	${}^2D$	3/2	289 637			3/2	933 400
		5/2	290 606			5/2	939 100
$3s3p^4$	${}^2P$	3/2	333 412	$3s^2 3p^2({}^3P)4s$	${}^2P$	1/2	943 300
						3/2	949 800
		1/2	337 370				
				$3s^2 3p^2({}^1D)4s$	${}^2D$	5/2	967 000
$3s3p^4$	${}^2S$	1/2	348 760			3/2	967 800
$3s^2 3p^2({}^3P)3d$	${}^2P$	3/2	432 830				
		1/2	440 870				
				Cr XI (${}^3P_0$)	*Limit*		1 971 000
$3s^2 3p^2({}^3P)3d$	${}^4P$	5/2	442 010				
		3/2	444 960				
		1/2	446 710				

Cr XI

$Z=24$

Si I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^2\ ^3P_0$

Ionization energy = 2 184 000±4000 cm^{-1} (270.8±0.5 eV)

Fawcett (1970, 1971) gave the first interpretation of the $3s^2 3p^2 - 3s3p^3$ array. The level values were later revised by Smitt, Svensson, and Outred (1976) on the basis of their more accurate measurements with an estimated uncertainty of ±0.008 Å or better. The connection between the singlet and triplet systems results from this later work and from the solar coronal line at 3996.8 Å (air) identified by Jefferies (1969) as arising from the forbidden $^1D_2 - ^3P_2$ transition in $3s^2 3p^2$. The uncertainty in these level values is estimated to be ±5 cm^{-1}.

The levels of $3s^2 3p3d$ are from Fawcett (1971). Those of $3s^2 3p4s$ and the $^3D_3$ and $^1F_3$ of $3s^2 3p4d$ are due to Fawcett, Cowan, and Hayes (1972). In table I of this reference the line given as 98.48 Å must be changed to 99.48 Å to fit its classification. Kastner et al. (1978) added to the known levels of $3s^2 3p4d$ and the ^1G of $3s^2 3p4f$. The uncertainty in the $3d$ level values is ±100 cm^{-1} and for the others 300 cm^{-1}.

The ionization energy was obtained by Lotz (1967) by extrapolation.

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Cr XI

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^2$	^3P	0	0	$3s^2 3p3d$	$^3D°$	1	*434 240*
		1	5 536			2	*436 210*
		2	11 980			3	*436 550*
$3s^2 3p^2$	^1D	2	36 994	$3s^2 3p3d$	$^1F°$	3	*478 590*
$3s3p^3$	$^3D°$	1	*242 346*	$3s^2 3p4s$	$^3P°$	0	*1 008 800*
		2	*242 456*			1	*1 010 700*
		3	*243 916*			2	*1 021 100*
$3s3p^3$	$^3P°$	0	*278 059*	$3s^2 3p4s$	$^1P°$	1	*1 028 100*
		1	*278 394*				
		2	*278 698*	$3s^2 3p4d$	$^3D°$	1	*1 234 300*
						2	*1 236 600*
$3s3p^3$	$^1D°$	2	*306 570*			3	*1 237 900*
$3s3p^3$	$^3S°$	1	*356 424*	$3s^2 3p4d$	$^3F°$	3	*1 243 800*
$3s3p^3$	$^1P°$	1	*372 498*	$3s^2 3p4d$	$^1F°$	3	*1 255 500*
$3s^2 3p3d$	$^3P°$	2	*418 980*	$3s^2 3p4f$	^1G	4	*1 347 200*
		1	*425 420*				
				Cr XII ($^2P°_{1/2}$)	*Limit*		2 184 000
$3s^2 3p3d$	$^1D°$	2	*427 090*				

Cr XII

Z = 24

Al I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p\ ^2P^\circ_{1/2}$

Ionization energy = 2 404 000±5000 cm^{-1} (298.0±0.6 eV)

The $3p-4d$ doublet was identified by Edlén (1936). Thirty years later new observations of this spectrum by Gabriel, Fawcett, and Jordan (1966) resulted in the discovery of the $3p-3d$ doublet. The non-diagonal line of this multiplet was identified by Fawcett, Gabriel, and Saunders (1967) by means of a laser-produced plasma. The uncertainty in the $3d$ and $4d$ level values is ±100 cm^{-1}.

The ^2P and ^2D terms of the low-lying $3s3p^2$ configuration were first reported by Fawcett and Peacock (1967) again utilizing a laser plasma. Fawcett (1970) revised the classification of the $3s^2 3p\ ^2P^\circ - 3s3p^2\ ^2D$ multiplet and added the $^2P^\circ - ^2S$ lines. He also reported the $^4P - ^4S^\circ$ lines of the $3s3p^2 - 3p^3$ array. The quartet term position relative to the doublet system is not observed or predicted and therefore cannot be included here.

Fawcett (1971) later revised the wavelengths of the $3s^2 3p - 3s3p^2$ array from new plates taken with the theta pinch source. His value of 412.46 Å for the $^2P^\circ_{3/2} - ^2D_{3/2}$ line is inconsistent with the $^2P^\circ_{1/2} - ^2D_{3/2}$ principal line and was not used here. He also reported the $3p-3d$ doublet of the same array. Calculated wavelengths enabled Fawcett, Cowan, Kononov, and Hayes (1972) to identify more lines from the theta pinch spectrum. They classified the $3d-4f$ doublet and several quartet transitions unconnected with the doublets. The uncertainty of the level values of $3s3p^2$ is ±50 cm^{-1}.

The ground term $^2P^\circ$ splitting is obtained from the solar coronal line 8153.8 Å classified by Jefferies (1969) and has an uncertainty of ±1 cm^{-1}.

The value for the ionization energy was obtained by extrapolation by Lotz (1967).

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Cr XII

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s^2 3p$	$^2P^\circ$	1/2	*0*	$3s^2 4d$	^2D	3/2	1 319 000
		3/2	*12 261*			5/2	1 319 660
$3s3p^2$	^2D	3/2	254 450	$3s^2 4f$	$^2F^\circ$	5/2	*1 395 000*
		5/2	255 620			7/2	*1 395 400*
$3s3p^2$	^2S	1/2	313 600				
$3s3p^2$	^2P	1/2	333 240	Cr XIII ($^1S_0$)	*Limit*		**2 404 000**
		3/2	339 250				
$3s^2 3d$	^2D	3/2	408 700				
		5/2	409 840				

Cr XIII

$Z=24$

Mg I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2\,{}^1S_0$

Ionization energy = 2 862 000±6000 cm^{-1} (354.8±0.7 eV)

The $3s^2\,{}^1S_0-3s4p\,{}^1P_1^\circ$ resonance line was identified by Edlén (1936). He also reported two unconnected triplet systems, one containing levels of $3s3p$, $3s4s$, $3s4d$, and $3s5d$, and the other $3s3d$, $3s4f$, and $3s5f$. The analysis was resumed 30 years later by Fawcett, Gabriel, and Saunders (1967) who unified the triplets by discovering the $3s3p\ {}^3P^\circ-3s3d\ {}^3D$ multiplet. They also identified the resonance line $3s^2\,{}^1S_0-3s3p\,{}^1P_1^\circ$ at 328.29±0.03 Å. The intersystem transition $3s^2\,{}^1S_0-3s3p\,{}^3P_1^\circ$ was observed at 482.2±0.2 Å in a tokamak plasma by Finkenthal, Bell, and Moos (1982). These two lines were measured in a tokamak plasma by Peacock, Stamp, and Silver (1984), who obtained the more accurate values of 328.267±0.004 Å and 482.17±0.02 Å, or level uncertainties of ±4 and ±9 cm^{-1}. The uncertainties in the rest of the levels of the above configurations is ±100 cm^{-1}.

The analysis was extended to $3p^2$ by Fawcett and Peacock (1967) who identified the $3s3p\,{}^3P^\circ-3p^2\,{}^3P$ multiplet. Fawcett (1970) later found the ${}^1S_0$ of $3p^2$, the ${}^1D_2$ of $3s3d$ and all the levels of $3p3d$ presently known. The uncertainty of these level values is ±100 cm^{-1}.

The analysis was augmented by Fawcett, Cowan, Kononov, and Hayes (1972) with their identification of transitions from $3s4f\,{}^3F_3^\circ$, $3s4d\,{}^3D_2$, and levels of $3p4f$. Some of the last group are not connected to known levels and are therefore not used here.

Improved measurements of the $3s3p\ {}^3P^\circ-3s3d\ {}^3D$ multiplet were made by Fawcett, Cowan, and Hayes (1972). In addition, they reported the ${}^1D_2$ of $3s3d$ and the ${}^1D_2$ of $3p^2$.

The ionization energy is an extrapolated value obtained by Lotz (1967).

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Cr XIII

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s^2$	${}^1S$	0	0	$3p3d$	${}^3F^\circ$	2	*805 220*
						3	*811 550*
$3s3p$	${}^3P^\circ$	0	*203 470*			4	*818 910*
		1	*207 400*				
		2	*216 590*	$3p3d$	${}^3P^\circ$	2	*857 230*
$3s3p$	${}^1P^\circ$	1	*304 630*	$3p3d$	${}^3D^\circ$	3	*861 010*
$3p^2$	${}^3P$	0	482 160	$3p3d$	${}^1P^\circ$	1	*885 300*
		1	488 250				
		2	499 220	$3s4s$	${}^3S$	1	1 385 280
$3p^2$	${}^1D$	2	483 170	$3s4p$	${}^1P^\circ$	1	*1 492 920*
$3p^2$	${}^1S$	0	569 460	$3s4d$	${}^3D$	1	1 616 060
						2	1 616 460
$3s3d$	${}^3D$	1	588 580			3	1 617 190
		2	589 210				
		3	590 100	$3s4d$	${}^1D$	2	1 617 500
$3s3d$	${}^1D$	2	662 240	$3s4f$	${}^3F^\circ$	2	*1 678 240*
						3	*1 678 630*
						4	*1 678 770*

Cr XIII—Continued

Configuration	Term	J	Level (cm⁻¹)	Configuration	Term	J	Level (cm⁻¹)
3s4f	$^1F°$	3	*1 690 800*	3s5d	^3D	2	2 076 350
						3	2 076 540
3p4f	^1F	3	1 916 140				
				3s5f	$^3F°$	4	*2 105 990*
3p4f	^3G	4	1 920 560				
		5	1 930 140				
				Cr XIV ($^2S_{1/2}$)	*Limit*		2 862 000
3p4f	^3F	4	1 931 440				
3p4f	^3D	3	1 940 840				

Cr XIV

$Z = 24$

Na I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s\ ^2S_{1/2}$

Ionization energy = 3 098 520±200 (384.171±0.020 eV)

Edlén (1936) reported three independent systems of doublets: $3s-np$, $3p-nd$ (and $3p-4s$), and $3d-nf$. These were unified by Fawcett and Peacock (1967) who identified the $3s-3p$ and $3p-3d$ doublets. New observations by Peacock, Stamp, and Silver (1984) of the $3s-3p$ doublet in a tokamak plasma were reported at 389.804 and 412.051 Å. We use these and the improved values for the $3p-3d$ doublet by Edlén (1978). The $4s$, $4p$, $4d$, $4f$, $5d$, $5f$, and $6f(^2F_{7/2})$ terms are from the identifications and measurements of Edlén (1936). The uncertainty of the $n=3$ levels is ±5 cm^{-1}, and the higher ones ±200 cm^{-1}.

The additional series members $5s-6s$, $6p-9p$, $6d-9d$, and $7f-8f$ were identified by Fawcett, Cowan, and Hayes (1972). Improved measurements by Cohen and Behring (1976) in the range of 35–70 Å were used. They estimate their measurement uncertainty to be ±0.005 Å although their measurements differ from those of Edlén (1936) by about + 0.02 Å. The $2p^5 3s^2\ ^2P°$ term was found by Feldman and Cohen (1967).

The value for the ionization energy was derived by Edlén (1978) from core polarization theory applied to the nf series.

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Cr XIV

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2p^6 3s$	^2S	1/2	0	$2p^6 6s$	^2S	1/2	2 424 470
$2p^6 3p$	$^2P°$	1/2	*242 688*	$2p^6 6p$	$^2P°$	1/2	*2 450 990*
		3/2	*256 500*			3/2	*2 452 060*
$2p^6 3d$	^2D	3/2	587 810	$2p^6 6d$	^2D	3/2	2 484 990
		5/2	589 505			5/2	2 485 240
$2p^6 4s$	^2S	1/2	1 478 580	$2p^6 6f$	$^2F°$	5/2	*2 499 090*
						7/2	*2 499 260*
$2p^6 4p$	$^2P°$	1/2	*1 574 180*				
		3/2	*1 579 550*	$2p^6 7s$	^2S	1/2	2 612 050
$2p^6 4d$	^2D	3/2	1 701 150			5/2	2 649 530
		5/2	1 701 940				
				$2p^6 7f$	$^2F°$	5/2	*2 658 200*
$2p^6 4f$	$^2F°$	5/2	*1 749 830*			7/2	*2 658 270*
		7/2	*1 750 080*				
				$2p^6 8p$	$^2P°$	1/2,3/2	*2 742 280*
$2p^6 5s$	^2S	1/2	2 102 780				
				$2p^6 8d$	^2D	3/2	2 755 510
$2p^6 5p$	$^2P°$	1/2	*2 149 290*			5/2	2 755 380
		3/2	*2 152 020*				
				$2p^6 8f$	$^2F°$	7/2	*2 761 580*
$2p^6 5d$	^2D	3/2	2 210 730				
		5/2	2 211 080	$2p^6 9p$	$^2P°$	1/2,3/2	*2 820 870*
$2p^6 5f$	$^2F°$	5/2	*2 235 280*				
		7/2	*2 235 440*				

Cr XIV—Continued

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2p^6 9d$	^2D	$5/2$	2 827 260				
		$3/2$	2 828 070				
Cr XV ($^1S_0$)	*Limit*		3 098 520				
$2p^5 3s^2$	$^2P^\circ$	$3/2$	*4 593 500*				
		$1/2$	*4 658 300*				

Cr XV

$Z = 24$

Ne I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6\ {}^1S_0$

Ionization energy 8 151 000 ± 5000 cm^{-1} (1010.6 ± 0.6 eV)

Only resonance lines are classified for this ion. Tyrén (1938) identified the lines due to the $2s^2 2p^5 3s$, $3d$ and $4d$ as well as the $2s 2p^6 3p$ levels. Swartz, Kastner, Rothe, and Neupert (1971) identified $5d$, and $6d$. The magnetic quadrupole transition $2p^6\ {}^1S_0 - 2p^5 3s\ {}^3P_2^\circ$ was identified in the spectrum of a tokamak plasma by Klapisch et al. (1978). They confirm the wavelengths of Tyrén for $2p^5 3s\ {}^3P$, and ${}^1P$, and $2p^5 3d\ {}^3D$, to within ±0.003 Å, but give the value 18.488 Å for $2p^5 3d\ {}^1P$, compared with Tyrén's value of 18.497 Å used here. The uncertainty in the level values is estimated to be ±2000 cm^{-1}.

Kastner, Behring, and Cohen (1975) identified transitions between $2p^5 3p$ and $2p^5 4d$ but there is no connection with known levels.

The percentage compositions were calculated by Bogdanovich et al. (1980).

We derived the ionization energy from the $2s^2 2p^5 nd\ {}^3D_1^\circ$ series for $n = 3, 4, 5$. The $n = 6$ term does not fit well to a series calculation.

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Cr XV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^6$	${}^1S$	0	0			
$2s^2 2p^5 3s$	${}^3P^\circ$	2	*4 714 100*	100		
		1	*4 727 500*	50	50	${}^1P^\circ$
$2s^2 2p^5 3s$	${}^1P^\circ$	1	*4 793 200*	50	50	${}^3P^\circ$
$2s^2 2p^5 3d$	${}^3P^\circ$	1	*5 259 000*	94		
$2s^2 2p^5 3d$	${}^3D^\circ$	1	*5 324 200*	83	12	${}^1P^\circ$
$2s^2 2p^5 3d$	${}^1P^\circ$	1	*5 406 300*	96		
$2s 2p^6 3p$	${}^3P^\circ$	1	*5 894 500*	92	8	${}^1P^\circ$
$2s 2p^6 3p$	${}^1P^\circ$	1	*5 921 000*	92	8	${}^3P^\circ$
$2s^2 2p^5 4d$	${}^3D^\circ$	1	*6 576 000*	53	41	${}^1P^\circ$
$2s^2 2p^5 4d$	${}^1P^\circ$	1	*6 641 000*	50	34	${}^3D^\circ$
$2s^2 2p^5 5d$	${}^3D^\circ$	1	*7 148 000*			
$2s^2 2p^5 5d$	${}^1P^\circ$	1	*7 215 000*			
$2s^2 2p^5 6d$	${}^3D^\circ$	1	*7 452 000*			
$2s^2 2p^5 6d$	${}^1P^\circ$	1	*7 524 000*			
Cr XVI (${}^2P^\circ_{1/2}$)	*Limit*		8 151 000			

Cr XVI

$Z = 24$

F I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^5\ ^2P^\circ_{3/2}$

Ionization energy = 8 850 000 ± 18 000 cm^{-1} (1097 ± 2 eV)

The ground term splitting was obtained by Fawcett (1971) from his identification of the $2s^2 2p^5 - 2s2p^6$ doublet. It was observed directly from a magnetic dipole transition at 1410.6 ± 0.3 Å in a tokamak discharge by Hinnov et al. (1982). The present value is taken in the more accurate measurement of 1410.60 ± 0.02 Å by Peacock, Stamp, and Silver (1984) in a similar light source, giving an uncertainty of 2 cm^{-1} for this interval. The $2s2p^6\ ^2S_{1/2}$ from the measurements of the resonance doublet by Doschek et al. (1974), and has an uncertainty of ± 200 cm^{-1}.

The $2s^2 2p^5 - 2s^2 2p^4 3s$ and $3d$ arrays were first analyzed by Cohen, Feldman and Kastner (1968). This work was revised and extended by Feldman et al. (1973) from whose classified lines we derived the energy levels. Their reported wavelength accuracy is ± 0.01 Å. The consequent level uncertainty is ± 6000 cm^{-1}.

The $2s2p^6\ ^2S_{1/2} - 2s2p^5 3s\ ^2P^\circ$ multiplet is from Feldman et al. (1973).

Bogdanovich et al. (1980) calculated the percentage compositions of the levels.

The ionization energy was obtained by extrapolation by Lotz (1967).

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Cr XVI

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^5$	$^2P^\circ$	3/2	*0*			
		1/2	*70 892*			
$2s2p^6$	^2S	1/2	937 940			
$2s^2 2p^4(^3P)3s$	^4P	5/2	5 048 700	94		
		3/2	5 072 300	56	42	$(^3P)\ ^2P$
		1/2	5 109 300	94		
$2s^2 2p^4(^3P)3s$	^2P	3/2	5 118 200	49	44	$(^3P)\ ^4P$
		1/2	5 143 400	94		
$2s^2 2p^4(^1D)3s$	^2D	5/2	5 193 500	94		
		3/2	5 196 100	90		
$2s^2 2p^4(^1S)3s$	^2S	1/2	5 323 500	90		
$2s^2 2p^4(^3P)3d$	^4P	1/2	5 607 600	72	13	$(^3P)\ ^2P$
		3/2	5 620 600	64	18	$(^3P)\ ^2D$
		5/2	5 640 200	37	34	$(^3P)\ ^4F$
$2s^2 2p^4(^3P)3d$	^4F	9/2	5 622 700	48	21	$(^3P)\ ^2F$
$2s^2 2p^4(^3P)3d$	^2P	1/2	5 628 500	42	32	$(^3P)\ ^4D$
		3/2	5 671 200	52	23	$(^1D)\ ^2P$
$2s^2 2p^4(^3P)3d$	^4D	3/2	5 648 100	29	17	$(^1D)\ ^2D$
		7/2	5 680 800	49	17	

Cr XVI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^4(^3P)3d$	^2F	$5/2$	5 659 000	46	36	$(^3P)\ ^4P$
$2s^2 2p^4(^1D)3d$	^2S	$1/2$	5 734 600	90		
$2s^2 2p^4(^1D)3d$	^2P	$3/2$	5 756 200	67	24	$(^3P)\ ^2P$
$2s^2 2p^4(^1D)3d$	^2D	$5/2$	5 757 100	56	26	$(^3P)\ ^2D$
		$3/2$	5 780 500	66	28	
$2s^2 2p^4(^1S)3d$	^2D	$5/2$	5 857 200	90		
		$3/2$	5 870 600	83		
$2s2p^5(^3P^\circ)3s$	$^2P^\circ$	$3/2$	*5 950 200*	83		
		$1/2$	*5 986 600*	90		
Cr XVII $(^3P_2)$	*Limit*		8 850 000			

Cr XVII

$Z = 24$

O I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^4\ ^3P_2$

Ionization energy = 9 560 000 ± 19 000 cm^{-1} (1185 ± 2 eV)

Several magnetic dipole transitions within the $2s^2 2p^4$ ground configuration were observed by Hinnov et al. (1982) in a tokamak light source with an accuracy of ±0.3 Å. They are $^3P_2 - ^3P_1$ at 1656.3 Å, $^3P_2 - ^1D_2$ at 740.8 Å and $^3P_1 - ^1S_0$ at 493.8 Å. The $^3P_1$, $^1D_2$, and $^1S_0$ levels are derived from these data. Peacock, Stamp, and Silver (1984) obtained the value 740.75±0.03 Å for the $^3P_2 - ^1D_2$ in a similar light source. The $2s^2 2p^4 - 2s 2p^5$ array was first interpreted by Fawcett (1971). It was reobserved by Lawson and Peacock (1980) who extended the analysis. The $2s2p^5\ ^1P_1^{\circ} - 2p^6\ ^1S_0$ transition was identified by Doschek et al. (1975). Both lines of this array were observed by Lawson and Peacock. Their measurements are used here to derive the levels of $2s 2p^5$, $2p^6$ and the $^3P_0$ of $2s^2 2p^4$ with an uncertainty of ±300 cm^{-1}. The percentage composition of these levels was provided by Kaufman and Sugar (1982). Their calculation includes configuration interaction between $2s^2 2p^4$ and $2p^6$.

The transition array $2s^2 2p^4 - 2s^2 2p^3 3s$ and 18 Å was analyzed by Doschek, Feldman, and Cohen (1973), and the $2s^2 2p^4 - 2s^2 2p^3 3d$ at 16 Å by Fawcett and Hayes (1975). Both report a measurement uncertainty of ±0.01 Å, resulting in level uncertainties of ±3000 cm^{-1}. Levels of $2p^3 3s$ with question marks were derived from doubly classified lines by Doschek et al. (1973). Some revisions of the $2p^3 3d$ levels due to Bromage and Fawcett (1977) are included.

The two levels of $2p^3 4d$ are from Spector et al. (1980) with an uncertainty of ±3000 cm^{-1}.

The value for the ionization energy was derived by Lotz (1967) by extrapolation.

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Cr XVII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^4$	^3P	2	0	93	7	^1D
		0	58 070	86	13	^1S
		1	60 376	100		
$2s^2 2p^4$	^1D	2	134 998	93	7	^3P
$2s^2 2p^4$	^1S	0	262 890	84	14	^3P
$2s2p^5$	$^3P^{\circ}$	2	*813 540*	100		
		1	*858 120*	98	2	$^1P^{\circ}$
		0	*887 920*	100		
$2s2p^5$	$^1P^{\circ}$	1	*1 116 380*	98	2	$^3P^{\circ}$
$2p^6$	^1S	0	1 886 920	98	2	$2s^2 2p^4\ ^1S$
$2s^2 2p^3(^4S^{\circ})3s$	$^5S^{\circ}$	1	*5 455 000?*			
$2s^2 2p^3(^2D^{\circ})3s$	$^3D^{\circ}$	1	*5 546 800?*			
		2	*5 549 400*			
		3	*5 568 900*			

Cr XVII—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$2s^2 2p^3(^2D^\circ)3s$	$^3D^\circ$	2	*5 588 700?*	
$2s^2 2p^3(^2P^\circ)3s$	$^3P^\circ$	1	*5 700 700*	
$2s^2 2p^3(^4S^\circ)3d$	$^3D^\circ$	3	*5 948 500*	
$2s^2 2p^3(^2D^\circ)3d$	$^3D^\circ$	2	*6 070 000*	
		3	*6 074 000*	
$2s^2 2p^3(^2D^\circ)3d$	$^3F^\circ$	3	*6 124 400*	
$2s^2 2p^3(^2P^\circ)3d$	$^3P^\circ$	2	*6 131 000*	
$2s^2 2p^3(^2P^\circ)3d$	$^3D^\circ$	3	*6 164 800*	
		1	*6 189 000*	
		2	*6 214 600*	
$2s^2 2p^3(^2P^\circ)3d$	$^3F^\circ$	3	*6 338 000*	
$2s^2 2p^3(^2P^\circ)4d$	$^1D^\circ$	2	*7 882 000*	
$2s^2 2p^3(^2P^\circ)4d$	$^3F^\circ$	3	*7 960 000*	
Cr XVIII ($^4S^\circ_{3/2}$)	*Limit*		9 560 000	

Cr XVIII

$Z = 24$

N I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^3\ ^4S^\circ_{3/2}$

Ionization energy $= 10\,480\,000 \pm 21\,000$ cm^{-1} $(1299 \pm 3$ eV$)$

Four lines of the $2s^22p^3\ ^2D^\circ - 2s2p^4(^2P, ^2D)$ multiplets were classified by Fawcett (1971). The analysis of this transition array was extended and partly revised by Doschek, Feldman, Cowan, and Cohen (1974). The $^2S_{1/2}$ of $2s2p^4$ was later reported by Feldman, Doschek, Cowan, and Cohen (1975). Fawcett and Hayes (1975) classified the resonance line arising from $2s^22p^2(^3P)3d\ ^4P_{5/2}$ and observed the $2s^22p^2(^1D)3d\ ^2F_{7/2}$ level of the doublet system. They also located the $2p^5$ configuration from transitions to $2s2p^4\ ^2D$. The $^2D_{5/2} - ^2P^\circ_{3/2}$ line of this multiplet was reported by Doschek, Feldman, Davis, and Cowan (1975).

The $2s^22p^3 - 2s2p^4$ and $2s2p^4 - 2p^5$ arrays were remeasured by Lawson and Peacock (1980) who found four intersystem lines. We used their wavelengths, accurate to ± 0.03 Å, to determine the energy levels with an uncertainty of ± 200 cm^{-1}. Magnetic dipole transitions within the ground configuration were observed in a tokamak plasma by Hinnov, Suckewer, Cohen, and Sato (1982). They reported privately the wavelengths 4038.6 Å for $^2D^\circ_{3/2} - ^2D^\circ_{5/2}$ and 2606.4 Å for $^2P^\circ_{1/2} - ^2P^\circ_{3/2}$, both in air with uncertainties of ± 0.3 Å. With these measurements and their published wavelength of 793.3 Å for the $^4S_{3/2} - ^2D_{5/2}$ transition, we obtained the position of the ^2D term with an uncertainty of ± 50 cm^{-1}, and the fine structure of the ^2P term with an uncertainty of ± 4 cm^{-1}.

The percentage compositions for the $2s^22p^3$, $2s2p^4$, and $2p^5$ configurations were provided by Kaufman and Sugar (1982). The calculation included configuration interaction between $2s^22p^3$ and $2p^5$.

The ionization energy was obtained by Lotz (1967) by extrapolation.

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Cr XVIII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^22p^3$	$^4S^\circ$	$3/2$	*0*	93	6	$^2P^\circ$
$2s^22p^3$	$^2D^\circ$	$3/2$	*126 060*	80	17	$^2P^\circ$
		$5/2$	*150 814*	100		
$2s^22p^3$	$^2P^\circ$	$1/2$	*226 100*	94	2	$2p^5\ ^2P^\circ$
		$3/2$	*264 456*	76	20	$2s^22p^3\ ^2D^\circ$
$2s2p^4$	^4P	$5/2$	667 560	94	2	^2D
		$3/2$	714 950	99	1	^2D
		$1/2$	732 490	97	3	^2S
$2s2p^4$	^2D	$3/2$	922 800	96	3	^2P
		$5/2$	931 420	98	2	^4P
$2s2p^4$	^2S	$1/2$	1 062 040	77	21	^2P
$2s2p^4$	^2P	$3/2$	1 103 370	96	3	^2D
		$1/2$	1 170 200	79	20	^2S
$2p^5$	$^2P^\circ$	$3/2$	*1 738 700*	98	2	$2s^22p^3\ ^2P^\circ$
		$1/2$	*1 813 490*	98	2	

Cr XVIII—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$2s^2 2p^2(^3P)3d$	^4P	$^5/_2$	6 443 900	
$2s^2 2p^2(^1D)3d$	^2F	$^7/_2$	6 555 000	
Cr XIX ($^2P_{1/2}$)	*Limit*		10 480 000	

Cr XIX

$Z = 24$

C I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^2\ ^3P_0$

Ionization energy = 11 260 000 ± 22 000 cm^{-1} (1396 ± 3 eV)

Transitions between the $2s^2 2p^2$ and $2s2p^3$ configurations were identified by Feldman et al. (1975). The spectrum was reobserved by Lawson and Peacock (1980) in the range of 95–203 Å with an accuracy of ±0.03 Å. They identified many more lines of this array, including several intersystem lines, and classified the $2s2p^3 - 2p^4$ array as well.

The levels of the $2s^2 2p^2$ ground configuration are determined from the magnetic dipole transitions observed in a tokamak plasma by Hinnov, Suckewer, Cohen, and Sato (1982). Their wavelengths, ranging from 398–2885 Å, have an uncertainty of ±0.3 Å. The uncertainty in the ^3P and ^1D levels is ±10, and for the ^1S ± 100 cm^{-1}. With the exception of the $2s2p^3\ ^5S_2^\circ$ level, the rest of the levels are due to Lawson and Peacock with an uncertainty of ±200 cm^{-1}. Edlén (1984) has compared the known values of the $^5S_2^\circ$ level in the isoelectronic sequence with theoretical predictions. He concluded that the values given by Lawson and Peacock are inconsistent with the trend. We give Edlén's predicted value in brackets. The percentage compositions were provided by Kaufman and Sugar (1982). The calculation includes configuration interaction between $2s^2 2p^2$ and $2p^4$.

Bromage and Fawcett (1977) have given predicted wavelengths of the $2s^2 2p^2 - 2s^2 2p3d$ array.

The value for the ionization energy was obtained by extrapolation by Lotz (1967).

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Cr XIX

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^2$	^3P	0	0	92	7	^1S
		1	47 811	99	1	$2p^4\ ^3P$
		2	82 458	83	16	$2s^2 2p^2\ ^1D$
$2s^2 2p^2$	^1D	2	184 597	83	16	^3P
$2s^2 2p^2$	^1S	0	298 800	89	9	^3P
$2s2p^3$	$^5S^\circ$	2	[*403 270*]	98	2	$^3P^\circ$
$2s2p^3$	$^3D^\circ$	2	*671 630*	88	12	$^3P^\circ$
		1	*672 770*	90	8	
		3	*686 830*	100		
$2s2p^3$	$^3P^\circ$	0	*789 160*	100		
		1	*794 130*	89	8	$^3D^\circ$
		2	*804 750*	82	12	
$2s2p^3$	$^3S^\circ$	1	*959 880*	86	12	$^1P^\circ$
$2s2p^3$	$^1D^\circ$	2	*976 220*	96	4	$^3P^\circ$
$2s2p^3$	$^1P^\circ$	1	*1 090 660*	87	12	^3S
$2p^4$	^3P	2	1 450 230	91	8	$2p^4\ ^1D$
		1	1 514 320	99	3	$2s^2 2p^2\ ^3P$
		0	1 517 990	90	8	$2p^4\ ^1S$

Cr XIX—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2p^4$	^1D	2	1 586 230	91	8	^3P
$2p^4$	^1S	0	1 787 180	88	9	^3P
Cr XX ($^2P^{\circ}_{1/2}$)	*Limit*		**11 260 000**			

Cr XX

B I isoelectronic sequence

Ground state: $1s^22s^22p\ ^2P^\circ_{1/2}$

Ionization energy = 12 070 000±24 000 cm^{-1} (1496±3 eV)

The splitting of the ground $^2P^\circ$ term was determined with an uncertainty of 20 cm^{-1} from a magnetic dipole transition at 1205.9±0.3 Å observed in a tokamak plasma by Hinnov et al. (1982).

The transition arrays $2s^22p-2s2p^2$ and $2s2p^2-2p^3$ were classified by Lawson and Peacock (1980). They observed the spectrum in the range of 116–271 Å with an accuracy of ±0.03 Å. The level values have an uncertainty of ±200 cm^{-1}. The percentage composition for these levels was provided by Kaufman and Sugar (1982). Their calculation includes configuration interaction between $2s^22p$ and $2p^3$.

The higher lying levels are from line identifications by Spector, Zigler, Zmora, and Schwob (1980) from laser-produced plasmas observed in the 10–14 Å range. The uncertainty in their values is ±3000 cm^{-1}.

The value for the ionization energy was obtained by extrapolation by Lotz (1967).

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Cr XX

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^22p$	$^2P^\circ$	1/2	*0*	96	2	$2p^3\ ^2P^\circ$
		3/2	*82 926*	97	3	
$2s2p^2$	^4P	1/2	354 570	98	2	^2S
		3/2	391 360	100		
		5/2	430 650	97	3	^2D
$2s2p^2$	^2D	3/2	640 980	97	3	^2P
		5/2	652 990	97	3	^4P
$2s2p^2$	^2P	1/2	760 400	55	43	^2S
		3/2	861 660	97	3	^2D
$2s2p^2$	^2S	1/2	847 750	55	45	^2P
$2p^3$	$^4S^\circ$	3/2	*1 101 840*	95	4	$^2P^\circ$
$2p^3$	$^2D^\circ$	3/2	*1 229 660*	88	10	$^2P^\circ$
		5/2	*1 248 380*	100		
$2p^3$	$^2P^\circ$	1/2	*1 380 270*	98	2	$2s^22p\ ^2P^\circ$
		3/2	*1 414 590*	84	11	$^2D^\circ$
$2s2p(^3P^\circ)3d$	$^4F^\circ$	7/2	*7 443 000*			
$2s^24s$	^2S	1/2	9 145 000			
$2s^24d$	^2D	5/2	9 308 000			
		3/2	9 335 000			
Cr XXI ($^1S_0$)	*Limit*		12 070 000			

Cr XXI

$Z = 24$

Be I isoelectronic sequence

Ground state: $1s^2 2s^2\ ^1S_0$

Ionization energy = 13 180 000±26 000 cm^{-1} (1634±3 eV)

Widing (1975) identified the $2s^2\ ^1S_0 - 2s2p\ ^3P_1^\circ$ intersystem line in a solar flare spectrum at 293.11±0.03 Å. The $^1S_0 - ^1P_1$ transition was found in a tokamak plasma at 149.90±0.03 Å by Hinnov (1979). The uncertainty of the $^3P_1$ is ±50 cm^{-1}, and of the $^1P_1$ ±150 cm^{-1}. The transition array $2s2p - 2p^2$ was observed by Lawson and Peacock (1980) in a laser-generated plasma. They obtained a level uncertainty of ±200 cm^{-1}. They identified the intersystem line $2s2p\ ^3P_2^\circ - 2p^2\ ^1D_2$, which confirms the solar identification of Widing.

The higher configurations are from the line classifications of Boiko et al. (1977) at 13 Å. A measurement uncertainty of ±0.003 Å is reported, giving a level uncertainty of ±2000 cm^{-1}. The two terms of $1s2s2p^2$ above the limit are from the observations of Boiko et al. (1978) at 2 Å, with a level uncertainty of ±10 000 cm^{-1}.

The ionization energy was obtained by extrapolation by Lotz (1967).

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Cr XXI

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2s^2$	^1S	0	0	$2p3p$	^3D	3	8 087 000
$2s2p$	$^3P^\circ$	0	*318 080*	$2p3p$	^1P	1	8 022 000
		1	*341 170*				
		2	*405 070*	$2p3p$	^3P	2	8 109 000
$2s2p$	$^1P^\circ$	1	*667 110*	$2p3d$	$^3D^\circ$	2	*8 121 000*
						1	*8 134 000*
$2p^2$	^3P	0	864 780			3	*8 204 000*
		1	911 130				
		2	947 130	$2p3d$	$^3P^\circ$	1,2	*8 219 000*
$2p^2$	^1D	2	1 051 810	$2p3d$	$^1P^\circ$	1	*8 275 000*
$2p^2$	^1S	0	1 254 790	$2p3d$	$^1F^\circ$	3	*8 275 000*
$2s3s$	^3S	1	7 463 000	Cr XXII ($^2S_{1/2}$)	*Limit*		13 180 000
$2s3p$	$^1P^\circ$	1	*7 620 000*	$1s2s2p^2$	^5D	2	45 550 000
$2s3d$	^3D	2	7 721 000	$1s2s2p^2$	^1D	2	45 800 000
		3	7 733 000				

Cr XXII

$Z=24$

Li I isoelectronic sequence

Ground state: $1s^2 2s\ ^2S_{1/2}$

Ionization energy = 13 882 000±2900 cm^{-1} (1721.4±0.4 eV)

The resonance lines $2s\ ^2S-2p\ ^2P^{\circ}_{1/2},\ ^2P^{\circ}_{3/2}$ were observed in the solar corona at 222.99 Å and 279.69 Å by Sandlin, Brueckner, Scherrer, and Tousey (1976). We use the laboratory measurements of Lawson and Peacock (1980) with an uncertainty of ±0.03 Å, giving a level uncertainty of ±50 cm^{-1}. Hinnov (1979) reported observing these lines in a tokamak plasma.

The $2s-3p$ and $2p-3s$, $3d$ transitions were reported by Goldsmith, Feldman, Oren, and Cohen (1972). These series were remeasured and extended by Boiko, Faenov, and Pikuz (1978) to $4p$ and $4d$ by measurements in the range of 9-13 Å with an uncertainty of ±0.003 Å. The uncertainty of these high-lying levels is ±3000 cm^{-1}.

The ionization energy was determined by Edlén (1979) from the $2p-nd$ series.

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Cr XXII

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2s$	^2S	1/2	0	$3d$	^2D	3/2	7 963 000
						5/2	7 972 000
$2p$	$^2P^{\circ}$	1/2	*357 470*				
		3/2	*448 470*	$4p$	$^2P^{\circ}$	1/2,3/2	*10 534 000*
$3s$	^2S	1/2	7 826 000	$4d$	^2D	3/2	10 552 000
						5/2	10 585 000
$3p$	$^2P^{\circ}$	1/2	*7 896 000*				
		3/2	*7 922 000*	Cr XXIII ($^1S_0$)	*Limit*		13 882 000

Cr XXIII

$Z = 24$

He I isoelectronic sequence

Ground state: $1s^2\ ^1S_0$

Ionization energy = 60 344 000 ± 12 000 cm^{-1} (7481.8 ± 0.6 eV)

Because of the excellent agreement of the calculated energies of the $n = 2$ shell by Safronova (1981) with the few well-measured spectra in the He I sequence, we have compliled her results for the $n = 2$ levels and for the ionization energy. Detailed comparisons are given in the Introduction. Levels of the $n = 3$–5 shells are from the calculated binding energies by Ermolaev and Jones (1974) subtracted from Safronova's value for the binding energy of the ground state. We have assumed an uncertainty of 2 parts in 10^4 for the excited levels relative to the ground state, and for the ionization energy (see Introduction). For differences between excited levels where $\Delta n = 0$, we assumed an uncertainty of 2 parts in 10^3.

Observations by Neupert (1971) of a solar flare spectrum place the $1s2p\ ^3P^\circ_1$ level at 45 540 000 cm^{-1} and the $1s2p\ ^1P^\circ_1$ at 45 890 000 cm^{-1} with an estimated uncertainty of ±60000 cm^{-1}.

Percentage compositions are from Ermolaev and Jones.

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Cr XXIII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$1s^2$	^1S	0	0			
$1s2s$	^3S	1	[45 383 500]			
$1s2p$	$^3P^\circ$	0	*[45 595 080]*			
		1	*[45 610 130]*	94	6	$^1P^\circ$
		2	*[45 691 370]*			
$1s2s$	^1S	0	[45 614 430]			
$1s2p$	$^1P^\circ$	1	*[45 827 110]*	94	6	$^3P^\circ$
$1s3s$	^3S	1	[53 759 820]			
$1s3p$	$^3P^\circ$	0	*[53 818 410]*			
		1	*[53 822 120]*	93	7	$^1P^\circ$
		2	*[53 846 400]*			
$1s3s$	^1S	0	[53 820 510]			
$1s3p$	$^1P^\circ$	1	*[53 883 700]*	93	7	$^3P^\circ$
$1s4s$	^3S	1	[56 658 460]			
$1s4p$	$^3P^\circ$	0	*[56 682 840]*			
		1	*[56 684 380]*	93	7	$^1P^\circ$
		2	*[56 694 650]*			
$1s4s$	^1S	0	[56 683 050]			
$1s4p$	$^1P^\circ$	1	*[56 709 860]*	93	7	$^3P^\circ$
$1s5s$	^3S	1	[57 992 520]			

Cr XXIII—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages		
1s5s	^1S	0	[58 004 800]			
1s5*p*	$^3P^\circ$	0	[*58 004 840*]			
		1	[*58 005 640*]	92	8	$^1P^\circ$
		2	[*58 010 900*]			
1s5*p*	$^1P^\circ$	1	[*58 018 580*]	92	8	$^3P^\circ$
Cr XXIV ($^2S_{1/2}$)	*Limit*		60 344 000			

Cr XXIV

$Z = 24$

H I isoelectronic sequence

Ground state: 1s $^2S_{1/2}$

Ionization energy = 63 675 900±200 cm^{-1} (7894.87±0.02 eV)

Swartz, Kastner, Rothe, and Neupert (1971) identified the $1s-2p$ unresolved pair of lines in a solar flare spectrum at 2.08 Å.

We give calculated values by Mohr (1983) for the $n = 2$ shell and by Erickson (1977) for $n = 3$-5 relative to the $2p$ $^2P^\circ_{1/2}$ level. Further details are given in the Introduction. Relative to the ground state, the level uncertainty is estimated to be 5 parts in 10^7. The uncertainty in the excited states relative to $2p$ $^2P^\circ_{1/2}$ is 1 part in 10^6.

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Cr XXIV

Configuration	Term	J	Level (cm^{-1})
1s	^2S	1/2	0
2p	$^2P^\circ$	1/2	[*47 719 790*]
		3/2	[*47 843 596*]
2s	^2S	1/2	[47 723 241]
3p	$^2P^\circ$	1/2	[*56 598 064*]
		3/2	[*56 634 766*]
3s	^2S	1/2	[56 599 135]
3d	^2D	3/2	[56 634 700]
		5/2	[56 646 759]
4p	$^2P^\circ$	1/2	[*59 700 397*]
		3/2	[*59 715 870*]
4s	^2S	1/2	[59 700 850]
4d	^2D	3/2	[59 715 842]
		5/2	[59 720 933]
4f	$^2F^\circ$	5/2	[*59 720 924*]
		7/2	[*59 723 460*]
5p	$^2P^\circ$	1/2	[*61 134 179*]
		3/2	[*61 142 095*]
5s	^2S	1/2	[61 134 411]
5d	^2D	3/2	[61 142 061]
		5/2	[61 144 687]
5f	$^2F^\circ$	5/2	[*61 144 683*]
		7/2	[*61 145 982*]
5g	^2G	7/2	[61 145 979]
		9/2	[61 146 758]
	Limit		**63 675 900**

F. Atomic Transition Probabilities of Chromium, Cr I through Cr XXIV

F. Atomic Transition Probabilities of Chromium

[Exerpted from: G. A. Martin, J. R. Fuhr, and W. L. Wiese, J. Phys. Chem. Ref. Data 17, Supplement 3 (1988)]

1. Introduction

The following tables, including the introductory comments, are excerpted from the above cited compilation of atomic transition probabilities by G. A. Martin, J. R. Fuhr, and W. L. Wiese of the Data Center on Atomic Transition Probabilities at the National Institute of Standards and Technology (formerly the National Bureau of Standards).

This is part of the third major critical compilation by the NBS Data Center on Atomic Transition Probabilities. A first tabulation[1] containing transition probabilities for about 4,000 spectral lines of the elements hydrogen through neon, atomic numbers $Z = 1$ through 10, including the neutral atoms as well as their various ions, was published in 1966. A second data volume[2] was issued in 1969, containing data for about 5,000 lines of the elements sodium ($Z = 11$) through calcium ($Z = 20$), again for all stages of ionization for which data were available. The data compilation work then continued with a series of smaller tables for the atoms and ions of the elements of the iron group, i.e., Sc and Ti[3]; V, Cr, and Mn[4]; Fe, Co, and Ni[5]; and the forbidden lines of all these elements.[6] From the beginning, it has been the intention to integrate these smaller tabulations into a single volume for the iron-group elements, in updated and expanded form. Unexpectedly, a great deal of new data were generated for these elements during the past few years, often with much improved accuracy, so that the revisions and additions became very extensive. Thus it took a much longer time than anticipated to complete these largely new data tables, and the greatly expanded tabulations had to be split into two separate volumes. Chromium is included in a volume that contains the material on the elements Sc ($Z = 21$) through Mn ($Z = 25$), and a companion volume[7] contains the material on Fe ($Z = 26$) through Ni ($Z = 28$).

In the present compilation, the scope and format of the earlier tabulations is maintained, i.e., critically evaluated atomic transition probabilities of allowed and forbidden discrete transitions of all stages of ionization are presented for which reliable data are available. Data are listed for at least the more prominent lines of each spectrum, even if some of these data are of low accuracy. Furthermore, transition-probability data are also presented for weaker transitions if the accuracy of these data has been estimated to be better than ± 50%.

The original literature is continually monitored by this NBS Data Center, and a master reference list is maintained from which all literature sources for this compilation have been taken.

2. Method of Evaluation

For the compilation of data on a critical basis, the central task is the evaluation of the data accuracy and the subsequent choice of the most accurate material. In order to accomplish this task in a consistent manner, general guideposts were established for each experimental and theoretical approach in earlier compilation work, and these criteria were maintained in this work. Specifically, each original literature source was judged by the following principal criteria:

(1) A general evaluation of the capabilities and reliability of the applied experimental or theoretical method.

(2) The author's consideration of the major critical factors in his approach that enter into the results.

(3) The degree of agreement and general consistency between the author's results and other reliable data.

(4) The degree of fit of the data into established systematic trends and, if deviations exist, the reasons for such disagreements.

(5) The author's estimate of his uncertainties.

The general evaluations of each experimental and theoretical method have been discussed in considerable detail in the introductions to previous tabulations.[1-6] Thus, these publications are to be consulted for further details. However, it should be pointed out that in this tabulation, particularly interesting situations are illustrated by providing comparison tables or graphs in the introductions to individual spectra.

With respect to error estimates, one should note that the theoretical literature sources, which provide a large part of the data, generally contain no error estimates, since no reliable assessment of the uncertainties introduced by the various approximations is possible. But even for the experimental papers, where error estimates may often readily be made, the statements by some authors are too imprecise and also incomplete, so that they are not particularly useful as presented. Sometimes only statistical measurement errors have been given, without allowance for systematic errors. It therefore became essential to judge each paper by the principal factors 1–4 listed above, in addition to utilizing the author's error estimate (point (5)) whenever appropriate.

3. General Arrangement of the Tables

The same general arrangement of the tables is used as in earlier volumes,[1,2] i.e., data are included which serve to identify the spectral lines, as well as the actual transition probabilities (and related quantities), accuracy estimates, and references to the sources of the compiled material. However, for most of the spectra of neutral and singly-ionized atoms of the iron-group elements, the transition array column was dropped. Instead, in order to identify the lower and upper levels of a transition, the level designation scheme of C. E. Moore[8] was adopted, who affixed lower-case letters ($a, b, c, ..., x, y, z$) to the term designations. This convention is also retained in the very recent tables of "Atomic Energy Levels" by J. Sugar and C. Corliss.[9] In other special cases, the notation was adapted to the special coupling situations encountered in those spectra, as, for example, the Jj coupling encountered in Ne-like ions and Jj and $J_1 \ell$ coupling for Ar-like ions.

Material pertaining to spectral-line identifications has been taken from the comprehensive wavelength tabulations of Reader and Corliss,[10] Kelly,[11,12] and Kelly and Palumbo,[13] the multiplet tables of C. E. Moore,[14,15] and the recent energy-level compilation of Sugar and Corliss[9] (this last reference supersedes earlier compilations by Sugar and others[16,17]). The wavelength and energy-level data from these sources have been supplemented by original literature data when needed in the course of preparing the transition-probability tables.

Wavelengths and energy levels which are the results of theoretical calculations, or which were either calculated from experimentally determined data or interpolated or extrapolated from data on similar (e.g., isoelectronic) species, are placed in square brackets in order to distinguish them from the usually more accurate experimental material.

For each transition-probability table which contains a minimum of twenty distinct wavelength values, a "list of tabulated lines," has been provided, in ascending order of wavelength, of the spectral lines contained therein, along with an index to the multiplet number (or numbers) in which each is to be found. Wavelengths that are printed in italics in the transition-probability tables are not included in these line lists.

The uncertainties in the atomic transition-probability data are denoted by letters as follows:

A . . for uncertainties within 3 percent,
B . . for uncertainties within 10 percent,
C . . for uncertainties within 25 percent,
D . . for uncertainties within 50 percent,
E . . for uncertainties greater than 50 percent.

The word *uncertainty* is used here with the connotation "estimated extent of the deviation from the true value." The estimation procedure is based on the evaluation of random errors *as well as estimates of the maximum effect of possible systematic errors*. Often, further distinctions were made in the uncertainty labels by assigning plus or minus signs to some transitions to indicate that these lines are estimated to be somewhat better or worse than similar lines. These should, therefore, be the first or last choice among similar transitions.

A summary of the abbreviations and special symbols used in the tables is given in Section 4. Included there for convenience are formulas which relate various properties of individual spectral lines to those for entire multiplets. In Table 1, the conversion factors are provided which have been used throughout this compilation to convert from transition probabilities to oscillator strengths and line strengths, and vice versa.

TABLE 1. Conversion factors

The factor in each box converts by multiplication the quantity above it into the one at its left.

	A_{ki}	f_{ik}	S
A_{ki}	1	$\frac{6.670_3 \times 10^{15} g_i}{g_k \lambda^2}$	E1 $\frac{2.026_1 \times 10^{18}}{g_k \lambda^3}$ E2 $\frac{1.679_9 \times 10^{18}}{g_k \lambda^5}$ M1 $\frac{2.697_4 \times 10^{13}}{g_k \lambda^3}$ M2 $\frac{6.626_5 \times 10^{12}}{g_k \lambda^5}$
f_{ik}	$\frac{1.499_2 \times 10^{-16} \lambda^2 g_k}{g_i}$	1	E1 $\frac{303.7_6}{g_i \lambda}$
S	E1 $4.935_5 \times 10^{-19}\ g_k \lambda^3$ E2 $5.952_6 \times 10^{-19}\ g_k \lambda^5$ M1 $3.707_3 \times 10^{-14}\ g_k \lambda^3$ M2 $1.509_1 \times 10^{-13}\ g_k \lambda^5$	E1 $3.292_1 \times 10^{-3}\ g_i \lambda$	1

The line strength (S) is given in atomic units; formulas and values for these quantities in SI units are as follows:

For E1 transitions, $a_0^2 e^2 = 7.188_3 \times 10^{-59}$ m^2 C^2

For E2 transitions, $a_0^4 e^2 = 2.012_9 \times 10^{-79}$ m^4 C^2

For M1 transitions, $\mu_B^2 = (eh/4\pi m_e)^2 = 8.600_7 \times 10^{-47}$ J^2 T^{-2}

For M2 transitions, $\mu_B^2 a_0^2 = 2.408_5 \times 10^{-67}$ J^2 m^2 T^{-2}.

where a_0, e, m_e, and h are the Bohr radius, electron charge, electron mass, and Planck constant, respectively, and μ_B is the Bohr magneton.

The transition probability (A_{ki}) is in units of s^{-1}, and the f-value is dimensionless. The wavelength (λ) is given in Ångström units, and g_i and g_k are the statistical weights of the lower and upper level, respectively.

[Note: the definition of the line strength for E2 transitions, which is used by some authors, yields an S-value that is 50% higher than that employed here and in earlier NBS transition-probability compilations. Such line strengths have been multiplied by $\frac{2}{3}$ before tabulating them here, and this fact is indicated in the short introductions to the pertinent data tables.]

For the atomic constants entering into the relations given in this table, the recommendations of the CODATA Task Group on Fundamental Constants (E. R. Cohen and B. N. Taylor, Rev. Mod. Phys. 59, 1121 (1987)) have been used. The 1987 values were not available at the time that most of the data was compiled for this publication; however, differences between these and the earlier (CODATA Task Group, 1973) values of the fundamental constants were utilized, which amount to only 0.002% or less for the E1 transitions and 0.05% or less for the M1, E2, and M2 (forbidden) transitions and have therefore not affected the tabulated data.

4. Key to Abbreviations and Symbols Used in the Tables

1. Symbols for indication of accuracy:

A...... uncertainties within 3 percent,
B...... uncertainties within 10 percent,
C...... uncertainties within 25 percent,
D...... uncertainties within 50 percent,
E...... uncertainties greater than 50 percent.

2. Abbreviations appearing in the source column of allowed transitions:

ls = *LS* coupling rules applied
n = normalized to a scale different from that of the author (as explained in the introductory remarks to the pertinent spectrum).
interp. = derived by an interpolation technique, rather than taken directly from the literature.

3. Special symbols used in the wavelength and energy level columns:

The number in parentheses under the multiplet designation refers to the sequence number of Ref. 14 (Revised Multiplet Table). If letters "uv" are added, they refer to the sequence number of Ref. 15 (Ultraviolet Multiplet Table).

Numbers in italics indicate multiplet values, i.e., weighted averages of *line* values.

Numbers in square brackets indicate approximate calculated or extrapolated values.

Useful Relations

(A) Statistical weights:

The statistical weights are related to the inner quantum number J_L (for one-electron spectra: j_l) of a level (i.e., initial or final state of a *line*) by

$$g_L = 2J_L + 1,$$

and to the quantum numbers of a term (initial or final state of a *multiplet*) by

$$g_M = (2L + 1)(2S + 1).$$

(The "multiplet" values g_M may also be obtained by summing over all possible "line" values g_L. S is the resultant spin.)

(B) Relations between the strengths of allowed lines and the total multiplet strength:

1. Line strength S:

$$S(i,k) = \sum_{J_i,J_k} S(J_i,J_k)$$

or

$$S\,(\text{Multiplet}) = \Sigma\, S\,(\text{line})$$

(k denotes the upper and i the lower term).

2. Absorption oscillator strength f_{ik}:

$$f_{ik}^{\text{multiplet}} = \frac{1}{\bar{\lambda}_{ik}\sum_{J_i}(2J+1)} \sum_{J_i,J_k} (2J_i+1) \times \lambda(J_i,J_k) \times f(J_i,J_k).$$

The mean wavelength for the multiplet, $\bar{\lambda}_{ik}$, may be obtained from the *weighted* energy levels. Often the wavelength differences for the lines within a multiplet are small, in which case the wavelength factors may be neglected.

3. Transition probability A_{ki}:

$$A_{ki}^{\text{multiplet}} = \frac{1}{(\bar{\lambda}_{ik})^3\sum_{J_k}(2J_k+1)} \sum_{J_i,J_k} (2J_k+1) \times \lambda(J_i,J_k)^3 \times A(J_i,J_k).$$

Relative strengths $S(J_i,J_k)$ of the components of a multiplet are listed for the case of LS coupling in C. W. Allen, *Astrophysical Quantities*, 3rd ed. (The Athlone Press, London, 1973); H. E. White and A. Y. Eliason, Phys. Rev. **44**, 753 (1933); B. W. Shore and D. H. Menzel, *Principles of Atomic Structure*, p. 447 (John Wiley & Sons, Inc., New York, 1968); L. Goldberg, Astrophys. J. **82**, 1 (1935) and **84**, 11 (1936).

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Chromium

Cr I

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s\ ^7S_3$

Ionization Energy: 6.76669 eV = 54575.6 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
1999.95	51	2703.48	32	3163.76	92	4065.71	173
2095.00	7	2716.18	31	3169.58	92	4081.74	68
2095.40	7	2726.50	15	3237.73	91	4097.69	82
2095.83	7	2731.90	15	3238.09	91	4109.58	69
2354.30	50	2736.46	15	3351.97	5	4111.33	82
2364.73	6	2751.58	30	3379.17	5	4126.51	57
2365.91	6	2752.85	30	3578.68	4	4165.52	193
2366.81	6	2757.09	30	3593.48	4	4203.59	57
2375.06	49	2761.74	30	3605.32	4	4204.48	168
2383.30	49	2764.36	30	3615.65	3	4211.48	90
2385.72	49	2769.90	30	3635.28	3	4213.18	115
2389.21	48	2780.70	30	3639.80	61	4222.75	104
2408.60	46	2871.63	29	3730.81	2	4230.49	104
2408.72	47	2879.27	29	3732.03	2	4232.23	188
2479.14	45	2887.00	29	3743.89	60	4234.52	126
2492.57	43	2889.22	29	3744.49	60	4235.99	103
2495.08	42	2893.25	29	3757.17	60	4237.72	103
2496.30	43	2894.17	29	3757.66	60	4238.96	102
2499.84	43	2896.76	29	3758.04	60	4242.84	102
2502.55	44	2899.20	29	3768.24	60	4248.34	102
2504.31	43	2905.48	29	3768.73	60	4252.24	102
2508.11	41	2909.05	29	3804.80	105	4254.33	1
2508.97	41	2910.89	29	3849.54	25	4255.50	89
2513.62	41	2911.15	29	3852.22	25	4257.35	102
2527.11	41	2967.64	28	3883.29	24	4261.35	81
2538.95	17	2971.10	28	3885.24	24	4261.63	127
2544.70	17	2975.48	28	3886.80	24	4262.37	114
2549.55	40	2980.78	28	3894.04	24	4263.15	161
2560.70	40	2988.64	14	3902.91	24	4268.79	167
2571.74	40	2991.88	28	3903.17	24	4269.96	114
2577.66	40	2994.06	14	3908.76	24	4271.07	114
2579.14	38	2995.09	13	3916.25	24	4272.93	81
2584.67	39	2996.57	28	3919.17	24	4274.81	1
2588.19	38	2998.78	14	3921.03	24	4275.98	155
2591.84	40	3000.88	28	3928.65	24	4280.42	161
2603.56	38	3005.06	28	3941.50	24	4280.89	145
2618.27	36	3013.72	27	3963.69	59	4283.00	187
2620.48	34	3015.20	26	3969.75	59	4288.40	124
2622.87	35	3020.67	26	3976.02	59	4289.73	1
2625.32	37	3021.58	26	3981.24	70	4291.97	145
2626.60	35	3024.36	27	3983.90	59	4293.58	81
2629.82	36	3029.17	27	3991.12	59	4296.11	200
2669.36	32	3030.25	26	4001.44	165	4296.30	124
2671.98	32	3031.35	26	4039.10	162	4296.63	161
2673.64	32	3034.19	27	4039.29	162	4297.06	67
2678.15	32	3037.05	26	4042.25	58	4297.75	161
2680.33	32	3040.84	26	4048.78	162	4298.05	200
2690.25	32	3053.87	27	4049.78	162	4299.72	81
2696.53	16	3148.44	92	4050.03	58	4300.52	145
2700.59	31	3155.16	92	4057.83	162	4301.19	145
2701.99	33	3160.62	92	4058.78	162	4302.78	199

List of tabulated lines — Continued

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
4305.47	81	4442.28	86	4578.33	159	4727.13	83
4307.67	198	4443.72	152	4580.05	12	4729.84	119
4309.73	186	4459.75	99	4582.40	171	4730.69	108
4312.48	125	4460.76	66	4583.90	97	4737.33	108
4317.91	186	4462.79	99	4584.10	122	4741.09	183
4319.66	81	4464.66	99	4584.76	97	4743.12	177
4321.25	74	4465.37	99	4584.94	134	4745.31	64
4321.62	125	4467.57	99	4585.10	144	4752.07	178
4325.08	88	4475.36	80	4586.15	122	4754.73	118
4325.65	124	4477.05	66	4591.41	22	4755.14	95
4330.76	113	4480.27	135	4592.55	190	4756.09	108
4332.57	124	4480.36	151	4595.60	179	4757.31	177
4337.25	185	4482.88	135	4600.11	55	4757.58	149
4337.57	23	4490.55	164	4600.75	22	4764.28	149
4338.80	136	4491.69	80	4601.02	55	4764.65	94
4339.45	23	4491.86	74	4606.36	191	4767.26	149
4339.74	23	4492.31	135	4611.06	84	4767.86	149
4340.14	67	4495.28	174	4611.96	134	4770.68	94
4341.46	67	4496.85	12	4613.36	22	4775.12	148
4343.17	67	4498.73	71	4614.51	158	4789.32	52
4344.51	23	4500.29	112	4616.12	22	4792.49	118
4345.08	136	4501.79	71	4617.37	84	4796.15	176
4346.83	88	4503.04	201	4619.54	71	4797.68	148
4347.49	77	4506.84	182	4622.47	150	4801.02	118
4351.06	23	4510.02	197	4622.76	71	4806.25	64
4351.77	23	4511.90	112	4625.91	157	4810.71	107
4353.94	136	4514.36	181	4626.18	22	4814.25	107
4356.77	101	4515.44	96	4628.48	128	4816.13	196
4357.51	136	4524.84	172	4633.27	128	4819.30	170
4359.65	23	4526.44	56	4639.52	128	4823.90	195
4362.97	73	4527.33	56	4639.70	150	4825.50	107
4363.13	87	4527.45	76	4641.49	184	4831.63	143
4368.25	101	4529.84	56	4641.96	157	4836.85	107
4368.90	136	4530.48	85	4646.15	22	4838.42	194
4370.76	166	4530.68	56	4646.50	109	4870.79	106
4370.87	160	4530.73	56	4646.80	128	4874.65	117
4371.28	23	4530.93	96	4648.12	54	4880.04	117
4373.26	23	4531.24	96	4648.33	84	4885.77	53
4373.65	192	4535.13	56	4651.29	22	4885.97	106
4374.17	88	4535.69	56	4652.16	22	4887.01	106
4375.34	87	4535.75	56	4654.76	128	4903.25	52
4376.80	192	4539.76	56	4656.18	109	4922.28	106
4377.55	74	4540.49	56	4656.82	202	4936.24	116
4379.77	101	4540.72	112	4663.33	128	4942.49	11
4381.11	67	4541.06	56	4665.90	150	4944.57	156
4382.86	67	4541.51	111	4666.20	83	4953.73	116
4384.97	23	4543.73	85	4669.24	128	4954.81	116
4387.38	74	4544.60	56	4680.86	120	4964.92	11
4391.76	23	4545.33	56	4689.38	128	4966.80	156
4393.54	86	4545.95	12	4693.94	83	5013.31	63
4397.24	100	4548.66	180	4695.14	83	5032.54	189
4399.82	100	4553.95	172	4697.04	65	5034.65	189
4410.31	100	4554.82	123	4697.38	133	5045.04	189
4410.97	86	4555.31	144	4698.46	128	5051.90	10
4411.11	100	4556.18	123	4698.94	110	5072.93	10
4412.25	23	4563.24	159	4699.59	183	5112.50	20
4413.00	204	4563.43	72	4700.60	65	5123.47	21
4413.86	152	4563.66	122	4706.09	120	5139.60	142
4422.70	152	4564.17	203	4707.73	133	5177.42	137
4424.10	75	4565.51	22	4708.02	128	5192.01	137
4424.29	100	4569.63	123	4717.67	120	5193.50	141
4428.52	100	4570.99	123	4718.43	128	5196.45	142
4429.93	152	4571.10	98	4722.65	121	5200.20	137
4432.16	71	4571.67	54	4723.06	108	5204.51	9
4432.77	205	4575.11	134	4724.40	108	5206.02	9

List of tabulated lines — Continued

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
5208.42	9	5300.74	19	5581.60	139	6630.00	18
5214.14	131	5304.19	147	5588.05	139	6661.10	175
5238.97	62	5312.88	147	5628.64	138	6669.27	175
5241.47	62	5318.79	147	5642.40	154	6882.40	146
5243.38	137	5328.36	79	5648.25	154	6883.05	146
5247.58	19	5329.17	79	5649.38	154	6925.22	146
5261.76	153	5329.76	79	5694.72	154	6978.46	146
5264.16	19	5340.46	147	5702.30	138	6979.81	146
5265.73	19	5344.77	147	5719.82	93	6980.91	146
5272.01	147	5345.77	19	5783.11	129	7170.56	169
5287.19	147	5348.30	19	5783.89	129	7355.93	78
5293.38	132	5400.58	130	5785.02	129	7400.22	78
5296.69	19	5409.78	19	5787.97	129	8916.24	16[illegible]
5297.37	79	5442.40	140	5838.68	93	8939.21	163
5297.99	79	5548.61	139	5844.60	93	8955.76	163
5298.29	19	5566.55	139	6330.13	8		

For this spectrum, we have utilized seventeen data sources, which are all fairly recent experiments. These include the absorption measurements of Bieniewski[1] and Blackwell and co-workers[15,16]; anomalous dispersion (hook) measurements (plus a few absorption measurements) of Huber and Sandeman[2]; emission experiments performed with a shock tube by Wolnik *et al.*,[9,10] with a hollow cathode by Cocke *et al.*,[11] and by Tozzi *et al.*,[17] and with a wall-stabilized arc by Wujec and Weniger[13]; shock tube absorption studies of Huber and Tobey[12]; and six lifetime determinations[4-8,19] from which oscillator strengths could be directly derived. Another source that we used in this compilation is that of Kostyk,[18] who derived log *gf*-values from solar spectra. The measurements of Cocke *et al.* were restricted to "branching ratio" determinations, which were then converted to transition probabilities by using available beam-foil lifetimes.

Accurate lifetime measurements are those by Marek,[6] by Measures and co-workers,[7,8] and by Hannaford and Lowe,[19] who all selectively populated the levels under study by means of dye laser excitation and then measured the corresponding radiative lifetimes. Other reliable lifetimes were measured by Becker *et al.*,[4] who employed the level-crossing (Hanle) method, and by Marek and Richter,[5] who used the phase-shift technique. It is possible to intercompare oscillator strengths derived from these lifetime sources for lines of the multiplets $a\,^7S - z\,^7P^\circ$ and $a\,^7S - y\,^7P^\circ$. This comparison, also including the absolute scale of Bieniewski, who has performed very careful absorption measurements with an electric furnace, is presented in Table 1. In converting the lifetimes to f-values, we did not include the contributions of non-resonance transitions because of lack of data. However, Huber and Sandeman estimated that these additional decay modes have a practically negligible effect ($\simeq$ 0.5%) on the lifetimes involved. We consider the averaged f-values for these two multiplets to be accurate to within ten percent, as supported by the excellent mutual agreement among the selected data sources.

TABLE 1. Comparison of absorption and lifetime data

Multiplet	λ(Å)	f_{ik} (Bieniewski[1])	f_{ik}[a] (Becker et al.[4])[b]	f_{ik}[a] (Marek and Richter[5])[c]	f_{ik}[a] (Marek[6])[d]	f_{ik}[a] (Measures et al.[7])[d]	f_{ik}[a] (Kwong and Measures[8])[d]	f_{ik}[a] (Hannaford and Lowe[19])[d]
$a\,^7S - z\,^7P^\circ$	4254.33	0.106	0.111	0.111	0.110	0.112		0.110
(1)	4274.81	0.082	0.0849	0.0841		0.0849		
	4289.73	0.059	0.0616	0.0646		0.0627	0.0633	
$a\,^7S - y\,^7P^\circ$	3578.68	0.34	0.355	0.402				
(4)	3593.48	0.28	0.271	0.319				
	3605.32	0.21	0.220	0.244				

[a] Listed oscillator strengths have been derived from lifetime measurements
[b] Level-crossing technique
[c] Phase shift method
[d] Laser excitation technique

The most reliable general *f*-value sources for this spectrum are those of Blackwell *et al.*[15,16] and Tozzi *et al.*[17] Blackwell's group obtained relative oscillator strengths by using their well-known absorption technique with an electric furnace. Their relative values were placed onto an absolute scale either by direct normalization to accurate radiative lifetimes or by comparing their newer measurements (at higher excitation potentials) to their earlier absolute data, via photoelectric pyrometry. Tozzi *et al.* measured branching ratios in emission, using a hollow-cathode discharge as a source and a Fourier transform spectrometer for the spectral recordings. These authors normalized their relative data to lifetimes measured by Kwiatkowski *et al.*[3] We estimate that the data of Refs. 15, 16, and 17 are generally accurate to within ten percent.

Another source providing accurate data is the work of Huber and Sandeman.[2] These authors normalized their relative data to the lifetimes of Ref. 4. Since these lifetimes are very close to our adopted absolute scale, we have tabulated the data of Ref. 2 without change or renormalization. We have also followed their carefully documented error estimates throughout. The data of Wolnik *et al.*,[9,10] which are systematically lower than those of Huber and Sandeman, have been increased by a factor of 1.35 to be consistent with our absolute scale. The data of Cocke *et al.*[11] agree quite well with those of Ref. 2 for overlapping lines, so that we have left their oscillator strength scale unchanged.

Another compehensive data source that have utilized in this compilation is that of Wujec and Weniger. These authors employed a wall-stabilized arc to measure the oscillator strengths of 275 lines in the wavelength range 4220–4850 Å. They measured the line intensities end-on with a photographic detection system. To determine the plasma conditions, Wujec and Weniger used a variety of spectroscopic techniques. These techniques revealed some significant inconsistencies in the experiment, although the *f*-values for overlapping lines agreed quite well with those of an earlier NBS compilation (Ref. 14). For example, a PLTE analysis and Stark broadening study of Ar I lines performed by Wujec and Weniger indicated high electron densities, with corresponding temperatures of about 11000 K. On the other hand, three other methods used by these authors yielded much lower temperatures ($\approx$ 8600 K) for the same experimental runs. These latter methods also produced consistently *lower* temperature determinations, even for runs performed at 50% *higher* arc currents. Because of these inconsistencies, we have assigned "D" accuracies to the data of Ref. 13 and have tabulated them only for unblended lines and only if no other data source was available.

Wujec and Weniger presented two different sets of transition probabilities, corresponding to their different plasma analyses. In this compilation, we have chosen the set of data that was determined by assuming an arc temperature derived from the scale of Younger *et al.*,[14] since this scale is based on reliable oscillator strengths.

Another reference providing reliable *f*-values is the work of Kostyk.[18] His oscillator strengths are derived from solar data on line depths of Cr I lines, taken from the Liege solar atlas.[20] For 45 lines, Kostyk's data overlapped with data from either Blackwell *et al.*[15,16] or Tozzi *et al.*[17] For the 45 lines in common, data for 28 lines agreed within 25 percent, and data for 43 lines agreed within 50 percent.

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Cr I: Allowed transitions

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$a\,^7S - z\,^7P^\circ$ (1)	*4269.6*	0	*23415*	7	21	0.312	0.256	25.2	0.254	B	1,4,5,6,7,8,19
		4254.33	0	23499	7	9	0.315	0.110	10.8	−0.114	B	1,4,5,6,7,19
		4274.81	0	23386	7	7	0.307	0.0840	8.27	−0.231	B	1,4,5,7
		4289.73	0	23305	7	5	0.316	0.0622	6.15	−0.361	B	1,4,5,7,8
2.	$a\,^7S - z\,^5P^\circ$ (2)											
		3732.03	0	26788	7	7	0.0016	3.3(−4)	0.029	−2.63	C+	17
		3730.81	0	26796	7	5	0.0016	2.4(−4)	0.020	−2.78	C+	17
3	$a\,^7S - z\,^5D^\circ$ (3)											
		3615.65	0	27650	7	9	5.1(−4)	1.3(−4)	0.011	−3.05	C−	2
		3635.28	0	27500	7	7	1.5(−4)	3.5(−5)	0.0026	−3.67	C−	2
4	$a\,^7S - y\,^7P^\circ$ (4)	*3589.9*	0	*27848*	7	21	1.52	0.881	72.9	0.790	B	1,4,5
		3578.68	0	27935	7	9	1.48	0.366	30.2	0.409	B	1,4,5
		3593.48	0	27820	7	7	1.50	0.290	24.0	0.307	B	1,4,5
		3605.32	0	27729	7	5	1.62	0.225	18.7	0.197	B	1,4,5
5	$a\,^7S - y\,^5P^\circ$ (5)											
		3351.97	0	29825	7	7	0.0012	2.0(−4)	0.015	−2.86	B	17
		3379.17	0	29585	7	5	9.9(−4)	1.2(−4)	0.0095	−3.07	C+	17
6	$a\,^7S - x\,^7P^\circ$ (uv 1)	*2365.6*	0	*42259*	7	21	0.057	0.014	0.78	−1.00	C	2
		2364.73	0	42275	7	9	0.053	0.0057	0.31	−1.40	C	2
		2365.91	0	42254	7	7	0.055	0.0046	0.25	−1.49	C	2
		2366.81	0	42238	7	5	0.069	0.0041	0.22	−1.54	C	2
7	$a\,^7S - w\,^7P^\circ$ (uv 2)	*2095.3*	0	*47710*	7	21	0.0114	0.00226	0.109	−1.80	C	2
		2095.00	0	47719	7	9	0.012	9.9(−4)	0.048	−2.16	C	2
		2095.40	0	47709	7	7	0.011	7.3(−4)	0.035	−2.29	C	2
		2095.83	0	47697	7	5	0.011	5.3(−4)	0.026	−2.43	C	2
8.	$a\,^5S - z\,^7P^\circ$ (6)											
		6330.13	7593	23386	5	7	2.9(−4)	2.4(−4)	0.025	−2.92	D	18
9	$a\,^5S - z\,^5P^\circ$ (7)	*5206.9*	7593	*26793*	5	15	0.509	0.621	53.2	0.492	B	15,17
		5208.42	7593	26788	5	7	0.506	0.288	24.7	0.158	B	15,17
		5206.02	7593	26796	5	5	0.514	0.209	17.9	0.019	B	15,17
		5204.51	7593	26802	5	3	0.509	0.124	10.6	−0.208	B	15,17

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log *gf*	Accuracy	Source
10.	$a\,^5S - z\,^7D^\circ$ (8)											
		5051.90	7593	27382	5	5	5.41(−4)	2.07(−4)	0.0172	−2.985	B	15
		5072.93	7593	27300	5	3	0.00159	3.69(−4)	0.0308	−2.734	B	15
11.	$a\,^5S - y\,^7P^\circ$ (9)											
		4942.49	7593	27820	5	7	0.00198	0.00102	0.0827	−2.294	B	15
		4964.92	7593	27729	5	5	0.00161	5.94(−4)	0.0486	−2.527	B	15
12.	$a\,^5S - y\,^5P^\circ$ (10)	*4529.6*	7593	*29664*	5	15	0.029	0.027	2.0	−0.87	B	15,17
		4496.85	7593	29825	5	7	0.033	0.014	1.0	−1.15	B	15,17
		4545.95	7593	29585	5	5	0.027	0.0085	0.64	−1.37	B	15,17
		4580.05	7593	29421	5	3	0.024	0.0045	0.34	−1.65	B	17
13.	$a\,^5S - y\,^5F^\circ$ (uv 3)											
		2995.09	7593	40971	5	5	0.43	0.058	2.8	−0.54	D	2
14.	$a\,^5S - x\,^5P^\circ$ (uv 4)	*2992.5*	7593	*41000*	5	15	0.41	0.16	8.1	−0.09	D	2,15
		2988.64	7593	41043	5	7	0.52	0.098	4.8	−0.31	C	2
		2994.06	7593	40983	5	5	0.25	0.034	1.7	−0.77	E	2
		2998.78	7593	40930	5	3	0.407	0.0329	1.62	−0.784	B	15
15.	$a\,^5S - w\,^5P^\circ$ (uv 7)	*2730.3*	7593	*44208*	5	15	0.76	0.256	11.5	0.107	C	2
		2726.50	7593	44259	5	7	0.75	0.12	5.3	−0.23	C	2
		2731.90	7593	44187	5	5	0.78	0.087	3.9	−0.36	C	2
		2736.46	7593	44126	5	3	0.75	0.050	2.3	−0.60	D	2
16.	$a\,^5S - v\,^5P^\circ$ (uv 8)											
		2696.53	7593	44667	5	3	0.12	0.0076	0.34	−1.42	D	2
17.	$a\,^5S - u\,^5P^\circ$ (uv 9)											
		2544.70	7593	46879	5	7	0.11	0.014	0.61	−1.14	D−	2
		2538.95	7593	46968	5	5	0.11	0.010	0.44	−1.28	E	2
18.	$a\,^5D - z\,^7P^\circ$ (16)											
		6630.00	8308	23386	9	7	6.0(−5)	3.1(−5)	0.0060	−3.56	D	18

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
19.	$a\,^5D - z\,^5P^\circ$ (18)	*5345.2*	*8090*	*26793*	25	15	0.096	0.022	9.7	−0.26	B	15,17
		5409.78	8308	26788	9	7	0.062	0.021	3.4	−0.72	B	15,17
		5345.77	8095	26796	7	5	0.049	0.015	1.8	−0.98	B	15,17
		5296.69	7927	26802	5	3	0.031	0.0079	0.69	−1.40	B	15,17
		5348.30	8095	26788	7	7	0.017	0.0073	0.90	−1.29	B	15,17
		5298.29	7927	26796	5	5	0.033	0.014	1.2	−1.15	B	15,17
		5264.16	7811	26802	3	3	0.041	0.017	0.88	−1.29	B	15,17
		5300.74	7927	26788	5	7	0.0025	0.0015	0.13	−2.12	B	15,17
		5265.73	7811	26796	3	5	0.0085	0.0059	0.31	−1.75	B	15,17
		5247.58	7751	26802	1	3	0.019	0.023	0.40	−1.64	B	15,17
20.	$a\,^5D - z\,^7D^\circ$ (19)											
		5112.50	8095	27650	7	9	5.7(−5)	2.9(−5)	0.0034	−3.70	D	18
21.	$a\,^5D - y\,^7P^\circ$ (20)											
		5123.47	8308	27820	9	7	4.0(−4)	1.2(−4)	0.018	−2.96	D	18
22.	$a\,^5D - y\,^5P^\circ$ (21)	*4633.9*	*8090*	*29664*	25	15	0.11	0.022	8.2	−0.27	B	15,17
		4646.15	8308	29825	9	7	0.087	0.022	3.0	−0.70	B	15,17
		4652.16	8095	29585	7	5	0.058	0.013	1.4	−1.03	B	17
		4651.29	7927	29421	5	3	0.036	0.0070	0.54	−1.46	B	15,17
		4600.75	8095	29825	7	7	0.025	0.0079	0.84	−1.26	B	15,17
		4616.12	7927	29585	5	5	0.041	0.013	0.99	−1.19	B	15,17
		4626.18	7811	29421	3	3	0.050	0.016	0.73	−1.32	B	15,17
		4565.51	7927	29825	5	7	0.0041	0.0018	0.14	−2.05	B	15,17
		4591.41	7811	29585	3	5	0.011	0.0060	0.27	−1.74	B	15,17
		4613.36	7751	29421	1	3	0.022	0.021	0.32	−1.68	B	15,17
23.	$a\,^5D - z\,^5F^\circ$ (22)	*4350.4*	*8090*	*31070*	25	35	0.117	0.0466	16.7	0.067	C	2,15
		4351.77	8308	31280	9	11	0.12	0.040	5.2	−0.44	C	2
		4344.51	8095	31106	7	9	0.11	0.040	4.0	−0.55	C	2
		4339.45	7927	30965	5	7	0.0692	0.0274	1.95	−0.864	B	15
		4337.57	7811	30859	3	5	0.0548	0.0258	1.10	−1.112	B	15
		4339.74	7751	30787	1	3	0.0440	0.0372	0.532	−1.429	B	15
		4384.97	8308	31106	9	9	0.027	0.0079	1.0	−1.15	D	2
		4371.28	8095	30965	7	7	0.041	0.012	1.2	−1.09	C	2
		4359.65	7927	30859	5	5	0.054	0.016	1.1	−1.11	C	2
		4351.06	7811	30787	3	3	0.0418	0.0119	0.509	−1.449	B	15
		4412.25	8308	30965	9	7	9.86(−4)	2.24(−4)	0.0293	−2.696	B	15
		4391.76	8095	30859	7	5	0.00288	5.96(−4)	0.0603	−2.380	B	15
		4373.26	7927	30787	5	3	0.00524	9.02(−4)	0.0649	−2.346	B	15

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
24.	$a\,^5D - z\,^5D^\circ$ (23)	*3910.5*	*8090*	*33655*	25	25	0.12	0.028	8.9	−0.16	C−	2
		3919.17	8308	33816	9	9	0.092	0.021	2.5	−0.72	C	2
		3908.76	8095	33672	7	7	0.062	0.014	1.3	−1.00	C−	2
		3902.91	7927	33542	5	5	0.035	0.0080	0.51	−1.40	D	2
		3903.17	7811	33424	3	3	0.018	0.0041	0.16	−1.91	D−	2
		3941.50	8308	33672	9	7	0.028	0.0051	0.59	−1.34	C−	2
		3928.65	8095	33542	7	5	0.052	0.0086	0.78	−1.22	C	2
		3921.03	7927	33424	5	3	0.058	0.0080	0.51	−1.40	C	2
		3916.25	7811	33338	3	1	0.097	0.0075	0.29	−1.65	C	2
		3886.80	8095	33816	7	9	0.022	0.0065	0.58	−1.34	C−	2
		3883.29	7927	33672	5	7	0.039	0.012	0.79	−1.21	C	2
		3885.24	7811	33542	3	5	0.039	0.015	0.56	−1.36	C−	2
		3894.04	7751	33424	1	3	0.039	0.026	0.34	−1.58	C−	2
25.	$a\,^5D - z\,^3P^\circ$ (24)											
		3849.54	7927	33897	5	3	0.023	0.0030	0.19	−1.82	E	2
		3852.22	7811	33763	3	1	0.070	0.0052	0.20	−1.81	E	2
26.	$a\,^5D - y\,^5F^\circ$ (27)											
		3021.58	8308	41393	9	11	2.91	0.487	43.6	0.642	B	15
		3015.20	7751	40906	1	3	1.63	0.668	6.63	−0.175	B	15
		3037.05	8308	41225	9	9	0.54	0.075	6.8	−0.17	C	2
		3030.25	8095	41086	7	7	1.1	0.15	10	0.02	C	2
		3020.67	7811	40906	3	3	1.5	0.21	6.1	−0.21	D−	2
		3040.84	8095	40971	7	5	0.74	0.073	5.1	−0.29	D	2
		3031.35	7927	40906	5	3	0.31	0.026	1.3	−0.89	E	2
27.	$a\,^5D - x\,^5P^\circ$ (26)											
		3053.87	8308	41043	9	7	0.797	0.0866	7.84	−0.108	B	15
		3029.17	7927	40930	5	3	0.38	0.032	1.6	−0.80	E	2
		3034.19	8095	41043	7	7	0.35	0.048	3.4	−0.47	D	2
		3024.36	7927	40983	5	5	1.27	0.174	8.65	−0.061	B	15
		3013.72	7811	40983	3	5	0.83	0.19	5.6	−0.25	C	2
28.	$a\,^5D - y\,^5D^\circ$ (uv 11)											
		3005.06	8308	41575	9	7	0.92	0.097	8.6	−0.06	C−	2
		3000.88	8095	41409	7	5	1.6	0.15	10	0.02	C−	2
		2996.57	7927	41289	5	3	2.0	0.16	7.8	−0.10	C	2
		2991.88	7811	41225	3	1	3.0	0.14	4.0	−0.39	D	2
		2967.64	8095	41782	7	9	0.39	0.067	4.6	−0.33	D	2
		2971.10	7927	41575	5	7	0.71	0.13	6.5	−0.18	C	2
		2975.48	7811	41409	3	5	0.89	0.20	5.8	−0.23	C	2
		2980.78	7751	41289	1	3	0.510	0.204	2.00	−0.691	B	15

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
29.	a ^{5}D – z ^{5}D° (uv 12)	*2893.5*	*8090*	*42640*	25	25	0.93	0.117	27.9	0.467	C–	2
		2889.22	8308	42909	9	9	0.66	0.082	7.1	–0.13	C	2
		2893.25	8095	42648	7	7	0.52	0.065	4.4	–0.34	C	2
		2896.76	7927	42439	5	5	0.30	0.037	1.8	–0.73	C–	2
		2899.20	7811	42293	3	3	0.15	0.019	0.55	–1.24	D–	2
		2911.15	8308	42648	9	7	0.26	0.025	2.2	–0.64	D	2
		2910.89	8095	42439	7	5	0.34	0.031	2.1	–0.66	D	2
		2909.05	7927	42293	5	3	0.68	0.051	2.5	–0.59	C	2
		2905.48	7811	42218	3	1	1.3	0.053	1.5	–0.80	D	2
		2871.63	8095	42909	7	9	0.12	0.018	1.2	–0.89	D–	2
		2879.27	7927	42648	5	7	0.21	0.036	1.7	–0.74	D	2
		2887.00	7811	42439	3	5	0.27	0.055	1.6	–0.78	D	2
		2894.17	7751	42293	1	3	0.33	0.12	1.2	–0.91	D–	2
30.	a ^{5}D – w ^{5}P° (uv 15)											
		2780.70	8308	44259	9	7	1.4	0.13	11	0.07	C	2
		2769.90	8095	44187	7	5	1.1	0.090	5.8	–0.20	C	2
		2761.74	7927	44126	5	3	0.68	0.047	2.1	–0.63	D	2
		2764.36	8095	44259	7	7	0.37	0.042	2.7	–0.53	D	2
		2757.09	7927	44187	5	5	0.68	0.078	3.5	–0.41	C	2
		2752.85	7811	44126	3	3	0.87	0.098	2.7	–0.53	D	2
		2751.58	7927	44259	5	7	0.069	0.011	0.50	–1.26	D–	2
31.	a ^{5}D – v ^{5}P° (uv 17)											
		2716.18	8308	45113	9	7	0.11	0.0092	0.74	–1.08	C	2
		2700.59	8095	45113	7	7	0.075	0.0082	0.51	–1.24	D	2
32.	a ^{5}D – x ^{5}F° (uv 18)											
		2678.15	7927	45256	5	7	0.12	0.018	0.79	–1.05	C	2
		2671.98	7811	45225	3	5	0.12	0.022	0.57	–1.19	D–	2
		2669.36	7751	45202	1	3	0.12	0.039	0.34	–1.41	E	2
		2703.48	8308	45286	9	9	0.063	0.0069	0.55	–1.21	D	2
		2690.25	8095	45256	7	7	0.085	0.0092	0.57	–1.19	D	2
		2680.33	7927	45225	5	5	0.10	0.011	0.47	–1.27	D	2
		2673.64	7811	45202	3	3	0.18	0.019	0.51	–1.24	E	2
33.	a ^{5}D – [illegible]											
		2701.99	8308	45306	9	11	0.21	0.028	2.2	–0.60	C	2
34.	a ^{5}D – [illegible]											
		2620.48	7927	46077	5	3	0.19	0.012	0.50	–1.24	E	2
35.	a ^{5}D – w ^{5}D° (uv 21)											
		2622.87	8308	46422	9	9	0.13	0.013	1.0	0.92	D	2
		2626.60	8308	46368	9	7	0.093	0.0075	0.58	1.17	E	2
36.	a ^{5}D – [illegible]											
		2629.82	8095	46109	7	5	0.10	0.0077	0.46	1.27	E	2
		2618.27	7927	46109	5	5	0.095	0.0098	0.42	1.31	E	2

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Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
37.	$a\ ^5\mathrm{D} - (\ ^\circ)^\circ$											
		2625.32	8095	46174	7	7	0.091	0.0094	0.57	−1.18	E	2
38.	$a\ ^5\mathrm{D} - w\ ^5\mathrm{F}^\circ$ (uv 22)											
		2603.56	8308	46705	9	11	0.062	0.0077	0.59	−1.16	E	2
		2588.19	8095	46721	7	9	0.088	0.011	0.68	−1.10	E	2
		2579.14	7927	46688	5	7	0.11	0.015	0.64	−1.12	D−	2
39.	$a\ ^5\mathrm{D} - z\ ^3\mathrm{G}^\circ$ (uv 23)											
		2584.67	8308	46986	9	11	0.061	0.0075	0.58	−1.17	E	2
40.	$a\ ^5\mathrm{D} - u\ ^5\mathrm{P}^\circ$ (uv 24)											
		2591.84	8308	46879	9	7	0.65	0.051	3.9	−0.34	C	2
		2571.74	8095	46968	7	5	0.64	0.045	2.7	−0.50	E	2
		2577.66	8095	46879	7	7	0.26	0.025	1.5	−0.75	D−	2
		2560.70	7927	46968	5	5	0.43	0.042	1.8	−0.68	D−	2
		2549.55	7811	47022	3	3	0.48	0.047	1.2	−0.85	D−	2
41.	$a\ ^5\mathrm{D} - v\ ^5\mathrm{D}^\circ$ (uv 30)											
		2527.11	8308	47866	9	9	0.53	0.051	3.6	−0.34	E	2
		2508.11	7927	47786	5	5	0.21	0.020	0.81	−1.01	D−	2
		2508.97	7927	47772	5	3	0.38	0.021	0.89	−0.97	C−	2
		2513.62	8095	47866	7	9	0.11	0.014	0.81	−1.01	C	2
42.	$a\ ^5\mathrm{D} - (\ ^\circ)^\circ$											
		2495.08	7811	47878	3	3	0.27	0.025	0.62	−1.12	C	2
43.	$a\ ^5\mathrm{D} - u\ ^5\mathrm{F}^\circ$ (uv 31)											
		2504.31	8095	48014	7	9	0.45	0.054	3.1	−0.42	C	2
		2496.30	7927	47975	5	7	0.56	0.073	3.0	−0.44	C	2
		2492.57	7811	47918	3	5	0.45	0.070	1.7	−0.68	C	2
		2499.84	7927	47918	5	5	0.16	0.015	0.61	−1.18	E	2
44.	$a\ ^5\mathrm{D} - (\ ^\circ)^\circ$											
		2502.56	8095	48043	7	9	0.22	0.026	1.6	−0.74	D	2
45.	$a\ ^5\mathrm{D} - \ ^5\mathrm{D}^\circ$											
		2479.14	7924	48252	5	7	0.098	0.013	0.51	−1.20	D	2
46.	$a\ ^5\mathrm{D} - t\ ^5\mathrm{P}^\circ$ (uv 26)											
		2408.60	8308	49812	9	7	0.67	0.045	3.2	−0.39	D−	2
47.	$a\ ^5\mathrm{D} - (\ ^\circ)^\circ$											
		2408.72	8096	49606	7	5	0.29	0.018	1.0	−0.90	D−	2

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
48.	$a\ ^5D - z\ ^5F^\circ$ (uv 37)											
		2389.21	7811	49653	3	5	0.23	0.033	0.77	−1.01	D−	2
49.	$a\ ^5D - s\ ^5F^\circ$ (uv 39)											
		2383.30	8308	50253	9	11	0.41	0.042	3.0	−0.42	D−	2
		2385.72	8308	50211	9	9	0.17	0.014	1.0	−0.89	D−	2
		2375.06	7927	50019	5	3	0.17	0.0085	0.33	−1.37	E	2
50.	$a\ ^5D - u\ ^5D^\circ$ (uv 40)											
		2354.30	8095	50558	7	9	0.081	0.0086	0.47	−1.22	D−	2
51.	$a\ ^5D - r\ ^5D^\circ$ (uv 48)											
		1999.95	8308	58293	9	9	1.4	0.082	4.9	−0.13	D−	2
52.	$a\ ^5G - y\ ^5F^\circ$ (31)											
		4789.32	20520	41393	13	11	0.114	0.0331	6.79	−0.366	B	16
		4903.25	20517	40906	5	3	0.074	0.016	1.3	−1.10	D	10n
53.	$a\ ^5G - x\ ^5P^\circ$ (30)											
		4885.77	20521	40983	7	5	0.0492	0.0126	1.42	−1.055	B	16
54.	$a\ ^5G - z\ ^5H^\circ$ (32)											
		4571.67	20520	42387	13	15	0.036	0.013	2.5	−0.77	D	13
		4648.12	20517	42026	5	7	0.018	0.0082	0.62	−1.39	D	13
55.	$a\ ^5G$ - [illegible]											
		4601.02	20524	42252	11	13	0.015	0.0056	0.94	−1.21	D	13
		4600.11	20520	42252	13	13	0.016	0.0051	1.0	−1.18	D	18
56.	$a\ ^5G - z\ ^5G^\circ$ (33)	*4533.7*	*20522*	*42573*	45	45	0.205	0.0633	42.5	0.454	B	16,17
		4526.44	20520	42606	13	13	0.175	0.0538	10.4	−0.156	B	17
		4530.73	20524	42589	11	11	0.158	0.0486	7.98	0.272	B	17
		4535.69	20524	42565	9	9	0.149	0.0460	6.18	0.383	B	17
		4540.49	20521	42539	7	7	0.150	0.0465	4.87	−0.487	B	16,17
		4544.60	20517	42515	5	5	0.169	0.0523	3.91	0.[illegible]82	B	17
		4529.84	20520	42589	13	11	0.011	0.0030	0.58	1.41	C+	17
		4535.75	20524	42565	11	9	0.025	0.0063	1.0	1.16	C+	17
		4541.06	20524	42539	9	7	0.034	0.0081	1.1	1.14	B	16,17
		4545.33	20521	42515	7	5	0.034	0.0075	0.79	1.28	B	17
		4527.33	20524	42606	11	13	0.021	0.0077	1.3	1.07	B	17
		4530.68	20524	42589	9	11	0.036	0.014	1.8	0.91	B	17
		4535.13	20521	42565	7	9	0.038	0.015	1.6	0.98	B	16,17
		4539.76	20517	42539	5	7	0.032	0.014	1.0	1.15	B	16,17

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
57.	$a\,^5G - y\,^5G^\circ$ (35)											
		4126.51	20520	44746	13	13	0.0671	0.0171	3.03	−0.652	B	16
		4203.59	20517	44300	5	5	0.057	0.015	1.0	−1.12	D	10n
58.	$a\,^5G - x\,^5F^\circ$ (36)											
		4042.25	20524	45256	9	7	0.0088	0.0017	0.20	−1.82	D	18
		4050.03	20517	45202	5	3	0.012	0.0017	0.12	−2.06	D	18
59.	$a\,^5G - y\,^5H^\circ$ (38)											
		3963.69	20520	45741	13	15	1.3	0.36	61	0.67	D−	2
		3969.75	20524	45707	11	13	1.2	0.35	50	0.58	D−	2
		3983.90	20521	45615	7	9	1.05	0.32	29	0.35	C−	11
		3991.12	20517	45566	5	7	1.07	0.357	23.5	0.252	B	16
		3976.02	20520	45663	13	11	0.0023	4.6(−4)	0.078	−2.22	D	11
60.	$a\,^5G - x\,^5G^\circ$ (43)											
		3743.89	20520	47222	13	13	0.761	0.160	25.6	0.318	B	16
		3757.66	20521	47126	7	7	0.413	0.0875	7.58	−0.213	B	16
		3768.24	20517	47047	5	5	0.510	0.109	6.74	−0.265	B	16
		3758.04	20524	47126	9	7	0.116	0.0192	2.14	−0.763	B	16
		3763.73	20521	47047	7	5	0.119	0.0181	1.57	−0.897	B	16
		3744.49	20524	47222	11	13	0.0501	0.0124	1.69	−0.864	B	16
		3757.17	20517	47126	5	7	0.0616	0.0182	1.13	−1.040	B	16
61.	$a\,^5G - u\,^5F^\circ$ (47)											
		3639.80	20520	47986	13	11	1.8	0.30	47	0.59	D	12
62.	$a\,^5P - x\,^5P^\circ$ (59)											
		5241.47	21857	40936	3	3	0.0067	0.0028	0.14	−2.08	D	18
		5238.97	21848	40936	5	3	0.0401	0.00991	0.855	−1.306	B	16
63.	$a\,^5P - y\,^5D^\circ$ (60)											
		5013.31	21841	41782	7	9	0.035	0.017	2.0	−0.92	D	10n
64.	$a\,^5P - x\,^5D^\circ$ (61)											
		4745.31	21841	42909	7	9	0.020	0.0087	0.95	−1.22	D	10n
		4806.25	21848	42648	5	7	0.0066	0.0027	0.21	−1.87	D−	13
65.	$a\,^5P - z\,^5S^\circ$ (62)											
		4697.04	21841	43125	7	5	0.063	0.012	1.2	−1.06	D	18
		4700.60	21857	43125	3	5	0.0336	0.0185	0.860	−1.256	B	16

Cr I: **Allowed transitions — Continued**

No.	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
66.	$a\,^5P - w\,^5P^\circ$ (63)											
		4460.76	21848	44259	5	7	0.015	0.0065	0.48	−1.49	D	18
		4477.05	21857	44187	3	5	0.013	0.0065	0.29	−1.71	D	18
67.	$a\,^5P - v\,^5P^\circ$ (64)											
		4341.46	21848	44875	5	5	0.0064	0.0018	0.13	−2.04	E	13
		4382.86	21857	44667	3	3	0.030	0.0086	0.37	−1.59	D−	13
		4340.14	21841	44875	7	5	0.12	0.024	2.4	−0.77	D	13
		4381.11	21848	44667	5	3	0.10	0.018	1.3	−1.05	D	10n
		4297.06	21848	45113	5	7	0.048	0.019	1.3	−1.03	D	13
		4343.17	21857	44875	3	5	0.036	0.017	0.73	−1.29	D	13
68.	$a\,^5P - w\,^5D^\circ$ (66)											
		4081.74	21857	46350	3	5	0.012	0.0050	0.20	−1.82	D	18
69.	$a\,^5P -$ ([illegible])											
		4109.58	21848	46174	5	7	0.031	0.011	0.74	−1.26	D	18
70.	$a\,^5P - u\,^5P^\circ$ (67)											
		3981.24	21857	46968	3	5	0.11	0.045	1.8	−0.87	D	10n
71.	$a\,^3P - y\,^3P^\circ$ (81)											
		4619.54	24093	45734	5	5	0.16	0.051	3.9	−0.59	D	13
		4501.79	23512	45719	3	3	0.10	0.030	1.4	−1.04	D	13
		4622.76	24093	45719	5	3	0.11	0.021	1.6	−0.98	D	18
		4498.73	23512	45734	3	5	0.079	0.040	1.8	−0.92	D	18
		4432.16	23163	45719	1	3	0.18	0.16	2.3	−0.80	D	18
72.	$a\,^3P - y\,^3F^\circ$											
		4563.43	24093	46000	5	7	0.0055	0.0024	0.18	−1.92	D−	13
73.	$a\,^3P -$ ([illegible])											
		4362.97	23163	46077	1	3	0.032	0.027	0.39	−1.56	D−	13
74.	$a\,^3P - w\,^3D^\circ$ (83)											
		4491.86	24093	46350	5	5	0.034	0.010	0.76	−1.29	D	18
		4397.38	23512	46298	3	3	0.054	0.016	0.68	−1.33	D	13
		4377.55	23512	46350	3	5	0.033	0.016	0.69	−1.32	D	18
		4321.25	23163	46298	1	3	0.034	0.029	0.41	−1.54	D−	13
75.	$a\,^3P -$ ([illegible])											
		4424.10	23512	46109	3	5	0.057	0.028	1.2	−1.08	D	13
76.	$a\,^3P -$ ([illegible])											
		4527.45	24093	46174	5	7	0.062	0.027	2.0	−0.87	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
77.	$a\ ^3P - z\ ^3S°$											
		4347.49	24093	47088	5	3	0.019	0.0032	0.23	−1.79	D−	13
78.	$z\ ^7P° - e\ ^7S$ (93)											
		7400.22	23386	36896	7	7	0.135	0.111	18.9	−0.111	B	16
		7355.93	23305	36896	5	7	0.0914	0.104	12.6	−0.285	B	16
79.	$z\ ^7P° - e\ ^7D$ (94)											
		5328.36	23499	42261	9	11	0.62	0.32	51	0.46	D	9n
		5297.37	23386	42258	7	9	0.388	0.210	25.6	0.167	B	16
		5329.17	23499	42258	9	9	0.225	0.0960	15.1	−0.064	B	16
		5297.99	23386	42256	7	7	0.30	0.12	15	−0.06	D	18
		5329.76	23499	42256	9	7	0.0538	0.0178	2.81	−0.796	B	16
80.	$z\ ^7P° - f\ ^7S$ (95)											
		4491.69	23386	45643	7	7	0.044	0.013	1.4	−1.03	D	18
		4475.36	23305	45643	5	7	0.030	0.013	0.93	−1.20	D	18
81.	$z\ ^7P° - f\ ^7D$ (96)											
		4261.35	23499	46960	9	11	0.066	0.022	2.8	−0.70	D	13
		4272.93	23386	46783	7	9	0.047	0.017	1.6	−0.94	D	13
		4293.58	23499	46783	9	9	0.025	0.0070	0.89	−1.20	D	18
		4299.72	23386	46637	7	7	0.061	0.017	1.7	−0.93	D	13
		4305.47	23305	46525	5	5	0.076	0.021	1.5	−0.98	D	10n
		4319.66	23305	46449	5	3	0.18	0.030	2.1	−0.82	D	10n
82.	$z\ ^7P° - g\ ^7D$ (97)											
		4097.60	23305	47702	5	7	0.053	0.019	1.3	−1.03	D	18
		4111.33	23386	47702	7	7	0.12	0.031	2.9	−0.67	D	18
83.	$a\ ^3H - z\ ^3H°$ (99)											
		4727.13	24200	45349	13	13	0.061	0.017	3.4	−0.66	D	10n
		4693.94	24066	45364	11	11	0.034	0.011	1.9	−0.91	D	18
		4666.20	23934	45360	9	9	0.036	0.012	1.6	−0.96	D	13
		4696.14	24066	45349	11	13	0.015	0.0060	1.0	−1.18	D	18
84.	$a\ ^3H - y\ ^3H°$											
		4617.37	24066	45707	11	13	5.1(−4)	1.9(−4)	0.032	−2.67	D−	11
		4648.33	24200	45707	13	13	0.0015	4.9(−4)	0.097	−2.20	D−	11
		4611.06	23934	45615	9	9	0.0020	6.4(−4)	0.087	−2.24	D−	11
85.	$a\ ^3H - y\ ^3F°$ (100)											
		4543.73	24066	46068	11	9	0.010	0.0025	0.42	−1.56	D−	13
		4530.48	23934	46000	9	7	0.0067	0.0016	0.22	−1.84	D−	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
86.	$a\,^3H - w\,^3F^\circ$ (102)											
		4442.28	24200	46705	13	11	0.019	0.0048	0.90	−1.21	D	13
		4410.97	24056	46721	11	9	0.023	0.0055	0.88	−1.22	D	13
		4393.54	23934	46688	9	7	0.007	0.002	0.2	−1.8	E	13
87.	$a\,^3H - z\,^3G^\circ$ (103)											
		4375.34	24056	46905	11	9	0.072	0.017	2.7	−0.73	D	10n
		4363.13	23934	46847	9	7	0.16	0.036	4.6	−0.50	D	13
88.	$a\,^3H - y\,^3G^\circ$ (104)											
		4374.17	24200	47055	13	11	0.103	0.0250	4.68	−0.488	C−	11
		4346.83	24056	47055	11	9	0.090	0.021	3.3	−0.64	D	18
		4325.08	23934	47048	9	7	0.14	0.031	3.9	−0.56	D	13
89.	$a\,^3H - z\,^3I^\circ$ (105)											
		4255.50	24200	47693	13	15	0.061	0.019	3.5	−0.60	D	13
90.	$a\,^3H - x\,^3H^\circ$ (106)											
		4211.48	24056	47794	11	11	0.0071	0.0019	0.29	−1.68	D	18
91.	$a\,^3H - v\,^3H^\circ$ (114)											
		3238.09	24056	54930	11	11	0.20	0.032	3.7	−0.46	D	12
		3237.73	23934	54811	9	9	1.3	0.20	19	0.25	D	12
92.	$a\,^3H - x\,^3I^\circ$ (115)											
		3163.76	24200	55799	13	15	0.60	0.10	14	0.13	B	17
		3155.16	24056	55741	11	13	0.57	0.10	11	0.04	B	17
		3148.44	23934	55686	9	11	0.56	0.10	9.5	−0.04	B	17
		3169.58	24200	55741	13	13	0.022	0.0033	0.45	−1.37	E	17
		3160.62	24056	55686	11	11	0.027	0.0041	0.46	−1.35	D−	17
93.	$b\,^3D - y\,^3D^\circ$ (119)											
		5844.60	24304	41409	7	5	0.0068	0.0025	0.33	−1.76	D	18
		5719.82	24304	41782	7	9	0.00496	0.00313	0.412	−1.660	B	16
		5838.68	24287	41409	3	5	0.0065	0.0055	0.32	−1.78	D	18
94.	$b\,^3D - x\,^3F^\circ$ (124)											
		4764.65	24304	45286	7	9	0.0073	0.0032	0.35	−1.65	D	13
		4770.68	24300	45256	5	7	0.0098	0.0047	0.37	−1.63	D	18

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
95.	$b\,^5D - (\,^5)^{\circ}$											
		4755.14	24282	45306	9	11	0.0096	0.0040	0.56	−1.45	D	13
96.	$b\,^5D - w\,^5D^{\circ}$ (126)											
		4515.44	24282	46422	9	9	0.022	0.0067	0.90	−1.22	D	13
		4530.93	24304	46368	7	7	0.0065	0.0020	0.21	−1.85	D−	13
		4531.24	24287	46350	3	5	0.010	0.0051	0.23	−1.81	D−	13
97.	$b\,^5D - (\,^5)^{\circ}$											
		4584.76	24304	46100	7	5	0.0075	0.0017	0.18	−1.93	D−	13
		4583.90	24300	46109	5	5	0.016	0.0050	0.38	−1.60	D−	13
98.	$b\,^5D - (\,^5)^{\circ}$											
		4571.10	24304	46174	7	7	0.0095	0.0030	0.31	−1.68	D−	13
99.	$b\,^5D - w\,^5F^{\circ}$ (127)											
		4459.75	24304	46721	7	9	0.084	0.032	3.3	−0.65	D	13
		4465.37	24300	46688	5	7	0.059	0.025	1.8	−0.91	D	18
		4462.79	24277	46678	1	3	0.056	0.050	0.74	−1.30	D	13
		4467.57	24300	46677	5	5	0.037	0.011	0.81	−1.26	D	18
		4464.66	24287	46678	3	3	0.049	0.015	0.65	−1.36	D	13
100.	$b\,^5D - u\,^5P^{\circ}$ (129)											
		4424.29	24282	46879	9	7	0.21	0.048	6.3	−0.37	D	13
		4411.11	24304	46968	7	5	0.13	0.027	2.8	−0.72	D	13
		43[illegible].82	24300	47022	5	3	0.098	0.017	1.2	−1.07	D	10n
		4428.[illegible]	24304	46879	7	7	0.055	0.016	1.7	−0.[illegible]5	D	13
		4410.31	24300	46968	5	5	0.067	0.020	1.4	−1.01	D	13
		4397.24	24287	47022	3	3	0.10	0.029	1.3	−1.06	D	10n
101.	$b\,^5D - x\,^5G^{\circ}$ (130)											
		4356.77	24282	47229	9	11	0.022	0.0077	0.99	−1.16	D	13
		4368.25	24304	47190	7	9	0.021	0.0077	0.78	−1.27	D	13
		4379.77	24300	47126	5	7	0.019	0.0076	0.55	−1.42	D	13
102.	$b\,^5D - v\,^5D^{\circ}$ (131)											
		4228.96	24282	47866	9	9	0.074	0.020	2.5	−0.74	D	10n
		4252.24	24304	47814	7	7	0.051	0.014	1.4	−1.01	D	13
		4248.34	24282	47814	9	7	0.028	0.0059	0.74	−1.28	D	13
		4257.35	24304	47786	7	5	0.029	0.0057	0.56	−1.40	D	18
		4242.84	24304	47[illegible]56	7	9	0.018	0.0062	0.61	−1.36	D	13
103.	$b\,^5D - (\,^5)^{\circ}$											
		4235.99	24277	47878	1	3	0.066	0.053	0.74	−1.27	D	13
		4237.72	24287	47878	3	3	0.040	0.011	0.45	−1.49	D	13

Cr I   Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
104.	$b\,^3D - u\,^3F^\circ$ (132)											
		4222.75	24300	47975	5	7	0.056	0.021	1.5	−0.98	D	18
		4230.49	24287	47918	3	5	0.051	0.023	0.95	−1.16	D	13
105.	$b\,^3D - a\,^3D^\circ$ (139)											
		3804.80	24282	50558	9	9	0.69	0.15	17	0.13	D	9n
106.	$a\,^3G - z\,^3H^\circ$ (143)											
		4922.28	25039	45349	11	13	0.40	0.17	30	0.27	D	9n
		4887.01	24898	45354	9	11	0.32	0.14	20	0.10	D	9n
		4870.79	24834	45359	7	9	0.35	0.16	18	0.05	D	9n
		4885.97	24898	45359	9	9	0.0244	0.00874	1.27	−1.104	B	16
107.	$a\,^3G - y\,^3H^\circ$ (144)											
		4836.85	25039	45707	11	13	0.0160	0.00665	1.16	−1.136	B	16
		4814.25	24898	45663	9	11	0.0161	0.0068	0.98	−1.211	C−	11
		4810.71	24834	45615	7	9	0.016	0.0071	0.79	−1.30	D	11
		4825.50	24898	45615	9	9	0.0036	0.0013	0.18	−1.95	D−	11
108.	$a\,^3G - y\,^3F^\circ$ (145)											
		4756.09	25039	46058	11	9	0.40	0.11	19	0.09	D	18
		4737.33	24898	46000	9	7	0.338	0.0885	12.4	−0.099	B	16
		4730.69	24834	45966	7	5	0.383	0.0918	10.0	−0.192	B	16
		4724.40	24898	46058	9	9	0.0614	0.0205	2.88	−0.733	B	16
		4723.06	24834	46000	7	7	0.093	0.031	3.4	−0.66	D	10n
109.	$a\,^3G - w\,^3D^\circ$ (147)											
		4656.18	24898	46368	9	7	0.0327	0.00826	1.14	−1.129	B	16
		4646.50	24834	46350	7	5	0.058	0.013	1.4	−1.03	D	13
110.	$a\,^3G$ - [illegible] $^3F^\circ$											
		4698.94	24834	46109	7	5	0.022	0.0052	0.56	−1.44	D	13
111.	$a\,^3G - z\,^3G^\circ$ (149)											
		4541.51	24834	46847	7	7	0.038	0.012	1.2	−1.08	D	13
112.	$a\,^3G - y\,^3G^\circ$ (150)											
		4540.72	25039	47055	11	11	0.314	0.0970	15.9	0.028	B	16
		4511.90	24898	47055	9	9	0.165	0.0504	6.74	0.343	B	16
		4500.29	24834	47048	7	7	0.21	0.064	6.6	0.35	D	13
113.	$a\,^3G - u\,^3F^\circ$											
		4330.76	24834	47918	7	5	0.014	0.0028	0.28	1.71	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
114.	$a\ ^3G - y\ ^3H^\circ$ (154)											
		4271.07	25039	48445	11	13	0.053	0.027	2.6	−0.73	D	10n
		4269.96	24898	48310	9	11	0.032	0.011	1.4	−1.02	D	13
		4262.37	24834	48288	7	9	0.024	0.0084	0.83	−1.23	D	13
115.	$a\ ^3G - x\ ^3G^\circ$ (155)											
		4213.18	24834	48562	7	9	0.079	0.027	2.6	−0.72	D	10n
116.	$a\ ^3F - z\ ^3H^\circ$ (166)											
		4954.81	25177	45354	9	11	0.12	0.056	8.2	−0.30	D	10n
		4936.34	25106	45359	7	9	0.14	0.065	7.5	−0.34	D	10n
		4953.73	25177	45359	9	9	0.0085	0.0031	0.46	−1.55	D	18
117.	$a\ ^3F - y\ ^3H^\circ$ (167)											
		4880.04	25177	45663	9	11	0.0081	0.0035	0.51	−1.50	D	18
		4874.65	25106	45615	7	9	0.0069	0.0032	0.36	−1.66	D	11
118.	$a\ ^3F - y\ ^3F^\circ$ (168)											
		4754.73	24941	45966	5	5	0.026	0.0088	0.69	−1.36	D	13
		4901.02	25177	46000	9	7	0.306	0.0822	11.7	−0.131	B	16
		4792.49	25106	45966	7	5	0.26	0.064	7.1	−0.35	D	10n
119.	$a\ ^3F - (\ )^\circ$											
		4729.84	24941	46077	5	3	0.17	0.035	2.7	−0.76	D	10n
120.	$a\ ^3F - w\ ^3D^\circ$ (170)											
		4717.67	25177	46368	9	7	0.0077	0.0020	0.28	−1.75	D−	13
		4706.09	25106	46350	7	5	0.035	0.0084	0.91	−1.23	D	18
		4680.86	24941	46298	5	3	0.16	0.031	2.4	−0.81	D	18
121.	$a\ ^3F - (\ )^\circ$											
		4722.65	24941	46109	5	5	0.0069	0.0023	0.18	−1.94	D−	13
122.	$a\ ^3F - z\ ^3G^\circ$ (172)											
		4584.10	25177	46986	9	11	0.021	0.0081	1.1	−1.14	D	13
		4586.15	25106	46906	7	9	0.027	0.011	1.2	−1.12	D	13
		4563.66	24941	46847	5	7	0.023	0.010	0.76	−1.20	D	13
123.	$a\ ^3F - y\ ^3G^\circ$ (172)											
		4554.82	25106	47056	7	9	0.020	0.0080	0.84	−1.25	D	18
		4569.62	25177	47056	9	9	0.082	0.026	3.5	−0.64	D	13
		4566.18	25106	47048	7	7	0.077	0.024	2.5	−0.78	D	13
		4570.99	25177	47048	9	7	0.0043	0.0010	0.14	−2.08	E	13

Cr I Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
124.	$a\,^3F - ^3D^\circ$											
		4302.57	25177	48252	9	7	0.021	0.0046	0.59	−1.38	D	13
		4325.65	25106	48218	7	5	0.028	0.0056	0.56	−1.41	D	13
		4296.30	24941	48210	5	3	0.032	0.0053	0.38	−1.58	D−	13
		4288.40	24941	48252	5	7	0.028	0.011	0.76	−1.27	D	13
125.	$a\,^3F - y\,^3H^\circ$ (177)											
		4321.62	25177	48310	9	11	0.017	0.0058	0.74	−1.28	D	13
		4312.48	25106	48288	7	9	0.017	0.0061	0.61	−1.37	D	13
126.	$a\,^3F - x\,^3G^\circ$ (178)											
		4234.52	25177	48786	9	11	0.022	0.0072	0.91	−1.19	D	13
127.	$a\,^3F - ^3F^\circ$											
		4261.63	25177	48636	9	7	0.064	0.014	1.7	−0.91	D	13
128.	$z\,^7F^\circ - f\,^7D$ (186)											
		4718.43	25771	46959	13	11	0.34	0.095	19	0.09	D	18
		4708.02	25549	46783	11	9	0.431	0.117	20.0	0.110	B	16
		4698.46	25360	46637	9	7	0.22	0.057	7.9	−0.29	D	13
		4689.38	25206	46525	7	5	0.23	0.054	5.8	−0.42	D	10n
		4669.34	25549	46959	11	11	0.0908	0.0297	5.02	−0.486	B	16
		4663.33	25011	46449	3	3	0.20	0.065	3.0	−0.71	D	13
		4628.48	25360	46959	9	11	0.012	0.0045	0.62	−1.39	D	18
		4633.27	25206	46783	7	9	0.020	0.0082	0.88	−1.24	D	18
		4639.52	25089	46637	5	7	0.095	0.043	3.3	−0.67	D	10n
		4646.80	25011	46525	3	5	0.078	0.042	1.9	−0.90	D	13
		4654.76	24971	46449	1	3	0.091	0.089	1.4	−1.05	D	13
129.	$z\,^5P^\circ - e\,^5D$ (188)											
		5787.97	26796	44069	5	7	0.235	0.165	15.7	−0.083	B	16
		5785.02	26788	44069	7	7	0.119	0.0596	7.94	−0.380	B	16
		5783.89	26796	44081	5	5	0.202	0.101	9.65	−0.295	B	16
		5783.11	26802	44089	3	3	0.21	0.11	6.0	−0.50	D	18
130.	$b\,^5P - y\,^5P^\circ$ (191)											
		5400.58	27223	45734	5	5	0.16	0.068	6.0	−0.47	D	10n
131.	$b\,^5P - u\,^5D^\circ$ (193)											
		5214.14	27176	46350	3	5	0.089	0.061	3.1	−0.74	D	18
132.	$b\,^5P$ - [illegible]											
		5293.38	27223	46109	5	5	0.021	0.0087	0.76	1.36	D	18

Cr I: Allowed transitions – Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
133.	$b\,^3P - x\,^3P^\circ$ (195)											
		4707.73	27223	48459	5	5	0.031	0.010	0.80	−1.29	D	13
		4697.38	27176	48459	3	5	0.031	0.017	0.79	−1.29	D	13
134.	$b\,^3P - x\,^3D^\circ$ (196)											
		4575.11	27176	49028	3	5	0.068	0.036	1.6	−0.97	D	18
		4611.96	27163	48840	1	3	0.080	0.077	1.2	−1.12	D	13
		4584.94	27223	49028	5	5	0.039	0.012	0.93	−1.21	D	13
135.	$b\,^3P - y\,^3S^\circ$ (197)											
		4492.31	27223	49477	5	3	0.447	0.0811	6.00	−0.392	B	16
		4482.88	27176	49477	3	3	0.30	0.090	4.0	−0.57	D	10n
		4480.27	27165	49477	1	3	0.10	0.090	1.3	−1.04	D	13
136.	$b\,^3P - w\,^3D^\circ$ (198)											
		4338.80	27223	50264	5	7	0.070	0.028	2.0	−0.86	D	13
		4345.08	27176	50184	3	5	0.098	0.046	2.0	−0.86	D	18
		4357.51	27163	50106	1	3	0.068	0.058	0.83	−1.24	D	13
		4353.94	27223	50184	5	5	0.13	0.037	2.7	−0.73	D	18
		4368.90	27223	50106	5	3	0.058	0.010	0.72	−1.30	D	13
137.	$z\,^7D^\circ - f\,^7D$ (201)											
		5243.38	27382	46449	5	3	0.219	0.0542	4.68	−0.567	B	16
		5177.42	27650	46959	9	11	0.061	0.030	4.6	−0.57	D	10n
		5192.01	27382	46637	5	7	0.14	0.081	6.9	−0.39	D	10n
		5200.20	27300	46525	3	5	0.11	0.073	3.7	−0.66	D	18
138.	$b\,^3G - z\,^3H^\circ$ (203)											
		5702.30	27817	45349	11	13	0.0340	0.0196	4.04	−0.667	B	16
		5628.64	27597	45359	7	9	0.0395	0.0241	3.13	−0.772	B	16
139.	$b\,^3G - y\,^3H^\circ$											
		5688.06	27817	45707	11	13	0.0011	6.1(−4)	0.12	−2.17	E	11
		5666.56	27704	45663	9	11	0.0015	8.5(−4)	0.14	−2.12	D	11
		5548.61	27597	45615	7	9	0.0019	0.0011	0.14	−2.10	D−	11
		5581.60	27704	45615	9	9	0.0019	8.9(−4)	0.15	−2.10	E	11
140.	$b\,^3G - y\,^3F^\circ$ (204)											
		5442.40	27597	45966	7	5	0.039	0.012	1.6	−1.06	D	18
141.	$b\,^3G - z\,^3G^\circ$ (206)											
		5193.50	27597	46847	7	7	0.067	0.027	3.2	−0.72	D	10n

Cr I Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
142.	$b\,^3G - y\,^3G°$ (207)											
		5196.45	27817	47055	11	11	0.12	[illegible]	9.1	−0.27	D	11
		5139.60	27597	47048	7	7	0.13	0.050	5.9	−0.46	D	10n
143.	$b\,^3G - y\,^3H°$ (208)											
		[illegible]	27597	49288	[illegible]	9	0.018	0.0054	0.40	−1.42	D	13
144.	$b\,^3G - z\,^3F°$ (212)											
		4587.10	27817	49621	11	9	[illegible]	[illegible]	1.4	−1.03	D	18
		4555.31	27704	49679	9	7	0.029	[illegible]	0.95	−1.26	D	18
145.	[illegible] $-$ $w\,^3F°$											
		4301.19	27817	51062	11	9	0.26	[illegible]	9.2	−0.19	D	13
		4300.52	27704	[illegible]	9	7	0.33	[illegible]	5.2	−0.43	D	13
		4291.97	27597	[illegible]	7	5	0.24	[illegible]	4.7	−0.48	D	13
		4280.89	27597	[illegible]	[illegible]	7	0.019	0.0052	0.51	−1.44	D	13
146.	$y\,^5P° - e\,^5D$ (222)											
		6978.46	27935	42261	9	11	0.173	0.154	31.9	0.142	B	16
		6979.81	27935	42258	9	9	0.050	[illegible]	8.9	−0.41	D	18
		6925.22	27820	42256	7	7	0.093	[illegible]	11	−0.33	D	18
		6882.40	27729	42255	5	5	0.139	0.0843	9.55	−0.375	B	16
		6980.91	27935	42256	9	7	0.015	[illegible]	1.7	−1.12	D	18
		6883.05	27729	[illegible]	5	[illegible]	0.178	0.0760	8.61	−0.420	B	16
147.	$y\,^5P° - f\,^5D$ (225)											
		5272.01	27820	[illegible]	7	9	0.101	0.0541	6.57	−0.422	B	16
		[illegible]	27729	[illegible]	5	7	0.0422	0.0248	2.16	−0.907	B	16
		5304.19	27935	[illegible]	9	9	0.0535	0.0226	3.55	−0.692	B	16
		5312.88	27820	[illegible]	7	7	0.0926	0.0392	4.80	−0.562	B	16
		[illegible]	27729	46525	5	5	0.0967	0.0410	3.59	−0.688	B	16
		5344.77	27820	[illegible]	7	5	0.041	0.012	1.5	−1.06	D	18
		5340.46	27729	46449	[illegible]	3	0.145	0.0372	3.27	−0.731	B	16
148.	$a\,^5D - w\,^5G°$ (230)											
		4775.12	[illegible]	[illegible]	7	9	0.029	0.013	1.4	−1.05	D	18
		4797.68	[illegible]	49520	5	7	0.013	0.0063	0.50	−1.50	D−	13
149.	$a\,^5D - z\,^5F°$ (231)											
		[illegible]	[illegible]	49621	7	9	0.17	0.075	8.2	−0.28	D	18
		[illegible]	[illegible]	49650	5	7	0.12	0.059	4.6	−0.53	D	18
		[illegible]	[illegible]	49650	7	7	0.051	0.017	1.9	−0.92	D	13
		[illegible]	[illegible]	49653	5	5	0.056	0.019	1.5	−1.02	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
150.	$a\ ^3D - w\ ^3D°$ (233)											
		4622.47	28637	50264	7	7	0.41	0.13	14	−0.04	D	18
		4665.90	28679	50106	3	3	0.30	0.098	4.5	−0.53	D	13
		4639.70	28637	50184	7	5	0.077	0.018	1.9	−0.91	D	13
151.	$a\ ^3D - w\ ^3F°$											
		4480.36	28637	50950	7	7	0.035	0.011	1.1	−1.13	D	13
152.	$a\ ^3D - w\ ^3P°$ (234)											
		4413.86	28637	51287	7	5	0.27	0.057	5.8	−0.40	D	18
		4443.72	28679	51177	3	1	0.45	0.044	1.9	−0.88	D	13
		4422.70	28682	51287	5	5	0.27	0.079	5.8	−0.40	D	13
		4429.93	28679	51247	3	3	0.24	0.071	3.1	−0.67	D	13
153.	$y\ ^5P° - f\ ^5D$ (237)											
		5261.76	29825	48825	7	9	0.13	0.069	8.4	−0.32	D	10a
154.	$z\ ^5F° - f\ ^5D$ (239)											
		5694.72	31106	48662	9	7	0.14	0.054	9.2	−0.31	D	18
		5642.40	31106	48825	9	9	0.034	0.016	2.7	−0.83	D	18
		5649.28	30865	48562	7	7	0.051	0.024	3.2	−0.77	D	18
		5648.25	30859	48559	5	5	0.042	0.020	1.9	−1.00	D	18
155.	$z\ ^5F° - e\ ^5F$ (240)											
		4275.98	31280	54660	11	11	0.22	0.060	9.3	−0.18	D	13
156.	$b\ ^3D - w\ ^3P°$ (250)											
		4944.57	31028	51247	5	3	0.13	0.029	2.4	−0.84	D	18
		4966.80	31049	51177	3	1	0.30	0.037	1.8	−0.96	D	18
157.	$a\ ^3I - y\ ^3I°$ (244)											
		4625.91	31049	52661	13	13	0.12	0.038	7.6	−0.31	D	18
		4641.96	31065	52592	11	11	0.060	0.019	3.3	−0.67	D	18
158.	$a\ ^3I - ^3G°$											
		4614.51	31065	52720	11	9	0.057	0.015	2.5	−0.79	D	13
159.	$a\ ^3I - x\ ^3H°$ (246)											
		4578.33	31049	52885	13	11	0.040	0.011	2.1	−0.86	D	13
		4563.24	31065	52968	11	9	0.10	0.026	4.3	−0.54	D	18

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
160.	$a\ ^3I - v\ ^3G^\circ$											
		4370.87	31055	53926	11	9	0.050	0.012	1.9	−0.89	D	13
161.	$a\ ^3I - z\ ^3K^\circ$ (247)											
		4263.15	31048	54498	15	17	0.64	0.20	42	0.47	D	13
		4280.42	31049	54405	13	15	0.47	0.15	27	0.29	D	10n
		4297.75	31055	54317	11	13	0.49	0.16	25	0.25	D	10n
		4296.63	31049	54317	13	13	0.028	0.0077	1.4	−1.00	D	13
162.	$a\ ^3I - x\ ^3I^\circ$ (251)											
		4039.10	31048	55799	15	15	0.67	0.16	33	0.39	B	17
		4048.78	31049	55741	13	13	0.64	0.16	27	0.31	B	17
		4058.78	31055	55686	11	11	0.67	0.17	24	0.26	B	17
		4057.83	31049	55686	13	11	0.0072	0.0015	0.26	−1.71	D	11
		4039.29	31049	55799	13	15	0.060	0.017	2.9	−0.66	D	17
		4049.78	31055	55741	11	13	0.056	0.016	2.4	−0.75	D	17
163.	$a\ ^5F - z\ ^5G^\circ$											
		8916.24	31393	42606	11	13	0.0025	0.0035	1.1	−1.41	D	17
		8939.21	31355	42539	5	7	9.9(−4)	0.0017	0.24	−2.08	D	17
		8955.76	31352	42515	3	5	0.0020	0.0040	0.35	−1.92	D	17
164.	$a\ ^5F - s\ ^5D^\circ$ (267)											
		4490.55	31378	53641	9	7	0.39	0.092	12	−0.08	D	13
165.	$a\ ^5F - v\ ^5G^\circ$ (268)											
		4001.44	31378	56362	9	11	0.68	0.20	24	0.26	D	10n
166.	$a\ ^1I - z\ ^1K^\circ$	4370.76	32097	54970	13	15	0.025	0.0083	1.5	−0.97	D	13
167.	$a\ ^1I - t\ ^1I^\circ$											
		4268.79	32097	55517	13	13	0.17	0.046	8.5	−0.22	D	13
168.	$a\ ^1I - u\ ^1H^\circ$ (272)											
		4204.48	32097	55875	13	11	0.31	0.070	13	−0.04	D	18
169.	$b\ ^3F - y\ ^3G^\circ$											
		7170.56	33113	47055	9	11	0.0025	0.0024	0.50	−1.67	E	11
170.	$b\ ^3F - v\ ^3G^\circ$											
		4819.30	33061	53805	7	7	0.13	0.045	5.0	−0.50	D	13
171.	$b\ ^3F - v\ ^3H^\circ$											
		4582.40	33113	54930	9	11	0.032	0.012	1.7	−0.96	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
172.	$b\,^3F - v\,^3F^{\circ}$ (275)											
		4524.84	33113	55207	9	9	0.11	0.034	4.5	−0.52	D	13
		4553.95	33040	54993	5	5	0.12	0.037	2.8	−0.73	D	13
173.	$b\,^3F - t\,^3G^{\circ}$ (279)											
		4065.71	33113	57702	9	11	0.35	0.11	13	−0.02	D	18
174.	$b\,^3F - u\,^3F^{\circ}$ (280)											
		4495.28	33113	55353	9	7	0.20	0.047	6.3	−0.37	D	13
175.	$z\,^5D^{\circ} - f\,^5D$ (285)											
		6661.10	33[illegible]6	48825	9	9	0.11	0.072	14	−0.19	D	18
		6669.27	336[illegible]	48662	7	7	0.059	0.039	6.0	−0.56	D	18
176.	$z\,^5D^{\circ} - e\,^5F$ (283)											
		4796.15	33816	54660	9	11	0.13	0.055	7.8	−0.31	D	13
177.	$z\,^3P^{\circ} - e\,^3D$ (290)											
		4757.31	34190	55205	5	7	0.12	0.057	4.6	−0.55	D	13
		4743.12	33897	54975	3	5	0.080	0.045	2.1	−0.87	D	13
178.	$b\,^1I - {}^3K^{\circ}$											
		4752.07	33763	54800	13	13	0.62	0.21	42	0.44	D	13
179.	$b\,^1I - (\,^*)^{\circ}$	4595.60	33763	55517	13	13	0.47	0.15	30	0.29	D	10n
180.	$b\,^1I - x\,^3I^{\circ}$											
		4548.65	33763	55741	13	13	0.028	0.0086	1.7	−0.95	E	17
181.	$b\,^1I - (\,^*)^{\circ}$											
		4514.26	33763	55908	13	13	0.11	0.034	6.5	−0.36	D	13
182.	$b\,^1I - y\,^1H^{\circ}$	4506.84	33763	55945	13	11	0.27	0.069	13	−0.05	D	10n
183.	$c\,^3D - v\,^3F^{\circ}$											
		4699.59	33935	55207	7	9	0.13	0.065	6.0	−0.41	D	13
		4741.09	33907	54993	3	5	0.22	0.12	5.8	−0.43	D	13
184.	$c\,^3D - u\,^3F^{\circ}$											
		4641.49	33935	55474	7	5	0.038	0.0088	0.94	−1.21	D	13
185.	$c\,^3D - (\,^*)^{\circ}$											
		4337.25	33936	56986	5	7	0.20	0.079	5.6	−0.40	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
186.	c 'D - u 'P°											
		4317.91	33935	57088	7	5	0.11	0.022	2.2	−0.81	D	13
		4309.73	33936	57133	5	3	0.17	0.028	2.0	−0.85	D	13
187.	c 'D - ('f°											
		4263.00	33935	57276	7	7	0.088	0.024	2.4	−0.77	D	13
188.	c 'D - t 'G° (294)											
		4232.23	33936	57557	5	7	0.17	0.064	4.5	−0.50	D	13
189.	b 'H - x 'I°											
		5032.54	35934	55799	13	15	0.020	0.0088	1.9	−0.94	E	17
		5034.65	35884	55741	11	13	0.017	0.0076	1.4	−1.08	E	17
		5045.04	35871	55686	9	11	0.016	0.0064	1.3	−1.12	D	11
190.	b 'H - t 'G° (303)											
		4592.55	35934	57702	13	11	0.13	0.035	6.8	−0.34	D	13
191.	b 'H - ('f°											
		4606.36	35884	57587	11	9	0.12	0.031	5.2	−0.46	D	13
192.	b 'H - t 'H° (304)											
		4376.80	35934	58775	13	13	0.32	0.092	17	0.08	D	13
		4373.65	35871	58728	9	9	0.28	0.080	10	−0.14	D	13
193.	b 'H - w 'I° (305)											
		4165.52	35884	59884	11	13	0.75	0.23	35	0.40	D	10n
194.	d 'F - ('f°											
		4838.42	36559	57221	5	5	0.11	0.039	3.1	−0.71	D	13
195.	d 'F - ('f°											
		4823.90	36552	57276	7	7	0.12	0.042	4.7	−0.53	D	13
196.	d 'F - ('f°											
		4816.13	36578	57335	9	9	0.18	0.061	8.7	−0.26	D	18
197.	d 'F - ('f°											
		4510.02	36559	58725	5	3	0.0041	7.5(−4)	0.056	−2.43	E	13
198.	c 'G - x 'I°											
		4307.67	37234	60441	11	13	0.082	0.027	4.2	−0.53	D	13
199.	c 'G - ('f°											
		4302.78	37234	60468	11	11	0.25	0.069	11	0.12	D	13

Cr I: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
200.	$e\ ^3G - s\ ^3G°$											
		4298.05	37244	60504	9	9	0.26	0.072	9.2	−0.19	D	13
		4296.11	37234	60504	11	9	0.089	0.020	3.1	−0.65	D	13
201.	$e\ ^5S - x\ ^5S°$ (310)	4503.04	37883	60084	5	3	0.083	0.015	1.1	−1.12	D	13
202.	$a\ ^1H - (\ °)^b$											
		4656.82	38538	60006	11	11	0.11	0.036	6.0	−0.41	D	13
203.	$a\ ^1H - x\ ^1I°$	4564.17	38538	60441	11	13	0.51	0.19	31	0.32	D	18
204.	$a\ ^1H - (\ °)^b$											
		4413.00	38538	61192	11	13	0.097	0.033	5.3	−0.43	D	13
205.	$z\ ^5H° - e\ ^5H$											
		4432.77	42387	64940	15	15	0.49	0.14	32	0.34	D	13

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.
[b] The term designation for the level in question was not provided by Sugar and Corliss in their energy level compilation (J. Phys. Chem. Ref. Data 14, Suppl. 2 (1985)), so we have accordingly omitted it from this work.

Cr II

V Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5\ ^6S_{5/2}$

Ionization Energy: $16.4858\ eV = 132966\ cm^{-1}$

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
2653.57	3	2867.09	6	3136.68	5	4848.24	16
2658.59	1	2867.65	1	4054.10	8	4856.18	16
2666.02	4	2870.43	6	4087.60	8	4876.41	16
2668.71	4	2873.81	6	4113.24	7	4884.58	16
2671.80	4	2878.45	1	4539.61	19	5097.33	10
2672.83	3	2880.86	6	4555.01	21	5237.35	20
2740.09	2	2898.53	18	4558.66	21	5246.76	9
2744.97	12	2921.81	18	4565.77	19	5249.43	9
2787.61	12	2930.83	11	4587.20	27	5279.88	20
2822.38	14	2935.12	11	4588.22	21	5305.88	10
2835.63	1	2953.34	11	4589.89	21	5308.46	20
2840.01	14	2966.03	17	4592.07	21	5310.73	20
2843.24	1	2971.90	13	4616.64	21	5313.61	20
2849.83	1	2979.73	13	4618.82	21	5846.12	10
2851.35	14	2985.32	13	4634.10	21	5369.36	15
2856.77	6	2989.18	13	4697.61	26	5420.91	9
2857.40	6	3118.64	5	4715.12	25	5502.07	22
2860.92	1	3120.36	5	4812.34	16	5508.63	22
2862.57	1	3122.59	23	4824.12	16	6053.48	24
2866.72	1	3128.69	5	4836.22	16	6129.23	24

For this spectrum, we have chosen the experiments by Musielok and Wujec[1] and by Wujec and Weniger,[2] who measured relative oscillator strengths in emission with similar wall-stabilized arc sources. To obtain an absolute scale, Musielok and Wujec normalized their data to beam-foil lifetimes measured by Engman *et al.*[3] Wujec and Weniger, in turn, normalized their data directly to the *f*-value of the 4242.36 Å line tabulated in Ref. 1. In both experiments, a photographic detection system was employed, and a low-current carbon arc served as the absolute radiation standard.

Another data source which we utilized in this compilation is the work of Kostyk and Orlova.[4] These authors derived log *gf*-values from solar spectra by using equivalent widths taken from the Liege solar atlas.[8] In the case of Fe I, Kostyk and co-workers[9] used a similar approach in deriving *f*-values, which are of approximately 50 percent accuracy. We feel that the data of Ref. 4 tabulated here are of similar accuracy.

For the evaluation of these data sources, we found very few cases of overlap, so that no significant direct comparisons were possible. Refs. 1 and 2 overlap only for the 4242.36 Å line, where the log *gf*-value of Ref. 2 was made to agree with that of Ref. 1. Thus, to obtain some indication of systematic errors or scatter for these data sources, we compared the experimental data to the comprehensive semiempirical calculations of Kurucz and Peytremann.[5] We had found earlier that for many neutral and singly-ionized members of the iron-group elements,[6] the *f*-values of Ref. 5 compare reasonably well with more reliable data sources. While these calculated data show considerable scatter in comparison to experiment, the *f*-values of Ref. 5 appear to be generally devoid of gross systematic errors in the absolute scale. If the weaker lines and the intercombination lines are excluded, the majority of the data of Ref. 5 is generally accurate within a factor of two.

By comparing various experimental data to the calculations of Kurucz and Peytremann for Cr II, we found indications of systematic deviations and/or errors in absolute scale in the experimental results. For example, the data of Ref. 1 exhibit a pronounced wavelength dependence. The authors indeed suggest that there may be problems with their standard source in certain spectral regions. The *f*-values of Ref. 2 show a similar (though not as pronounced) dependence—the log *gf*-values of near *uv* lines are too strong. On the basis of these comparisons, we have limited the tabulation of data from Ref. 1 to lines having wavelengths shorter than 3150 Å and upper energy levels less than 67000 cm^{-1}.

Wujec and Weniger[2] normalized their data to the 4242.36 Å line of Ref. 1, which appears to be an inappropriate choice, since this wavelength falls in the region strongly affected by calibration problems with the carbon arc, due to molecular-band emission. Additional errors in the work of Wujec and Weniger may have occurred because of inconsistencies in the temperature measurement (discussed by us in the Cr I introduction). On the basis of a comparison with Ref. 5, we have shifted all log *gf*-values of Ref. 2 downward by 0.84 dex and have omitted all lines having wavelengths less than 4500 Å.

A comparison of Refs. 4 and 5 reveals considerable scatter, as well as a shift in scale — the log *gf*-values of Kostyk and Orlova are, on the average, about 50 percent higher than those of Kurucz and Peytremann. This comparison, however, deals only with the weak lines (log *gf* < -1.00), where the data of Ref. 5 are known to be less accurate. Therefore, we have tabulated the data of Kostyk and Orlova without renormalization.

Another reference which we originally considered for this spectrum is the paper by Goly and Weniger.[7] These authors measured *f*-values for over one hundred lines in the 2413 - 2718 Å region by using a wall-stabilized arc. Our graphical comparisons indicate that these data exhibit pronounced scatter, as well as a substantial deviation in absolute scale. Therefore, they have not been included in this compilation.

References

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[8] L. Delbouille, L. Neven, and C. Roland, "Photometric Atlas of the Solar Spectrum from 3000 to 10,000 Å," (Institut d'Astrophysique de l'Université de Liege, Observatoire Royal de Belgique, 1973).

[9] E. A. Gurtovenko and R. I. Kostyk, Astron. Astrophys., Suppl. Ser. 47, 193 (1982).

Cr II: Allowed transitions

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$a\,^6D - z\,^6F^\circ$ (uv 5)											
		2835.63	12497	47752	10	12	2.0	0.29	27	0.46	C	3
		2843.24	12304	47465	8	10	0.64	0.097	7.3	−0.11	D	1
		2849.83	12148	47228	6	8	0.92	0.15	8.4	−0.05	D	1
		2860.92	11962	46906	2	4	0.69	0.17	3.2	−0.47	D	1
		2862.57	12304	47228	8	8	0.63	0.077	5.8	−0.21	D	1
		2866.72	12033	46906	4	4	1.2	0.15	5.6	−0.23	D	1
		2867.65	11962	46824	2	2	1.1	0.14	2.6	−0.57	D	1
		2878.45	12497	47228	10	8	0.074	0.0074	0.70	−1.13	D−	1
2.	$a\,^6D - z\,^6P^\circ$ (uv 6)											
		2740.09	12148	48632	6	8	0.11	0.017	0.89	−1.00	D−	1
3.	$a\,^6D - z\,^4P^\circ$ (uv 7)											
		2672.83	12304	49706	8	6	0.55	0.044	3.1	−0.45	D	1
		2653.57	12033	49706	4	6	0.35	0.055	1.9	−0.65	D	1
4.	$a\,^6D - z\,^6D^\circ$ (uv 8)											
		2671.80	12148	49565	6	4	1.0	0.071	3.8	−0.37	D	1
		2668.71	12033	49493	4	2	1.4	0.075	2.6	−0.52	D	1
		2666.02	12148	49646	6	8	0.59	0.084	4.4	−0.30	D	1
		2658.59	11962	49565	2	4	0.58	0.12	2.2	−0.61	D	1
5.	$a\,^4D - z\,^4F^\circ$ (5)											
		3120.36	19631	51670	4	6	1.5	0.33	13	0.12	D	1
		3118.64	19528	51584	2	4	1.7	0.50	10	−0.00	D	1
		3136.68	19798	51670	6	6	0.64	0.094	5.8	−0.25	D	1
		3128.69	19631	51584	4	4	0.81	0.12	4.9	−0.32	D	1
6.	$a\,^4D - z\,^4D^\circ$ (uv 11)											
		2870.43	19798	54626	6	6	1.3	0.16	9.1	−0.02	D	1
		2867.09	19631	54500	4	4	1.1	0.14	5.1	−0.27	D	1
		2880.86	19798	54500	6	4	0.79	0.066	3.7	−0.41	D	1
		2873.81	19631	54418	4	2	0.88	0.054	2.1	−0.66	D	1
		2857.40	19798	54785	6	8	0.28	0.046	2.6	−0.56	D	1
		2856.77	19631	54626	4	6	0.43	0.079	3.0	−0.50	D	1
7.	$b\,^4D - z\,^4P^\circ$ (18)											
		4113.24	25047	49706	6	6	0.0012	3.0(−4)'	0.025	−2.7ɨ	D	4
8.	$b\,^4D - z\,^6D^\circ$ (19)											
		4064.10	25047	49352	6	6	0.0017	4.2(−4)	0.034	−2.59	D	4
		4087.60	25036	49493	2	2	0.0012	3.0(−4)	0.0081	−3.22	D	4

Cr II: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
9.	$b\,^4P - z\,^4P^o$ (23)											
		5420.91	30308	48750	4	2	0.0050	0.0011	0.78	−2.36	D	4
		5249.43	30308	49706	4	6	9.7(−4)	6.0(−4)	0.041	−2.62	D	4
		5246.76	29952	49006	2	4	0.0021	0.0018	0.061	−2.45	D	4
10.	$b\,^4P - z\,^4D^o$ (24)											
		5097.33	29952	49565	2	4	0.0015	0.0011	0.038	−2.64	D	4
		5305.86	20865	49352	6	6	0.0033	0.0014	0.15	−2.08	D	4
		5346.12	30865	49565	6	4	0.0013	3.7(−4)	0.039	−2.65	D	4
11.	$b\,^4P - y\,^4D^o$ (uv 55)											
		2[illegible]35.12	30865	64924	6	8	1.8	0.31	18	0.27	D	1
		[illegible]0.83	29952	64062	2	4	1.1	0.28	5.5	−0.25	D	1
		2953.34	29952	63802	2	2	1.8	0.24	4.6	−0.33	D	1
12.	$b\,^4P - y\,^4P^o$ (uv 58)											
		[illegible]	30865	66727	6	6	1.5	0.17	9.6	0.02	D	1
		2744.97	30308	66727	4	6	0.85	0.14	5.2	−0.24	D	1
13.	$a\,^4H - z\,^4H^o$ (uv 80)											
		2971.90	30392	64031	14	14	2.0	0.26	36	0.57	D	1
		2979.73	30299	63849	12	12	1.8	0.24	28	0.46	D	1
		2985.32	30219	63707	10	10	2.2	0.29	29	0.47	D	1
		2989.18	30157	63601	8	8	2.2	0.29	23	0.37	D	1
14.	$a\,^4H - z\,^4I^o$ (uv 82)											
		2822.38	30392	65813	14	16	2.3	0.31	41	0.64	C	3
		2840.01	30219	65420	10	12	2.7	0.39	37	0.59	D	1
		2851.35	30157	65218	8	10	2.2	0.34	25	0.43	D	1
15.	$a\,^4F - z\,^4D^o$ (29)											
		5369.36	31219	49838	10	10	3.2(−4)	1.4(−4)	0.024	−2.86	D	4
16.	$a\,^4F - z\,^4F^o$ (30)											
		4824.12	31219	51943	10	10	0.017	0.0060	0.96	−1.22	D	2n
		4848.24	31169	51789	8	8	0.026	0.0091	1.2	−1.14	D	4
		4876.41	31169	51670	8	6	0.016	0.0043	0.56	−1.46	D	4
		4884.58	31118	51584	6	4	0.0058	0.0014	0.13	−2.08	D	4
		4812.34	31169	51943	8	10	0.0046	0.0020	0.25	−1.80	D	4
		4836.22	31118	51789	6	8	0.0020	9.4(−4)	0.090	−2.25	D	2n
		4856.18	31083	51670	4	6	0.0026	0.0014	0.088	−2.26	D	4

Cr II: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
17.	$a\,^4F - y\,^4D°$ (uv 94)											
		2966.03	31219	64924	10	8	0.54	0.057	5.6	−0.24	D	1
18.	$a\,^4F - z\,^4G°$ (uv 95)											
		2898.53	31219	65170	10	12	1.2	0.18	17	0.26	D	1
		2921.81	31169	65384	8	10	0.90	0.14	11	0.06	D	1
19.	$a\,^2F - z\,^4D°$ (30)											
		4530.61	32604	54626	6	6	0.0016	4.9(−4)	0.044	−2.53	D	2n
		4565.77	32604	54500	6	4	0.0062	0.0013	0.12	−2.11	D	2n
20.	$b\,^4F - z\,^4F°$ (43)											
		5237.35	32854	51943	10	10	0.017	0.0069	1.2	−1.16	D	4
		5313.61	32855	51670	6	6	0.0088	0.0037	0.39	−1.65	D	4
		5279.88	32854	51789	10	8	0.0024	7.9(−4)	0.14	−2.10	D	4
		5308.46	32837	51670	8	6	0.0061	0.0019	0.27	−1.81	D	4
		5310.73	32845	51670	4	6	0.0021	0.0013	0.092	−2.28	D	4
21	$b\,^4F - z\,^4D°$ (44)											
		4558.66	32854	54785	10	8	0.088	0.022	3.3	−0.66	D	2n
		4588.22	32837	54626	8	6	0.12	0.029	3.5	−0.63	D	4
		4618.82	32855	54500	6	4	0.061	0.013	1.2	−1.11	D	2n
		4634.10	32845	54418	4	2	0.089	0.014	0.88	−1.24	D	2n
		4555.01	32837	54785	8	8	0.017	0.0052	0.63	−1.38	D	4
		4592.07	32855	54626	6	6	0.032	0.010	0.91	−1.22	D	4
		4616.64	32845	54500	4	4	0.040	0.013	0.78	−1.29	D	4
		4589.89	32845	54626	4	6	0.0012	5.5(−4)	0.033	−2.66	D	2n
22.	$b\,^4G - z\,^4F°$ (50)											
		5502.07	33619	51789	10	8	0.0028	0.0010	0.19	−1.99	D	4
		5508.63	33521	51670	8	6	0.0028	9.7(−4)	0.14	−2.11	D	4
23.	$b\,^4G - z\,^4G°$ (54)											
		3122.59	33694	65710	12	12	0.44	0.064	7.9	−0.11	D	1
24.	$c\,^4D - z\,^4D°$ (105)											
		6053.48	38270	54785	8	8	0.0016	8.6(−4)	0.14	−2.16	D	4
		6129.23	38315	54626	6	6	0.0011	6.1(−4)	0.073	−2.44	D	4
25.	$c\,^2D - ^2P°$											
		4715.12	45670	66872	4	2	0.0073	0.0012	0.076	−2.31	D	2n

Cr II: Allowed transitions — Continued

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
26.	$c\,^2D - y\,^2F°$											
		4697.61	45731	67012	6	6	0.0066	0.0022	0.20	−1.88	D	2a
27.	$d\,^2G - x\,^2F°$											
		4587.30	52321	74114	10	8	0.0089	0.0022	0.34	−1.65	D	2a

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr II

Forbidden Transitions

For this spectrum, we selected the work of Nussbaumer and Swings,[1] who calculated numerous M1 and E2 transition probabilities. They derived their radial wavefunctions by using a central potential which was adjusted to give the optimum fit to observed energy levels. Their calculation included spin-orbit interaction but neglected the effects of configuration interaction. Because of the strong likelihood of configuration interaction, we have tabulated only the E2 transitions of the $a\,^6S - a\,^6D$ multiplet. These lines have been observed in stellar spectra.

Another data source for lines in the $a\,^6S - a\,^6D$ multiplet is that of Garstang.[2] His calculated A-values are approximately 15 percent less than those of Nussbaumer and Swings, because different radial wavefunctions were used. The data tabulated here are estimated to be accurate to within a factor of two.

References

[1]H. Nussbaumer and J. P. Swings, Astrophys. J. 162, 589 (1970).
[2]R. H. Garstang, J. Res. Nat. Bur. Stand., Sect A 68, 61 (1964).

Cr II. Forbidden transitions

No.	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$a\,^6S - a\,^6D$ (1F)										
		[8000.1]	0	12496	6	10	E2	0.10	20	E	1
		[8125.3]	0	12304	6	8	E2	0.094	16	E	1
		[8229.7]	0	12148	6	6	E2	0.088	12	E	1
		[8308.5]	0	12033	6	4	E2	0.084	7.9	E	1
		[8357.6]	0	11962	6	2	E2	0.082	4.0	E	1

Cr IV

Sc Isoelectronic Sequence

Ground State: $1s^22s^22p^63s^23p^63d^3\ ^4F_{3/2}$

Ionization Energy: 49.16 eV = 396500 cm^{-1}

Forbidden Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
1881.7	7	2966.1	16	5294.3	4	7297.9	17
1887.6	7	2973.3	16	5323.5	21	7330.5	2
1890.1	7	2980.9	16	5371.4	21	7390.8	2
1896.1	7	2988.2	16	5378.6	21	7410.9	19
1901.6	7	2991.5	6	5427.5	21	7518.2	19
1907.7	7	3076.7	18	6613.0	15	7664.7	19
1921.9	7	3078.1	18	6648.8	15	16142	9
2557.8	10	3092.6	18	6698.4	15	16180	9
2565.6	10	3094.0	18	6734.0	3	16625	11
2568.8	10	3133.0	20	6747.5	3	16801	11
2576.6	10	4837.6	5	6806.0	3	17649	11
2585.1	10	4841.0	5	6915.2	3	18307	8
2596.3	10	4893.9	5	7023.1	2	18684	8
2624.6	13	4897.3	5	7061.5	2	18999	8
2636.2	13	4971.5	5	7086.2	3	26127	8
2660.6	13	5125.9	12	7110.5	2	81537	14
2902.9	6	5142.8	4	7171.6	2	82513	14
2912.9	6	5177.0	12	7184.1	2	88456	14
2929.4	6	5206.3	4	7189.2	17	256000	1
2940.3	6	5219.3	12	7196.7	17	313400	1
2957.0	6	5272.3	12	7232.6	2		

For this spectrum, we have chosen the work of Pasternack,[1] who calculated M1 and E2 transition probabilities within the $3d^3$ configuration by using the central-field approximation without consideration of configuration interaction. However, the $3d^3$ configuration is well-separated from the next configuration—$3d^24s$. For electric quadrupole transitions, we modified the data of Ref. 1 by applying correction factors suggested by Garstang.[2] These factors were introduced because of the availability of better wavefunctions. In the case of Fe VI, which is isoelectronic to Cr IV, we compared the A-values of Ref. 1 to those of Nussbaumer and Storey,[3] who could utilize, in their much later work, modern theoretical and computational techniques. The agreement between Refs. 1 and 3 is surprisingly good—generally within 50 percent—even for the E2 transitions (after undergoing Garstang's correction). Weak lines are subject to greater uncertainties, so we have omitted lines having A-values less than 0.001 s^{-1}.

References

[1] S. Pasternack, Astrophys. J. 92, 129 (1940).
[2] R. H. Garstang, J. Res. Nat. Bur. Stand., Sect. A 68, 61 (1964).
[3] H. Nussbaumer and P. J. Storey, Astron. Astrophys. 70, 37 (1978).

Cr IV: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$3d^3-3d^3$	$^4F - ^4F$										
			[256900]	556.4	945.5	8	10	M1	0.0017	11	C	1
			[313400]	237.4	556.4	6	8	M1	0.0014	13	C	1
2.		$^4F - ^4P$ (1F)										
			[7390.8]	945.5	14472	10	6	E2	0.035	2.8	E	1n
			[7339.5]	556.4	14178	8	4	E2	0.026	1.3	E	1n
			[7232.6]	237.4	14060	6	2	E2	0.022	0.52	E	1n
			[7184.1]	556.4	14472	8	6	E2	0.013	0.89	E	1n
			[7171.6]	237.4	14178	6	4	E2	0.020	0.90	E	1n
			[7110.5]	0.0	14060	4	2	E2	0.035	0.76	E	1n
			[7023.1]	237.4	14472	6	6	E2	0.0032	0.20	E	1n
			[7051.5]	0.0	14178	4	4	E2	0.0073	0.30	E	1n
3.		$^4F - ^2G$ (2F)										
			[6915.2]	945.5	15402	10	10	M1	0.093	0.011	E	1
			[6896.0]	556.4	15054	8	8	M1	0.035	0.0034	E	1
			[7086.2]	945.5	15054	10	8	M1	0.0023	2.4(−4)	E	1
			[6734.0]	556.4	15402	8	10	M1	0.036	0.0041	E	1
			[6747.5]	237.4	15054	6	8	M1	0.032	0.0029	E	1
4.		$^4F - ^2P$ (3F)										
			[5294.3]	556.4	19439	8	4	E2	0.0011	0.011	E	1n
			[5206.3]	237.4	19439	6	4	M1	0.055	0.0012	E	1
			[5142.8]	0.0	19439	4	4	M1	0.034	6.9(−4)	E	1
5.		$^4F - ^2D2$ (4F)										
			[4971.5]	556.4	20666	8	6	M1	0.16	0.0044	E	1
			[4897.3]	237.4	20651	6	4	M1	0.13	0.0023	E	1
			[4893.9]	237.4	20666	6	6	M1	0.020	5.2(−4)	E	1
			[4841.0]	0.0	20651	4	4	M1	0.071	0.0012	E	1
			[4837.6]	0.0	20666	4	6	M1	0.0073	1.8(−4)	E	1
6		$^4F - ^2F$										
			[2991.5]	945.5	34364	10	8	M1	0.034	2.7(−4)	D	1
			"	"	"	10	8	E2	0.0011	0.0013	E	1n
			[2940.3]	556.4	34557	8	6	M1	0.0060	3.4(−5)	D	1
			[2957.0]	556.4	34364	8	8	M1	0.0034	2.6(−5)	D	1
			[2912.9]	237.4	34557	6	6	M1	0.0046	2.5(−5)	D	1
			[2929.4]	237.4	34364	6	8	M1	0.013	9.7(−5)	D	1
			[2892.9]	0.0	34557	4	6	M1	0.031	1.7(−4)	D	1
			"	"	"	4	6	E2	0.0011	8.0(−4)	E	1n
7.		$^4F - ^2D1$										
			[1921.9]	945.5	52976	10	6	E2	0.017	0.0016	E	1n
			[1901.6]	556.4	53144	8	4	E2	0.0039	2.3(−4)	E	1n
			[1907.7]	556.4	52976	8	6	M1	0.043	6.6(−5)	E	1
			"	"	"	8	6	E2	0.0011	9.9(−5)	E	1n
			[1890.1]	237.4	53144	6	4	M1	0.048	4.8(−5)	E	1
			[1896.1]	237.4	52976	6	6	M1	0.0046	7.0(−6)	E	1
			[1881.7]	0.0	53144	4	4	M1	0.025	2.5(−5)	E	1
			"	"	"	4	4	E2	0.0013	7.3(−5)	E	1n
			[1887.6]	0.0	52976	4	6	M1	0.0016	2.4(−6)	E	1

Cr IV: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
8.		$^4P - ^2P$										
			[20127]	14472	19439	6	4	M1	0.020	0.024	D	1
			[18999]	14178	19439	4	4	M1	0.028	0.028	D	1
			[18307]	14060	19521	2	2	M1	0.052	0.024	D	1
			[18584]	14060	19439	2	4	M1	0.013	0.012	D	1
9.		$^4P - ^2D2$										
			[16142]	14472	20666	6	6	M1	0.0077	0.0072	E	1
			[16180]	14472	20651	6	4	M1	0.018	0.011	E	1
10.		$^4P - ^2D1$										
			[2596.3]	14472	52976	6	6	M1	0.23	9.6(−4)	E	1
			[2565.6]	14178	53144	4	4	M1	0.089	2.2(−4)	E	1
			″	″	″	4	4	E2	0.024	0.0056	E	1n
			[2585.1]	14472	53144	6	4	M1	0.022	5.6(−5)	E	1
			[2576.6]	14178	52976	4	6	M1	0.041	1.6(−4)	E	1
			″	″	″	4	6	E2	0.026	0.011	E	1n
			[2557.8]	14060	53144	2	4	M1	0.023	5.7(−5)	E	1
			″	″	″	2	4	E2	0.0092	0.0024	E	1n
			[2568.8]	14060	52976	2	6	E2	0.0024	9.6(−4)	E	1n
11.		$^2G - ^2H$										
			[16891]	15402	21321	10	12	M1	0.016	0.034	E	1
			[16625]	15054	21067	8	10	M1	0.016	0.027	E	1
			[17649]	15402	21067	10	10	M1	0.030	0.061	E	1
12.		$^2G - ^2F$										
			[5219.3]	15402	34557	10	6	E2	0.0012	0.017	E	1n
			[5272.3]	15402	34364	10	8	M1	0.019	8.3(−4)	E	1
			″	″	″	10	8	E2	0.088	1.7	E	1n
			[5125.9]	15054	34557	8	6	M1	0.022	6.6(−4)	E	1
			″	″	″	8	6	E2	0.098	1.2	E	1n
			[5177.0]	15054	34364	8	8	M1	0.041	0.0017	E	1
			″	″	″	8	8	E2	0.0065	0.15	E	1n
13.		$^2G - ^2D1$										
			[2660.6]	15402	52976	10	6	E2	8.2	3.9	E	1n
			[2624.6]	15054	53144	8	4	E2	9.4	2.8	E	1n
			[2636.2]	15054	52976	8	6	E2	0.71	0.32	E	1n
14.		$^2P - ^2D2$										
			[81537]	19439	20666	4	6	M1	0.0062	0.75	E	1
			[88456]	19521	20651	2	4	M1	0.0041	0.42	E	1
			[82513]	19439	20651	4	4	M1	0.011	0.92	E	1
15.		$^2P - ^2F$										
			[6698.4]	19439	34364	4	8	E2	0.016	1.0	E	1n
			[6648.8]	19521	34557	2	6	E2	0.0096	0.44	E	1n
			[6613.0]	19439	34557	4	6	E2	0.0040	0.18	E	1n

Cr IV: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
16.		^{2}P - ^{2}D1										
			[2988.2]	19521	52976	2	6	E2	0.52	0.44	E	1n
			[2980.9]	19439	52976	4	6	M1	0.040	2.4(−4)	E	1
			"	"	"	4	6	E2	0.79	0.66	E	1n
			[2973.3]	19521	53144	2	4	E2	1.2	0.66	E	1n
			[2966.1]	19439	53144	4	4	E2	1.9	1.0	E	1n
17.		^{2}D2 - ^{2}F										
			[7297.9]	20666	34364	6	8	M1	0.0015	1.7(−4)	E	1
			"	"	"	6	8	E2	0.027	2.7	E	1n
			[7189.2]	20651	34557	4	6	M1	0.0010	8.3(−5)	E	1
			"	"	"	4	6	E2	0.023	1.6	E	1n
			[7196.7]	20666	34557	6	6	M1	0.0039	3.2(−4)	E	1
			"	"	"	6	6	E2	0.0065	0.45	E	1n
18.		^{2}D2 - ^{2}D1										
			[3094.0]	20666	52976	6	6	E2	0.69	0.70	E	1n
			[3076.7]	20651	53144	4	4	E2	0.0060	0.0039	E	1n
			[3078.1]	20666	53144	6	4	M1	0.14	6.1(−4)	D	1
			"	"	"	6	4	E2	0.29	0.19	E	1n
			[3092.6]	20651	52976	4	6	M1	0.063	4.1(−4)	D	1
			"	"	"	4	6	E2	1.1	1.1	E	1n
19.		^{2}H - ^{2}F										
			[7664.7]	21321	34364	12	8	E2	0.039	4.9	E	1n
			[7410.9]	21067	34557	10	6	E2	0.046	3.7	E	1n
			[7518.2]	21067	34364	10	8	E2	0.0012	0.14	E	1n
20.		^{2}H - ^{2}D1										
			[3133.0]	21067	52976	10	6	E2	0.040	0.043	E	1n
21.		^{2}F - ^{2}D1										
			[5323.5]	34364	53144	8	4	E2	0.075	0.76	E	1n
			[5371.4]	34364	52976	8	6	M1	0.057	0.0020	E	1
			"	"	"	8	6	E2	0.40	6.4	E	1n
			[5378.6]	34557	53144	6	4	M1	0.060	0.0014	E	1
			"	"	"	6	4	E2	0.40	4.3	E	1n
			[5427.5]	34557	52976	6	6	M1	0.10	0.0036	E	1
			"	"	"	6	6	E2	0.069	1.2	E	1n

*The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr V

Ca Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2\ {}^3F_2$

Ionization Energy: 69.46 eV = 560200 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
434.306	2	456.743	7	1127.63	16	1607.04	10
435.143	2	457.028	7	1134.77	16	1611.33	10
435.636	2	457.504	7	1465.86	14	1622.61	9
436.351	2	464.015	8	1481.65	11	1638.50	9
436.601	2	469.311	6	1482.76	11	1639.40	9
437.420	1	469.634	3	1484.67	11	1644.05	9
437.655	1	469.893	6	1489.71	11	1652.60	9
441.056	5	470.567	6	1497.97	11	1655.64	9
445.751	4	1103.39	15	1519.03	13	1837.44	12
456.272	7	1106.25	15	1579.70	10		
456.357	7	1121.07	16	1591.72	10		
456.637	7	1126.09	16	1603.19	10		

For this spectrum, Kurucz and Peytremann[1] have calculated oscillator strengths for over one hundred transitions using a scaled Thomas-Fermi-Dirac approach with limited configuration interaction. Of these lines, we have chosen only the stronger lines, i.e., with log $gf > -1.5$, and have omitted all intercombination (spin-forbidden) lines. An additional criterion for selecting the data was that all lines had to be experimentally observed, i.e., they appear in the line list of Ekberg.[2]

We estimate that for the stronger lines of this relatively simple spectrum, Kurucz and Peytremann's data should be fairly reliable. There is indirect support for this estimate from the good consistency between similarly calculated values and lifetime measurements for the isoelectronic ion Ti III.

References

[1] R. L. Kurucz and E. Peytremann, Smithsonian Astrophysical Observatory Special Report 362 (1975).
[2] J. O. Ekberg, Phys. Scr. 7, 59 (1973).

Cr V: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3d^2$–$3d4p$	^3F – $^3D°$											
			437.420	508.2	229121	7	7	14	0.039	0.40	−0.56	D	1
			437.655	0.0	228489	5	5	13	0.038	0.27	−0.72	D	1
2.		^3F – $^3F°$											
			424.306	1141.7	231393	9	9	15	0.042	0.54	−0.42	D	1
			435.143	508.2	230316	7	7	2.9	0.0082	0.082	−1.24	D	1
			435.636	0.0	229662	5	5	2.8	0.0080	0.057	−1.40	D	1
			436.351	1141.7	230316	9	7	24	0.053	0.69	−0.32	D	1
			436.601	508.2	229662	7	5	21	0.043	0.43	−0.52	D	1
3.		^1D – $^1D°$	469.634	13188	226120	5	5	23	0.076	0.59	−0.42	D	1

Cr v: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
4.		$^1D - ^1F^o$	445.751	13188	237530	5	7	1.9	0.0078	0.057	−1.41	D	1
5.		$^1D - ^1P^o$	441.056	13188	239918	5	3	23	0.040	0.29	−0.70	D	1
6.		$^3P - ^3D^o$											
			469.311	16041	229121	5	7	3.9	0.018	0.14	−1.04	D	1
			469.893	15677	228489	3	5	4.9	0.027	0.13	−1.09	D	1
			470.567	15492	228002	1	3	4.9	0.049	0.076	−1.31	D	1
7.		$^3P - ^3P^o$	*456.85*	*15859*	*234750*	9	9	33	0.10	1.4	−0.03	D	1
			457.028	16041	234846	5	5	27	0.083	0.63	−0.38	D	1
			456.743	15677	234618	3	3	9.1	0.028	0.13	−1.07	D	1
			457.504	16041	234618	5	3	12	0.023	0.18	−0.93	D	1
			456.637	15677	234669	3	1	33	0.035	0.16	−0.98	D	1
			456.272	15677	234846	3	5	6.7	0.035	0.16	−0.98	D	1
			456.357	15492	234618	1	3	9.5	0.089	0.13	−1.05	D	1
8.		$^1G - ^1F^o$	464.015	22019	237530	9	7	36	0.090	1.2	0.09	D	1
9.	$3d4s - 3d4p$	$^3D - ^3D^o$											
			1638.50	168090	229121	7	7	6.8	0.27	10	0.28	D	1
			1639.40	167491	228489	5	5	4.9	0.20	5.3	−0.01	D	1
			1644.05	167176	228002	3	3	5.0	0.20	3.3	−0.22	D	1
			1655.64	168090	228489	7	5	1.6	0.048	1.8	−0.47	D	1
			1652.60	167491	228002	5	3	2.5	0.062	1.7	−0.51	D	1
			1622.61	167491	229121	5	7	0.74	0.041	1.1	−0.69	D	1
10.		$^3D - ^3F^o$											
			1579.70	168090	231393	7	9	8.6	0.41	15	0.46	D	1
			1591.72	167491	230316	5	7	7.3	0.39	10	0.29	D	1
			1603.19	167176	229552	3	5	7.0	0.45	7.1	0.13	D	1
			1607.04	168090	230316	7	7	0.83	0.032	1.2	−0.65	D	1
			1611.33	167491	229552	5	5	0.23	0.0089	0.24	−1.35	D	1
11.		$^3D - ^3P^o$											
			1497.97	168090	234846	7	5	7.5	0.18	6.2	0.10	D	1
			1489.71	167491	234618	5	3	6.6	0.13	3.2	−0.18	D	1
			1481.65	167176	234669	3	1	10	0.11	1.7	−0.47	D	1
			1484.67	167491	234846	5	5	2.2	0.073	1.8	−0.44	D	1
			1482.76	167176	234618	3	3	3.5	0.12	1.7	−0.46	D	1
12.		$^1D - ^1D^o$	1837.44	171698	226120	5	5	4.3	0.22	6.6	0.04	D	1
13.		$^1D - ^1F^o$	1519.03	171698	237530	5	7	9.5	0.46	11	0.36	D	1
14.		$^1D - ^1P^o$	1465.86	171698	239918	5	3	11	0.21	5.1	0.02	D	1
15.	$3d4p - 3d4d$	$^3D^o - ^3G$											
			1106.25	229121	319517	7	9	12	0.29	7.4	0.31	D	1
			1103.39	228489	319119	5	7	2.4	0.062	1.1	−0.51	D	1
16.		$^3F^o - ^3G$											
			1127.63	231393	320074	9	11	35	0.80	27	0.86	D	1
			1121.07	230316	319517	7	9	21	0.51	13	0.56	D	1
			1134.77	231393	319517	9	9	2.0	0.038	1.3	−0.47	D	1
			1126.09	230316	319119	7	7	6.1	0.12	3.0	−0.09	D	1

Cr V

Forbidden Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
582.42	12	642.44	16	829.52	20	6709.9	3
584.15	12	645.57	13	859.52	19	7580.6	2
586.32	12	648.08	13	1955.2	5	7884.4	2
594.92	11	649.40	13	2633.7	8	8299.0	2
596.73	11	656.11	15	2818.5	10	11320	7
597.05	11	657.68	15	2847.7	10	35041	6
598.17	11	657.90	15	4540.2	4	40172	6
598.86	11	658.70	15	4647.5	4	157800	1
598.99	11	660.07	15	4788.5	4	196700	1
599.99	11	660.28	15	6232.3	3	274300	9
601.14	11	661.66	15	6377.2	3	541000	9
630.87	14	668.10	18	6426.2	3		
640.18	16	684.60	17	6453.2	3		
640.94	16	687.42	17	6580.8	3		

For this ion, we selected the work of Warner and Kirkpatrick,[1] who used a single-configuration approximation and calculated radial integrals with scaled Thomas-Fermi wavefunctions. We have tabulated M1 and E2 transition probabilities for 23 lines within the $3d^2$ (ground) configuration and E2 data for 30 lines in the $3d^2$–$3d4s$ transition array. For long-wavelength lines within the $3d^2\ ^3F$ and $3d^2\ ^3P$ terms, we have recalculated Warner and Kirkpatrick's A-values by using observed energy-level data instead of theoretically derived values.

Reference

[1] B. Warner and R. C. Kirkpatrick, Mon. Not. R. Astron. Soc. 144, 397 (1969).

Cr V: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
1.	$3d^2$-$3d^2$	^3F - ^3F										
			[157800]	508.2	1141.7	7	9	M1	0.0051	6.7	C	1n
			[196700]	0.0	508.2	5	7	M1	0.0037	7.3	C	1n
2.		^3F - ^1D (1F)										
			[8299.0]	1141.7	13188	9	5	E2	3.4(−4)[a]	0.040	E	1
			[7884.4]	508.2	13188	7	5	M1	0.10	0.0091	E	1
			″	″	″	7	5	E2	8.2(−5)	0.0074	E	1
			[7580.6]	0.0	13188	5	5	M1	0.067	0.0046	E	1
			″	″	″	5	5	E2	5.7(−5)	0.0042	E	1
3.		^3F - ^3P (2F)										
			[6709.9]	1141.7	16041	9	5	E2	0.031	1.3	E	1
			[6600.8]	508.2	15677	7	3	E2	0.081	0.69	E	1
			[6453.2]	0.0	15492	5	1	E2	0.051	0.34	E	1
			[6426.2]	508.2	16041	7	5	M1	0.0034	1.7(−4)	E	1
			″	″	″	7	5	E2	0.010	0.33	E	1
			[6377.2]	0.0	15677	5	3	M1	1.0(−4)	2.9(−6)	E	1
			″	″	″	5	3	E2	0.018	0.34	E	1
			[6232.3]	0.0	16041	5	5	M1	8.7(−4)	3.9(−5)	E	1
			″	″	″	5	5	E2	0.0016	0.045	E	1

Cr V: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
4.		$^3F - ^1G$ (3F)										
			[4788.5]	1141.7	22019	9	9	M1	0.072	0.0025	E	1
			"	"	"	9	9	E2	4.2(−5)	5.7(−4)	E	1
			[4647.5]	508.2	22019	7	9	M1	0.047	0.0016	E	1
			[4540.2]	0.0	22019	5	9	E2	8.9(−5)	9.2(−4)	E	1
5.		$^3F - ^1S$										
			[1955.2]	0.0	51146	5	1	E2	0.025	4.3(−4)	E	1
6.		$^1D - ^3P$										
			[35041]	13188	16041	5	5	M1	0.024	0.19	E	1
			[40172]	13188	15677	5	3	M1	0.0092	0.066	E	1
7.		$^1D - ^1G$	[11320]	13188	22019	5	9	E2	6.1(−4)	0.61	E	1
8.		$^1D - ^1S$ (4F)	[2633.7]	13188	51146	5	1	E2	9.8	0.74	E	1
9.		$^3P - ^3P$										
			[274300]	15677	16041	3	5	M1	5.2(−4)	2.0	C	1a
			[541000]	15492	15677	1	3	M1	1.27(−4)	2.24	C	1a
10.		$^3P - ^1S$ (5F)										
			[2847.7]	16041	51146	5	1	E2	0.21	0.023	E	1
			[2818.5]	15677	51146	3	1	M1	1.1	9.1(−4)	E	1
11.	$3d^2-3d4s$	$^3F - ^3D$										
			[601.14]	1141.7	167491	9	5	E2	2700	0.63	E	1
			[599.99]	508.2	167176	7	3	E2	4300	0.60	E	1
			[598.99]	1141.7	168090	9	7	E2	1.0(+4)	3.2	E	1
			[598.86]	508.2	167491	7	5	E2	6500	1.5	E	1
			[598.17]	0.0	167176	5	3	E2	8800	1.2	E	1
			[596.73]	508.2	168090	7	7	E2	2900	0.91	E	1
			[597.05]	0.0	167491	5	5	E2	3800	0.86	E	1
			[594.92]	0.0	168090	5	7	E2	270	0.084	E	1
12.		$^3F - ^1D$										
			[586.22]	1141.7	171698	9	5	E2	16	0.0033	E	1
			[584.15]	508.2	171698	7	5	E2	88	0.018	E	1
			[582.42]	0.0	171698	5	5	E2	11	0.0022	E	1
13.		$^1D - ^3D$										
			[645.57]	13188	168090	5	7	E2	77	0.026	E	1
			[648.08]	13188	167491	5	5	E2	200	0.068	E	1
			[649.40]	13188	167176	5	3	E2	61	0.013	E	1
14.		$^1D - ^1D$	[630.87]	13188	171698	5	5	E2	6800	2.0	E	1

Cr V: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
15.		$^3P - ^3D$										
			[656.11]	15677	168090	3	7	E2	1200	0.61	E	1
			[657.90]	15492	167491	1	5	E2	1200	0.44	E	1
			[657.68]	16041	168090	5	7	E2	2300	1.2	E	1
			[658.70]	15677	167491	3	5	E2	290	0.11	E	1
			[660.28]	16041	167491	5	5	E2	1800	0.67	E	1
			[660.07]	15677	167176	3	3	E2	2600	0.58	E	1
			[661.66]	16041	167176	5	3	E2	810	0.18	E	1
16.		$^3P - ^1D$										
			[642.44]	16041	171698	5	5	E2	340	0.11	E	1
			[640.94]	15677	171698	3	5	E2	4.0	0.0013	E	1
			[640.18]	15492	171698	1	5	E2	10	0.0032	E	1
17.		$^1G - ^3D$										
			[687.42]	22019	167491	9	5	E2	80	0.041	E	1
			[684.60]	22019	168090	9	7	E2	1.2	7.5(−4)	E	1
18.		$^1G - ^1D$	[668.10]	22019	171698	9	5	E2	9600	3.8	E	1
19.		$^1S - ^3D$										
			[859.52]	51146	167491	1	5	E2	2.4	0.0034	E	1
20.		$^1S - ^1D$	[829.52]	51146	171698	1	5	E2	390	0.44	E	1

ᵃThe number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr VI

K Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^6 3d\ ^2D_{3/2}$

Ionization Energy: 90.6356 eV = 731020 cm⁻¹

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
161.687	8	172.487	6	202.442	5	269.776	2
161.930	8	172.841	6	202.739	5	279.154	1
162.565	9	201.007	4	226.241	3	280.143	1
168.088	7	201.224	4	227.202	3	280.879	1
168.356	7	201.388	4	227.689	3		
169.435	7	201.606	4	264.078	2		
172.204	6	202.057	5	264.732	2		

For this spectrum, we have chosen the data of Tiwary,[1,2] who calculated absolute multiplet oscillator strengths for the $3p^6 3d-3p^5 3d^2$ and $3p^6 3d-3p^5 3d4s$ arrays by using configuration interaction wavefunctions. For the $3p^6 3d-3p^5 3d4s$ array, *LS*-coupling line strengths generally agree quite well with the intermediate coupling calculations of Cowan.[3] For the few cases where the agreement is not good (worse than ±50%), we have omitted the lines from this compilation. Within this transition array, we have normalized Cowan's line strengths to the multiplet strengths of Ref. 2.

For lines within the $3p^6 3d-3p^5 3d^2$ transition array, we have obtained line strengths from Tiwary's multiplet strengths by applying *LS*-coupling rules. We estimate these data to be accurate within fifty percent for stronger lines.

References

[1] S. N. Tiwary, Chem. Phys. Lett. 93, 47 (1982).
[2] S. N. Tiwary, Astrophys. J. 269, 803 (1983).
[3] R. D. Cowan, Astrophys. J. 147, 377 (1967).

Cr VI: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3p^6 3d-$ $3p^5(^2P^\circ)3d^2(^1G)$	$^2D-^2F^\circ$	*279.60*	*564*	*358221*	10	14	5.1	0.010	0.092	−1.00	D−	1
			279.154	940	359165	6	8	6.2	0.0096	0.053	−1.24	D−	*ls*
			280.143	0	356962	4	6	5.7	0.010	0.037	−1.40	D−	*ls*
			280.879	940	356962	6	6	0.40	4.7(−4)*	0.0026	−2.55	E	*ls*
2.	$3p^6 3d-$ $3p^5(^2P^\circ)3d^2(^1D)$	$^2D-^2F^\circ$	*267.32*	*564*	*374643*	10	14	27	0.041	0.36	−0.39	D−	1
			269.776	940	371618	6	8	27	0.039	0.21	−0.63	D−	*ls*
			264.078	0	378677	4	6	26	0.040	0.14	−0.79	D−	*ls*
			264.732	940	378677	6	6	1.8	0.0019	0.010	−1.94	E	*ls*
3.	$3p^6 3d-$ $3p^5(^2P^\circ)3d^2(^1F)$	$^2D-^2F^\circ$	*226.67*	*564*	*441741*	10	14	710	0.77	5.7	0.89	D−	1
			226.241	940	442945	6	8	720	0.74	3.3	0.65	D−	*ls*
			227.202	0	440135	4	6	660	0.77	2.3	0.49	D−	*ls*
			227.689	940	440135	6	6	46	0.036	0.16	−0.67	E	*ls*
4.		$^2D-^2D^\circ$	*201.37*	*564*	*497173*	10	10	2600	1.6	11	1.20	D−	1
			201.606	940	496958	6	6	2600	1.6	6.2	0.97	D−	*ls*
			201.097	0	497495	4	4	2500	1.5	4.0	0.78	D−	*ls*
			201.388	940	497495	6	4	270	0.11	0.44	−0.18	E	*ls*
			201.224	0	496958	4	6	180	0.17	0.44	−0.18	E	*ls*
5.	$3p^6 3d-$ $3p^5(^2P^\circ)3d^2(^1P)$	$^2D-^2P^\circ$	*202.51*	*564*	*494356*	10	6	1200	0.44	2.9	0.64	D−	1
			202.442	940	494911	6	4	1000	0.43	1.7	0.41	D−	*ls*
			202.739	0	493247	4	2	1200	0.36	0.97	0.16	D−	*ls*
			202.057	0	494911	4	4	120	0.071	0.19	−0.54	E	*ls*
6.	$3p^6 3d-$ $3p^5 3d(^1P^\circ)4s$	$^2D-^2P^\circ$	*172.59*	*564*	*579987*	10	6	120	0.032	0.18	−0.49	D	2
			172.487	940	580697	6	4	110	0.032	0.11	−0.71	D	3*n*
			172.841	0	578566	4	2	120	0.026	0.060	−0.98	D	3*n*
			172.204	0	580697	4	4	16	0.0071	0.016	−1.55	E	3*n*

Cr VI: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
7.	$3p^63d$ - $3p^53d(^3F^\circ)4s$	$^2D - ^2F^\circ$	*168.86*	*564*	*592751*	10	14	180	0.11	0.61	0.04	D	2
			165.435	940	591137	6	8	160	0.093	0.31	−0.26	D	3a
			168.088	0	594926	4	6	200	0.13	0.28	−0.30	D	3a
			168.355	940	594926	6	6	11	0.0045	0.015	−1.57	E	3a
8.	$3p^63d$ - $3p^53d(^3D^\circ)4s$	$^2D - ^2D^\circ$	*161.73*	*564*	*618862*	10	10	190	0.073	0.39	−0.14	D	2
			161.687	940	618491	6	6	170	0.066	0.21	−0.40	D	3a
			161.687	0	619419	4	4	140	0.056	0.12	−0.65	D	3a
			161.930	940	619419	6	4	30	0.0078	0.025	−1.33	E	3a
9.	$3p^63d$ - $3p^53d(^1F^\circ)4s$	$^2D - ^2F^\circ$	*162.66*	*564*	*615853*	10	14	79	0.044	0.24	−0.36	D	2
			162.565	940	616079	6	8	83	0.044	0.14	−0.58	D	3a

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr VII

Ar Isoelectronic Sequence

Ground State: $1s^22s^22p^63s^23p^6\ ^1S_0$

Ionization Energy: 160.18 eV = 1291900 cm^{-1}

Allowed Transitions

Line strengths for the $3p^6$-$3p^53d$ resonance transitions of this argon-like ion were interpolated from the superposition-of-configurations (SOC) calculations of Weiss,[1] which are expected to be fairly accurate.

Oscillator strengths for transitions of the $3p^6$-$3p^54s$ array were interpolated from the Dirac-Hartree-Fock data of Lin *et al.*,[2] who included correlation only in the lower state. Their results for lines of the $3p^6$-$3p^54d$ array in nearby Ar-like species have not been interpolated to provide *f*-values for Cr VII, since cancellation effects at or near V VI—one of the ions treated—introduce considerable uncertainty into the results at the low-*Z* end of the Ar sequence.

References

[1]A. W. Weiss, private communication.

[2]D. L. Lin, W. Fielder, Jr., and L. Armstrong, Jr., Phys. Rev. A 16, 589 (1977).

Cr VII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3p^6$–$3p^5 3d$	$^1S - {}^3D^o$											
			259.181	0	385828	1	3	0.93	0.0028	0.0024	−2.55	E	*interp.*
2.		$^1S - {}^1P^o$	202.828	0	493035	1	3	1670	3.06	2.06	0.489	C	*interp.*
3.	$3p^6$–$3p^5(^2P^o_{3/2})4s$	$^1S - (^3/_2,^1/_2)^o$											
			148.714	0	672428	1	3	130	0.13	0.064	−0.89	D	*interp.*
4.	$3p^6$–$3p^5(^2P^o_{1/2})4s$	$^1S - (^1/_2,^1/_2)^o$											
			146.497	0	682610	1	3	300	0.29	0.14	−0.54	D	*interp.*

Cr VIII

Cl Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^5\ {}^2P^o_{3/2}$

Ionization Energy: 184.7 eV = 1490000 cm^{-1}

Allowed Transitions

Line strengths for transitions of the arrays $3s^2 3p^5$–$3s 3p^6$ and $3p^5$–$3p^4 3d$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang *et al.*[1] These relativistic calculations include a perturbative treatment of the Breit interaction and the Lamb shift. Configuration mixing was limited to some configurations within the $n = 3$ complex. Those configurations which were assumed to lie far above $3p^5$ or $3p^4 3d$ in energy were excluded, as were all configurations outside the complex.

According to the semi-empirical HX (Hartree-Fock with statistical allowance for exchange) calculations of Bromage *et al.*[2] for Fe X, some levels of the $3p^4 3d$ configuration are strongly mixed in the *LS* basis, and in a few cases the *LS* designations given in Ref. 2 differed from those of Huang *et al.* The level designations used in this compilation are in accord with the theoretical results of Refs. 1 and 2 for Fe X. Percentage compositions published by Bromage[3] for the levels of the $3p^4 3d$ configuration in V VII and Ni XII indicate that the designations for the iron ion are appropriate for the neighboring ions of the chlorine isoelectronic sequence. Transitions involving highly mixed levels have been excluded, as have the very weak transitions.

The calculated wavelengths of Huang *et al*. differ appreciably from the observed ones found in the literature. Thus the available experimentally determined wavelengths were used in making the conversion from line strengths to *f*- and *A*-values. (Otherwise, the calculated wavelengths of Huang *et al*. were used, but they provide only a rough idea of the spectral-line positions.) Bromage *et al*. indicate that it was necessary to scale down some configuration-interaction parameters by a greater amount than usual in order to fit their calculated energy levels for Fe x to the experimental data. This could be an indication that neglecting to take configuration interaction into account on a larger scale yields significant errors in the energy levels and/or *f*-values.

References

[1] K.-N. Huang, Y.-K. Kim, K. T. Cheng, and J. P. Desclaux, At. Data Nucl. Data Tables 28, 355 (1983).

[2] G. E. Bromage, R. D. Cowan, and B. C. Fawcett, Phys. Scr. 15, 177 (1977).

[3] G. E. Bromage, Astron. Astrophys., Suppl. Ser. 41, 79 (1980).

Cr VIII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3s^23p^5$–$3s3p^6$	$^2P^o$ – ^2S	*418.82*	*3297*	242065	6	2	40.3	0.0353	0.292	−0.67	C−	1
			413.112	0	242065	4	2	27.9	0.0357	0.194	−0.85	C−	1
			430.713	9892	242065	2	2	12	0.035	0.098	−1.16	C−	1
2.	$3p^5$–$3p^4(^3P)3d$	$^2P^o$ – ^4F											
			[265]			4	6	0.083	1.3(−4)[a]	4.6(−4)	−3.28	E	1
			[271]			2	4	0.11	2.4(−4)	4.2(−4)	−3.33	E	1
3.		$^2P^o$ – ^4P											
			[265]			2	4	0.25	5.2(−4)	9.1(−4)	−2.98	E	1
			[259]			4	4	0.27	2.7(−4)	9.3(−4)	−2.96	E	1
			[267]			2	2	0.27	2.8(−4)	5.0(−4)	−3.25	E	1
			[261]			4	2	0.85	4.4(−4)	0.0015	−2.76	E	1
4.		$^2P^o$ – ^2D	*204.99*	*3297*	*491140*	6	10	1500	1.6	6.5	0.98	C−	1
			205.01	0	487780	4	6	1520	1.44	3.88	0.76	C	1
			205.65	9892	496180	2	4	1440	1.83	2.48	0.56	C	1
			201.54	0	496180	4	4	68	0.041	0.11	−0.78	D	1
5.	$3p^5$–$3p^4(^1D)3d$	$^2P^o$ – ^2F											
			[233]			4	6	0.56	6.8(−4)	0.0021	−2.56	E	1
6.		$^2P^o$ – ^2S	*218.23*	*3297*	461530	6	2	1310	0.311	1.34	0.271	C−	1
			216.67	0	461530	4	2	950	0.33	0.95	0.12	C−	1
			221.41	9892	461530	2	2	368	0.270	0.394	−0.267	C−	1
7.	$3p^5$–$3p^4(^1S)3d$	$^2P^o$ – ^2D	*218*			6	10	2.5	0.0030	0.013	−1.74	E	1
			[216]			4	6	0.37	3.9(−4)	0.0011	−2.81	E	1
			[222]			2	4	5.1	0.0075	0.011	−1.82	E	1
			[217]			4	4	0.59	4.2(−4)	0.0012	−2.77	E	1

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr VIII

Forbidden Transitions

Line strengths for the magnetic dipole and electric quadrupole contributions to the transition between the two levels of the $3p^5$ configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for mixing among odd-parity configurations was limited to the set $3s^23p^5$, $3s3p^53d$, $3p^53d^2$, and $3s^23p^33d^2$. The strength of the electric quadrupole transition as defined in Ref. 1 was multiplied by the factor $^2/_3$ which is needed to bring this value into conformance with the definition of quadrupole strengths used in the NBS tables.

Reference

[1] K.-N. Huang, Y.-K. Kim, K. T. Cheng, and J. P. Desclaux, At. Data Nucl. Data Tables 28, 355 (1983).

Cr VIII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$3p^5-3p^5$	$^2P^\circ-{}^2P^\circ$										
			[10110]	0	9892	4	2	M1	17.4	1.33	B	1
			"	"	"	4	2	E2	0.0028	0.35	D−	1

Cr IX

S Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^4\ ^3P_2$

Ionization Energy: 209.3 eV = 1688000 cm^{-1}

Allowed Transitions

Oscillator strengths for a few transitions of the arrays $3s^2 3p^4$–$3s3p^5$ and $3p^4$–$3p^3 3d$ were interpolated from the results of Bromage[1] for V VIII and those of Mason[2] and Bromage *et al.*[3] for Fe XI. The term designations used here are in accord with the results of Refs. 1 and 3.

References

[1]G. E. Bromage, Astron. Astrophys., Suppl. Ser. 41, 79 (1980).
[2]H. E. Mason, Mon. Not. R. Astron. Soc. 170, 651 (1975).
[3]G. E. Bromage, R. D. Cowan, and B. C. Fawcett, Phys. Scr. 15, 177 (1977).

Cr IX: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3s^2 3p^4$–$3s3p^5$	$^3P - ^3P°$											
			418.290	0	239069	5	5	14	0.037	0.25	−0.73	E	*interp.*
2.		$^1D - ^1P°$	363.271	30284	305561	5	3	57	0.068	0.41	−0.47	D	*interp.*
3.	$3p^4$–$3p^3(^2D°)3d$	$^3P - ^3P°$											
			220.02	0	454500	5	5	920	0.67	2.4	0.53	E	*interp.*
						3	1		0.29		−0.06	E	*interp.*
4.		$^1D - ^1D°$	215.97	30284	493310	5	5	1100	0.75	2.7	0.57	D	*interp.*
5.		$^1D - ^1F°$	209.44	30284	507740	5	7	1400	1.3	4.5	0.81	D	*interp.*
6.	$3p^4$–$3p^3(^2P°)3d$	$^3P - ^3P°$											
						5	5		0.021		−0.98	D	*interp.*
7.		$^1S - ^1P°$	215.04	66865	531890	1	3	1300	2.6	1.8	0.41	D	*interp.*

Cr IX

Forbidden Transitions

Transition probabilities for magnetic dipole and electric quadrupole lines within the $3p^4$ configuration are the results of the scaled Thomas-Fermi calculations of Mendoza and Zeippen.[1] They included a number of correlation configurations in their basis set and introduced Breit-Pauli relativistic corrections as a perturbation to the nonrelativistic Hamiltonian.

Reference

[1]C. Mendoza and C. J. Zeippen, Mon. Not. R. Astron. Soc. 202, 981 (1983).

Cr IX: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$3p^4$-$3p^4$	^3P - ^3P										
			[12790]	0	7818	5	3	M1	10.5	2.44	C+	1
			"	"	"	5	3	E2	5.4(−4)[a]	0.33	D−	1
			[57790]	7818	9548	3	1	M1	0.270	1.98	C+	1
			[10470]	0	9548	5	1	E2	0.0021	0.16	D−	1
2.		^3P - ^1D										
			[3301.1]	0	30284	5	5	M1	30	0.20	D−	1
			"	"	"	5	5	E2	0.053	0.062	E	1
			[4449.9]	7818	30284	3	5	M1	4.2	0.069	E	1
			"	"	"	3	5	E2	0.0018	0.0093	E	1
			[4821.2]	9548	30284	1	5	E2	6.1(−4)	0.0047	E	1
3.		^3P - ^1S										
			[1495.8]	0	66855	5	1	E2	0.88	0.0039	E	1
			[1693.9]	7818	66855	3	1	M1	330	0.059	E	1
4.		^1D - ^1S	[2733.6]	30284	66855	5	1	E2	6.4	0.58	D−	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr X

P Isoelectronic Sequence

Ground State: $1s^22s^22p^63s^23p^3\ ^4S^o_{3/2}$

Ionization Energy: 244.4 eV = 1971000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
209.79	9	228.63	11	248.40	7	399.707	2
216.72	8	228.71	11	253	10	411.655	1
217.71	12	231.21	14	254	4	416.690	1
218.83	12	232.96	14	256	4	427.551	1
223.86	5	242.20	13	286	6	443.062	3
224.74	5	244.10	13	287	6	447.529	3
226.24	5	244.13	7	394.47	2	449.48	3
227.42	11	244.19	13	395.984	2		
227.50	11	246.97	7	398.150	2		

Line strengths for transitions of the arrays $3s^23p^3$–$3s3p^4$ and $3p^3$–$3p^23d$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to configurations within the $n=3$ complex having no more than two electrons in the $3d$ subshell.

Huang published neither an energy-level diagram nor percentage compositions for levels of the $3s^23p^3$, $3s3p^4$, and $3s^23p^23d$ configurations in Cr X. We have used the percentages given by Bromage *et al.*[2] for Fe XII, and by Bromage[3] for V IX and Ni XIV, as a guide to naming the levels; their values resulted from Hartree-Fock calculations with relativistic effects and statistical allowance for exchange (HXR), and incorporated correlation effects due to a few configurations within the $n=3$ complex. Whenever a term designation of a level in Fe XII, as given in Ref. 1, is different from that indicated in Ref. 2, all transitions involving the corresponding level in Cr X are omitted from this compilation.

Transitions involving levels which are indicated to be of low purity in *LS* coupling are omitted here. Lines which are characterized by very small *f*-values are assigned lower accuracy ratings; the weakest lines have been excluded.

References

[1] K.-N. Huang, At. Data Nucl. Data Tables 30, 313 (1984).
[2] G. E. Bromage, R. D. Cowan, and B. C. Fawcett, Mon. Not. R. Astron. Soc. 183, 19 (1978).
[3] G. E. Bromage, Astron. Astrophys., Suppl. Ser. 41, 79 (1980).

Cr X: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log *gf*	Accuracy	Source
1.	$3s^23p^3$–$3s3p^4$	$^4S^o$ - ^4P	*421.18*	0	*237428*	4	12	12	0.097	0.54	−0.41	D	1
			427.551	0	233890	4	6	12	0.048	0.27	−0.72	D	1
			416.690	0	239987	4	4	13	0.033	0.18	−0.88	D	1
			411.655	0	242922	4	2	13	0.017	0.090	−1.18	D	1
2.		$^2D^o$ - ^2D	*397.28*	*38507*	*290218*	10	10	23	0.055	0.72	−0.26	E	1
			398.150	39444	290606	6	6	21	0.051	0.40	−0.52	D	1
			395.984	37102	289637	4	4	24	0.058	0.30	−0.64	D	1
			399.707	39444	289637	6	4	0.71	0.0011	0.0090	−2.16	E	1
			[394.47]	37102	290606	4	6	0.34	0.0012	0.0062	−2.32	E	1

Cr X: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
3.		$^2P^\circ - ^2D$	*446.16*	*66083*	*290218*	6	10	3.4	0.017	0.15	−0.99	D−	1
			447.529	67157	290686	4	6	4.1	0.019	0.11	−1.13	D	1
			443.062	63935	289637	2	4	2.4	0.014	0.041	−1.55	D	1
			[449.48]	67157	289637	4	4	0.033	1.0(−4)*	5.9(−4)	−3.40	E	1
4.	$3p^3-3p^4(^3P)3d$	$^4S^\circ - ^4D$											
			[254]			4	6	1.1	0.0015	0.0051	−2.21	E	1
			[256]			4	4	1.1	0.0011	0.0036	−2.37	E	1
5.		$^4S^\circ - ^4P$	*225.34*	0	*443780*	4	12	750	1.7	5.1	0.84	D	1
			226.24	0	442010	4	6	730	0.84	2.5	0.53	D	1
			224.74	0	444960	4	4	760	0.57	1.7	0.36	D	1
			223.86	0	446710	4	2	770	0.29	0.85	0.06	D	1
6.		$^2D^\circ - ^2D$											
			[297]			6	4	1.3	0.0010	0.0059	−2.20	E	1
			[286]			4	2	1.7	0.0011	0.0040	−2.57	E	1
7.		$^2D^\circ - ^4P$											
			[248.40]	39444	442010	6	6	5.7	0.0053	0.026	−1.50	E	1
			[244.13]	37102	446710	4	2	3.4	0.0015	0.0049	−2.21	E	1
			[246.97]	37102	442010	4	6	1.6	0.0022	0.0071	−2.06	E	1
8.		$^2D^\circ - ^2F$											
			216.72	39444	500860	6	8	900	0.84	3.6	0.70	E	1
9.	$3p^3-3p^4(^1D)3d$	$^4S^\circ - ^2D$											
			[209.79]	0	476670	4	6	1.1	0.0011	0.0030	−2.36	E	1
10.		$^2D^\circ - ^2G$											
			[253]			6	8	1.0	0.0013	0.0066	−2.10	E	1
11.		$^2D^\circ - ^2D$	*228.20*	*38507*	*476730*	10	10	530	0.41	3.1	0.62	D	1
			228.71	39444	476670	6	6	450	0.35	1.6	0.33	D	1
			227.42	37102	476820	4	4	520	0.40	1.2	0.20	D	1
			[228.63]	39444	476820	6	4	81	0.042	0.19	−0.60	D	1
			[227.50]	37102	476670	4	6	18	0.021	0.064	−1.07	D	1
12.		$^2D^\circ - ^2P$											
			[218.83]	39444	496420	6	4	10	0.0049	0.021	−1.54	E	1
			[217.71]	37102	496420	4	4	7.4	0.0052	0.015	−1.68	E	1
13.		$^2P^\circ - ^2D$	*243.52*	*66083*	*476730*	6	10	55	0.081	0.39	−0.31	E	1
			[244.19]	67157	476670	4	6	58	0.078	0.25	−0.51	D	1
			[242.20]	63935	476820	2	4	50	0.088	0.14	−0.76	D	1
			[244.10]	67157	476820	4	4	1.0	9.3(−4)	0.0030	−2.43	E	1
14.		$^2P^\circ - ^2P$											
			232.96	67157	496420	4	4	440	0.36	1.1	0.16	E	1
			231.21	63935	496420	2	4	120	0.20	0.30	−0.40	E	1

*The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied

Cr X

Forbidden Transitions

Line strengths for magnetic dipole and electric quadrupole transitions within the $3p^3$ configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to configurations within the $n=3$ complex having no more than two electrons in the $3d$ subshell. Strengths of electric quadrupole transitions as defined in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables. We have excluded from this compilation the electric quadrupole contributions to the $^4S^o_{3/2} - {}^2P^o_{3/2}$ and $^4S^o_{3/2} - {}^2P^o_{1/2}$ transitions, since their strengths are very small and thus subject to considerable uncertainty.

Data for these same transitions calculated by Mendoza and Zeippen[2] with the scaled Thomas-Fermi approach with allowance for correlation are generally in very good agreement with the results of Ref. 1. These latter calculations treated relativistic effects by introducing Breit-Pauli corrections as a perturbation to the nonrelativistic Hamiltonian.

References

[1]K.-N. Huang, At. Data Nucl. Data Tables 30, 313 (1984).

[2]C. Mendoza and C. J. Zeippen, Mon. Not. R. Astron. Soc. 198, 127 (1982).

Cr X: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
1.	$3p^3-3p^3$	$^4S^o - {}^2D^o$										
			[2534.5]	0	39444	4	6	M1	0.30	0.0011	E	1
			"	"	"	4	6	E2	0.040	0.015	E	1
			[2694.5]	0	37102	4	4	M1	11	0.033	D	1
			"	"	"	4	4	E2	0.020	0.0066	E	1
2.		$^4S^o - {}^2P^o$										
			1489.04	0	67157	4	4	M1	120	0.059	D	1
			1564.10	0	63935	4	2	M1	60	0.017	D	1
3.		$^2D^o - {}^2D^o$										
			[42690]	37102	39444	4	6	M1	0.127	2.20	C+	1
			"	"	"	4	6	E2	1.8(−7)ᵃ	0.092	E	1
4.		$^2D^o - {}^2P^o$										
			[4082.0]	39444	63935	6	2	E2	0.25	0.34	D−	1
			[3607.4]	39444	67157	6	4	M1	27	0.19	C	1
			"	"	"	6	4	E2	0.76	1.1	D−	1
			[3725.7]	37102	63935	4	2	M1	26	0.10	C	1
			"	"	"	4	2	E2	0.56	0.47	D−	1
			[3326.3]	37102	67157	4	4	M1	62	0.34	C	1
			"	"	"	4	4	E2	0.36	0.35	D−	1
5.		$^2P^o - {}^2P^o$										
			[31030]	63935	67157	2	4	M1	0.273	1.21	C+	1
			"	"	"	2	4	E2	5.1(−7)	0.085	E	1

ᵃThe number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XI

Si Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2 3p^2\ ^3P_0$

Ionization Energy: 270.8 eV = 2184000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
198	9	250.28	11	366.942	2	431.154	1
214.31	8	273	5	374.927	2	433.88	1
226.45	12	299	10	375.35	2	434.09	1
232	6	359.20	2	412.629	1	483.27	3
235.53	7	366.085	2	422.083	1	496	4
240.76	13	366.491	2	422.282	1		

Line strengths for transitions of the arrays $3s^2 3p^2$–$3s3p^3$ and $3p^2$–$3p3d$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing included all configurations within the $n=3$ complex.

Huang published neither an energy-level diagram nor percentage compositions for levels of the $3s^2 3p^2$, $3s3p^3$, and $3s^2 3p3d$ configurations in Cr XI. We have used the percentages given by Bromage *et al.*[2] for Fe XIII, and by Bromage[3] for V X and Ni XV, as a guide to naming the levels; their values resulted from Hartree-Fock calculations with relativistic effects and statistical allowance for exchange (HXR), and incorporated correlation effects due to a partial set of configurations within the $n=3$ complex. Whenever the term designation of a level in Fe XIII, as given in Ref. 1, is different from that indicated in Ref. 2, all transitions involving the corresponding level in Cr XI are omitted from this compilation.

Transitions involving levels which are indicated to be of low purity in *LS* coupling are omitted here. Lines which are characterized by very small *f*-values are assigned lower accuracy ratings; the weakest lines have been excluded.

References

[1] K.-N. Huang, At. Data Nucl. Data Tables 32, 503 (1985).

[2] G. E. Bromage, R. D. Cowan, and B. C. Fawcett, Mon. Not. R. Astron. Soc. 183, 19 (1978).

[3] G. E. Bromage, Astron. Astrophys., Suppl. Ser. 41, 79 (1980).

Cr XI: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log *gf*	Accuracy	Source
1.	$3s^2 3p^2$–$3s3p^3$	^3P - $^3D°$	*426.23*	*8502*	*243117*	9	15	10	0.048	0.60	−0.37	D−	1
			431.154	11981	243917	5	7	9.8	0.038	0.27	−0.72	D	1
			422.083	5539	242459	3	5	10	0.046	0.19	−0.86	D	1
			412.629	0	242348	1	3	8.3	0.063	0.086	−1.20	D	1
			[433.88]	11981	242459	5	5	0.74	0.0021	0.015	−1.98	D−	1
			422.282	5539	242348	3	3	3.0	0.0079	0.033	−1.62	D−	1
			[434.09]	11981	242348	5	3	0.083	1.4(−4)	0.0010	−3.16	E	1
2.		^3P - $^3P°$	*370.33*	*8502*	*278528*	9	9	28	0.058	0.64	−0.28	D	1
			374.927	11981	278700	5	5	23	0.049	0.30	−0.61	D	1
			366.491	5539	278397	3	3	12	0.024	0.087	−1.14	D	1
			[375.35]	11981	278397	5	3	8.0	0.010	0.063	−1.29	D	1
			366.942	5539	278062	3	1	30	0.020	0.073	−1.22	C−	1
			366.085	5539	278700	3	5	4.1	0.014	0.050	−1.38	D	1
			[359.20]	0	278397	1	3	9.5	0.055	0.065	−1.26	D	1

Cr XI: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
3.		$^1D - ^3D^o$	[483.27]	36994	243917	5	7	0.51	0.0015	0.012	−2.12	E	1
4.		$^1S - ^3P^o$	[496]			1	3	0.094	0.0010	0.0017	−2.98	E	1
5.	$3p^2-3p3d$	$^3P - ^3F^o$	[273]			5	7	1.3	0.0020	0.0091	−1.99	E	1
6.		$^3P - ^3P^o$	[232]			3	1	410	0.11	0.25	−0.48	D	1
7.		$^3P - ^3D^o$	235.53	11981	436550	5	7	550	0.64	2.5	0.51	D	1
8.		$^3P - ^1F^o$	[214.31]	11981	478590	5	7	14	0.013	0.046	−1.19	E	1
9.		$^3P - ^1P^o$	[198]			1	3	2.9	0.0051	0.0033	−2.29	E	1
10.		$^1D - ^3F^o$	[299]			5	5	1.5	0.0020	0.010	−1.99	E	1
11.		$^1D - ^3D^o$	[250.28]	36994	436550	5	7	10	0.013	0.054	−1.18	E	1
12.		$^1D - ^1F^o$	226.45	36994	478590	5	7	600	0.65	2.41	0.51	C	1
13.		$^1S - ^1P^o$	240.76			1	3	480	1.2	0.90	0.10	D	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XI

Forbidden Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
519.13	11	1500	5	2799.2	8	15520	1
520	10	1590	3	2807.9	8	18060	1
710	9	2630	4	2874.1	8	63720	7
740	9	2750.1	8	2899.4	8	68570	7
940	6	2758.5	8	3178.2	2	901000	7
1400	5	2773.2	8	3996.8	2		
1440	3	2781.7	8	8344.2	1		

Line strengths for magnetic dipole and electric quadrupole transitions are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration interaction encompassed all configurations within the $n = 3$ complex. Huang calculated line strengths for transitions within the $3p^2$ configuration, as well as for transitions between pairs of odd-parity levels whose lower level is one of the four lowest-lying odd-parity levels in the $n = 3$ complex. Transitions involving odd-parity levels which are indicated by Bromage *et al.*[2] (for Fe XIII) or Bromage[3] (for V X and Ni XV) to be of low purity in *LS* coupling in Fe-group species are omitted here, as are lines whose strengths are very small. Strengths of electric quadrupole transitions as reported in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables.

References

[1] K.-N. Huang, At. Data Nucl. Data Tables 32, 503 (1985) and private communication.

[2] G. E. Bromage, R. D. Cowan, and B. C. Fawcett, Mon. Not. R. Astron. Soc. 183, 19 (1978).

[3] G. E. Bromage, Astron. Astrophys., Suppl. Ser. 41, 79 (1980).

Cr XI: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$3p^2$-$3p^2$	^3P - ^3P										
			[15520]	5539	11981	3	5	M1	3.45	2.39	C+	1
			″	″	″	3	5	E2	1.0(−4)	0.27	D−	1
			[18050]	0	5539	1	3	M1	2.98	1.95	C+	1
			[8344.3]	0	11981	1	5	E2	0.0011	0.13	D−	1
2.		^3P - ^1D										
			3996.8	11981	36994	5	5	M1	26	0.31	E	1
			″	″	″	5	5	E2	0.027	0.081	E	1
			[3178.2]	5539	36994	3	5	M1	18	0.11	E	1
			″	″	″	3	5	E2	0.012	0.012	E	1
3.		^3P - ^1S										
			[1580]			5	1	E2	1.5	0.0092	E	1
			[1440]			3	1	M1	370	0.041	E	1
4.		^1D - ^1S	[2630]			5	1	E2	6.9	0.52	D−	1
5.	$3s3p^3$-$3s3p^3$	$^5S^\circ$ - $^3D^\circ$										
			[1400]			5	7	E2	0.25	0.0056	E	1
			[1500]			5	5	M1	7.5	0.0047	E	1
			″	″	″	5	5	E2	0.16	0.0037	E	1
6.		$^5S^\circ$ - $^3P^\circ$										
			[940]			5	5	M1	240	0.037	E	1
			[940]			5	3	M1	120	0.012	E	1
7.		$^3D^\circ$ - $^3D^\circ$										
			[68570]	242450	243917	5	7	M1	0.054	4.52	C−	1
			″	″	″	5	7	E2	7.2(−9)	0.046	E	1
			[901000]	242348	242450	3	5	M1	3.2(−5)	4.4	E	1
			[63720]	242348	243917	3	7	E2	2.5(−9)	0.011	E	1

Cr XI: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
8.		$^3D^\circ - {}^3P^\circ$										
			[2899.4]	243907	278397	7	3	E2	1.4	0.53	D–	1
			[2807.9]	242450	278062	5	1	E2	3.5	0.36	D–	1
			[2874.1]	243907	278700	7	5	M1	32	0.14	E	1
			"	"	"	7	5	E2	1.7	0.99	D–	1
			[2781.7]	242450	278397	5	3	E2	0.28	0.083	E	1
			[2799.2]	242348	278062	3	1	M1	42	0.034	E	1
			[2758.5]	242450	278700	5	5	M1	25	0.006	E	1
			"	"	"	5	5	E2	1.3	0.60	D–	1
			[2773.2]	242348	278397	3	3	M1	42	0.000	E	1
			"	"	"	3	3	E2	1.6	0.47	D–	1
			[2750.1]	242348	278700	3	5	M1	7.3	0.028	E	1
			"	"	"	3	5	E2	0.38	0.18	D–	1
9.	$3s3p^2 - 3s^23p3d$	$^3D^\circ - {}^3F^\circ$										
			[710]			5	9	E2	6.5	0.0063	E	1
			[740]			3	7	E2	3.0	0.0028	E	1
			[710]			7	9	M1	540	0.064	E	1
10.		$^3D^\circ - {}^3P^\circ$										
			[520]			5	1	E2	250	0.0067	E	1
11.		$^3D^\circ - {}^3D^\circ$										
			[519.13]	243907	436550	7	7	M1	41	0.0015	E	1

*The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XII

Al Isoelectronic Sequence

Ground State: $1s^22s^22p^63s^23p\ ^2P^\circ_{1/2}$

Ionization Energy: 298.0 eV = 2404000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
196	29	247	19,20	269	28	308	15
198	22	248	25	273	28	309	15,16
209	31	250	20	274	28	311.66	3
216	30	251	36	275	6	318.82	2
217	30	251.52	17	278	6,28	320.20	5
218	30	252	19	280	18	324	14
221	21	252.11	17	282	18	325	4,14
222	26	254	25,34,36	286	24	325.13	5
229	32	256	25	294	23	327	14
244	19	256	19,27	294.77	3	330	8
244.70	17	260	27	300.32	3	331	8
246	20	265	33	306.81	3	331.96	2

List of tabulated lines — Continued

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
332	8	401	7	410.91	1	449	11
332.06	5	402	12	412.46	1	458	11
338	4	403	7	413	9	461	11
344	13	405	7	417	12	509	10
346	13	407	7	419	12		
393.00	1	410	9	446	11		

Line strengths for transitions of the arrays $3s^23p$–$3s3p^2$, $3s3p^2$–$3p^3$, $3s^23d$–$3s3p3d$, $3s^23p$–$3s^23d$, and $3s3p^2$–$3s3p3d$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction. Allowance for configuration mixing included all configurations within the $n=3$ complex.

Huang published neither an energy-level diagram nor percentage compositions for levels of the $3s^23p$, $3s3p^2$, $3s^23d$, $3p^3$, and $3s3p3d$ configurations in Cr XII. We have used the percentages given by Fawcett[2] as a guide to naming the levels; the latter's values resulted from Hartree-Fock calculations with relativistic effects and statistical allowance for exchange (HXR), and incorporated correlation effects due to all configurations within the $n=3$ complex.

Transitions involving levels which are indicated to be of low purity in *LS* coupling are omitted here. Lines which are characterized by very small *f*-values are assigned lower accuracy ratings; the weakest lines have been excluded. A few wavelengths computed by Huang differ significantly from those which resulted from the fitting and scaling procedure applied by Fawcett[2]; lines for which the wavelengths are in serious disagreement have been omitted.

References

[1] K.-N. Huang, At. Data Nucl. Data Tables 34, 1 (1986) and private communication.

[2] B. C. Fawcett, At. Data Nucl. Data Tables 28, 557 (1983).

Cr XII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3s^23p$–$3s3p^2$	$^2P^o$ - ^2D	*404.86*	*8000*	*255000*	6	10	16	0.064	0.51	−0.42	E	1
			410.91	12000	255360	4	6	15	0.066	0.30	−0.65	D	1
			393.00	0	254450	2	4	17	0.077	0.20	−0.81	D	1
			412.46	12000	254450	4	4	0.94	0.0024	0.013	−2.02	E	1
2.		$^2P^o$ - ^2S	*327.16*	*8000*	313660	6	2	130	0.068	0.44	−0.39	D	1
			331.95	12000	313660	4	2	21	0.017	0.075	−1.16	D	1
			318.82	0	313660	2	2	110	0.17	0.36	−0.46	D	1
3.		$^2P^o$ - ^2P	*303.80*	*8000*	*337160*	6	6	230	0.45	2.7	0.43	D	1
			305.81	12000	339250	4	4	276	0.387	1.56	0.190	C−	1
			[300.22]	0	332980	2	2	140	0.19	0.38	−0.42	D	1
			311.55	12000	332980	4	2	160	0.12	0.48	−0.33	D	1
			294.77	0	339250	2	4	60	0.157	0.304	−0.50	C−	1
4.	$3s3p^2$–$3p^3$	^4P - $^2D^o$											
			[328]			6	4	1.6	0.0018	0.012	−1.97	E	1
			[325]			2	4	0.56	0.0018	0.0038	−2.45	E	1
5.		^4P - $^4S^o$	*327.71*			12	4	290	0.15	2.0	0.27	D	1
			332.06			6	4	140	0.15	1.0	−0.04	D	1
			325.13			4	4	99	0.16	0.67	−0.20	D	1
			320.20			2	4	52	0.16	0.34	−0.49	D	1

Cr XII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
6.		$^4P - ^2P^°$											
			[278]			4	4	2.2	0.0026	0.0095	−1.98	E	1
			[275]			2	4	0.97	0.0022	0.0040	−2.35	E	1
7.		$^2D - ^2D^°$	*404*			10	10	28	0.069	0.92	−0.16	E	1
			[403]			6	6	26	0.064	0.51	−0.42	E	1
			[405]			4	4	21	0.051	0.27	−0.69	E	1
			[407]			6	4	6.6	6.011	0.088	−1.18	E	1
			[401]			4	6	2.5	0.0089	0.047	−1.45	E	1
8.		$^2D - ^2P^°$	*331*			10	6	100	0.10	1.1	0.00	D	1
			[331]			6	4	85	0.093	0.61	−0.25	D	1
			[332]			4	2	110	0.087	0.38	−0.46	D	1
			[330]			4	4	11	0.018	0.077	−1.15	D	1
9.		$^2S - ^2P^°$	*411*			2	6	12	0.089	0.24	−0.75	E	1
			[410]			2	4	16	0.081	0.22	−0.79	D	1
			[413]			2	2	3.0	0.0077	0.021	−1.81	E	1
10.		$^2P - ^4S^°$											
			[599]			4	4	0.31	0.0016	0.013	−2.18	E	1
11.		$^2P - ^2P^°$	*455*			6	6	26	0.081	0.73	−0.31	E	1
			[458]			4	4	22	0.070	0.42	−0.56	D	1
			[449]			2	2	27	0.081	0.24	−0.79	D	1
			[461]			4	2	6.5	0.010	0.063	−1.38	D	1
			[446]			2	4	0.23	0.0014	0.0041	−2.55	E	1
12.	$3s^23d - 3s3p(^3P^°)3d$	$^2D - ^2F^°$	*408*			10	14	17	0.061	0.82	−0.21	E	1
			[402]			6	8	19	0.60	0.48	−0.44	E	1
			[417]			4	6	14	0.053	0.29	−0.68	E	1
			[419]			6	6	2.4	0.0063	0.052	−1.42	E	1
13.		$^2D - ^2P^°$											
			[346]			6	4	2.1	0.0025	0.017	−1.83	E	1
			[344]			4	4	2.6	0.0046	0.021	−1.73	E	1
14.	$3s^23d - 3s3p(^1P^°)3d$	$^2D - ^2F^°$	*326*			10	14	230	0.50	5.4	0.70	E	1
			[327]			6	8	220	0.48	3.1	0.46	E	1
			[324]			4	6	220	0.52	2.2	0.31	E	1
			[325]			6	6	9.8	0.016	0.10	−1.03	E	1
15.		$^2D - ^2D^°$											
			[309]			6	6	160	0.23	1.4	0.14	E	1
			[308]			4	6	5.0	0.011	0.043	−1.37	E	1
16.		$^2D - ^2P^°$											
			[309]			4	2	270	0.19	0.79	−0.11	D	1

Cr XII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
17.	3p–3d	$^2P^o - ^2D$	*249.25*	*8000*	*409210*	6	10	350	0.55	2.7	0.52	D	1
			251.52	12000	409580	4	6	340	0.48	1.6	0.29	D	1
			244.70	0	408660	2	4	300	0.55	0.88	0.04	D	1
			[252.11]	12000	408660	4	4	66	0.063	0.21	−0.60	D	1
18.	$3s3p^2$– $3s3p(^3P^o)3d$	$^4P - ^4F^o$											
			[282]			6	8	1.2	0.0020	0.011	−1.93	E	1
			[280]			4	6	0.72	0.0013	0.0047	−2.29	E	1
19.		$^4P - ^4P^o$											
			[256]			6	6	54	0.034	0.17	−0.70	D	1
			[244]			2	2	12	0.011	0.017	−1.67	D	1
			[247]			4	2	240	0.11	0.36	−0.35	D	1
			[252]			4	6	200	0.28	0.94	0.05	D	1
20.		$^4P - ^4D^o$											
			[250]			6	8	350	0.437	2.16	0.419	C−	1
			[246]			4	6	110	0.15	0.48	−0.23	D	1
			[250]			6	6	220	0.20	1.0	0.08	D	1
			[247]			2	2	330	0.30	0.49	−0.22	D	1
21.		$^4P - ^2F^o$											
			[221]			6	8	1.9	0.0019	0.0082	−1.95	E	1
22.		$^4P - ^2P^o$											
			[198]			2	4	1.6	0.0018	0.0024	−2.43	E	1
23.		$^2D - ^4P^o$											
			[294]			6	6	4.9	0.0064	0.037	−1.42	E	1
24.		$^2D - ^4D^o$											
			[286]			6	8	1.5	0.0025	0.014	−1.83	E	1
25.		$^2D - ^2F^o$	*251*			10	14	140	0.18	1.5	0.26	E	1
			[248]			6	8	140	0.17	0.84	0.01	E	1
			[254]			4	6	120	0.17	0.57	−0.17	E	1
			[255]			6	6	18	0.017	0.086	−0.99	E	1
26.		$^2D - ^2P^o$											
			[222]			4	2	0.44	1.6(−4)	4.8(−4)	−3.18	E	1
27.		$^2S - ^2P^o$	*258*			2	6	280	0.82	1.4	0.22	D	1
			[259]			2	4	320	0.65	1.1	0.11	D	1
			[256]			2	2	150	0.15	0.25	−0.53	D	1
28.		$^2P - ^2P^o$	*275*			6	6	150	0.17	0.93	0.01	D	1
			[278]			4	4	97	0.11	0.41	0.35	D	1
			[269]			2	2	210	0.23	0.40	−0.35	D	1
			[274]			4	2	42	0.024	0.086	−1.02	D	1
			[273]			2	4	7.7	0.017	0.031	−1.46	D	1

Cr XII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
29.	$3s3p^2$-$3s3p(^1P^\circ)3d$	^4P - $^2F^\circ$											
			[196]			6	8	1.6	0.0012	0.0048	−2.13	E	1
30.		^2D - $^2F^\circ$	*217*			10	14	250	0.25	1.8	0.40	E	1
			[218]			6	8	240	0.23	1.0	0.14	E	1
			[216]			4	6	240	0.25	0.72	0.01	E	1
			[217]			6	6	14	0.010	0.043	−1.22	E	1
31.		^2D - $^2P^\circ$											
			[209]			4	2	1.7	5.5(−4)	0.0015	−2.66	E	1
32.		^2S - $^2P^\circ$											
			[239]			2	2	160	0.13	0.21	−0.57	D	1
33.		^2P - $^2F^\circ$											
			[265]			4	6	1.3	0.0020	0.0070	−2.10	E	1
34.		^2P - $^2D^\circ$											
			[254]			4	6	520	0.75	2.5	0.48	E	1
35.		^2P - $^2P^\circ$											
			[251]			2	2	70	0.067	0.11	−0.88	D	1
			[254]			4	2	75	0.0362	0.121	−0.84	C−	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XII

Forbidden Transitions

Line strengths for magnetic dipole and electric quadrupole transitions within the $3s^23p$ $^2P^\circ$ and $3s3p^2$ ^4P terms are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Huang.[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing included all configurations within the $n=3$ complex. Strengths of electric quadrupole transitions as reported in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables.

Reference

[1]K.-N. Huang, At. Data Nucl. Data Tables 34, 1 (1986).

Cr XII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	Type of transition	A_{ki} (s⁻¹)	S (at. u.)	Accuracy	Source
1.	$3p-3p$	$^2P^\circ - ^2P^\circ$										
			[8331]	0	12000	2	4	M1	15.5	1.33	C	1
			"	"	"	2	4	E2	0.0025	0.24	D–	1
2.	$3s3p^2-3s3p^2$	$^4P - ^4P$										
			[15600]			4	6	M1	4.24	3.58	C	1
			"			4	6	E2	1.1(–4)ᵃ	0.36	D–	1
			[21100]			2	4	M1	2.38	3.31	C	1
			"			2	4	E2	3.0(–6)	0.030	E	1
			[8966]			2	6	E2	0.0013	0.27	D–	1

ᵃThe number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XIII

Mg Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s^2\ ^1S_0$

Ionization Energy: 354.8 eV = 2862000 cm⁻¹

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
49.59	14	276.4	18	362.6	4	449.76	7
67.01	13	277	22	363.96	3	451.7	7
224	21	279.32	16	367.9	9	461.60	7
228	20	286	24	368.06	3	463.2	7
259.68	15	298	19	369.13	9	465.1	7
261.91	15	328.29	2	371	8	482.2	1
262.33	15	342.69	3	374	12	560.11	5
267.73	15	345	23	375.1	4	638	10
268.4	15	351.14	3	377.60	6		
268.9	15	353.81	3	385	11		
270	17	356.12	3	437.05	7		

Oscillator strengths for the three transitions $3s^2\ ^1S_0 - 3snp\ ^1P_1^\circ$ ($n = 3-5$) are the results of the relativistic random phase approximation (RRPA) calculations of Shorer *et al.*,[1] who allowed for correlation within the context of a frozen core. Oscillator strength data of Fawcett,[2] quoted for most transitions of the arrays $3s3p-3p^2$, $3s3d-3p3d$, $3s3p-3s3d$, and $3p^2-3p3d$, were derived by means of Hartree-Fock calculations which included relativistic effects and statistical allowance for exchange (HXR); he incorporated correlation effects due to all configurations in the $n = 3$ complex. Froese Fischer and Godefroid[3] determined f-values for singlet-singlet transitions within the complex by applying a nonrelativistic multiconfiguration Hartree-Fock (MCHF) technique with large-scale allowance for configuration interaction; their resluts are quoted for two transitions of the $3p3d-3d^2$ array for which we estimate the contribution of singlet-triplet mixing to the f-value to be insignificant. A-values for the three intercombination lines tabulated here were calculated by Kastner and Bhatia[4] using a scaled Thomas-Fermi approach that allowed for correlation due to all configurations in the $n = 3$ complex.

Transitions involving levels which are indicated in Ref. 2 to be of low purity in LS coupling are omitted here. Lines which are characterized by very small f-values are assigned lower accuracy ratings.

References

[1]P. Shorer, C. D. Lin, and W. R. Johnson, Phys. Rev. A 16, 1109 (1977).

[2]B. C. Fawcett, At. Data Nucl. Data Tables 28, 579 (1983).

[3]C. Froese Fischer and M. Godefroid, Nucl. Instrum. Methods 202, 307 (1982).

[4]S. O. Kastner and A. K. Bhatia, J. Opt. Soc. Am. 69, 1391 (1979).

Cr XIII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$3s^2$–$3s3p$	^{1}S – ^{3}P°											
			482.2	0	207400	1	3	0.18	0.0019	0.0030	–2.73	E	4
2.		^{1}S – ^{1}P°	328.29	0	304610	1	3	186	0.902	0.975	–0.045	B	1
3.	$3s3p$–$3p^2$	^{3}P° – ^{3}P	*355.2*	*212100*	*493600*	9	9	150	0.28	2.9	0.40	D	2
			353.81	216600	499200	5	5	100	0.19	1.1	–0.02	D	2
			356.12	207400	488200	3	3	40	0.077	0.27	–0.64	C	2
			368.06	216600	488200	5	3	61	0.074	0.45	–0.43	C	2
			363.96	207400	482200	3	1	150	0.10	0.36	–0.52	C	2
			342.69	207400	499200	3	5	34	0.10	0.34	–0.52	D	2
			351.14	203400	488200	1	3	56	0.31	0.36	–0.51	C	2
4.		^{3}P° – ^{1}D											
			[375.1]	216600	483150	5	5	13	0.027	0.17	–0.86	E	4
			[362.6]	207400	483150	3	5	6.4	0.021	0.075	–1.20	E	4
5.		^{1}P° – ^{1}D	560.11	304610	483150	3	5	13	0.10	0.55	–0.52	E	2
6.		^{1}P° – ^{1}S	377.60	304610	569440	3	1	150	0.11	0.41	–0.48	C	2
7.	$3s3d$–$3p3d$	^{3}D – ^{3}F°	*447.2*	*589500*	*813100*	15	21	42	0.18	3.9	0.42	D	2
			437.05	590100	818900	7	9	46.4	0.171	1.72	0.078	C	2
			449.76	589200	811500	5	7	35	0.15	1.1	–0.12	C	2
			461.60	588500	805100	3	5	28	0.15	0.68	–0.35	D	2
			[451.7]	590100	811500	7	7	6.9	0.021	0.22	–0.83	C	2
			[463.2]	589200	805100	5	5	6.8	0.022	0.17	–0.96	D	2
			[465.1]	590100	805100	7	5	0.13	2.9(–4)	0.0031	–2.69	E	2
8.		^{3}D – ^{3}P°											
			[371]			3	1	87	0.060	0.22	–0.74	C	2
9.		^{3}D – ^{3}D°											
			369.13	590100	861000	7	7	64	0.13	1.1	–0.04	C	2
			[367.9]	589200	861000	5	7	13	0.038	0.23	–0.72	C	2
10.		^{1}D – ^{1}D°	[638]			5	5	5.9	0.036	0.38	–0.74	D	2
11.		^{1}D – ^{1}F°	[385]			5	7	150	0.48	3.0	0.38	D	2
12.		^{1}D – ^{1}P°	[374]			5	3	100	0.13	0.80	–0.19	D	2
13.	$3s^2$–$3s4p$	^{1}S – ^{1}P°	67.01	0	1492000	1	3	1670	0.338	0.075	–0.471	C	1
14.	$3s^2$–$3s5p$	^{1}S – ^{1}P°	49.59	0	2017000	1	3	990	0.109	0.0178	–0.96	C	1

Cr XIII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
15.	$3s3p-3s3d$	$^3P^\circ - ^3D$	*265.0*	*212100*	*588500*	9	15	197	0.345	2.71	0.492	C	2
			267.73	216600	590100	5	7	190	0.286	1.26	0.155	C	2
			261.91	207400	589200	3	5	150	0.26	0.67	−0.11	C	2
			259.68	203400	588500	1	3	120	0.35	0.30	−0.46	C	2
			[268.4]	216600	589200	5	5	48	0.052	0.23	−0.59	C	2
			262.33	207400	588500	3	3	84	0.087	0.23	−0.58	C	2
			[268.9]	216600	588500	5	3	5.2	0.0034	0.015	−1.77	D	2
16.		$^1P^\circ - ^1D$	279.32	304610	662620	3	5	350	0.69	1.9	0.32	D	2
17.	$3p^2-3p3d$	$^3P - ^3P^\circ$											
			[270]			3	1	170	0.063	0.17	−0.72	C	2
18.		$^3P - ^3D^\circ$											
			[276.4]	499200	861000	5	7	220	0.35	1.6	0.24	D	2
19.		$^1D - ^1D^\circ$	[298]			5	5	130	0.17	0.83	−0.07	E	2
20.		$^1D - ^1F^\circ$	[228]			5	7	180	0.20	0.75	0.00	E	2
21.		$^1D - ^1P^\circ$	[224]			5	3	2.9	0.0013	0.0048	−2.19	E	2
22.		$^1S - ^1P^\circ$	[277]			1	3	210	0.73	0.67	−0.14	C	2
23.	$3p3d-3d^2$	$^1F^\circ - ^1G$	[345]			7	9	174	0.399	3.17	0.446	C−	3
24.		$^1P^\circ - ^1S$	[286]			3	1	460	0.188	0.53	−0.249	C−	3

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XIV

Na Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6 3s\ ^2S_{1/2}$

Ionization Energy: 384.171 eV = 3098520 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
36.466	6	54.164	10	104.5	48	217.2	51
38.036	5	60.699	21	107.7	47	217.4	62
39.796	17	60.756	21	107.8	47	221.5	43
40.016	17	60.761	21	109.8	37	221.9	43
40.018	17	63.324	2	110.4	37	222.9	43
40.782	4	63.539	2	111.2	53	223.3	70
40.800	4	63.935	20	117.6	36	223.4	70
41.556	15	64.006	20	118.3	36	238.8	69
41.788	15	64.045	20	125.2	46	239.0	69
41.796	15	68.594	9	125.3	46	241.5	74
42.297	14	69.213	9	133.1	45	241.7	74
42.453	14	69.247	9	133.2	45	286.3	56
44.597	13	79.126	32	133.3	45	287.2	56
44.869	13	84.631	41	136.0	52	289.735	7
44.873	13	85.012	41	148.5	29	297.9	61
45.835	12	85.020	41	149.1	29	300.1	61
46.125	12	86.060	19	156.4	58	300.271	7
46.417	26	86.169	19	157.1	35	300.3	61
46.453	26	86.185	19	158.4	35	301.814	7
46.468	3	86.911	31	165.0	65	346.3	68
46.527	3	93.006	39	165.7	65	346.5	68
48.300	25	93.432	39	187.02	44	346.6	68
48.336	25	93.467	39	187.2	44	363.5	60
48.340	25	95.997	49	187.30	44	367.1	60
48.991	24	96.061	49	188.0	71	389.81	1
49.032	24	96.330	38	188.1	71	400.3	73
50.821	11	96.824	38	189.1	34	400.5	73
51.172	11	99.443	54	190.0	27	400.6	73
51.180	11	99.453	54	191.0	34	411.99	1
52.321	23	99.473	54	192.3	75	413.7	67
52.363	23	100.88	18	200.1	63	414.3	67
52.367	23	101.06	18	201.0	63	415.6	67
53.642	22	101.42	18	201.2	63	789.3	33
53.674	22	102.7	30	216.1	62	819.0	33
53.691	22	102.8	30	217.0	51	823.7	33
53.760	10	104.4	48	217.1	51		

Strengths of the lines of the $3s$–$3p$ and $3p$–$3d$ transitions were taken from Edlén's interpolation formulae.[1] These were based on the results of Weiss' Hartree-Fock calculations,[2] in which ratios of relativistic Dirac to nonrelativistic line strengths in hydrogenic ions were applied as scaling factors to the nonrelativistic Hartree-Fock line strengths in the corresponding sodiumlike species. Oscillator strengths for the $4p$–$4d$ transitions were derived by Gruzdev and Sherstyuk[3] using the relativistic variant of their effective orbital quantum number method, which utilizes a Coulomb potential in conjunction with a semiempirical orbital quantum number which is determined from experimental energy levels. Strengths of the lines of the $3s$–$4p$ transition were interpolated from the results of the relativistic single-configuration Hartree-Fock calculations of Kim and Desclaux[4] for V XIII and Fe XVI.

Multiplet f-values calculated by Biemont[5] using a fully variational Hartree-Fock approach are quoted for numerous transitions nl–$n'l'$ ($3 \leq n \leq 5$; $4 \leq n' \leq 8$; $l, l' = s, p, d, f$). Data for additional transitions (namely, those for which $n > 5$, where n is the principal quantum number of the lower state) can be found in Ref. 5. Whenever wavelengths of individual lines within a multiplet either were available directly or could be determined from the energy levels, the multiplet strength was distributed among the lines according to *LS*-coupling rules, except in cases where the wavelengths of all the lines in the multiplet are identical. The strength of the $3p\ ^2P^{\circ} - 4s\ ^2S$ multiplet was not distributed between the two lines in the multiplet, however, since the relativistic single-configuration Hartree-Fock calculations of Kim and Cheng[6] indicate that in the corresponding transition in sodiumlike iron the ratio of the two line strengths deviates somewhat from the value that would be obtained in the case of pure *LS* coupling.

Transitions with small *f*-values were generally assigned lower accuracy ratings.

References

[1] B. Edlén, Phys. Scr. 17, 565 (1978).
[2] A. W. Weiss, J. Quant. Spectrosc. Radiat. Transfer 18, 481 (1977).
[3] P. F. Gruzdev and A. I. Sherstyuk, Opt. Spectrosc. (USSR) 46, 353 (1979).
[4] Y.-K. Kim and J.-P. Desclaux, Argonne National Laboratory Report ANL-76-88, Part I (1976).
[5] E. Biemont, Astron. Astrophys., Suppl. Ser. 31, 285 (1978).
[6] Y.-K. Kim and K.-T. Cheng, J. Opt. Soc. Am. 68, 836 (1978).

Cr XIV: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	3s–3p	$^2S - ^2P^{\circ}$	*396.94*	0	*251930*	2	6	60.5	0.429	1.12	−0.067	B	1
			389.81	0	256540	2	4	64.1	0.292	0.750	−0.233	B	1
			411.99	0	242720	2	2	53.7	0.137	0.371	−0.563	B	1
2.	3s–4p	$^2S - ^2P^{\circ}$	*63.395*	0	*1577410*	2	6	1090	0.197	0.0823	−0.404	C+	*interp.*
			63.324	0	1579180	2	4	1070	0.129	0.0537	−0.589	C+	*interp.*
			63.539	0	1573860	2	2	1130	0.0684	0.0286	−0.864	C+	*interp.*
3.	3s–5p	$^2S - ^2P^{\circ}$	*46.488*	0	*2151100*	2	6	660	0.064	0.020	−0.89	C	5
			46.468	0	2152000	2	4	660	0.042	0.013	−1.07	C	*ls*
			46.527	0	2149300	2	2	670	0.022	0.0067	−1.36	C	*ls*
4.	3s–6p	$^2S - ^2P^{\circ}$	*40.788*	0	*2451700*	2	6	390	0.0292	0.0078	−1.234	C	5
			40.782	0	2452100	2	4	390	0.019	0.0052	−1.41	C	*ls*
			40.800	0	2451000	2	2	390	0.0097	0.0026	−1.71	D	*ls*
5.	3s–7p	$^2S - ^2P^{\circ}$	38.036	0	2629100	2	6	247	0.0161	0.00403	−1.492	C	5
6.	3s–8p	$^2S - ^2P^{\circ}$	36.466	0	2742300	2	6	167	0.0100	0.00240	−1.70	C	5
7.	3p–3d	$^2P^{\circ} - ^2D$	*296.77*	*251930*	*588890*	6	10	146	*0.321*	*1.88*	*0.284*	B	1
			300.271	256540	589570	4	6	141	0.286	1.13	0.058	B	1
			289.735	242720	587860	2	4	131	0.329	0.627	−0.182	B	1
			301.814	256540	587860	4	4	23.0	0.0315	0.125	−0.900	B	1
8.	3p–4s	$^2P^{\circ} - ^2S$	*81.526*	*251930*	1478500	6	2	2000	0.066	0.11	−0.40	C	5
9.	3p–4d	$^2P^{\circ} - ^2D$	*69.008*	*251930*	*1701000*	6	10	2240	0.278	0.379	0.222	C	5
			69.213	256540	1701200	4	6	2310	0.249	0.227	−0.002	C	*ls*
			68.594	242720	1700600	2	4	1980	0.279	0.126	−0.253	C	*ls*
			69.247	256540	1700600	4	4	280	0.027	0.025	−0.96	D	*ls*
10.	3p–5s	$^2P^{\circ} - ^2S$	*54.028*	*251930*	2102800	6	2	890	0.0129	0.0138	−1.111	C	5
			54.164	256540	2102800	4	2	590	0.013	0.0092	−1.29	C	*ls*
			53.760	242720	2102800	2	2	300	0.0130	0.00460	−1.59	C	*ls*
11.	3p–5d	$^2P^{\circ} - ^2D$	*51.054*	*251930*	*2210600*	6	10	1400	0.091	0.092	−0.26	C	5
			51.172	256540	2210700	4	6	1400	0.082	0.055	−0.49	C	*ls*
			50.821	242720	2210400	2	4	1200	0.093	0.031	−0.73	C	*ls*
			[51.180]	256540	2210400	4	4	230	0.0091	0.0061	−1.44	D	*ls*

Cr XIV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
12.	3p–6s	$^2P^\circ$ - ^2S	46.030	251930	2424400	6	2	470	0.0050	0.0045	−1.52	D	5
			46.125	256540	2424400	4	2	310	0.0049	0.0030	−1.70	D	ls
			45.835	242720	2424400	2	2	160	0.0050	0.0015	−2.00	D	ls
13.	3p–6d	$^2P^\circ$ - ^2D	44.779	251930	2485100	6	10	940	0.0421	0.0372	−0.60	C	5
			44.880	256540	2485200	4	6	880	0.0377	0.0223	−0.82	C	ls
			44.597	242720	2485000	2	4	710	0.0422	0.0124	−1.073	C	ls
			[44.873]	256540	2485000	4	4	140	0.0042	0.0025	−1.77	D	ls
14.	3p–7s	$^2P^\circ$ - ^2S	42.371	251930	2612000	6	2	290	0.0026	0.0022	−1.81	D	5
			42.453	256540	2612000	4	2	200	0.0027	0.0015	−1.97	D	ls
			[42.207]	242720	2612000	2	2	98	0.0026	7.3(−4)	−2.28	D	ls
15.	3p–7d	$^2P^\circ$ - ^2D	41.712	251930	2649000	6	10	540	0.0238	0.0192	−0.85	C	5
			41.788	256540	2649500	4	6	530	0.0209	0.0115	−1.078	C	ls
			41.556	242720	2649100	2	4	450	0.023	0.0064	−1.33	C	ls
			[41.796]	256540	2649100	4	4	90	0.0024	0.0013	−2.02	D	ls
16.	3p–8s	$^2P^\circ$ - ^2S				6	2		0.0015		−2.05	D	5
17.	3p–8d	$^2P^\circ$ - ^2D	39.944	251930	2755400	6	10	361	0.0144	0.0114	−1.063	C	5
			40.018	256540	2755400	4	6	360	0.013	0.0068	−1.29	C	ls
			39.796	242720	2755500	2	4	305	0.0145	0.00380	−1.54	C	ls
			[40.016]	256540	2755500	4	4	60	0.0014	7.6(−4)	−2.24	D	ls
18.	3d–4p	^2D - $^2P^\circ$	101.16	588890	1577410	10	6	485	0.0446	0.149	−0.351	C	5
			101.05	589570	1579180	6	4	440	0.045	0.089	−0.57	C	ls
			101.42	587860	1573860	4	2	483	0.0372	0.0497	−0.83	C	ls
			[100.88]	587860	1579180	4	4	49	0.0075	0.0099	−1.53	D	ls
19.	3d–4f	^2D - $^2F^\circ$	86.125	588890	1750000	10	14	5900	0.92	2.6	0.96	C	5
			86.169	589570	1750100	6	8	5900	0.88	1.5	0.72	C	ls
			86.060	587860	1749900	4	6	5200	0.88	1.0	0.55	C	ls
			[86.185]	589570	1749900	6	6	390	0.043	0.074	−0.58	D	ls
20.	3d–5p	^2D - $^2P^\circ$	64.012	588890	2151100	10	6	190	0.0070	0.015	−1.15	D	5
			64.006	589570	2152000	6	4	170	0.0071	0.0090	−1.37	D	ls
			[64.045]	587860	2149300	4	2	190	0.0059	0.0050	−1.62	D	ls
			[63.925]	587860	2152000	4	4	19	0.0012	0.0010	−2.32	E	ls
21.	3d–5f	^2D - $^2F^\circ$	60.731	588890	2235500	10	14	2200	0.170	0.340	0.230	C	5
			60.756	589570	2235500	6	8	2190	0.162	0.194	−0.012	C	ls
			60.699	587860	2235400	4	6	2050	0.170	0.136	−0.167	C	ls
			[60.761]	589570	2235400	6	6	150	0.0081	0.0097	−1.21	D	ls
22.	3d–6p	^2D - $^2P^\circ$	53.683	588890	2451700	10	6	96	0.0025	0.0044	−1.60	D	5
			[53.691]	589570	2452100	6	4	85	0.0025	0.0028	−1.83	D	ls
			[53.674]	587860	2451000	4	2	98	0.0021	0.0015	−2.07	D	ls
			[53.642]	587860	2452100	4	4	9.5	4.1(−4)	2.9(−4)	−2.78	E	ls

Cr XIV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
23.	3d-6f	^{2}D - ^{2}F°	*52.345*	*588890*	*2499300*	10	14	1100	0.063	0.11	−0.20	C	5
			52.363	589570	2499300	6	8	1100	0.061	0.063	−0.44	C	ls
			52.321	587860	2499200	4	6	1000	0.064	0.044	−0.59	C	ls
			[52.367]	589570	2499200	6	6	73	0.0030	0.0031	−1.75	D	ls
24.	3d-7p	^{2}D - ^{2}P°	*49.015*	*588890*	2629100	10	6	56	0.0012	0.0019	−1.92	D	5
			[49.032]	589570	2629100	6	4	47	0.0011	0.0011	−2.17	D	ls
			[48.991]	587860	2629100	4	2	54	9.8(−4)	6.3(−4)	−2.41	E	ls
			[48.991]	587860	2629100	4	4	5.6	2.0(−4)	1.3(−4)	−3.09	E	ls
25.	3d-7f	^{2}D - ^{2}F°	*48.321*	*588890*	*2658400*	10	14	640	0.0312	0.0496	−0.51	C	5
			48.338	589570	2658400	6	8	630	0.0296	0.0283	−0.75	C	ls
			48.300	587860	2658300	4	6	590	0.0311	0.0198	−0.90	C	ls
			[48.340]	589570	2658300	6	6	42	0.0015	0.0014	−2.06	D	ls
26.	3d-8p	^{2}D - ^{2}P°	*46.438*	*588890*	2742300	10	6	36	7.0(−4)	0.0011	−2.15	E	5
			[46.453]	589570	2742300	6	4	33	7.2(−4)	6.6(−4)	−2.36	E	ls
			[46.417]	587860	2742300	4	2	37	6.1(−4)	3.7(−4)	−2.62	E	ls
			[46.417]	587860	2742300	4	4	3.7	1.2(−4)	7.2(−5)	−3.32	E	ls
27.	3d-8f	^{2}D - ^{2}F°				10	14		0.0180		−0.74	C	5
28.	4s-4p	^{2}S - ^{2}P°				2	6		0.60		0.08	C	5
29.	4s-5p	^{2}S - ^{2}P°	*148.7*	1478500	*2151100*	2	6	217	0.216	0.211	−0.365	C	5
			[148.5]	1478500	2152000	2	4	218	0.144	0.141	−0.54	C	ls
			[149.1]	1478500	2149300	2	2	210	0.071	0.070	−0.85	C	ls
30.	4s-6p	^{2}S - ^{2}P°	*102.8*	1478500	*2451700*	2	6	150	0.070	0.047	−0.85	C	5
			[102.7]	1478500	2452100	2	4	140	0.046	0.031	−1.04	C	ls
			[102.8]	1478500	2451000	2	2	150	0.024	0.016	−1.33	C	ls
31.	4s-7p	^{2}S - ^{2}P°	[86.911]	1478500	2629100	2	6	96	0.0327	0.0187	−1.184	C	5
32.	4s-8p	^{2}S - ^{2}P°	[79.126]	1478500	2742300	2	6	66	0.0185	0.0096	−1.432	C	5
33.	4p-4d	^{2}P° - ^{2}D	*809.1*	*1577410*	*1701000*	6	10	29	0.47	7.5	0.45	C	3
			[819.0]	1579180	1701300	4	6	28	0.42	4.5	0.23	C	3
			[789.3]	1573460	1700600	2	4	26	0.48	2.5	−0.02	C	3
			[823.7]	1579180	1700600	4	4	4.5	0.046	0.50	−0.74	C	3
34.	4p-5s	^{2}P° - ^{2}S	*190.3*	*1577410*	2102800	6	2	620	0.113	0.425	−0.169	C	5
			[191.0]	1579180	2102800	4	2	411	0.113	0.283	−0.347	C	ls
			[189.1]	1573460	2102800	2	2	213	0.114	0.142	−0.64	C	ls
35.	4p-5d	^{2}P° - ^{2}D	*157.9*	*1577410*	*2210600*	6	10	379	0.236	0.74	0.151	C	5
			[158.4]	1579180	2210700	4	6	370	0.21	0.44	−0.07	C	ls
			[157.1]	1573460	2210400	2	4	330	0.24	0.25	−0.32	C	ls
			[158.4]	1579180	2210400	4	4	62	0.023	0.049	−1.03	D	ls
36.	4p-6s	^{2}P° - ^{2}S	*118.1*	*1577410*	2424400	6	2	316	0.0220	0.051	−0.88	C	5
			[118.3]	1579180	2424400	4	2	210	0.022	0.034	−1.06	C	ls
			[117.6]	1573460	2424400	2	2	110	0.022	0.017	−1.36	C	ls

Cr XIV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
37.	4p–6d	$^2P^\circ - {}^2D$	*110.2*	*1577410*	*2485100*	6	10	270	0.083	0.18	−0.30	C	5
			[110.4]	1579180	2485200	4	6	280	0.076	0.11	−0.52	C	ls
			[109.8]	1573060	2485000	2	4	230	0.083	0.060	−0.78	C	ls
			[110.4]	1579180	2485000	4	4	45	0.0083	0.012	−1.48	D	ls
38.	4p–7s	$^2P^\circ - {}^2S$	*96.656*	*1577410*	2612000	6	2	180	0.0086	0.016	−1.29	D	5
			[96.824]	1579180	2612000	4	2	120	0.0086	0.011	−1.46	D	ls
			[96.330]	1573060	2612000	2	2	60	0.0084	0.0053	−1.78	D	ls
39.	4p–7d	$^2P^\circ - {}^2D$	*93.298*	*1577410*	*2649300*	6	10	185	0.0402	0.074	−0.62	C	5
			[93.432]	1579180	2649500	4	6	180	0.036	0.044	−0.84	C	ls
			[93.006]	1573060	2649100	2	4	160	0.041	0.025	−1.09	C	ls
			[93.467]	1579180	2649100	4	4	30	0.0040	0.0049	−1.80	D	ls
40.	4p–8s	$^2P^\circ - {}^2S$				6	2		0.0044		−1.58	D	5
41.	4p–8d	$^2P^\circ - {}^2D$	*84.890*	*1577410*	*2755400*	6	10	128	0.0230	0.0386	−0.86	C	5
			[85.020]	1579180	2755400	4	6	127	0.0207	0.0232	−1.082	C	ls
			[84.631]	1573060	2755500	2	4	108	0.0232	0.0129	−1.334	C	ls
			[85.012]	1579180	2755500	4	4	21	0.0023	0.0026	−2.03	D	ls
42.	4d–4f	$^2D - {}^2F^\circ$				10	14		0.122		0.086	C	5
43.	4d–5p	$^2D - {}^2P^\circ$	*222.2*	*1701000*	*2151100*	10	6	220	0.099	0.72	−0.00	C	5
			[221.9]	1701300	2152000	6	4	200	0.098	0.43	−0.23	C	ls
			[222.9]	1700600	2149300	4	2	220	0.082	0.24	−0.49	C	ls
			[221.5]	1700600	2152000	4	4	22	0.016	0.048	−1.18	D	ls
44.	4d–5f	$^2D - {}^2F^\circ$	*187.1*	*1701000*	*2235500*	10	14	970	0.71	4.4	0.85	C	5
			187.30	1701300	2235600	6	8	960	0.68	2.5	0.61	C	ls
			187.02	1700600	2235400	4	6	930	0.73	1.8	0.47	C	ls
			[187.2]	1701300	2235400	6	6	67	0.035	0.13	−0.68	D	ls
45.	4d–6p	$^2D - {}^2P^\circ$	*133.2*	*1701000*	*2451700*	10	6	103	0.0165	0.072	−0.78	C	5
			[133.2]	1701300	2452100	6	4	92	0.016	0.043	−1.01	C	ls
			[133.3]	1700600	2451000	4	2	100	0.014	0.024	−1.26	C	ls
			[133.1]	1700600	2452100	4	4	10	0.0027	0.0048	−1.96	D	ls
46.	4d–6f	$^2D - {}^2F^\circ$	*125.3*	*1701000*	*2499300*	10	14	540	0.178	0.73	0.250	C	5
			[125.3]	1701300	2499300	6	8	540	0.17	0.42	0.01	C	ls
			[125.2]	1700600	2499200	4	6	500	0.18	0.29	−0.15	C	ls
			[125.3]	1701300	2499200	6	6	36	0.0085	0.021	−1.29	D	ls
47.	4d–7p	$^2D - {}^2P^\circ$	*107.7*	*1701000*	2629100	10	6	58	0.0060	0.021	−1.22	D	5
			[107.8]	1701300	2629100	6	4	58	0.0061	0.013	−1.44	D	ls
			[107.7]	1700600	2629100	4	2	57	0.0049	0.0070	−1.70	D	ls
			[107.7]	1700600	2629100	4	4	5.7	9.9(−4)	0.0014	−2.40	E	ls
48.	4d–7f	$^2D - {}^2F^\circ$	*104.6*	*1701000*	*2658400*	10	14	320	0.074	0.25	−0.13	C	5
			[104.5]	1701300	2658400	6	8	310	0.068	0.14	−0.39	C	ls
			[104.4]	1700600	2658300	4	6	300	0.073	0.10	−0.54	C	ls
			[104.5]	1701300	2658300	6	6	21	0.0034	0.0071	−1.09	D	ls

Cr XIV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
49.	4d-8p	$^2D - ^2P^o$	*96.026*	*1701000*	2742300	10	6	36	0.0030	0.0095	−1.52	D	5
			[96.061]	1701300	2742300	6	4	33	0.0030	0.0057	−1.74	D	ls
			[96.997]	1700600	2742300	4	2	37	0.0025	0.0032	−1.99	D	ls
			[96.097]	1700600	2742300	4	4	3.6	5.0(−4)	6.2(−4)	−2.70	E	ls
50.	4d-8f	$^2D - ^2F^o$				10	14		0.0389		−0.410	C	5
51.	4f-5d	$^2F^o - ^2D$	*217.1*	*1750000*	*2210000*	14	10	39.8	0.0201	0.201	−0.55	C	5
			[217.1]	1750100	2210700	8	6	38.0	0.0201	0.115	−0.79	C	ls
			[217.2]	1749900	2210400	6	4	40	0.019	0.080	−0.95	C	ls
			[217.0]	1749900	2210700	6	6	1.9	0.0013	0.0057	−2.10	D	ls
52.	4f-6d	$^2F^o - ^2D$	[136.0]	*1750000*	*2485100*	14	10	17	0.0034	0.021	−1.32	D	5
53.	4f-7d	$^2F^o - ^2D$	[111.2]	*1750000*	*2649300*	14	10	9.1	0.0012	0.0062	−1.77	D	5
54.	4f-8d	$^2F^o - ^2D$	*99.463*	*1750000*	*2755400*	14	10	5.4	5.7(−4)	0.0026	−2.10	E	5
			[99.473]	1750100	2755400	8	6	5.1	5.7(−4)	0.0015	−2.34	E	ls
			[99.443]	1749900	2755500	6	4	5.2	5.1(−4)	0.0010	−2.52	E	ls
			[99.453]	1749900	2755400	6	6	0.25	2.8(−5)	7.4(−5)	−3.65	E	ls
55.	5s-5p	$^2S - ^2P^o$				2	6		0.78		0.19	C	5
56.	5s-6p	$^2S - ^2P^o$	*286.6*	2102800	*2451700*	2	6	63	0.233	0.440	−0.332	C	5
			[286.3]	2102800	2452100	2	4	63	0.155	0.293	−0.51	C	ls
			[287.2]	2102800	2451000	2	2	63	0.078	0.147	−0.81	C	ls
57.	5s-7p	$^2S - ^2P^o$	[190.0]	2102800	2629100	2	6	47	0.076	0.095	−0.82	C	5
58.	5s-8p	$^2S - ^2P^o$	[156.4]	2102800	2742300	2	6	32.7	0.0360	0.0371	−1.143	C	5
59.	5p-5d	$^2P^o - ^2D$				6	10		0.67		0.60	C	5
60.	5p-6s	$^2P^o - ^2S$	*365.9*	*2151100*	2424400	6	2	241	0.161	1.16	−0.015	C	5
			[367.1]	2152000	2424400	4	2	160	0.16	0.77	−0.20	C	ls
			[363.5]	2149300	2424400	2	2	82	0.162	0.387	−0.490	C	ls
61.	5p-6d	$^2P^o - ^2D$	*299.4*	*2151100*	*2485100*	6	10	98	0.219	1.30	0.119	C	5
			[300.1]	2152000	2485200	4	6	97	0.20	0.78	−0.10	C	ls
			[297.9]	2149300	2485000	2	4	83	0.221	0.433	−0.355	C	ls
			[300.3]	2152000	2485000	4	4	16	0.022	0.087	−1.06	D	ls
62.	5p-7s	$^2P^o - ^2S$	*217.0*	*2151100*	2612000	6	2	133	0.0313	0.134	−0.73	C	5
			[217.4]	2152000	2612000	4	2	88	0.031	0.089	−0.91	C	ls
			[216.1]	2149300	2612000	2	2	44.9	0.0314	0.0447	−1.202	C	ls
63.	5p-7d	$^2P^o - ^2D$	*200.7*	*2151100*	*2649300*	6	10	78	0.079	0.31	−0.32	C	5
			[201.0]	2152000	2649500	4	6	79	0.072	0.19	−0.54	C	ls
			[200.1]	2149300	2649100	2	4	63	0.076	0.10	−0.82	C	ls
			[201.2]	2152000	2649100	4	4	13	0.0079	0.021	−1.50	D	ls
64.	5p-8s	$^2P^o - ^2S$				6	2		0.0123		−1.132	C	5

Cr XIV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
65.	5p–8d	$^2P^\circ$ - ^2D	*165.5*	*2151100*	*2755600*	6	10	57	0.0392	0.128	−0.63	C	5
			[165.7]	2152000	2755400	4	6	57	0.035	0.077	−0.85	C	ls
			[165.6]	2149300	2755500	2	4	48.1	0.0393	0.0427	−1.105	C	ls
			[165.7]	2152000	2755500	4	4	9.5	0.0039	0.0085	−1.81	D	ls
66.	5d–5f	^2D - $^2F^\circ$				10	14		0.214		0.330	C	5
67.	5d–6p	^2D - $^2P^\circ$	*414.8*	*2210000*	*2451700*	10	6	101	0.157	2.14	0.196	C	5
			[414.3]	2210700	2452100	6	4	91	0.156	1.28	−0.028	C	ls
			[415.6]	2210400	2451000	4	2	100	0.13	0.71	−0.28	C	ls
			[413.7]	2210400	2452100	4	4	10	0.026	0.14	−0.99	D	ls
68.	5d–6f	^2D - $^2F^\circ$	*346.4*	*2210000*	*2498700*	10	14	250	0.63	7.2	0.80	C	5
			[346.5]	2210700	2499300	6	8	250	0.60	4.1	0.56	C	ls
			[346.3]	2210400	2499200	4	6	240	0.64	2.9	0.41	C	ls
			[346.6]	2210700	2499200	6	6	17	0.031	0.21	−0.74	D	ls
69.	5d–7p	^2D - $^2P^\circ$	*238.9*	*2210000*	2629100	10	6	52	0.0268	0.212	−0.57	C	5
			[239.0]	2210700	2629100	6	4	47.1	0.0269	0.127	−0.79	C	ls
			[238.8]	2210400	2629100	4	2	53	0.023	0.071	−1.04	C	ls
			[238.8]	2210400	2629100	4	4	5.2	0.0045	0.014	−1.75	D	ls
70.	5d–7f	^2D - $^2F^\circ$	*223.3*	*2210000*	*2658400*	10	14	166	0.174	1.28	0.241	C	5
			[223.4]	2210700	2658400	6	8	170	0.17	0.73	−0.00	C	ls
			[223.3]	2210400	2658300	4	6	150	0.17	0.51	−0.16	C	ls
			[223.4]	2210700	2658300	6	6	11	0.0084	0.037	−1.30	D	ls
71.	5d–8p	^2D - $^2P^\circ$	*188.1*	*2210000*	2742300	10	6	31.4	0.0100	0.062	−1.000	C	5
			[188.1]	2210700	2742300	6	4	28	0.010	0.037	−1.22	C	ls
			[188.0]	2210400	2742300	4	2	32	0.0085	0.021	−1.47	D	ls
			[188.0]	2210400	2742300	4	4	3.1	0.0017	0.0041	−2.18	D	ls
72.	5d–8f	^2D - $^2F^\circ$				10	14		0.077		−0.11	C	5
73.	5f–6d	$^2F^\circ$ - ^2D	*400.6*	*2235500*	*2485100*	14	10	28.4	0.0488	0.90	−0.165	C	5
			[400.5]	2235500	2485200	8	6	27	0.048	0.51	−0.41	C	ls
			[400.6]	2235400	2485000	6	4	28	0.045	0.36	−0.56	C	ls
			[400.3]	2235400	2485200	6	6	1.4	0.0033	0.026	−1.70	D	ls
74.	5f–7d	$^2F^\circ$ - ^2D	*241.7*	*2235500*	*2649300*	14	10	14	0.0086	0.096	−0.92	D	5
			[241.5]	2235500	2649600	8	6	13	0.0086	0.055	−1.16	D	ls
			[241.7]	2235400	2649100	6	4	14	0.0080	0.038	−1.32	D	ls
			[241.5]	2235400	2649600	6	6	0.65	5.7(−4)[a]	0.0027	−2.47	E	ls
75.	5f–8d	$^2F^\circ$ - ^2D	[192.3]	*2235500*	*2755400*	14	10	7.8	0.0031	0.027	−1.36	D	5

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XIV

Forbidden Transitions

The electric quadrupole gf-value for the $3s$–$3d$ multiplet in this sodiumlike ion was reported by Godefroid *et al.*;[1] it was calculated earlier by Biemont and Godefroid[2] using a fully variational Hartree-Fock approach. This f-value was converted to a multiplet strength, which was then distributed between the two lines of the multiplet according to LS-coupling rules.

References

[1] M. Godefroid, C. E. Magnusson, P. O. Zetterberg, and I. Joelsson, Phys. Scr. 32, 125 (1985).

[2] E. Biemont and M. Godefroid, Phys. Scr. 18, 323 (1978).

Cr XIV: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$3s$–$3d$	^2S – ^2D										
			[169.62]	0	589570	2	6	E2	5.5(+5)[a]	0.277	C	1,*ls*
			[170.11]	0	587860	2	4	E2	5.5(+5)	0.185	C	1,*ls*

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XV

Ne Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^6\ {}^1S_0$

Ionization Energy: 1010.6 eV = 8151000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
18.497	9	102	3	293	13	327	14
18.782	8	102.18	1	304	13	405.127	11
19.015	7	103	3	309	13	417	16
20.863	6	105	4	321.262	15	469	10
21.153	5	111.27	2	324	17	703	12

For resonance transitions to $J = 1$ levels of the $2p^5 3s$ and $2p^5 3d$ configurations, we quote A-values which were calculated by Vainshtein and Safronova[1] using a charge-expansion perturbation theory approach with allowance for mixing of the $2p^5 3s$, $2p^5 3d$, and $2s 2p^6 3p$ configurations. Their results for the $2p^6$–$2p^5 3d$ transitions in the isoelectronic ions Ar IX and Fe XVII are in rather good agreement with those of Shorer,[2] who used the relativistic random phase approximation (RRPA) with allowance for mixing between configurations of type $2p^5 ns$ and $2p^5 nd$, as well as correlation effects due to configurations having a vacancy in the $1s$ or $2s$ subshell. But the data of Ref. 1 for the two $2p^6$–$2p^5 3s$ transitions are approximately a factor of two smaller than those of Shorer for the abovementioned neon-like species, so we have increased the transition probabilities of Ref. 1 for these two lines by a factor of two.

A-values quoted here for a number of transitions involving an electron jump of the type $2s$–$2p$, $3s$–$3p$, or $3p$–$3d$ were taken from the work of Pokleba and Safronova,[3] who used wavefunctions calculated by a charge-expansion perturbation theory approach with allowance for mixing of configurations in which a single $2s$ or $2p$ electron is excited to an $n = 3$ orbital but with no inclusion of configurations in which an electron occupies the $n=4$ shell. In cases where better wavelength data were available, these transition probabilities were first converted to line strengths, which were then reconverted to f- and A-values by using the more accurate wavelengths. Transitions involving levels of the $2p^53p$ and $2p^53d$ configurations which are indicated by Fawcett[4] (in Ti XII) or by Jupen and Litzen[5] (in Ti XII or Fe XVII) to be of low to moderate purity in *LS* coupling are excluded here, as are very weak lines. The pattern of levels within the $2s2p^63d$ configuration in the isoelectronic ions Fe XVII and Ni XIX resulting from the scaled Thomas-Fermi calculations of Loulergue and Nussbaumer[6] with extensive allowance for correlation is entirely different from that determined by Vainshtein and Safronova, whose energy levels were apparently used by Pokleba and Safronova in their transition probability calculations. We have thus excluded transitions out of these levels from our tabulation.

References

[1] L. A. Vainshtein and U. I. Safronova, *Spektroskopicheskie Konstanty Atomov*, 5-122 (Ed. V. B. Belyanin, Akad. Nauk SSSR, Ot. Ob. Fiz. Astron., Nauch. Sov. Spektrosk., Moscow, 1977).

[2] P. Shorer, Phys. Rev. A 20, 642 (1979).

[3] A. K. Pokleba and U. I. Safronova, Preprint No. 11, Akad. Nauk SSSR, Ot. Ob. Fiz. Astron., Inst. Spektrosk. (Moscow, 1981).

[4] B. C. Fawcett, private communication, as quoted in E. Träbert, Z. Phys. A 319, 25 (1984).

[5] C. Jupen and U. Litzen, Phys. Scr. 30, 112 (1984).

[6] M. Loulergue and H. Nussbaumer, Astron. Astrophys. 45, 125 (1975).

Cr XV: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^22p^5(^2P^o_{3/2})3s$ - $2s2p^63s$	$(^3/_2,^1/_2)^o$ - ^2S											
			102.18	4713200	5691900	5	3	700	0.065	0.11	−0.49	D	3
2.	$2s^22p^5(^2P^o_{1/2})3s$ - $2s2p^63s$	$(^1/_2,^1/_2)^o$ - ^2S											
			111.27	4793200	5691900	3	3	170	0.031	0.034	−1.03	D	3
3.	$2s^22p^53p$ - $2s2p^63p$	^3S - $^3P^o$											
			[102]			3	3	160	0.025	0.025	−1.13	E	3
			[103]			3	1	380	0.020	0.020	−1.22	D	3
4.		^3D - $^3P^o$											
			[105]			7	5	590	0.063	0.15	−0.36	D	3
5.	$2p^6$ - $2p^5(^2P^o_{3/2})3s$	^1S - $(^3/_2,^1/_2)^o$											
			21.153	0	4727500	1	3	5600	0.11	0.0078	−0.96	C−	1n
6.	$2p^6$ - $2p^5(^2P^o_{1/2})3s$	^1S - $(^1/_2,^1/_2)^o$											
			20.863	0	4793200	1	3	6000	0.12	0.0081	−0.93	C−	1n
7.	$2p^6$-$2p^53d$	^1S - $^3P^o$											
			19.015	0	5259000	1	3	630	0.010	6.4(−4)	−1.99	E	1
8.		^1S - $^3D^o$											
			18.782	0	5324200	1	3	2.8(+4)	0.44	0.02[illegible]	−0.36	D	1
9.		^1S - $^1P^o$	18.497	0	5406300	1	3	1.62(+5)	2.49	0.152	0.397	C−	1
10.	$2p^5(^2P^o_{3/2})3s$ - $2p^53p$	$(^3/_2,^1/_2)^o$ - ^3S											
			[469]			5	3	25	0.049	0.38	−0.61	D	3

Cr XV: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
11.		$(^3/_2,^1/_2)^\circ - ^3D$											
			405.127	4713200	4960000	5	7	44	0.15	1.0	−0.13	D	3
12.	$2p^5(^2P^\circ_{1/2})3s - 2p^53p$	$(^1/_2,^1/_2)^\circ - ^3S$											
			[703]			1	3	0.19	0.0042	0.0098	−2.37	E	3
13.	$2p^53p - 2p^53d$	$^3S - ^3P^\circ$	*298*			3	9	56	0.22	0.66	−0.17	E	3
			[293]			3	5	42	0.090	0.26	−0.57	E	3
			[304]			3	3	67	0.093	0.28	−0.56	D	3
			[309]			3	1	79	0.038	0.12	−0.95	D	3
14.		$^3D - ^3P^\circ$											
			[327]			7	5	3.5	0.0040	0.030	−1.55	E	3
15.		$^3D - ^3F^\circ$											
			321.262	4960000	5271300	7	9	81	0.16	1.2	0.05	D	3
16.		$^3P - ^3P^\circ$											
			[417]			1	3	1.7	0.013	0.018	−1.88	D−	3
17.		$^3P - D^\circ$											
			[324]			1	3	39	0.18	0.20	−0.73	D	3

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XV

Forbidden Transitions

The A-value for the single transition tabulated here is the result of the Hartree-Fock-Relativistic (HFR) calculations of Cowan.[1] The wavelength is the result of these same calculations and may be somewhat uncertain, as the energy of the $J = 0$ level has not been determined experimentally.

Reference

[1] R. D. Cowan, Los Alamos Scientific Laboratory Informal Report LA-6679-MS (Jan. 1977).

Cr XV: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2p^5(^2P^\circ_{3/2})3s - 2p^5(^2P^\circ_{1/2})3s$	$(^3/_2,^1/_2)^\circ - (^1/_2,^1/_2)^\circ$										
			[1710]			3	1	M1	5200	0.96	D+	1

Cr XVI

F Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^5\ ^2P^o_{3/2}$

Ionization Energy: 1097 eV = 8850000 cm^{-1}

Allowed Transitions

Oscillator strengths for lines of the multiplet $2s^2 2p^5\ ^2P^o - 2s2p^6\ ^2S$ are the results of the Dirac-Fock calculations of Cheng *et al.*,[1] which included a perturbative treatment of the Breit interaction and the Lamb shift.

For lines of the arrays $2p^5$–$2p^4 3s$ and $2p^5$–$2p^4 3d$, we quote the f-values calculated by Fawcett[2] using Cowan's Hartree-Fock-Relativistic (HFR) method and incorporating scaling of energy parameters on the basis of a least-squares fit to observed energies. Fawcett's calculations included fairly extensive allowance for configuration mixing in both odd- and even-parity states. Transitions involving levels which are indicated by Fawcett to be of low to moderate purity in *LS* coupling in neighboring fluorinelike ions are excluded from this compilation, as are lines characterized by very small f-values.

The ratio of A-values for the two resonance lines out of the $2s2p^6\ ^2S_{1/2}$ level as given in Ref. 1 is in reasonably good agreement with the result of Stratton *et al.*[3] derived from relative-intensity measurements.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).
[2] B. C. Fawcett, At. Data Nucl. Data Tables 31, 495 (1984).
[3] B. C. Stratton, H. W. Moos, S. Suckewer, U. Feldman, J. F. Seely, and A. K. Bhatia, Phys. Rev. A 31, 2534 (1985).

Cr XVI: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^2 2p^5$–$2s2p^6$	$^2P^o - ^2S$	*109.38*	*23631*	937910	6	2	1050	0.0625	0.135	−0.426	C+	1
			106.62	0	937910	4	2	758	0.0646	0.0907	−0.588	C+	1
			115.33	70892	937910	2	2	296	0.0589	0.0447	−0.929	C+	1
2.	$2p^5$–$2p^4(^3P)3s$	$^2P^o - ^4P$											
			19.807	0	5048700	4	6	430	0.0038	9.9(−4)	−1.82	E	2
3.		$^2P^o - ^2P$											
			19.714	70892	5143500	2	2	1.1(+4)	0.064	0.0083	−0.89	D	2
			19.442	0	5143500	4	2	9900	0.028	0.0072	−0.95	D	2
4.	$2p^5$–$2p^4(^1D)3s$	$^2P^o - ^2D$											
			19.255	0	5193500	4	6	7700	0.064	0.016	−0.59	D	2
			19.511	70892	5196200	2	4	8800	0.10	0.013	−0.70	D	2
5.	$2p^5$–$2p^4(^1S)3s$	$^2P^o - ^2S$	*18.868*	*23631*	5323600	6	2	9200	0.016	0.0061	−1.01	E	2
			18.775	0	5323600	4	2	2600	0.0068	0.0017	−1.57	E	2
			19.038	70892	5323600	2	2	6400	0.035	0.0044	−1.15	D	2
6.	$2p^5$–$2p^4(^1D)3d$	$^2P^o - ^2S$	*17.510*	*23631*	5734600	6	2	1.2(+5)	0.19	0.066	0.06	D	2
			17.438	0	5734600	4	2	1.1(+5)	0.24	0.055	−0.02	D	2
			[17.656]	70892	5734600	2	2	2.0(+4)	0.094	0.011	−0.73	D	2

Cr XVI: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
7.		$^2P^o$ - ^2P											
			[17.372]	0	5756300	4	4	1.4(+5)	0.62	0.14	0.39	E	2
			17.587	70892	5756300	2	4	2.0(+4)	0.19	0.022	−0.42	E	2
8.		$^2P^o$ - ^2D											
			17.514	70892	5780600	2	4	1.1(+5)	0.97	0.11	0.29	E	2
			[17.299]	0	5780600	4	4	2.5(+4)	0.11	0.025	−0.36	E	2
9.	$2p^5$-$2p^4(^1S)3d$	$^2P^o$ - ^2D	*17.126*	*23631*	*5862600*	6	10	4.0(+4)	0.30	0.10	0.25	E	2
			17.073	0	5857200	4	6	1.2(+4)	0.077	0.017	−0.51	D	2
			17.242	70892	5870700	2	4	8.6(+4)	0.77	0.087	0.19	D	2
			[17.034]	0	5870700	4	4	9.0	0.0043	9.6(−4)	−1.76	E	2

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XVI

Forbidden Transitions

Line strengths for the magnetic dipole and electric quadrupole contributions to the transition between the two levels of the $2p^5$ configuration are the results of the Dirac-Fock calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. The strength of the electric quadrupole transition as defined in Ref. 1 was multiplied by the factor $^3/_2$ which is needed to bring this value into conformance with the definition of quadrupole strengths used in the NBS tables.

Reference

[1]K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

Cr XVI: Forbidden transitions

No	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2p^5$-$2p^5$	$^2P^o$ - $^2P^o$										
			1410.60	0	70892	4	2	M1	6390	1.33	B	1
			"	"	"	4	2	E2	0.45	0.0030	D	1

Cr XVII

O Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^4\ ^3P_2$

Ionization Energy: 1185 eV = 9560000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
16.11	29	16.80	19	18.088	12	101.91	4
16.27	27	16.81	25	18.12	15	116.53	1
16.31	31	16.97	18,19	18.219	11	117.20	6
16.32	24	17.19	20	18.226	11	120.84	1
16.37	28	17.59	14	18.336	10,13	122.91	1
16.44	22,27	17.77	14	18.389	17	125.00	1
16.59	23	17.87	14	18.52	9	125.35	1
16.62	21	17.892	12	18.531	10	129.78	8
16.64	30	17.90	14	18.73	9	132.76	1
16.65	30	17.957	11	89.572	2	147.40	3
16.66	32	17.968	16	94.49	2	168.08	5
16.68	26	18.01	15	94.69	2		
16.78	21	18.020	11	97.20	7		

The tabulated oscillator strengths for transitions of the arrays $2s^2 2p^4$–$2s 2p^5$ and $2s 2p^5$–$2p^6$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to the $n = 2$ complex. The results should be quite accurate, except in the case of weak lines. (The $2s^2 2p^4\ ^1D_2$ – $2s 2p^5\ ^3P^\circ_1$ transition has been omitted from this tabulation, because its f-value as reported in Ref. 1 is extremely small, and thus very uncertain.)

Transition probabilities for lines of the $2s^2 2p^4$–$2s 2p^5$ array were calculated by Froese Fischer and Saha[2] using the multiconfiguration Hartree-Fock (MCHF) method with Breit-Pauli corrections. Their basis set included many configurations outside the $n = 2$ complex, but relativistic effects were not treated to the same degree as in Ref. 1. Line strengths derived from these two sources are in reasonably good agreement, particularly for the stronger transitions.

A-values for lines of the $2p^4\ ^3P$ – $2p^3(^4S^\circ)3s\ ^5S^\circ$ multiplet are taken from the scaled Thomas-Fermi approach of Kastner *et al.*[3] with configuration interaction and relativistic effects. For all other lines of the $2p^4$–$2p^3 3s$ array, and for lines of the $2p^4$–$2p^3 3d$ array, we quote the f-values calculated by Fawcett[4] using Cowan's Hartree-Fock-Relativistic (HFR) method and incorporating scaling of energy parameters on the basis of a least-squares fit to observed energies. Fawcett's calculations included fairly extensive allowance for configuration mixing in both odd- and even-parity states. The weakest lines were not reported, and thus are not tabulated here. Transitions involving levels which are indicated by Fawcett to be of low to moderate purity in LS coupling in neighboring oxygenlike ions are excluded from this compilation.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2] C. Froese Fischer and H. P. Saha, J. Phys. B 17, 943 (1984).

[3] S. O. Kastner, A. K. Bhatia, and L. Cohen, Phys. Scr. 15, 259 (1977).

[4] B. C. Fawcett, At. Data Nucl. Data Tables 34, 215 (1986).

Cr XVII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^22p^4$–$2s2p^5$	^{3}P – ^{3}P°	*122.44*	*26590*	*836710*	9	9	450	0.10	0.38	−0.05	C	1
			122.91	0	813600	5	5	330	0.074	0.15	−0.43	C	1
			125.35	60380	858150	3	3	109	0.0257	0.0318	−1.113	C	1
			116.53	0	858150	5	3	244	0.0298	0.057	−0.83	C	1
			120.84	60380	887920	3	1	499	0.0364	0.0434	−0.96	C	1
			132.76	60380	813600	3	5	93	0.0409	0.054	−0.91	C	1
			125.00	58150	858150	1	3	140	0.096	0.040	−1.02	C	1
2.		^{3}P – ^{1}P°											
			[89.572]	0	1116420	5	3	85	0.0061	0.0090	−1.52	E	1
			94.69	60380	1116420	3	3	4.6	6.5(−4)	6.1(−4)	−2.71	E	1
			94.49	58150	1116420	1	3	9.5	0.0038	0.0012	−2.42	E	1
3.		^{1}D – ^{3}P°											
			147.40	135160	813600	5	5	14	0.0047	0.011	−1.63	E	1
4.		^{1}D – ^{1}P°	101.91	135160	1116420	5	3	1320	0.123	0.206	−0.211	C	1
5.		^{1}S – ^{3}P°											
			[168.08]	263180	858150	1	3	5.6	0.0064	0.0035	−2.19	E	1
6.		^{1}S – ^{1}P°	117.20	263180	1116420	1	3	96	0.059	0.023	−1.23	C	1
7.	$2s2p^5$–$2p^6$	^{3}P° – ^{1}S											
			97.20	858150	1886950	3	1	59	0.0028	0.0027	−2.08	E	1
8.		^{1}P° – ^{1}S	129.78	1116420	1886950	3	1	1400	0.118	0.151	−0.451	C	1
9.	$2p^4$–$2p^3(^4$S°$)3s$	^{3}P – ^{5}S°											
			[18.52]			5	5	160	8.2(−4)	2.5(−4)	−2.39	E	3
			[18.73]			3	5	12	1.1(−4)	1.9(−5)	−3.50	E	3
10.	$2p^4$–$2p^3(^4$S°$)3s$	^{3}P – ^{3}S°	*18.426*	*26590*	5453800	9	3	2.7(+4)	0.046	0.025	−0.38	C−	4
			18.336	0	5453800	5	3	1.7(+4)	0.052	0.016	−0.59	C−	4
			18.531	60380	5453800	3	3	5800	0.030	0.0055	−1.05	C−	4
			18.531	58150	5455800	1	3	3200	0.050	0.0031	−1.30	C−	4
11.	$2p^4$–$2p^3(^2$D°$)3s$	^{3}P – ^{3}D°											
			17.957	0	5568900	5	7	7800	0.053	0.016	−0.58	C	4
			18.219	60380	5549400	3	5	2000	0.017	0.0031	−1.29	D	4
			18.219	58150	5547000	1	3	1700	0.026	0.0016	−1.59	D	4
			18.020	0	5549400	5	5	6400	0.031	0.0092	−0.81	D	4
			[18.226]	60380	5547000	3	3	7000	0.035	0.0063	−0.98	D	4
12.		^{3}P – ^{1}D°											
			[17.892]	0	5589000	5	5	960	0.0046	0.0014	−1.64	E	4
			[18.0[illegible]]	60380	5589000	3	5	1700	0.014	0.0025	−1.38	E	4
13.		^{1}D – ^{1}D°	18.336	135160	5589000	5	5	1.6(+4)	0.081	0.024	−0.39	D	4

Cr XVII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
14.	$2p^4 - 2p^3(^2P^\circ)3s$	$^3P - {}^3P^\circ$											
			[17.59]			5	5	1300	0.0060	0.0017	−1.52	D−	4
			[17.90]			3	1	7500	0.012	0.0021	−1.44	C	4
			[17.77]			3	5	4400	0.035	0.0061	−0.98	D	4
			[17.87]			1	3	4900	0.071	0.0042	−1.15	D	4
15.		$^1D - {}^3P^\circ$											
			[18.01]			5	5	4300	0.021	0.0062	−0.98	E	4
			[18.12]			5	3	2900	0.0086	0.0026	−1.37	E	4
16.		$^1D - {}^1P^\circ$	17.968	135160	5701200	5	3	8600	0.025	0.0074	−0.90	D	4
17.		$^1S - {}^1P^\circ$	18.389	263180	5701200	1	3	9200	0.14	0.0085	−0.85	D	4
18.	$2p^4 - 2p^3(^4S^\circ)3d$	$^3P - {}^5D^\circ$											
			[16.97]			5	5	1100	0.0046	0.0013	−1.64	E	4
19.	$2p^4 - 2p^3(^4S^\circ)3d$	$^3P - {}^3D^\circ$											
			[16.80]			5	7	4.4(+4)	0.26	0.072	0.11	D	4
			[16.97]			1	3	2.63(+4)	0.341	0.0191	−0.467	C−	4
			[16.97]			3	3	1.5(+4)	0.066	0.011	−0.70	C−	4
			[16.80]			5	3	1800	0.0046	0.0013	−1.64	D	4
20.		$^1D - {}^3D^\circ$											
			[17.19]			5	7	680	0.0042	0.0012	−1.68	E	4
21.	$2p^4 - 2p^3(^2D^\circ)3d$	$^3P - {}^3F^\circ$											
			[16.78]			3	5	3600	0.025	0.0041	−1.12	E	4
			[16.62]			5	5	5600	0.023	0.0063	−0.94	E	4
22.	$2p^4 - 2p^3(^2D^\circ)3d$	$^3P - {}^3D^\circ$											
			[16.44]			5	7	1.3(+5)	0.74	0.20	0.57	D	4
23.		$^3P - {}^3P^\circ$											
			[16.59]			3	1	5.7(+4)	0.078	0.013	−0.63	D	4
24.		$^3P - {}^1F^\circ$											
			[16.32]			5	7	3.2(+4)	0.18	0.048	−0.06	E	4
25.		$^1D - {}^3D^\circ$											
			[16.81]			5	7	2000	0.012	0.0033	−1.22	E	4
26.		$^1D - {}^1F^\circ$	[16.68]			5	7	6.8(+4)	0.40	0.11	0.30	D	4
27.	$2p^4 - 2p^3(^2D^\circ)3d$	$^3P - {}^3F^\circ$											
			[16.27]			5	7	5400	0.030	0.0080	−0.82	E	4
			[16.44]			3	5	5800	0.039	0.0063	−0.93	E	4
28.		$^3P - {}^3P^\circ$											
			[16.37]			3	1	9.7(+4)	0.13	0.021	−0.41	D	4

Cr XVII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
29.		$^3P - {}^1P^o$											
			[16.11]			3	3	3300	0.015	0.0024	−1.35	E	4
30.		$^1D - {}^3F^o$											
			[16.64]			5	7	5200	0.030	0.0082	−0.66	E	4
			[16.65]			5	5	1.1(+4)	0.046	0.013	−0.99	E	4
31.		$^1D - {}^1P^o$	[16.31]			5	3	9600	0.023	0.0062	−0.94	D	4
32.		$^1S - {}^1P^o$	[16.66]			1	3	1.8(+5)	2.3	0.13	0.36	D	4

ᵃThe number in parenthesis following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XVII

Forbidden Transitions

Line strengths tabulated for magnetic dipole and electric quadrupole transitions within the $2p^4$ configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to the $n=2$ complex. Strengths of electric quadrupole transitions as defined in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables.

Transition probabilities for these same lines were calculated by Froese Fischer and Saha[2] using the multiconfiguration Hartree-Fock (MCHF) method with Breit-Pauli corrections. Their basis included many configurations outside the $n=2$ complex, but relativistic effects were not treated to the same degree as in Ref. 1. Line strengths derived from these data are in quite good agreement with the data of Cheng *et al.* For this ion of the oxygen isoelectronic sequence, correlation effects due to mixing with configurations outside the complex were found by Froese Fischer and Saha to be rather small, as shown by a comparison of the results of their calculations employing an extensive basis to those derived by the same technique but limited to configurations within the $n=2$ complex.

The weakest lines are excluded from this compilation, as their transition probabilities are considered to be very uncertain.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2] C. Froese Fischer and H. P. Saha, Phys. Rev. A 28, 3169 (1983).

Cr XVII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2p^4-2p^4$	$^3P - {}^3P$										
			1656.3	0	60380	5	3	M1	4590	2.32	C+	1
			"	"	"	5	3	E2	0.13	0.0029	E	1
			[1720]	0	58150	5	1	E2	0.19	0.0017	E	1
2		$^3P - {}^1D$										
			740.75	0	135160	5	5	M1	6600	0.50	D	1
			"	"	"	5	5	E2	2.3	0.0015	E	1
			1340.7	60380	135160	3	5	M1	400	0.18	D	1

Cr XVII: Forbidden transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
3.		^{3}P – ^{1}S										
			493.8	60380	263180	3	1	M1	6.5(+4)[a]	0.29	D	1
4.		^{1}D – ^{1}S	[781.13]	135160	263180	5	1	E2	28	0.0049	E	1

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XVIII

N Isoelectronic Sequence

Ground State: $1s^22s^22p^3\ ^4S^o_{3/2}$

Ionization Energy: 1299 eV = 10480000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
90.63	4	108.37	2	129.53	6	157.40	16
92.508	13	110.41	12	133.08	15	164.89	5
93.36	13	112.27	14	136.52	1	169.81	5
94.16	3	113.99	12	139.87	1	175.90	16
95.77	8	119.21	12	140.82	16	184.67	5
97.660	13	119.62	11	143.53	10	193.51	5
99.383	13	122.56	14	147.79	15	197.48	9
102.32	8	123.87	14	149.80	1	222.00	9
104.98	8	125.38	11	149.94	10	248.10	9
105.92	12	125.51	6	151.90	10		
106.84	7	128.10	6	155.46	16		

The tabulated oscillator strengths for transitions of the arrays $2s^22p^3$-$2s2p^4$ and $2s2p^4$-$2p^5$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. The results should be quite accurate, except in the case of weak lines. (A few very weak lines have been omitted from this tabulation.)

Reference

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

Cr XVIII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^22p^3$-$2s2p^4$	$^4S^o$ - ^4P	*144.05*	0	*694180*	4	12	140	0.13	0.24	−0.30	C	1
			140.80	0	667600	4	6	120	0.060	0.12	−0.62	C	1
			139.87	0	714060	4	4	140	0.0437	0.080	−0.76	C	1
			136.52	0	732400	4	2	166	0.0232	0.0417	−1.032	C	1

Cr XVIII Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
2.		$^4S^\circ - ^2D$											
			108.37	0	922800	4	4	6.2	0.0011	0.0016	−2.36	E	1
3.		$^4S^\circ - ^2S$											
			94.16	0	1062060	4	2	9.2	6.1(−4)	7.6(−4)	−2.61	E	1
4.		$^4S^\circ - ^2P$											
			90.63	0	1103370	4	4	24	0.0030	0.0036	−1.92	E	1
5.		$^2D^\circ - ^4P$											
			[193.51]	150800	667560	6	6	1.4	8.0(−4)	0.0031	−2.32	E	1
			[169.81]	126040	714950	4	4	0.42	1.8(−4)	4.0(−4)	−3.14	E	1
			[164.80]	126040	732490	4	2	1.3	2.6(−4)	5.6(−4)	−2.98	E	1
			[184.67]	126040	667560	4	6	2.6	0.0020	0.0049	−2.10	E	1
6.		$^2D^\circ - ^2D$											
			128.10	150800	931420	6	6	280	0.068	0.17	−0.39	C	1
			125.51	126040	922800	4	4	340	0.081	0.13	−0.49	C	1
			[129.53]	150800	922800	6	4	2.9	4.9(−4)	0.0013	−2.53	E	1
7.		$^2D^\circ - ^2S$											
			106.84	126040	1062060	4	2	340	0.029	0.041	−0.94	E	1
8.		$^2D^\circ - ^2P$	*101.55*	*140900*	*1125650*	10	6	840	0.078	0.26	−0.11	C	1
			104.98	150800	1103370	6	4	870	0.096	0.20	−0.24	C	1
			95.77	126040	1170210	4	2	308	0.0212	0.0267	−1.072	C	1
			102.32	126040	1103370	4	4	154	0.0242	0.0326	−1.014	C	1
9.		$^2P^\circ - ^4P$											
			[248.10]	264490	667560	4	6	0.23	3.2(−4)	0.0010	−2.89	E	1
			[222.00]	264490	714950	4	4	1.1	8.4(−4)	0.0025	−2.47	E	1
			[197.48]	226100	732490	2	2	1.0	5.9(−4)	7.7(−4)	−2.93	E	1
10.		$^2P^\circ - ^2D$	*147.87*	*251690*	*927970*	6	10	46	0.025	0.074	−0.82	C−	1
			149.94	264490	931420	4	6	53	0.0270	0.053	−0.97	C	1
			143.53	226100	922800	2	4	28.5	0.0176	0.0166	−1.453	C	1
			[151.90]	264490	922800	4	4	6.1	0.0021	0.0042	−2.08	D	1
11.		$^2P^\circ - ^2S$	*123.40*	*251690*	1062060	6	2	350	0.026	0.064	−0.80	C−	1
			125.38	264490	1062060	4	2	53	0.0063	0.010	−1.60	D	1
			119.62	226100	1062060	2	2	320	0.068	0.054	−0.87	C	1
12.		$^2P^\circ - ^2P$	*114.42*	*251690*	*1125650*	6	6	360	0.071	0.16	−0.37	C−	1
			119.21	264490	1103370	4	4	89	0.0190	0.0298	−1.119	C	1
			105.92	226100	1170210	2	2	49	0.0083	0.0058	−1.78	D	1
			110.41	264490	1170210	4	2	790	0.072	0.10	−0.54	C	1
			113.99	226100	1103370	2	4	70	0.0274	0.0206	−1.261	C	1

Cr XVIII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
13.	$2s2p^6$-$2p^5$	^4P - $^2P°$											
			93.36	667500	1738700	6	4	17	0.0015	0.0028	−2.05	E	1
			[97.680]	714950	1738700	4	4	7.0	0.0010	0.0013	−2.40	E	1
			[92.508]	732490	1813480	2	2	5.5	7.1(−4)	4.2(−4)	−2.85	E	1
			[99.383]	732490	1738700	2	4	2.5	7.2(−4)	4.8(−4)	−2.84	E	1
14.		^2D - $^2P°$	*119.67*	*927970*	*1763630*	10	6	490	0.063	0.25	−0.20	C	1
			123.87	931420	1738700	6	4	300	0.060	0.15	−0.44	C	1
			112.27	922800	1813480	4	2	424	0.0401	0.050	−0.79	C	1
			122.56	922800	1738700	4	4	124	0.0280	0.0452	−0.95	C	1
15.		^2S - $^2P°$	*142.54*	1062060	*1763630*	2	6	56	0.051	0.0476	−0.99	C−	1
			147.79	1062060	1738700	2	4	72	0.0469	0.0456	−1.028	C	1
			[133.08]	1062060	1813480	2	2	8.7	0.0023	0.0020	−2.34	D	1
16.		^2P - $^2P°$	*156.74*	*1125650*	*1763630*	6	6	367	0.135	0.418	−0.091	C	1
			157.40	1103370	1738700	4	4	283	0.105	0.218	−0.377	C	1
			155.46	1170210	1813480	2	2	284	0.103	0.105	−0.69	C	1
			[140.82]	1103370	1813480	4	2	[illegible]	0.0396	0.073	−0.80	C	1
			[175.90]	1170210	1738700	2	4	20.5	0.0190	0.0220	−1.420	C	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XVIII

Forbidden Transitions

Line strengths tabulated for magnetic dipole and electric quadrupole transitions within the $2p^5$ configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to the $n=2$ complex. Strengths of electric quadrupole transitions as defined in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables. The weakest lines are excluded from this compilation, as their strengths are considered to be very uncertain.

A-values for the M1 and E2 components of the single transition within the $2p^5$ configuration were obtained by applying *Z*-expansion formulas published by Oboladze and Safronova.[2] Their values for the magnetic dipole contribution to this line are in very good agreement with the results of the scaled Thomas-Fermi calculations of Bhatia *et al.*[3] and Bhatia[4] for nitrogenlike Ti and Mn, respectively. It is not clear whether Oboladze and Safronova incorporated configuration interaction into their calculations. Thus the *A*-value for the E2 contribution should be considered rather uncertain.

References

[1]K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2]N. S. Oboladze and U. I. Safronova, Opt. Spectrosc. (USSR) 48, 469 (1980).

[3]A. K. Bhatia, U. Feldman, and G. A. Doschek, J. Appl. Phys. 51, 1464 (1980).

[4]A. K. Bhatia, J. Appl. Phys. 53, 59 (1982).

Cr XVIII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2p^3-2p^3$	$^4S^o-^2D^o$										
			663.1	0	150800	4	6	M1	320	0.021	D–	1
			793.3	0	126040	4	4	M1	6100	0.45	D	1
2.		$^4S^o-^2P^o$										
			378.0	0	264490	4	4	M1	1.6(+4)[a]	0.13	D	1
			442.1	0	226100	4	2	M1	1.3(+4)	0.084	D–	1
3.		$^2D^o-^2D^o$										
			4039	126040	150800	4	6	M1	127	1.66	C+	1
			"	"	"	4	6	E2	4.9(–4)	0.0019	E	1
4.		$^2D^o-^2P^o$										
			[1328]	150800	226100	6	2	E2	0.63	0.0031	E	1
			[879.58]	150800	264490	6	4	M1	5200	0.52	D	1
			"	"	"	6	4	E2	6.3	0.0079	E	1
			[999.40]	126040	226100	4	2	M1	3400	0.25	D	1
			"	"	"	4	2	E2	3.0	0.0036	E	1
			722.1	126040	264490	4	4	M1	1.6(+4)	0.87	D	1
			"	"	"	4	4	E2	3.0	0.0014	E	1
5.		$^2P^o-^2P^o$										
			2606.4	226100	264490	2	4	M1	382	1.00	C	1
6.	$2p^4-2p^4$	$^4P-^4P$										
			[1337]	1738700	1813480	4	2	M1	7600	1.3	C+	2
			"	"	"	4	2	E2	0.53	0.0027	E	2

[a] The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XIX

C Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p^2\ ^3P_0$

Ionization Energy: 1396 eV = 11260000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
14.73	30	107.70	5	118.83	17	129.00	9
14.80	29	109.33	18	120.86	23	130.99	17
14.81	30	109.64	4	125.93	3	132.11	3
14.84	29	110.37	11	126.24	20	133.99	3
90.102	16	111.18	18	126.30	15	134.89	3
95.62	16	111.88	5	126.33	10	137.89	19
95.88	6	113.97	4	127.95	20	138.15	19
100.69	21	118.21	17	128.43	17	138.46	3
104.18	4	118.67	17	128.63	17	140.51	3

List of tabulated lines — Continued

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
140.92	19	161.29	8	185.87	24	236.11	26
143.57	28	163.94	25	199.16	7	267.55	12
148.64	2	164.09	8	201.82	27	278.21	26
151.32	14	165.46	2	201.97	13	280.37	1
152.42	19	169.40	2	203.94	22	310.54	1
154.92	19	169.73	2	204.89	7		
160.01	2	179.18	22	206.38	7		
160.30	2	180.37	22	211.00	24		

The tabulated oscillator strengths for transitions of the arrays $2s^22p^2$–$2s2p^3$ and $2s2p^3$–$2p^4$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to the $n=2$ complex. The results should be quite accurate, except in the case of weak lines. (A few very weak lines have been omitted from this tabulation.)

Transition probabilities for lines of the $2s^22p^2$–$2s2p^3$ array were calculated by Froese Fischer and Saha[2] using the multiconfiguration Hartree-Fock (MCHF) method with Breit-Pauli corrections. Their basis included many configurations outside the $n=2$ complex, but relativistic effects were not treated to the same degree as in Ref. 1. Line strengths derived from these two sources are in reasonably good agreement, particularly for the stronger transitions.

Data for a few lines of the $2p^2$–$2p3d$ array were interpolated from the HX (Hartree-Fock with statistical allowance for exchange) f-values of Bromage and Fawcett[3] for the isoelectronic ions Ca XV and Fe XXI.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2] C. Froese Fischer and H. P. Saha, Phys. Scr. 32, 181 (1985).

[3] G. E. Bromage and B. C. Fawcett, Mon. Not. R. Astron. Soc. 178, 605 (1977).

Cr XIX: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^22p^2$–$2s2p^3$	^{3}P - ^{5}S°											
			[310.54]	82420	404440	5	5	0.17	2.5(−4)[a]	0.0013	−2.90	E	1
			[280.37]	47770	404440	3	5	0.15	2.9(−4)	8.0(−4)	−3.06	E	1
2.		^{3}P - ^{3}D°	*162.02*	*61710*	*678920*	9	15	72	0.0473	0.227	−0.371	C−	1
			165.46	82420	686510	5	7	59	0.0339	0.092	−0.77	C	1
			160.30	47770	671600	3	5	83	0.053	0.084	−0.80	C	1
			148.64	0	672750	1	3	90	0.089	0.044	−1.05	C	1
			169.73	82420	671590	5	5	0.096	4.1(−5)	1.1(−4)	−3.69	E	1
			160.01	47770	672750	3	3	11	0.0041	0.0065	−1.91	D	1
			[169.40]	82420	672750	5	3	0.26	6.7(−5)	1.9(−4)	−3.47	E	1
3.		^{3}P - ^{3}P°	*135.55*	*61710*	*799430*	9	9	190	0.052	0.210	−0.327	C−	1
			138.45	82420	804690	5	5	171	0.0491	0.112	−0.61	C	1
			133.99	47770	794120	3	3	121	0.0326	0.0430	−1.011	C	1
			140.51	82420	794120	5	3	35	0.0063	0.015	−1.50	D	1
			134.80	47770	789100	3	1	198	0.0180	0.0240	−1.268	C	1
			132.11	47770	804690	3	5	7.1	0.0031	0.0040	−2.03	D	1
			125.98	0	794120	1	3	40.5	0.0289	0.0120	−1.54	C	1
4.		^{3}P - ^{3}S°	*111.34*	*61710*	959860	9	3	880	0.055	0.18	−0.31	C	1
			113.97	82420	959860	5	3	550	0.064	0.12	−0.49	C	1
			109.64	47770	959860	3	3	246	0.0444	0.0481	−0.88	C	1
			104.18	0	959860	1	3	90	0.0438	0.0150	−1.359	C	1

Cr XIX: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
5.		$^3P - {^1D^\circ}$											
			111.88	82420	976270	5	5	53	0.010	0.018	−1.30	E	1
			[107.70]	47770	976270	3	5	2.4	7.1(−4)	7.6(−4)	−2.67	E	1
6.		$^3P - {^1P^\circ}$											
			95.88	47770	1090760	3	3	36	0.0049	0.0046	−1.83	E	1
7.		$^1D - {^3D^\circ}$											
			[199.16]	184690	686810	5	7	6.2	0.0052	0.017	−1.59	E	1
			[205.38]	184690	671590	5	5	0.33	2.1(−4)	7.1(−4)	−2.98	E	1
			[204.89]	184690	672750	5	3	1.2	4.6(−4)	0.0016	−2.64	E	1
8.		$^1D - {^3P^\circ}$											
			[161.29]	184690	804690	5	5	1.9	7.6(−4)	0.0020	−2.42	E	1
			[164.09]	184690	794120	5	3	2.8	6.7(−4)	0.0018	−2.47	E	1
9.		$^1D - {^3S^\circ}$	[129.00]	184690	959860	5	3	0.73	1.1(−4)	2.3(−4)	−3.26	E	1
10.		$^1D - {^1D^\circ}$	126.33	184690	976270	5	5	435	0.104	0.216	−0.284	C	1
11.		$^1D - {^1P^\circ}$	110.37	184690	1090760	5	3	600	0.066	0.12	−0.48	C	1
12.		$^1S - {^3D^\circ}$											
			[267.55]	298990	672750	1	3	0.37	0.0012	0.0011	−2.92	E	1
13.		$^1S - {^3P^\circ}$											
			[201.97]	298990	794120	1	3	1.1	0.0020	0.0013	−2.70	E	1
14.		$^1S - {^3S^\circ}$	[151.32]	298990	959860	1	3	4.2	0.0043	0.0021	−2.37	E	1
15.		$^1S - {^1P^\circ}$	126.30	298990	1090760	1	3	156	0.112	0.0466	−0.95	C	1
16.	$2s2p^3$-$2p^4$	$^5S^\circ - {^3P}$											
			95.62	404440	1450200	5	5	7.2	9.9(−4)	0.0016	−2.31	E	1
			[90.102]	404440	1514290	5	3	1.8	1.3(−4)	1.9(−4)	−3.19	E	1
17.		$^3D^\circ - {^3P}$	*124.97*	*678920*	*1479090*	15	9	400	0.057	0.35	−0.07	C−	1
			130.99	686810	1450200	7	5	290	0.053	0.16	−0.43	C	1
			118.67	671590	1514290	5	3	210	0.0266	0.052	−0.88	C	1
			118.31	672750	1517960	3	1	329	0.0230	0.0269	−1.161	C	1
			128.43	671590	1450200	5	5	119	0.0295	0.062	−0.83	C	1
			118.83	672750	1514290	3	3	135	0.0286	0.0336	−1.067	C	1
			128.63	672750	1450200	3	5	23	0.0097	0.012	−1.54	D	1
18.		$^3D^\circ - {^1D}$											
			111.18	686810	1586250	7	5	37	0.0049	0.012	−1.46	E	1
			[109.33]	671590	1586250	5	5	5.5	9.8(−4)	0.0018	−2.31	E	1

Cr XIX: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
19.		$^3P^\circ - ^3P$											
			154.92	804690	1450200	5	5	35.3	0.0127	0.0324	−1.197	C	1
			140.92	804690	1514290	5	3	138	0.0247	0.057	−0.91	C	1
			138.15	794120	1517960	3	1	175	0.0167	0.0228	−1.300	C	1
			152.42	794120	1450200	3	5	32.7	0.0190	0.0286	−1.244	C	1
			137.89	789100	1514290	1	3	41.6	0.0356	0.0162	−1.449	C	1
20.		$^3P^\circ - ^1D$											
			127.95	804690	1586250	5	5	10	0.0025	0.0053	−1.90	E	1
			[126.24]	794120	1586250	3	5	7.0	0.0028	0.0035	−2.08	E	1
21.		$^3P^\circ - ^1S$											
			[100.69]	794120	1787280	3	1	26	0.0013	0.0013	−2.41	E	1
22.		$^3S^\circ - ^3P$	*192.59*	959860	*1479090*	3	9	86	0.14	0.27	−0.37	C	1
			[203.94]	959860	1450200	3	5	63	0.065	0.13	−0.71	C	1
			180.37	959860	1514290	3	3	110	0.054	0.096	−0.79	C	1
			179.18	959860	1517960	3	1	145	0.0232	0.0411	−1.157	C	1
23.		$^3S^\circ - ^1S$	[120.86]	959860	1787280	3	1	45	0.0033	0.0039	−2.00	E	1
24.		$^1D^\circ - ^3P$											
			[211.00]	976270	1450200	5	5	6.3	0.0042	0.015	−1.68	E	1
			[185.87]	976270	1514290	5	3	1.4	4.5(−4)	0.0014	−2.65	E	1
25.		$^1D^\circ - ^1D$	163.94	976270	1586250	5	5	310	0.125	0.337	−0.204	C	1
26.		$^1P^\circ - ^3P$											
			[278.21]	1090760	1450200	3	5	0.88	0.0017	0.0047	−2.29	E	1
			[236.11]	1090760	1514290	3	3	4.7	0.0039	0.0091	−1.93	E	1
27		$^1P^\circ - ^1D$	201.82	1090760	1586250	3	5	41.6	0.0423	0.084	−0.90	C	1
28.		$^1P^\circ - ^1S$	143.57	1090760	1787280	3	1	720	0.074	0.10	−0.65	C	1
29.	$2p^2 - 2p3d$	$^3P - ^3D^\circ$											
			[14.84]			5	7	1.3(+5)	0.61	0.15	0.48	E	*interp.*
			[14.80]			1	3	1.3(+5)	1.3	0.063	0.11	D	*interp.*
30.		$^3P - ^3P^\circ$											
			[14.73]			3	3	7.1(+4)	0.23	0.033	−0.16	E	*interp.*
			[14.81]			5	3	3.4(+4)	0.068	0.017	−0.47	E	*interp.*

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XIX

Forbidden Transitions

Line strengths tabulated for magnetic dipole and electric quadrupole transitions within the $2p^2$ configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing was limited to the $n=2$ complex. Strengths of electric quadrupole transitions as defined in Ref. 1 were multiplied by the factor $^2/_3$ which is needed to bring these values into conformance with the definition of quadrupole strengths used in the NBS tables. The weakest lines are excluded from this compilation, as their strengths are considered to be very uncertain.

Transition probabilities for these same lines were calculated by Froese Fischer and Saha[2] using the multiconfiguration Hartree-Fock (MCHF) method with Breit-Pauli corrections. Their basis included many configurations outside the $n=2$ complex, but relativistic effects were not treated to the same degree as in Ref. 1. Line strengths derived from these data are in good agreement with the data of Cheng *et al*.

References

[1]K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2]C. Froese Fischer and H. P. Saha, Phys. Scr. 32, 181 (1985).

Cr XIX: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2p^2$-$2p^2$	^{3}P - ^{3}P										
			2885.4	47770	82420	3	5	M1	469	2.09	C+	1
			"	"	"	3	5	E2	0.0035	0.0021	E	1
			2090.9	0	47770	1	3	M1	1810	1.84	C+	1
			[1213]	0	82420	1	5	E2	0.18	0.0014	E	1
2.		^{3}P - ^{1}D										
			979.0	82420	184690	5	5	M1	5700	1.0	C	1
			"	"	"	5	5	E2	0.90	0.0024	E	1
			731.1	47770	184690	3	5	M1	5700	0.41	D	1
3.		^{3}P - ^{1}S										
			398.4	47770	298990	3	1	M1	6.4(+4)[a]	0.15	D	1
4.		^{1}D - ^{1}S	[874.89]	184690	298990	5	1	E2	13	0.0041	E	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XX

B Isoelectronic Sequence

Ground State: $1s^2 2s^2 2p\ ^2P^\circ_{1/2}$

Ionization Energy: 1496 eV = 12070000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
14.13	14	128.42	3	164.63	8	216.99	7
14.26	14	129.26	9	167.97	8	258.57	11
97.494	6	131.31	9	169.87	8	271.72	11
97.729	6	133.82	4	173.42	8	281.99	1
101.63	6	135.26	9	175.42	2	287.63	1
116.05	3	140.75	4	179.21	2	368.20	1
119.29	5	148.99	4	180.85	12	416.34	10
122.29	5	156.00	2	192.82	12		

The tabulated oscillator strengths for transitions of the arrays $2s^2 2p - 2s 2p^2$ and $2s 2p^2 - 2p^3$ are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations included a perturbative treatment of the Breit interaction and the Lamb shift. The results should be quite accurate, except in the case of weak lines. (A few very weak lines have been omitted from this tabulation.)

According to several sources (see, e.g., introduction to Fe XXII), the two levels $2s 2p^2\ ^2P_{1/2}$ and $^2S_{1/2}$ "cross" at about V XIX or Cr XX. Transitions to these levels in Cr XX have been omitted from this compilation, since the precise location of the level crossing, and thus the correct designations of the levels, are uncertain.

The Hartree-Fock results of Shamey[2] for the isoelectronic ions Ar XIV and Fe XXII, which allowed for limited configuration interaction, were interpolated to provide f-values for the $2p-3s$, $2p-3d$, and $2p-4d$ transitions.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2] L. J. Shamey, J. Opt. Soc. Am. 61, 942 (1971).

Cr XX: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^2 2p - 2s 2p^2$	$^2P^\circ - ^4P$											
			[287.63]	83030	430700	4	6	0.23	6.1(−4)[a]	0.0023	−2.61	E	1
			[281.99]	0	354620	2	2	0.42	5.0(−4)	9.2(−4)	−3.00	E	1
			[368.20]	83030	354620	4	2	0.11	1.1(−4)	5.2(−4)	−3.36	E	1
2.		$^2P^\circ - ^2D$	*168.66*	*55350*	*648270*	6	10	63	0.045	0.15	−0.57	D	1
			175.42	83030	653090	4	6	53	0.0368	0.085	−0.83	C	1
			156.00	0	641030	2	4	84	0.061	0.063	−0.91	C	1
			179.21	83030	641030	4	4	1.1	5.4(−4)	0.0013	−2.67	E	1
3.		$^2P^\circ - ^2P$											
			128.42	83030	861700	4	4	380	0.093	0.16	−0.43	C	1
			116.05	0	861700	2	4	57	0.0230	0.0176	−1.337	C	1

Cr XX: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
4.	$2s2p^2$-$2p^3$	^4P - $^4S^\circ$	*143.48*	*404920*	1101890	12	4	389	0.0400	0.227	−0.318	C	1
			148.99	430700	1101890	6	4	175	0.0388	0.114	−0.63	C	1
			140.75	391410	1101890	4	4	135	0.0400	0.074	−0.80	C	1
			133.82	354620	1101890	2	4	83	0.0445	0.0392	−1.051	C	1
5.		^4P - $^2D^\circ$											
			122.29	430700	1248440	6	6	9.8	0.0022	0.0053	−1.88	E	1
			[119.29]	391410	1229720	4	4	9.8	0.0021	0.0033	−2.08	E	1
6.		^4P - $^2P^\circ$											
			[101.63]	430700	1414650	6	4	1.1	1.1(−4)	2.2(−4)	−3.18	E	1
			[97.729]	391410	1414650	4	4	2.0	2.8(−4)	3.6(−4)	−2.95	E	1
			[97.494]	354620	1380320	2	2	1.5	2.1(−4)	1.3(−4)	−3.38	E	1
7.		^2D - $^4S^\circ$											
			[216.99]	641030	1101890	4	4	0.42	3.0(−4)	8.6(−4)	−2.92	E	1
8.		^2D - $^2D^\circ$	*168.73*	*648270*	*1240950*	10	10	126	0.054	0.298	−0.270	C	1
			167.97	653090	1248440	6	6	112	0.0474	0.157	−0.55	C	1
			169.87	641030	1229720	4	4	71	0.0306	0.068	−0.91	C	1
			173.42	653090	1229720	6	4	40.3	0.0121	0.0414	−1.139	C	1
			164.63	641030	1248440	4	6	24.1	0.0147	0.0319	−1.231	C	1
9.		^2D - $^2P^\circ$	*132.46*	*648270*	*1403210*	10	6	195	0.0307	0.134	−0.51	C	1
			131.31	653090	1414650	6	4	127	0.0219	0.057	−0.88	C	1
			135.26	641030	1380320	4	2	241	0.0331	0.059	−0.88	C	1
			129.26	641030	1414650	4	4	42.7	0.0107	0.0182	−1.369	C	1
10.		^2P - $^4S^\circ$											
			[416.34]	861700	1101890	4	4	0.19	5.0(−4)	0.0027	−2.70	E	1
11.		^2P - $^2D^\circ$											
			[258.57]	861700	1248440	4	6	29.8	0.0448	0.153	−0.75	C	1
			271.72	861700	1229720	4	4	0.54	6.0(−4)	0.0021	−2.62	E	1
12.		^2P - $^2P^\circ$											
			180.85	861700	1414650	4	4	160	0.077	0.18	−0.51	C	1
			192.82	861700	1380320	4	2	23	0.0065	0.017	−1.59	D	1
13.	$2p$-$3s$	$^2P^\circ$ - ^2S											
						4	2		0.019		−1.12	E	*interp.*
						2	2		0.020		−1.40	E	*interp.*
14.	$2p$-$3d$	$^2P^\circ$ - ^2D											
			[14.26]			4	6	1.3(+5)	0.56	0.11	0.37	D	*interp.*
			[14.13]			2	4	1.1(+5)	0.65	0.060	0.11	D	*interp.*
						4	4		0.064		−0.59	D	*interp.*

Cr XX: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
15.	2p–4d	$^2P^o$ - ^2D											
						4	6		0.11		−0.36	D	*interp.*
						2	4		0.12		−0.62	E	*interp.*
						4	4		0.012		−1.32	D	*interp.*

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XX

Forbidden Transitions

The line strengths tabulated for the single magnetic dipole and single electric quadrupole transition within the $2s^22p$ ground state configuration are the results of the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations include a perturbative treatment of the Breit interaction and the Lamb shift. Allowance for configuration mixing is limited to the $n=2$ complex. The strength of the electric quadrupole transition as defined in Ref. 1 was multiplied by the factor $^2/_3$ in order to bring this value into conformance with the definition of the quadrupole strength used in the NBS tables.

Transition probabilities for the same lines were calculated by Froese Fischer and Saha[2] using the multiconfiguration Hartree-Fock (MCHF) method with Breit-Pauli corrections. Their orbital basis includes many configurations outside the $n=2$ complex, but relativistic effects were not treated to the same degree as in Ref. 1. The line strengths for both the M1 and E2 transitions, derived from these data by interpolation between appropriately spaced ions of the B sequence, are in very good agreement with the data of Cheng *et al.*[1]

References

[1]K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2]C. Froese Fischer and H. P. Saha, Phys. Rev. A 28, 3169 (1983).

Cr XX: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	2p-2p	$^2P^o$ - $^2P^o$										
			1205.9	0	82926	2	4	M1	5110	1.33	B	1
			"	"	"	2	4	E2	0.336	0.00204	C	1

Cr XXI

Be Isoelectronic Sequence

Ground State: $1s^2 2s^2\ {}^1S_0$

Ionization Energy: 1634 eV = 13180000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
12.87	11	13.60	12,29	13.99	28	140.72	4
12.97	11	13.65	24	14.00	19	149.90	2
12.98	10,11	13.66	29	14.04	19,25	154.62	4
13.01	10	13.67	24	14.12	30	165.03	3
13.02	10	13.68	29	14.17	19,21	168.62	3
13.08	9	13.75	29	14.20	31	170.16	7
13.12	8	13.76	27	14.23	21	175.45	3
13.13	10	13.78	27	14.24	35	184.48	3
13.22	16	13.84	27,33,34	14.25	21	190.98	3
13.34	15	13.87	27	14.32	21	197.61	3
13.44	14	13.91	27	14.35	21	259.94	6
13.49	24	13.92	28	14.38	22	293.11	1
13.53	24	13.93	26	14.39	21	357.12	5
13.55	24	13.94	27	14.58	20	409.80	5
13.59	13	13.95	32	14.81	23	505.89	5

Oscillator strengths for transitions of the arrays $2s^2$–$2s2p$ and $2s2p$–$2p^2$ are taken from the multiconfiguration Dirac-Fock (MCDF) calculations of Cheng *et al.*[1] These relativistic calculations include the configuration interaction most relevant for the states of these configurations, as well as a perturbative treatment of the Breit interaction and the Lamb shift. The results should be quite accurate, except for the weakest intercombination lines. (The ${}^3P_1^o$ - ${}^1S_0$ transition of the $2s2p$–$2p^2$ array has been omitted here, since the f-value is considerably smaller than those of the other lines of this array.)

A number of sources of reliable data, from other relativistic calculations, are available for the $2s$–$2p$ transitions. However, with the exception of some of the weaker lines, they all agree well with the results of Cheng *et al.*[1] The latter are quoted exclusively here since they provide data from a single set of comprehensive calculations, all done at a uniform and reasonably accurate level of approximation, for the valence shell $2s$–$2p$ transitions for all ions of the isoelectronic sequence.

The f-values for the $2s^2$–$2s3p$, $2s2p$–$2p3p$, $2s2p$–$2s3s$, $2p^2$–$2p3s$, $2s2p$–$2s3d$, and $2p^2$–$2p3d$ arrays of transitions are taken from the work of Fawcett,[2] who used Cowan's version of the relativistic Hartree-Fock method with intermediate coupling and configuration interaction. This work provides a comprehensive set of data for the entire isoelectronic sequence, calculated at a uniform level of approximation. Some of these transitions, for some ions of this sequence, have also been calculated by Bhatia *et al.*[3] using the program SUPERSTRUCTURE, which includes configuration interaction and intermediate coupling. Where they overlap, these two sets of calculations agree to within the uncertainties assigned here. Transitions involving the $J=1$ levels of $2p3p\ {}^3S$ and ${}^3P$ have been omitted because of erratic behavior of the f-values along the sequence.

Oscillator strengths for the transition array $2s^2$–$2s4p$ have been interpolated from the relativistic random phase approximation (RRPA) calculations along the isoelectronic sequence by Lin and Johnson.[4]

A few multiplet f-values for transitions involving the outer electron alone, $2s3s$–$2s3p$ and $2s3p$–$2s3d$, have been interpolated along the isoelectronic sequence and assigned a low accuracy.

References

[1] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[2] B. C. Fawcett, At. Data Nucl. Data Tables 30, 1 (1984); 33, 479 (1985).

[3] A. K. Bhatia, U. Feldman, and J. F. Seely, At. Data Nucl. Data Tables 35, 449 (1986).

[4] C. D. Lin and W. R. Johnson, Phys. Rev. A 15, 1046 (1977).

Cr XXI: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$2s^2-2s2p$	$^1S - ^3P^\circ$											
			[293.11]	0	341170	1	3	0.26	0.0010	9.6(−4)	−3.00	D	1
2.		$^1S - ^1P^\circ$	[149.90]	0	667110	1	3	162	0.164	0.0809	−0.785	B	1
3.	$2s2p-2p^2$	$^3P^\circ - ^3P$	*181.90*	*374160*	*923900*	9	9	117	0.0576	0.310	−0.286	B	1
			[184.48]	405070	947130	5	5	73.7	0.0376	0.114	−0.726	B	1
			[175.45]	341170	911130	3	3	34.2	0.0158	0.0274	−1.324	B	1
			[197.61]	405070	911130	5	3	40.1	0.0141	0.0459	−1.152	B	1
			[190.98]	341170	864780	3	1	109	0.0199	0.0375	−1.224	B	1
			[165.93]	341170	947130	3	5	42.8	0.0291	0.0474	−1.059	B	1
			[168.62]	318080	911130	1	3	52.4	0.0670	0.0372	−1.174	B	1
4.		$^3P^\circ - ^1D$											
			[154.62]	405070	1051810	5	5	28.2	0.0101	0.0257	−1.297	C	1
			[140.72]	341170	1051810	3	5	2.4	0.0012	0.0017	−2.44	D	1
5.		$^1P^\circ - ^3P$											
			[357.12]	667110	947130	3	5	2.1	0.0066	0.023	−1.70	D	1
			[409.80]	667110	911130	3	3	0.040	1.0(−4)	4.0(−4)	−3.52	E	1
			[505.89]	667110	864780	3	1	0.19	2.4(−4)	0.0012	−3.14	E	1
6.		$^1P^\circ - ^1D$	[259.94]	667110	1051810	3	5	36.5	0.0616	0.158	−0.733	B	1
7.		$^1P^\circ - ^1S$	[170.16]	667110	1254790	3	1	271	0.0392	0.0659	−0.930	B	1
8.	$2s^2-2s3p$	$^1S - ^3P^\circ$											
			[13.12]	0	7620000	1	3	3.7(+4)	0.29	0.013	−0.54	C−	2
9.		$^1S - ^1P^\circ$	[13.08]	0	[7648000]	1	3	5.2(+4)	0.40	0.017	−0.40	C−	2
10.	$2s2p-2p3p$	$^3P^\circ - ^3D$											
			[13.02]	405070	8087000	5	7	3.9(+4)	0.14	0.030	−0.15	C−	2
			[13.02]	341170	[8022000]	3	5	3.8(+4)	0.16	0.021	−0.32	C−	2
			[12.98]	318080	[8025000]	1	3	1.1(+4)	0.082	0.0035	−1.09	D	2
			[13.13]	405070	[8022000]	5	5	1900	0.0060	0.0011	−1.60	D	2
			[13.01]	341170	[8025000]	3	3	1.9(+4)	0.047	0.0060	−0.85	D	2
11.		$^3P^\circ - ^3P$											
			[12.98]	405070	8109000	5	5	3.9(+4)	0.098	0.021	−0.31	C−	2
			[12.97]	341170	[8049000]	3	1	4.8(+4)	0.040	0.0051	−0.92	D	2
			[12.87]	341170	8109000	3	5	2700	0.011	0.0014	−1.48	D	2
12.		$^1P^\circ - ^1P$	[13.60]	667110	8022000	3	3	1.6(+4)	0.043	0.0068	−0.89	D	2
13.		$^1P^\circ - ^3D$											
			[13.59]	667110	[8025000]	3	3	1.2(+4)	0.033	0.0044	−1.00	D	2
14.		$^1P^\circ - ^3P$											
			[13.44]	667110	8109000	3	5	1.2(+4)	0.065	0.0070	−0.80	D	2
			[13.44]	667110	[8109000]	3	3	2.5(+4)	0.087	0.0089	−0.70	C−	2

Cr XXI Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
15.		$^1P^\circ - ^1D$	[13.34]	667110	[8161000]	3	5	5.2(+4)	0.23	0.030	−0.16	C−	2
16.		$^1P^\circ - ^1S$	[13.22]	667110	[8231000]	3	1	4.6(+4)	0.040	0.0052	−0.92	D	2
17.	$2s^2-2s4p$	$^1S - ^3P^\circ$											
						1	3		0.020		−1.70	D	*interp.*
18.		$^1S - ^1P^\circ$				1	3		0.16		−0.80	D	*interp.*
19.	$2s2p-2s3s$	$^3P^\circ - ^3S$	*14.11*	*374100*	7463000	9	3	2.6(+4)	0.026	0.011	−0.63	D	2
			[14.17]	405070	7463000	5	3	1.4(+4)	0.026	0.0061	−0.89	D	2
			[14.04]	341170	7463000	3	3	9100	0.027	0.0037	−1.09	D	2
			[14.00]	318080	7463000	1	3	3200	0.028	0.0013	−1.55	D	2
20.		$^1P^\circ - ^1S$	[14.58]	667110	[7526000]	3	1	9400	0.010	0.0014	−1.52	D	2
21.	$2p^2-2p3s$	$^3P - ^3P^\circ$	*14.27*	*925980*	*[7933000]*	9	9	1.8(+4)	0.054	0.023	−0.31	D	2
			[14.25]	947130	[7966000]	5	5	1.2(+4)	0.038	0.0089	−0.72	D	2
			[14.32]	911130	[7894000]	3	3	3600	0.011	0.0016	−1.48	D	2
			[14.39]	947130	[7894000]	5	3	8100	0.015	0.0036	−1.12	D	2
			[14.35]	911130	[7881000]	3	1	1.7(+4)	0.017	0.0024	−1.29	D	2
			[14.17]	911130	[7966000]	3	5	6000	0.030	0.0042	−1.05	D	2
			[14.23]	864780	[7894000]	1	3	6100	0.055	0.0026	−1.25	D	2
22.		$^1D - ^1P^\circ$	[14.38]	1051810	[8008000]	5	3	1.5(+4)	0.028	0.0066	−0.85	D	2
23.		$^1S - ^1P^\circ$	[14.81]	1254790	[8008000]	1	3	5800	0.057	0.0028	−1.24	D	2
24.	$2s2p-2s3d$	$^3P^\circ - ^3D$	*13.60*	*374100*	*[7728000]*	9	15	1.6(+5)	0.72	0.29	0.81	C−	2
			[13.65]	405070	7733000	5	7	1.5(+5)	0.60	0.13	0.48	C−	2
			[13.55]	341170	7721000	3	5	1.2(+5)	0.55	0.074	0.22	C−	2
			[13.49]	318080	[7730000]	1	3	9.0(+4)	0.74	0.033	−0.13	C−	2
			[13.67]	405070	7721000	5	5	3.9(+4)	0.11	0.025	−0.26	C−	2
			[13.53]	341170	[7730000]	3	3	6.6(+4)	0.18	0.024	−0.27	C−	2
			[13.65]	405070	[7730000]	5	3	4300	0.0072	0.0016	−1.44	C−	2
25.		$^1P^\circ - ^1D$	[14.04]	667110	[7792000]	3	5	1.2(+5)	0.61	0.085	0.26	C−	2
26.	$2p^2-2p3d$	$^3P - ^3F^\circ$											
			[13.93]	947130	[8124000]	5	7	4.2(+4)	0.17	0.039	−0.07	C−	2
27.		$^3P - ^3D^\circ$	*13.82*	*925980*	*8162000*	9	15	1.5(+5)	0.71	0.29	0.80	C−	2
			[13.78]	947130	8204000	5	7	1.7(+5)	0.68	0.15	0.53	C−	2
			[13.87]	911130	8121000	3	5	8.5(+4)	0.407	0.056	0.067	C−	2
			[13.76]	864780	8134000	1	3	1.51(+5)	1.29	0.058	0.111	C−	2
			[13.94]	947130	8121000	5	5	1.1(+4)	0.032	0.0073	−0.80	D	2
			[13.84]	911130	8134000	3	3	3.5(+4)	0.10	0.014	−0.52	C−	2
			[13.91]	947130	8134000	5	3	1000	0.0018	4.1(−4)	−2.05	D	2
28.		$^3P - ^1D^\circ$											
			[13.99]	947130	[8093000]	5	5	8200	0.024	0.0055	−0.92	C	2
			[13.92]	911130	[8093000]	3	5	8.5(+4)	0.41	0.056	0.09	D	2

Cr XXI Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
29.		^{3}P - ^{3}P°	*13.71*	*925900*	[illegible]	9	9	1.15(+5)	0.325	0.132	0.466	C–	2
			[13.75]	947130	8219000	5	5	9.5(+4)	0.270	0.061	0.130	C–	2
			[13.68]	911130	8219000	3	3	8.2(+4)	0.23	0.031	−0.16	C–	2
			[13.75]	947130	8219000	5	3	4.5(+4)	0.076	0.017	−0.42	C–	2
			[13.66]	911130	[8231000]	3	1	1.2(+5)	0.11	0.015	−0.48	C–	2
			[13.68]	911130	8219000	3	5	1.2(+4)	0.057	0.0077	−0.77	D	2
			[13.60]	864780	8219000	1	3	610	0.0051	2.3(−4)	−2.29	D	2
30.		^{1}D - ^{3}F°											
			[14.12]	1051810	[8132000]	5	5	7400	0.022	0.0051	−0.96	D	2
31.		^{1}D - ^{1}D°	[14.20]	1051810	[8093000]	5	5	1.7(+4)	0.050	0.012	−0.60	C–	2
32.		^{1}D - ^{3}P°											
			[13.95]	1051810	8219000	5	5	3.8(+4)	0.11	0.025	−0.26	C–	2
33.		^{1}D - ^{1}P°	[13.84]	1051810	8275000	5	3	8700	0.015	0.0034	−1.12	D	2
34.		^{1}D - ^{1}F°	[13.84]	1051810	8275000	5	7	2.58(+5)	1.04	0.237	0.72	C–	2
35.		^{1}S - ^{1}P°	[14.24]	1254790	8275000	1	3	1.41(+5)	1.29	0.060	0.111	C–	2
36.	$2s3s$-$2s3p$	^{3}S - ^{3}P°				3	9		0.13		−0.41	D	*interp.*
37.		^{1}S - ^{1}P°				1	3		0.066		−1.25	E	*interp.*
38.	$2s3p$-$2s3d$	^{3}P° - ^{3}D				9	15		0.029		−0.58	E	*interp.*
39.		^{1}P° - ^{1}D				3	5		0.052		−0.81	E	*interp.*

*The number in parentheses following the tabulated vlaue indicates the power of ten by which this value has to be multiplied.

Cr XXI

Forbidden Transitions

Transition probabilities for magnetic dipole and electric quadrupole transitions within the $2s2p$ and $2p^2$ configurations were calculated by Feldman *et al.*[1] using scaled Thomas-Fermi wavefunctions with allowance for configuration interaction and relativistic effects. We modified their transition probability data by the application of experimental wavelengths, i.e., we first converted their A-values into line strength data utilizing their theoretical transition energies and then reconverted the line strengths into A-values with wavelengths derived from experimental data. This approach should normally yield transition probabilities that are more accurate than those based on theoretically determined wavelengths.

The one E2 transition listed, which is relatively strong compared to other E2 transitions, has been taken from the multiconfiguration relativistic Hartree-Fock calculations of Anderson and Anderson,[2] and has been included to indicate the small magnitude of the E2 line strengths.

References

[1] U. Feldman, G. A. Doschek, Ch.-Ch. Cheng, and A. K. Bhatia, J. Appl. Phys. **51**, 190 (1980).

[2] E. K. Anderson and E. M. Anderson, Opt. Spectrosc. (USSR) **52**, 478 (1982).

Cr XXI: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$2s2p-2s2p$	$^3P^\circ - {}^3P^\circ$										
			1566.4	341170	405070	3	5	M1	3450	2.46	C+	1
			[4329.7]	318080	341170	1	3	M1	218	1.97	C+	1
2.		$^3P^\circ - {}^1P^\circ$										
			[381.62]	405070	667110	5	3	M1	6000	0.037	D	1
			[306.80]	341170	667110	3	3	M1	6800	0.022	D−	1
			"	"	"	3	3	E2	23	1.1(−4)ᵃ	D−	2
			[286.51]	318080	667110	1	3	M1	1.1(+4)	0.030	D	1
3.	$2p^2-2p^2$	$^3P - {}^3P$										
			[2777.0]	911130	947130	3	5	M1	520	2.07	C	1
			[2156.8]	864780	911130	1	3	M1	1720	1.92	C	1
4.		$^3P - {}^1D$										
			[955.29]	947130	1051810	5	5	M1	6800	1.1	D+	1
			[710.83]	911130	1051810	3	5	M1	6300	0.42	D+	1
5.		$^3P - {}^1S$										
			[290.99]	911130	1254790	3	1	M1	9.2(+4)	0.084	D	1

ᵃThe number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XXII

Li Isoelectronic Sequence

Ground State: $1s^22s\ ^2S_{1/2}$

Ionization Energy: 1721.4 eV = 13882000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
2.190	5	8.04	17	9.493	8	36.8	18
2.191	2	8.07	10	9.809	14	37.5	22
2.196	1	8.10	17	9.866	14	37.7	22
2.198	4	8.20	16	12.623	7	38.0	22
2.199	1,3,4	8.27	16	12.664	7	222.98	6
2.202	3	8.52	9	13.149	13	279.74	6
2.203	4	8.78	15	13.292	13		
7.82	11	8.86	15	13.308	13		

Transition probabilities for the strongest inner-shell transitions to doubly excited $n = 2$ states are taken from the multiconfiguration Dirac-Fock (MCDF) calculations of Hata and Grant.[1] Their results are in good agreement with the Z-expansion perturbation calculations of Vainshtein and Safronova,[2] who included relativistic corrections at the level of the Pauli approximation.

Oscillator strengths for lines of the principal ($2s$–$2p$) resonance multiplet are the results of the MCDF calculations of Cheng *et al.*,[3] which include a perturbative treatment of the Breit interaction and the Lamb shift. The results of the MCDF calculations of Armstrong *et al.*[4] were interpolated to provide f-values for the $2p$–$3d$ transitions.

The f-value for the $3d$–$4f$ transition was taken from a study of systematic trends along isoelectronic sequences by Smith and Wiese.[5] The tabulated data for many additional transitions were taken from the theoretical analysis of Martin and Wiese,[6] which was based on a generalized study of systematic trends for several spectral series of the lithium isoelectronic sequence.

Results of the relativistic Hartree-Fock calculations of Kim and Desclaux[7] for several ions of the Li sequence were incorporated into the data of Ref. 6 for the $2s$–$3p$ transitions. For all other transitions for which the results of Ref. 6 are quoted here, no relativistic calculations were available. However, the relativistic calculations of Younger and Weiss[8] for the hydrogen isoelectronic sequence provide a means of assessing the magnitude of relativistic corrections since the Li sequence is very similar in structure to the H sequence. For those transitions for which relativistic effects were estimated to be significant (specifically, whenever the ratio of the weighted relativistic hydrogenic f-values gf_{ik} of any two lines within a multiplet was found to deviate from the corresponding LS-coupling linestrength ratio by more than 5% for the appropriate value of the nuclear charge Z), the f-values were excluded from the compilation. A more detailed discussion of this comparison is given in Ref. 6.

Although the $2p$–$3s$ multiplet did not satisfy the criterion described in the paragraph above, we have nevertheless quoted the multiplet f-value obtained by Onello[9] using a Z-expansion technique based on a variational calculation for O VI That allowed for large-scale configuration interaction. The resulting multiplet oscillator strengths for Fe XXIV and Ni XXVI are in very good agreement with data derived from the results of calculations that included relativistic effects.[10,11] We thus felt that the results of Ref. 9 should be sufficiently accurate for inclusion in this compilation.

Transition probability data are available for numerous transitions involving doubly excited states with the spectator electron occupying the $n=3$ shell, or higher.[12] These have not been tabulated, however, since they belong to, or are very close to belonging to, the unresolved satellites of the helium-like ion.

References

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[9] J. S. Onello, Phys. Rev. A 11, 743 (1975).
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[12] L. A. Vainshtein and U. I. Safronova, At. Data Nucl. Data Tables 25, 311 (1980).

Cr XXII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm⁻¹)	E_k (cm⁻¹)	g_i	g_k	A_{ki} (10^8 s⁻¹)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$1s^22s$ - $1s(^2S)2s2p(^3P^\circ)$	^2S - $^2P^\circ$	*2.196*			2	6	4.1(+5)*	0.090	0.0018	−0.75	D	1
			[2.196]			2	4	3.4(+4)	0.0049	7.1(−5)	−2.01	D	1
			[2.199]			2	2	1.1(+6)	0.080	0.0012	−0.80	C	1
2.	$1s^22s$ - $1s(^2S)2s2p(^1P^\circ)$	^2S - $^2P^\circ$											
			[2.191]			2	2	2.5(+6)	0.18	0.0026	−0.44	C	1
3.	$1s^22p$ - $1s2p^2$	$^2P^\circ$ - ^2D											
			[2.202]			4	6	1.6(+6)	0.17	0.0051	−0.16	C	1
			[2.199]			2	4	2.2(+6)	0.33	0.0048	−0.18	C	1

Cr XXII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
4.		$^2P° - {}^2P$											
			[2.198]			4	4	4.5(+6)	0.33	0.0094	0.12	C	1
			[2.199]			2	2	3.9(+6)	0.28	0.0041	−0.25	C	1
			[2.203]			4	2	1.3(+6)	0.047	0.0014	−0.72	C	1
5.		$^2P° - {}^2S$											
			[2.190]			4	2	1.7(+6)	0.061	0.0018	−0.61	C	1
6.	2s–2p	$^2S - {}^2P°$	*239.15*	0	*418140*	2	6	26.4	0.0680	0.107	−0.867	B+	3
			222.98	0	448470	2	4	32.9	0.0490	0.0719	−1.009	B+	3
			279.74	0	357470	2	2	16.5	[illegible]	[illegible]	−1.413	B+	3
7.	2s–3p	$^2S - {}^2P°$	*12.637*	0	*7913500*	2	6	5.19(+4)	0.373	0.0310	−0.128	P	6
			12.623	0	7922000	2	4	5.13(+4)	0.245	0.0204	−0.310	E	6
			12.664	0	7896400	2	2	5.28(+4)	0.127	0.0106	−0.596	B	6
8.	2s–4p	$^2S - {}^2P°$	9.493	0	10530000	2	6	2.5(+4)	0.10	0.0063	−0.70	C+	6
9.	2s–5p	$^2S - {}^2P°$	[8.52]			2	6	1.2(+4)	0.040	0.0022	−1.10	C+	6
10.	2s–6p	$^2S - {}^2P°$	[8.07]			2	6	7240	0.0212	0.00113	−1.373	C+	6
11.	2s–7p	$^2S - {}^2P°$	[7.82]			2	6	4510	0.0124	6.38(−4)	−1.606	C+	6
12.	2p–3s	$^2P° - {}^2S$	*13.54*	*418140*	7805000	6	2	1.9(+4)	0.017	0.0045	−0.99	D	9
13.	2p–3d	$^2P° - {}^2D$	*13.245*	*418140*	*7968100*	6	10	1.54(+5)	0.677	0.177	0.608	B	*interp.*
			1..292	448470	7971800	4	6	1.54(+5)	0.611	0.107	0.388	B	*interp.*
			13.149	357470	7962600	2	4	1.29(+5)	0.671	0.0581	0.128	B	*interp.*
			[13.208]	448470	7962600	4	4	2.6(+4)	0.068	0.012	−0.57	B	*interp.*
14.	2p–4d	$^2P° - {}^2D$	*9.852*	*41E140*	*10570000*	6	10	4.9(+4)	0.12	0.023	−0.14	B	6
			9.865	448470	10590000	4	6	4.9(+4)	0.11	0.014	−0.37	B	*ls*
			9.809	357470	10550000	2	4	4.1(+4)	0.12	0.0077	−0.62	B	*ls*
			9.865	448470	10550000	4	4	7900	0.012	0.0015	−1.34	C+	*ls*
15.	2p–5d	$^2P° - {}^2D$	*8.83*			6	10	2.31(+4)	0.0450	0.00785	−0.569	C+	6
			[8.85]			4	6	2.29(+4)	0.0404	0.00471	−0.791	C+	*ls*
			[8.78]			2	4	1.96(+4)	0.0453	0.00262	−1.043	C+	*ls*
			[8.85]			4	4	3800	0.0045	5.2(−4)	−1.75	D	*ls*
16.	2p–6d	$^2P° - {}^2D$	*8.35*			6	10	1.28(+4)	0.0220	0.00363	−0.879	C+	6
			[8.37]			4	6	1.26(+4)	0.0198	0.00218	−1.102	C+	*ls*
			[8.30]			2	4	1.07(+4)	0.0221	0.00121	−1.354	C+	*ls*
			[8.37]			4	4	2100	0.0022	2.4(−4)	−2.06	D	*ls*
17.	2p–7d	$^2P° - {}^2D$	*8.08*			6	10	7720	0.0126	0.00201	−1.121	C+	6
			[8.10]			4	6	7690	0.0113	0.00121	−1.343	C+	*ls*
			[8.04]			2	4	6530	0.0127	6.70(−4)	−1.597	C+	*ls*
			[8.10]			4	4	1200	0.0012	1.3(−4)	−2.31	D	*ls*
18.	3s–4p	$^2S - {}^2P°$	[36.8]	7805000	10530000	2	6	7100	0.43	0.10	−0.07	C	6

Cr XXII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
19.	3s–5p	^{2}S - ^{2}P°				2	6		0.107		−0.67	C	6
20.	3s–6p	^{2}S - ^{2}P°				2	6		0.047		−1.03	C	6
21.	3s–7p	^{2}S - ^{2}P°				2	6		0.0246		−1.308	C	6
22.	3p–4d	^{2}P° - ^{2}D	*37.6*	*7913500*	*10570000*	6	10	1.7(+4)	0.50	0.44	0.55	B	6
			[37.5]	7922000	10500000	4	6	1.7(+4)	0.58	0.26	0.32	B	ls
			[37.7]	7806400	10550000	2	4	1.4(+4)	0.60	0.15	0.08	B	ls
			[38.0]	7922000	10550000	4	4	2700	0.055	0.029	−0.63	C+	ls
23.	3p–5d	^{2}P° - ^{2}D				6	10		0.138		−0.082	C+	6
24.	3p–6d	^{2}P° - ^{2}D				6	10		0.0558		−0.475	C+	6
25.	3p–7s	^{2}P° - ^{2}S				6	2		0.0018		−1.97	C−	6
26.	3p–7d	^{2}P° - ^{2}D				6	10		0.0289		−0.761	C+	6
27.	3d–4f	^{2}D - ^{2}F°				10	14		1.00		1.000	B	5
28.	4s–5p	^{2}S - ^{2}P°				2	6		0.473		−0.024	C	6
29.	4s–6p	^{2}S - ^{2}P°				2	6		0.128		−0.59	C	6
30.	4s–7p	^{2}S - ^{2}P°				2	6		0.056		−0.95	C	6
31.	4p–5d	^{2}P° - ^{2}D				6	10		0.583		0.544	C+	6
32.	4p–6d	^{2}P° - ^{2}D				6	10		0.141		−0.073	C+	6
33.	4p–7s	^{2}P° - ^{2}S				6	2		0.0060		−1.44	C−	6
34.	4p–7d	^{2}P° - ^{2}D				6	10		0.0616		−0.432	C+	6

*The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XXII

Forbidden Transitions

The single magnetic dipole transition within the $1s^22p$ configuration has the line strength of 1.33 in the absence of relativistic effects in the wavefunctions.[1] It is estimated that these effects are negligible, since comprehensive relativistic calculations by Cheng *et al.*[2] for the analogous transition in the $1s^22s^22p$ configuration of the boron sequence show that such relativistic corrections are negligible until much more highly charged ions.

The listed transition probability data are also expected to be quite accurate since the energy levels are derived from experimental data.

An electric quadrupole transition at the same wavelength is estimated to be of negligible strength, as calculated by Bhatia[3] for this transition in the case of Mn XXIII. (He obtains a ratio of about 10^{-3} for the ratio of E2 to M1 line strengths).

References

[1] W. L. Wiese, M. W. Smith, and B. M. Miles, "Atomic Transition Probabilities", Vol. II, NSRDS-NBS 22, U.S. Govt. Print. Office, Washington, DC 1969.

[2] K. T. Cheng, Y.-K. Kim, and J. P. Desclaux, At. Data Nucl. Data Tables 24, 111 (1979).

[3] A. K. Bhatia, private communication (1986).

Cr XXII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	2p-2p	$^2P^\circ - {}^2P^\circ$										
			[1098.9]	357470	448470	2	4	M1	6760	1.33	B	*interp.*

Cr XXIII

He Isoelectronic Sequence

Ground State: $1s^2\ {}^1S_0$

Ionization Energy: 7481.8 eV = 60344000 cm^{-1}

Allowed Transitions

List of tabulated lines

Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.	Wavelength (Å)	No.
1.7235	17	2.107	3,7,10	9.0513	31	35.722	45
1.7238	16	2.109	7	9.2126	32	74.234	55
1.7632	15	2.113	9	11.852	21	74.878	56
1.7640	14	2.119	5	12.093	22	76.447	58
1.8557	13	2.129	6	12.271	27	77.226	59
1.8578	12	2.1818	2	12.512	73	225.3	19
2.095	11	2.1923	1	23.553	41	326.3	18
2.101	4,8	7.9233	25	23.820	42	442.9	18
2.102	3	8.0619	26	23.979	48	467.5	20
2.103	7	8.0762	35	24.265	49	471.0	18
2.104	7	8.2126	36	34.193	39		
2.105	7	8.8497	23	34.609	40		
2.106	3	9.0127	24	35.256	44		

Oscillator strengths for transitions of the $1s^2$–$1s2p$ array are taken from the results of Drake,[1] who incorporated accurate nonrelativistic matrix elements and Dirac hydrogenic matrix elements into a Z-expansion technique in order to provide f-values which would accurately reflect correlation effects for low-Z ions and relativistic effects for high-Z ions of the helium isoelectronic sequence. The f-values for the $1s^2\ {}^1S - 1snp\ {}^3P^\circ$ ($n = 3$–5) transitions were interpolated from results of the relativistic random phase approximation (RRPA) calculations of Johnson and Lin.[2] Data for other s–p and p–s transitions were interpolated from the RRPA results of Lin *et al.*,[3] with the exception of the $2s$–$2p$ transitions, where we tabulate the actual published RRPA A-values of these same authors.[4]

The charge expansion results of Laughlin[5] are given for various p–d and d–p transitions, as well as transitions between $4d$ and $4f$ levels. For those multiplets involving no change in principal quantum number ($3p$–$3d$, $4p$–$4d$, $4d$–$4f$) the f-values should be considered rather uncertain, since they are sensitive to energy differences. Oscillator strengths for the $2p$–$3d$ transitions, and for $1s3p\ {}^3P^\circ - 1s3d\ {}^3D$, were interpolated from the variational calculations of Weiss.[6] Both of these calculations indicate that, unlike the triplets, the $nd\ {}^1D$ energy levels ($n = 3,4$) lie below the $np\ {}^1P^\circ$ levels, and the $4f\ {}^1F^\circ$ lies below the $4d\ {}^1D$.

Brown and Cortez[7] have provided f-values for numerous d–f and f–d transitions for the isoelectronic sequence by fitting Z-expansion formulas to the results of variational calculations for the low-Z ions. Their results for transitions between the lower-lying D and F° terms are tabulated here.

Transition probabilities for the stronger transitions involving the doubly excited $n = 2$ states are taken from the comprehensive, charge expansion perturbation theory calculations of Vainshtein and Safronova.[8] Numerous data are also available for transitions involving doubly excited states where the spectator electron has principal quantum number $n = 3$.[9] However, these data are not tabulated here since most of the transitions are very close to belonging to the unresolved satellites of the H-like ions, if they do not in fact do so.

References

[1] G. W. F. Drake, Phys. Rev. A 19, 1387 (1979).
[2] W. R. Johnson and C. D. Lin, Phys. Rev. A 14, 565 (1976).
[3] C. D. Lin, W. R. Johnson, and A. Dalgarno, Astrophys. J. 217, 1011 (1977).
[4] C. D. Lin, W. R. Johnson, and A. Dalgarno, Phys. Rev. A 15, 154 (1977).
[5] C. J. Laughlin, J. Phys. B 6, 1942 (1973).
[6] A. W. Weiss, J. Res. Nat. Bur. Stand., Sect. A 71, 163 (1[illegible]7).
[7] R. T. Brown and J.-L. M. Cortez, Astrophys. J. 176, 267 (1972).
[8] L. A. Vainshtein and U. I. Safronova, At. Data Nucl. Data Tables 21, 49 (1978).
[9] L. A. Vainshtein and U. I. Safronova, At. Data Nucl. Data Tables 25, 311 (1980).

Cr XXIII: Allowed transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
1.	$1s^2$–$1s2p$	${}^1S - {}^3P^{\circ}$											
			[2.1923]	0	[45614900]	1	3	2.34(+5)*	0.0505	3.64(−4)	−1.297	B	1
2.		${}^1S - {}^1P^{\circ}$	[2.1818]	0	[45832900]	1	3	3.37(+6)	0.721	0.00518	−0.142	B	1
3.	$1s2s$–$2s2p$	${}^3S - {}^3P^{\circ}$	*2.104*	[45389100]	*[92920000]*	3	9	2.1(+6)	0.41	0.0085	0.09	C	8
			[2.102]	[45389100]	[92960000]	3	5	2.1(+6)	0.23	0.0048	−0.16	C	8
			[2.106]	[45389100]	[92870000]	3	3	2.0(+6)	0.13	0.0028	−0.40	C	8
			[2.107]	[45389100]	[92850000]	3	1	2.0(+6)	0.044	9.2(−4)	−0.88	C	8
4.		${}^1S - {}^1P^{\circ}$	[2.101]	[45619000]	[93220000]	1	3	2.0(+6)	0.40	0.0027	−0.40	C	8
5.	$1s2p$–$2s^2$	${}^3P^{\circ} - {}^1S$											
			[2.119]	[45614900]	[92800000]	3	1	2.7(+5)	0.0061	1.3(−4)	−1.74	D	8
6.		${}^1P^{\circ} - {}^1S$	[2.129]	[45832900]	[92800000]	3	1	5.1(+5)	0.012	2.4(−4)	−1.46	D	8
7.	$1s2p$–$2p^2$	${}^3P^{\circ} - {}^3P$	*2.106*	*[45658200]*	*[93140000]*	9	9	3.9(+6)	0.26	0.016	0.36	D+	8
			[2.107]	[45695600]	[93160000]	5	5	2.3(+6)	0.15	0.0053	−0.12	C	8
			[2.105]	[456[illegible]900]	[93130000]	3	3	9.6(+5)	0.064	0.0013	−0.72	D	8
			[2.109]	[45695600]	[93130000]	5	3	1.7(+6)	0.068	0.0024	−0.47	C	8
			[2.107]	[45614900]	[93070000]	3	1	3.8(+6)	0.084	0.0018	−0.60	C	8
			[2.103]	[45614900]	[93160000]	3	5	1.2(+6)	0.13	0.0028	−0.40	C	8
			[2.104]	[45601400]	[93130000]	1	3	1.4(+6)	0.28	0.0019	−0.55	C	8
8.		${}^3P^{\circ} - {}^1D$											
			[2.101]	[45695600]	[93290000]	5	5	7.9(+5)	0.052	0.0018	−0.58	D	8
9.		${}^1P^{\circ} - {}^3P$											
			[2.113]	[45832900]	[93160000]	3	5	5.9(+5)	0.066	0.0014	−0.70	D	8
10.		${}^1P^{\circ} - {}^1D$	[2.107]	[45832900]	[93290000]	3	5	3.3(+6)	0.37	0.0076	0.04	C	8
11.		${}^1P^{\circ} - {}^1S$	[2.095]	[45832900]	[93560000]	3	1	3.5(+6)	0.077	0.0016	−0.64	C	8
12.	$1s^2$–$1s3p$	${}^1S - {}^3P^{\circ}$											
			[1.8578]	0	[53826600]	1	3	8.4(+4)	0.013	8.0(−5)	−1.89	E	*interp*
13.		${}^1S - {}^1P^{\circ}$	[1.8557]	0	[53888200]	1	3	8.97(+5)	0.139	8.49(−4)	−0.857	C+	*interp*
14.	$1s^2$–$1s4p$	${}^1S - {}^3P^{\circ}$											
			[1.7640]	0	[56688900]	1	3	3.2(+4)	0.0045	2.6(−5)	−2.35	E	*interp*
15.		${}^1S - {}^1P^{\circ}$	[1.7632]	0	[56714400]	1	3	3.68(+5)	0.0514	2.98(−4)	−1.289	C+	*interp*
16.	$1s^2$–$1s4p$	${}^1S - {}^3P^{\circ}$											
			[1.7238]	0	[58010100]	1	3	1.6(+4)	0.0022	1.2(−5)	−2.66	E	*interp*

Cr XXIII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} ($10^8 s^{-1}$)	f_{ik}	S (at. u.)	log gf	Accuracy	Source
17.		$^1S - ^1P^\circ$	[1.7235]	0	[58023100]	1	3	1.86(+5)	0.0248	1.41(−4)	−1.606	C+	*interp.*
18.	1*s*2*s*–1*s*2*p*	$^3S - ^3P^\circ$	*371.6*	[45389100]	*[45658800]*	3	9	6.71	0.0417	0.153	−0.903	B	4
			[326.3]	[45389100]	[45695600]	3	5	10.1	0.0269	0.0866	−1.094	B	4
			[442.9]	[45389100]	[45614900]	3	3	3.80	0.0112	0.0489	−1.475	B	4
			[471.0]	[45389100]	[45601400]	3	1	3.36	0.00372	0.0173	−1.952	B	4
19.		$^3S - ^1P^\circ$											
			[225.3]	[45389100]	[45832900]	3	3	1.93	0.00147	0.00327	−2.356	B	4
20.		$^1S - ^1P^\circ$	[467.5]	[45619000]	[45832900]	1	3	3.32	0.0326	0.0502	−1.486	B	4
21.	1*s*2*s*–1*s*3*p*	$^3S - ^3P^\circ$											
			[11.852]	[45389100]	[53826600]	3	3	5.8(+4)	0.123	0.0144	−0.433	C	*interp.*
22.		$^1S - ^1P^\circ$	[12.093]	[45619000]	[53888200]	1	3	5.6(+4)	0.368	0.0147	−0.434	C	*interp.*
23.	1*s*2*s*–1*s*4*p*	$^3S - ^3P^\circ$											
			[8.8497]	[45389100]	[56688900]	3	3	2.6(+4)	0.030	0.0026	−1.05	C+	*interp.*
24.		$^1S - ^1P^\circ$	[9.0127]	[45619000]	[56714400]	1	3	2.4(+4)	0.089	0.0026	−1.05	C+	*interp.*
25.	1*s*2*s*–1*s*5*p*	$^3S - ^3P^\circ$											
			[7.9233]	[45389100]	[58010100]	3	3	1.3(+4)	0.012	9.4(−4)	−1.44	C+	*interp.*
26.		$^1S - ^1P^\circ$	[8.0619]	[45619000]	[58023100]	1	3	1.3(+4)	0.037	9.8(−4)	−1.43	C+	*interp.*
27.	1*s*2*p*–1*s*3*s*	$^3P^\circ - ^3S$											
			[12.271]	[45614900]	[53764300]	3	3	6200	0.014	0.0017	−1.38	C−	*interp.*
28.		$^1P^\circ - ^1S$	[12.512]	[45832900]	[53825000]	3	1	1.9(+4)	0.015	0.0019	−1.35	C+	*interp.*
29.	1*s*2*p*–1*s*3*d*	$^3P^\circ - ^3D$				9	15		0.69		0.79	C+	*interp.*
30.		$^1P^\circ - ^1D$				3	5		0.70		0.32	C+	*interp.*
31.	1*s*2*p*–1*s*4*s*	$^3P^\circ - ^3S$											
			[9.0513]	[45614900]	[56663000]	3	3	2500	0.0031	2.8(−4)	−2.03	D	*interp.*
32.		$^1P^\circ - ^1S$	[9.2126]	[45832900]	[56687600]	3	1	7300	0.0031	2.8(−4)	−2.03	C	*interp.*
33.	1*s*2*p*–1*s*4*d*	$^3P^\circ - ^3D$				9	15		0.12		0.03	C	5
34.		$^1P^\circ - ^1D$				3	5		0.12		−0.44	C	5
35.	1*s*2*p*–1*s*5*s*	$^3P^\circ - ^3S$											
			[8.0762]	[45614900]	[57997000]	3	3	1300	0.0013	1.0(−4)	−2.41	D	*interp.*

Cr XXIII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
36.		$^3P^\circ$ - ^1S	[8.2126]	[45832900]	[58009300]	3	1	3900	0.0013	1.1(−4)	−2.41	C	*interp.*
37.	1s3s–1s3p	^3S - $^3P^\circ$											
						3	3		0.018		−1.27	E	*interp.*
38.		^1S - $^1P^\circ$				1	3		0.057		−1.24	D	*interp.*
39.	1s3s–1s4p	^3S - $^3P^\circ$											
			[34.193]	[53764300]	[56688900]	3	3	7800	0.136	0.0459	−0.389	C	*interp.*
40.		^1S - $^1P^\circ$	[34.609]	[53825000]	[56714400]	1	3	7500	0.405	0.0461	−0.393	C	*interp.*
41.	1s3s–1s5p	^3S - $^3P^\circ$											
			[23.553]	[53764300]	[58010100]	3	3	4200	0.035	0.0081	−0.98	C	*interp.*
42.		^1S - $^1P^\circ$	[23.820]	[53825000]	[58023100]	1	3	4080	0.104	0.00816	−0.983	C+	*interp.*
43.	1s3p–1s3d	$^3P^\circ$ - ^3D				9	15		0.012		−0.97	D	*interp.*
44.	1s3p–1s4s	$^3P^\circ$ - ^3S											
			[35.256]	[53826600]	[56663000]	3	3	1800	0.033	0.011	−1.00	C−	*interp.*
45.		$^1P^\circ$ - ^1S	[35.722]	[53888200]	[56687600]	3	1	5300	0.034	0.012	−0.99	C	*interp.*
46.	1s3p–1s4d	$^3P^\circ$ - ^3D				9	15		0.60		0.73	C	5
47.		$^1P^\circ$ - ^1D				3	5		0.62		0.27	C	5
48.	1s3p–1s5s	$^3P^\circ$ - ^3S											
			[23.979]	[53826600]	[57997000]	3	3	890	0.0077	0.0018	−1.64	D	*interp.*
49.		$^1P^\circ$ - ^1S	[24.265]	[53888200]	[58009300]	3	1	2600	0.0077	0.0018	−1.64	C	*interp.*
50.	1s3d–1s3p	^1D - $^1P^\circ$				5	3		0.0022		−1.96	F	5
51.	1s3d–1s4p	^3D - $^3P^\circ$				15	9		0.012		−0.74	C	5
52.		^1D - $^1P^\circ$				5	3		0.011		−1.26	C	5
53.	1s4s–1s4p	^3S - $^3P^\circ$											
						3	3		0.025		−1.12	E	*interp.*
54.		^1S - $^1P^\circ$				1	3		0.080		−1.10	E	*interp.*
55.	1s4s–1s5p	^3S - $^3P^\circ$											
			[74.234]	[56663000]	[58010100]	3	3	1830	0.151	0.111	−0.344	C	*interp.*
56.		^1S - $^1P^\circ$	[74.878]	[56687600]	[58023100]	1	3	1800	0.45	0.11	−0.35	D	*interp.*
57.	1s4p–1s4d	$^3P^\circ$ - ^3D				9	15		0.021		−0.72	D	5
58.	1s4p–1s5s	$^3P^\circ$ - ^3S											
			[76.447]	[56688900]	[57997000]	3	3	630	0.055	0.042	−0.78	D	*interp.*

Cr XXIII: Allowed transitions — Continued

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	A_{ki} (10^8 s^{-1})	f_{ik}	S (at. u.)	log gf	Accuracy	Source
59.		$^1P^\circ - ^1S$	[77.226]	[56714400]	[58009300]	3	1	1800	0.055	0.042	−0.78	C	*interp.*
60.	1s4d–1s4p	$^1D - ^1P^\circ$				5	3		0.0034		−1.77	E	5
61.	1s4d–1s4f	$^3D - ^3F^\circ$				15	21		8.5(−4)[a]		−1.89	E	5
62.	1s4d–1s5f	$^3D - ^3F^\circ$				15	21		0.89		1.13	B	7
63.		$^1D - ^1F^\circ$				5	7		0.89		0.65	B	7
64.	1s4f–1s4d	$^1F^\circ - ^1D$				7	5		4.5(−4)		−2.50	E	5
65.	1s4f–1s5d	$^3F^\circ - ^3D$				21	15		0.0089		−0.73	C	7
66.		$^1F^\circ - ^1D$				7	5		0.0089		−1.21	C	7
67.	1s5s–1s5p	$^3S - ^3P^\circ$											
						3	3		0.031		−1.03	E	*interp.*
68.		$^1S - ^1P^\circ$				1	3		0.10		−1.00	E	*interp.*

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XXIII

Forbidden Transitions

The results of multi-configuration Dirac-Fock calculations by Hata and Grant[1] have been selected for this tabulation. Their work includes both a very detailed consideration of configuration interaction—with configurational wavefunction sets containing as many as 51 interacting states—as well as a fully relativistic treatment based on the Dirac Hamiltonian. Their calculated wavelengths are in very close agreement with experiment, and the agreement between an experimentally determined lifetime[2] for the 2p $^3P^\circ_2$ state and the theoretical result is excellent, the difference being only 5%. A comprehensive comparison table containing all experimental data on these He-sequence transitions is given in the introduction to the forbidden lines of Ti XXI.

References

[1]J. Hata and I. P. Grant, Mon. Not. R. Astr. Soc. 211, 549 (1984).
[2]H. D. Dohmann, R. Mann, and E. Pfeng, Z. Phys. A 309, 101 (1982).

Cr XXIII: Forbidden transitions

No.	Transition Array	Multiplet	λ (Å)	E_i (cm^{-1})	E_k (cm^{-1})	g_i	g_k	Type of transition	A_{ki} (s^{-1})	S (at. u.)	Accuracy	Source
1.	$1s^2$–1s2s	$^1S - ^3S$	[2.2034]	0	[45383500]	1	3	M1	9.37(+7)[a]	1.11(−4)	B	1
2.	$1s^2$–1s2p	$^1S - ^3P^\circ$										
			[2.1886]	0	[45691370]	1	5	M2	3.45(+9)	0.131	B	1

[a]The number in parentheses following the tabulated value indicates the power of ten by which this value has to be multiplied.

Cr XXIV

H Isoelectronic Sequence

Ground State: 1s $^2S_{1/2}$

Ionization Energy: 7894.87 eV = 63675900 cm^{-1}

Allowed Transitions

Electric dipole transition probability data for this hydrogen-like ion can be obtained directly, in a non-relativistic approximation, from the data for neutral hydrogen.[1] The oscillator strength is independent of Z along the entire isoelectronic sequence and is therefore identical to the value for the hydrogen atom. Line strengths scale as Z^{-2} and transition probabilities scale as Z^4, i.e.,

$$S_Z = Z^{-2} S_H, \quad A_Z = Z^4 A_H.$$

For higher nuclear charges in this sequence, relativistic corrections will cause these values to deviate increasingly from the non-relativistic ones. The first effect of relativity will be to alter the transition energies, or wavelengths, from the non-relativistic, even though the line strength itself is still well approximated by the non-relativistic value. In this case, experimental energies should be used in the standard conversion formulas, given in the general introduction to this volume, to calculate the most accurate values of f and A. It should be noted that the relativistic removal of the j-degeneracy introduces dipole transitions which do not occur in the non-relativistic theory, e.g., $2s_{1/2} - 2p_{1/2}$.

For very high Z, it is necessary to use the four-component Dirac spinors rather than two-component Schroedinger functions in theoretical calculations, and this introduces relativistic corrections to the line strengths themselves. Several recent systematic studies of the problem[2,3] indicate that these corrections are not large for stages of ionization in the range 20-30. Corrections for $Z = 30$ are usually no larger than 5-10% and generally substantially less than 5%. If an accuracy greater than this is required, the reader is referred to these papers[2,3] for a more detailed error analysis.

References

[1] W. L. Wiese, M. W. Smith, and B. M. Glennon, Atomic Transition Probabilities - Hydrogen through Neon (A Critical Data Compilation), Vol. I, 157 pp., Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 4 (May 1966).

[2] S. M. Younger and A. W. Weiss, J. Res. Nat. Bur. Stand., Sect. A 79, 629 (1975).

[3] S. J. Rose, Rutherford Appleton Laboratory Report RL-82-114 (December 1982).