43
2-19-76

BL-2045

LA-6186-MS

Informal Report

UC-34d

Reporting Date: December 1975

Issued: January 1976

Tabulated $p\text{-}^4\text{He}$ Phase Shifts

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
CONTRACT W-7405-ENG. 36

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National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22151
Price: Printed Copy \$4.50 Microfiche \$2.25**

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TABULATED p - ^4He PHASE SHIFTS

by

D. C. Dodder, G. M. Hale, Nelson Jarmie, J. H. Jett, P. W. Keaton, Jr.,
R. Nisley, and K. Witte

ABSTRACT

This table contains calculated phase shifts for p - ^4He elastic scattering from 0 to 17 MeV at intervals suitable for linear interpolation.

The phase shifts in this table are calculated from an R-matrix fit to a carefully selected subset of all available data from 0 to 17.84 MeV. Observables calculated from these phase shifts fit the selected data with a weighted variance of 1.0. The errors on the phase shifts are standard deviations and are calculated from the error matrix for the R-matrix parameters. The R-matrix parameters, a description of the data selection, and a comparison of the calculated values of the observables with the data will be found in a forthcoming publication.

The phase shifts are listed for laboratory energies from 0 to 17 MeV, at intervals of 50 keV from 0 to 5 MeV and 250 keV from 5 to 17 MeV. These intervals should be small enough so that linear interpolation will give phase shifts well within the estimated uncertainties.

The errors on the phase shifts are to be assumed as minimum values; we do not believe the present data can determine them any better. However, inadequacies in the energy parameterization or unsuspected errors in the data could have resulted in erroneous values of the phase shifts which were outside the estimates.

The errors should not be used to calculate uncertainties in predicted values of observables. The errors are highly correlated and we present only the diagonal values of the error matrix. The most suitable way of calculating such uncertainties is to calculate them directly from the error matrix for the R-matrix parameters.

No confusion should arise from the fact that the computer program occasionally prints phase shifts that differ by 180° from the true ones.

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LAB ENERGY (MeV)	PHASE SHIFT	STANDARD DEVIATION (Degrees)	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
.050			.450		
2S1/2	-.0130	.0000	2S1/2	-0.0066	.0130
2P3/2	.0000	.0000	2P3/2	.0100	.0032
2P1/2	.0002	.0000	2P1/2	.0215	.0017
2D5/2	.0000	.0000	2D5/2	.0000	.0000
2D3/2	-.0000	.0000	2D3/2	-.0001	.0000
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.100			.500		
2S1/2	-.1719	.0000	2S1/2	-5.1623	.0150
2P3/2	.0103	.0000	2P3/2	1.2271	.0041
2P1/2	.0036	.0000	2P1/2	.3746	.0022
2D5/2	.0000	.0000	2D5/2	.0000	.0001
2D3/2	-.0000	.0000	2D3/2	-.0001	.0000
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.150			.550		
2S1/2	-.5350	.0010	2S1/2	-5.8727	.0170
2P3/2	.0017	.0001	2P3/2	1.5617	.0052
2P1/2	.0143	.0001	2P1/2	.4619	.0027
2D5/2	.0000	.0000	2D5/2	.0000	.0001
2D3/2	-.0000	.0000	2D3/2	-.0001	.0001
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.200			.600		
2S1/2	-1.0005	.0035	2S1/2	-6.5751	.0190
2P3/2	.1017	.0000	2P3/2	1.9441	.0065
2P1/2	.0343	.0002	2P1/2	.5713	.0033
2D5/2	.0000	.0000	2D5/2	.0001	.0001
2D3/2	-.0000	.0000	2D3/2	-.0001	.0001
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.250			.650		
2S1/2	-1.6570	.0055	2S1/2	-7.2676	.0210
2P3/2	.1944	.0007	2P3/2	2.3771	.0070
2P1/2	.0646	.0000	2P1/2	.6840	.0040
2D5/2	.0000	.0000	2D5/2	.0001	.0001
2D3/2	-.0000	.0000	2D3/2	-.0002	.0001
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.300			.700		
2S1/2	-2.3217	.0075	2S1/2	-7.9095	.0237
2P3/2	.3223	.0011	2P3/2	2.8630	.0095
2P1/2	.1050	.0006	2P1/2	.8002	.0047
2D5/2	.0000	.0000	2D5/2	.0001	.0002
2D3/2	-.0000	.0000	2D3/2	-.0002	.0001
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.350			.750		
2S1/2	-3.0170	.0097	2S1/2	-8.6201	.0253
2P3/2	.4076	.0017	2P3/2	3.4062	.0112
2P1/2	.1560	.0009	2P1/2	.9413	.0058
2D5/2	.0000	.0000	2D5/2	.0001	.0002
2D3/2	-.0000	.0000	2D3/2	-.0003	.0002
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000
.400			.800		
2S1/2	-3.7240	.0110	2S1/2	-9.2791	.0272
2P3/2	.6022	.0023	2P3/2	4.0090	.0132
2P1/2	.2189	.0013	2P1/2	1.0842	.0063
2D5/2	.0000	.0000	2D5/2	.0001	.0002
2D3/2	-.0000	.0000	2D3/2	-.0003	.0002
2F7/2	.0000	.0000	2F7/2	.0000	.0000
2F5/2	.0000	.0000	2F5/2	.0000	.0000

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
.050		
2S1/2	-9.9266	.0789
2P3/2	9.6755	.0153
2P1/2	1.2366	.0071
2D5/2	.0002	.0001
2D3/2	-.0004	.0002
2F7/2	.0000	.0000
2F5/2	.0000	.0000
.400		
2S1/2	-10.5625	.0305
2P3/2	5.4899	.0177
2P1/2	1.3985	.0000
2D5/2	.0002	.0003
2D3/2	-.0005	.0003
2F7/2	.0000	.0000
2F5/2	.0000	.0000
.950		
2S1/2	-11.1072	.0321
2P3/2	6.2167	.0203
2P1/2	1.5690	.0000
2D5/2	.0003	.0004
2D3/2	-.0006	.0003
2F7/2	.0000	.0000
2F5/2	.0000	.0000
1.000		
2S1/2	-11.0009	.0337
2P3/2	7.1006	.0231
2P1/2	1.7504	.0100
2D5/2	.0003	.0005
2D3/2	-.0006	.0004
2F7/2	.0001	.0000
2F5/2	.0000	.0000
1.050		
2S1/2	-12.0030	.0352
2P3/2	8.0060	.0202
2P1/2	1.9002	.0111
2D5/2	.0004	.0005
2D3/2	-.0007	.0004
2F7/2	.0001	.0000
2F5/2	.0001	.0000
1.100		
2S1/2	-12.9903	.0367
2P3/2	9.1209	.0295
2P1/2	2.1391	.0122
2D5/2	.0004	.0006
2D3/2	-.0004	.0005
2F7/2	.0001	.0000
2F5/2	.0001	.0000
1.150		
2S1/2	-13.5707	.0381
2P3/2	10.2600	.0331
2P1/2	2.3070	.0130
2D5/2	.0005	.0007
2D3/2	-.0007	.0006
2F7/2	.0001	.0000
2F5/2	.0001	.0000
1.200		
2S1/2	-14.1513	.0395
2P3/2	11.5166	.0370
2P1/2	2.5639	.0146
2D5/2	.0006	.0008
2D3/2	-.0011	.0006
2F7/2	.0001	.0000
2F5/2	.0001	.0000

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
1.250		
2S1/2	-14.7144	.0409
2P3/2	12.5706	.0412
2P1/2	2.7496	.0159
2D5/2	.0007	.0009
2D3/2	-.0012	.0007
2F7/2	.0001	.0000
2F5/2	.0001	.0000
1.300		
2S1/2	-15.2604	.0422
2P3/2	14.3375	.0450
2P1/2	3.0242	.0172
2D5/2	.0007	.0010
2D3/2	-.0013	.0008
2F7/2	.0002	.0000
2F5/2	.0001	.0000
1.350		
2S1/2	-15.8136	.0435
2P3/2	15.9230	.0506
2P1/2	3.2675	.0186
2D5/2	.0008	.0011
2D3/2	-.0014	.0009
2F7/2	.0002	.0000
2F5/2	.0001	.0000
1.400		
2S1/2	-16.3502	.0447
2P3/2	17.6360	.0550
2P1/2	3.5194	.0200
2D5/2	.0010	.0012
2D3/2	-.0016	.0010
2F7/2	.0002	.0000
2F5/2	.0002	.0000
1.450		
2S1/2	-16.8766	.0460
2P3/2	19.4799	.0613
2P1/2	3.7790	.0210
2D5/2	.0011	.0010
2D3/2	-.0017	.0011
2F7/2	.0003	.0000
2F5/2	.0002	.0000
1.500		
2S1/2	-17.3991	.0472
2P3/2	21.4600	.0671
2P1/2	4.0400	.0229
2D5/2	.0012	.0015
2D3/2	-.0019	.0012
2F7/2	.0003	.0000
2F5/2	.0002	.0000
1.550		
2S1/2	-17.9110	.0483
2P3/2	23.5031	.0731
2P1/2	4.3261	.0240
2D5/2	.0014	.0016
2D3/2	-.0021	.0013
2F7/2	.0003	.0001
2F5/2	.0002	.0000
1.600		
2S1/2	-18.4172	.0495
2P3/2	25.6095	.0795
2P1/2	4.6117	.0260
2D5/2	.0015	.0018
2D3/2	-.0022	.0015
2F7/2	.0003	.0001
2F5/2	.0003	.0000

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
1.650			2.050		
231/2	-10.9153	.0901	231/2	-22.6077	.0500
2P3/2	20.2600	.0000	2P3/2	51.0732	.1500
2P1/2	4.4056	.0270	2P1/2	7.5006	.0015
2D5/2	.0017	.0020	2D5/2	.0035	.0030
2D3/2	-0.0024	.0016	2D3/2	.0000	.0029
2F7/2	.0000	.0001	2F7/2	.0010	.0001
2F5/2	.0003	.0001	2F5/2	.0007	.0001
1.700			2.100		
231/2	-19.0065	.0517	231/2	-23.1100	.0597
2P3/2	30.0154	.0027	2P3/2	55.1120	.1002
2P1/2	5.2070	.0292	2P1/2	7.0030	.0030
2D5/2	.0019	.0021	2D5/2	.0030	.0030
2D3/2	-0.0026	.0017	2D3/2	-0.0042	.0031
2F7/2	.0005	.0001	2F7/2	.0011	.0002
2F5/2	.0001	.0001	2F5/2	.0000	.0001
1.750			2.150		
231/2	-19.0000	.0520	231/2	-23.5001	.0600
2P3/2	33.5007	.0095	2P3/2	50.3350	.1000
2P1/2	5.5176	.0309	2P1/2	8.2702	.0052
2D5/2	.0020	.0023	2D5/2	.0041	.0041
2D3/2	-0.0020	.0019	2D3/2	-0.0045	.0033
2F7/2	.0005	.0001	2F7/2	.0012	.0002
2F5/2	.0000	.0001	2F5/2	.0000	.0001
1.800			2.200		
231/2	-20.3000	.0530	231/2	-23.0000	.0615
2P3/2	30.3326	.1002	2P3/2	61.5152	.1071
2P1/2	5.0355	.0320	2P1/2	8.0516	.0072
2D5/2	.0023	.0025	2D5/2	.0040	.0043
2D3/2	-0.0030	.0020	2D3/2	-0.0047	.0035
2F7/2	.0000	.0001	2F7/2	.0013	.0002
2F5/2	.0000	.0001	2F5/2	.0009	.0002
1.850			2.250		
231/2	-20.0005	.0500	231/2	-24.0001	.0620
2P3/2	30.2755	.1120	2P3/2	60.0200	.1005
2P1/2	6.1013	.0303	2P1/2	9.0350	.0491
2D5/2	.0025	.0027	2D5/2	.0040	.0040
2D3/2	-0.0032	.0022	2D3/2	-0.0040	.0030
2F7/2	.0007	.0001	2F7/2	.0010	.0002
2F5/2	.0005	.0001	2F5/2	.0010	.0002
1.900			2.300		
231/2	-21.3000	.0550	231/2	-24.0007	.0632
2P3/2	42.3217	.1102	2P3/2	67.0551	.1513
2P1/2	6.0000	.0301	2P1/2	9.0000	.0510
2D5/2	.0027	.0020	2D5/2	.0052	.0040
2D3/2	-0.0030	.0020	2D3/2	-0.0052	.0040
2F7/2	.0007	.0001	2F7/2	.0015	.0002
2F5/2	.0005	.0001	2F5/2	.0011	.0002
1.950			2.350		
231/2	-21.7050	.0500	231/2	-25.2007	.0601
2P3/2	45.0522	.1252	2P3/2	70.5700	.1526
2P1/2	6.0350	.0370	2P1/2	9.0000	.0530
2D5/2	.0030	.0031	2D5/2	.0050	.0050
2D3/2	-0.0036	.0025	2D3/2	-0.0050	.0042
2F7/2	.0000	.0001	2F7/2	.0010	.0001
2F5/2	.0000	.0001	2F5/2	.0012	.0002
2.000			2.400		
231/2	-22.2195	.0570	231/2	-25.0000	.0600
2P3/2	40.0000	.1300	2P3/2	73.3700	.1533
2P1/2	7.1000	.1000	2P1/2	10.2200	.0500
2D5/2	.0032	.0033	2D5/2	.0050	.0045
2D3/2	-0.0030	.0027	2D3/2	-0.0050	.0045
2F7/2	.0009	.0001	2F7/2	.0010	.0003
2F5/2	.0000	.0001	2F5/2	.0013	.0002

LAB ENERGY	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION	LAB ENERGY	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
2.450	2.450	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.06709 .0657 .1536 .0569 .0858 .0847 .0803 .0802	2.850	2.850	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0717 .0712 .1472 .0729 .0807 .0871 .0805 .0804
2.500	2.500	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.26.4755 70.5804 11.0543 .0869 .0861 .0850 .0803 .0803	2.900	2.900	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0720 .0720 .1460 .0749 .0891 .0874 .0805 .0804
2.550	2.550	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.26.8750 -.99.0129 11.4763 .0873 .0865 .0853 .0822 .0816	2.950	2.950	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0731 .0731 .1444 .0769 .0895 .0877 .0806 .0805
2.600	2.600	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.27.2720 -.96.7533 11.9041 .0878 .0855 .0864 .0824 .0817	3.000	3.000	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0734 .0734 .1436 .0784 .0899 .0881 .0806 .0805
2.650	2.650	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.27.6641 -.94.6310 12.3373 .0884 .0858 .0826 .0819	3.050	3.050	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0745 .0745 .1424 .0804 .0810 .0804 .0807 .0805
2.700	2.700	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.28.0524 -.92.6425 12.7759 .0809 .0871 .0828 .0820	3.100	3.100	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0751 .0751 .1412 .0827 .0810 .0804 .0807 .0806
2.750	2.750	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.28.4367 -.90.7431 13.2197 .0895 .0873 .0810 .0810	3.150	3.150	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0758 .0758 .1401 .0847 .0813 .0802 .0807 .0806
2.800	2.800	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.28.8173 -.89.8408 13.6683 .0883 .0876 .0812 .0823	3.200	3.200	281/2 2P3/2 2P1/2 2P1/2 2D5/2 2D3/2 2F7/2 2F5/2	-.0764 .0764 .1389 .0866 .0817 .0806 .0805 .0806

LAB ENERGY PHASE SHIFT STANDARD DEVIATION

3.250

2S1/2 -32.0873 .0770
2P3/2 -77.0857 .1379
2P1/2 17.0928 .0805
2D5/2 .0167 .0122
2D3/2 -.0096 .0099
2F7/2 .0055 .0008
2F5/2 .0048 .0007

3.300

2S1/2 -32.4347 .0776
2P3/2 -77.0552 .1368
2P1/2 10.3778 .0908
2D5/2 .0176 .0127
2D3/2 -.0099 .0103
2F7/2 .0050 .0009
2F5/2 .0042 .0007

3.350

2S1/2 -32.7791 .0782
2P3/2 -76.2632 .1350
2P1/2 18.0659 .0922
2D5/2 .0105 .0132
2D3/2 -.0101 .0108
2F7/2 .0062 .0009
2F5/2 .0044 .0008

3.400

2S1/2 -33.1206 .0788
2P3/2 -75.5255 .1349
2P1/2 19.3563 .0941
2D5/2 .0194 .0137
2D3/2 -.0102 .0112
2F7/2 .0065 .0010
2F5/2 .0047 .0008

3.450

2S1/2 -33.4593 .0798
2P3/2 -74.8302 .1339
2P1/2 19.8486 .0950
2D5/2 .0204 .0143
2D3/2 -.0108 .0116
2F7/2 .0069 .0010
2F5/2 .0049 .0008

3.500

2S1/2 -33.7952 .0800
2P3/2 -74.1977 .1330
2P1/2 20.3425 .0977
2D5/2 .0215 .0148
2D3/2 -.0106 .0129
2F7/2 .0072 .0011
2F5/2 .0052 .0009

3.550

2S1/2 -34.1283 .0806
2P3/2 -73.6006 .1322
2P1/2 20.8379 .0995
2D5/2 .0225 .0153
2D3/2 -.0108 .0125
2F7/2 .0076 .0011
2F5/2 .0055 .0009

3.600

2S1/2 -34.4588 .0811
2P3/2 -73.0440 .1314
2P1/2 21.3340 .1013
2D5/2 .0236 .0159
2D3/2 -.0109 .0129
2F7/2 .0080 .0012
2F5/2 .0058 .0010

LAB ENERGY PHASE SHIFT STANDARD DEVIATION

3.650

2S1/2 -34.7866 .0817
2P3/2 -72.5256 .1306
2P1/2 21.8319 .1030
2D5/2 .0247 .0165
2D3/2 -.0111 .0134
2F7/2 .0084 .0013
2F5/2 .0060 .0010

3.700

2S1/2 -35.1118 .0823
2P3/2 -72.0420 .1299
2P1/2 22.3301 .1047
2D5/2 .0259 .0170
2D3/2 -.0112 .0139
2F7/2 .0089 .0013
2F5/2 .0064 .0011

3.750

2S1/2 -35.4345 .0828
2P3/2 -71.5911 .1292
2P1/2 22.8207 .1064
2D5/2 .0271 .0176
2D3/2 -.0114 .0143
2F7/2 .0093 .0014
2F5/2 .0067 .0012

3.800

2S1/2 -35.7547 .0833
2P3/2 -71.1706 .1285
2P1/2 23.3275 .1081
2D5/2 .0283 .0182
2D3/2 -.0115 .0148
2F7/2 .0098 .0015
2F5/2 .0070 .0012

3.850

2S1/2 -36.0725 .0839
2P3/2 -70.7787 .1278
2P1/2 23.8263 .1097
2D5/2 .0296 .0190
2D3/2 -.0116 .0153
2F7/2 .0102 .0019
2F5/2 .0073 .0013

3.900

2S1/2 -36.3878 .0844
2P3/2 -70.4133 .1272
2P1/2 24.3240 .1118
2D5/2 .0309 .0193
2D3/2 -.0117 .0158
2F7/2 .0107 .0016
2F5/2 .0077 .0013

3.950

2S1/2 -36.7000 .0849
2P3/2 -70.0720 .1267
2P1/2 24.8227 .1130
2D5/2 .0323 .0201
2D3/2 -.0118 .0163
2F7/2 .0112 .0017
2F5/2 .0081 .0014

4.000

2S1/2 -37.0114 .0854
2P3/2 -69.7556 .1261
2P1/2 25.3199 .1146
2D5/2 .0337 .0207
2D3/2 -.0119 .0169
2F7/2 .0118 .0018
2F5/2 .0084 .0015

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
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4.050

2S1/2	-37.3198	.0059
2P3/2	-69.4602	.1256
2P1/2	25.8161	.1161
2D5/2	.0351	.0214
2D3/2	-.0119	.0174
2F7/2	.0123	.0019
2F5/2	.0088	.0015

4.100

2S1/2	-37.6258	.0064
2P3/2	-69.1452	.1251
2P1/2	26.3112	.1177
2D5/2	.0366	.0221
2D3/2	-.0120	.0179
2F7/2	.0129	.0019
2F5/2	.0092	.0016

4.150

2S1/2	-37.9297	.0069
2P3/2	-68.9294	.1247
2P1/2	26.0047	.1192
2D5/2	.0381	.0227
2D3/2	-.0120	.0185
2F7/2	.0134	.0020
2F5/2	.0096	.0017

4.200

2S1/2	-38.2314	.0074
2P3/2	-68.6916	.1243
2P1/2	27.2967	.1207
2D5/2	.0397	.0234
2D3/2	-.0120	.0190
2F7/2	.0140	.0021
2F5/2	.0101	.0017

4.250

2S1/2	-38.5310	.0079
2P3/2	-68.4707	.1239
2P1/2	27.7868	.1222
2D5/2	.0413	.0241
2D3/2	-.0120	.0196
2F7/2	.0147	.0022
2F5/2	.0105	.0018

4.300

2S1/2	-38.8280	.0084
2P3/2	-68.2656	.1235
2P1/2	28.2748	.1237
2D5/2	.0430	.0249
2D3/2	-.0120	.0202
2F7/2	.0153	.0023
2F5/2	.0110	.0019

4.350

2S1/2	-39.1217	.0089
2P3/2	-68.0755	.1232
2P1/2	28.7605	.1257
2D5/2	.0447	.0256
2D3/2	-.0119	.0208
2F7/2	.0159	.0024
2F5/2	.0114	.0020

4.400

2S1/2	-39.4170	.0093
2P3/2	-67.8995	.1229
2P1/2	29.2438	.1266
2D5/2	.0464	.0263
2D3/2	-.0119	.0214
2F7/2	.0166	.0025
2F5/2	.0119	.0021

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
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4.450

2S1/2	-39.7083	.0094
2P3/2	-67.7368	.1226
2P1/2	29.7245	.1281
2D5/2	.0482	.0271
2D3/2	-.0118	.0220
2F7/2	.0173	.0026
2F5/2	.0120	.0021

4.500

2S1/2	-39.9976	.0093
2P3/2	-67.5866	.1223
2P1/2	30.2023	.1295
2D5/2	.0501	.0278
2D3/2	-.0117	.0226
2F7/2	.0180	.0027
2F5/2	.0129	.0022

4.550

2S1/2	-40.2849	.0098
2P3/2	-67.4482	.1221
2P1/2	30.6771	.1310
2D5/2	.0520	.0286
2D3/2	-.0116	.0232
2F7/2	.0187	.0028
2F5/2	.0134	.0023

4.600

2S1/2	-40.5703	.0092
2P3/2	-67.3209	.1219
2P1/2	31.1468	.1324
2D5/2	.0539	.0294
2D3/2	-.0114	.0238
2F7/2	.0195	.0029
2F5/2	.0140	.0024

4.650

2S1/2	-40.8538	.0097
2P3/2	-67.2042	.1217
2P1/2	31.6171	.1338
2D5/2	.0559	.0301
2D3/2	-.0113	.0245
2F7/2	.0203	.0031
2F5/2	.0145	.0025

4.700

2S1/2	-41.1354	.0092
2P3/2	-67.0974	.1215
2P1/2	32.0820	.1352
2D5/2	.0580	.0309
2D3/2	-.0111	.0251
2F7/2	.0211	.0032
2F5/2	.0151	.0026

4.750

2S1/2	-41.4152	.0092
2P3/2	-67.0000	.1214
2P1/2	32.5432	.1367
2D5/2	.0601	.0318
2D3/2	-.0109	.0258
2F7/2	.0219	.0033
2F5/2	.0157	.0027

4.800

2S1/2	-41.6931	.0093
2P3/2	-66.9116	.1213
2P1/2	33.0006	.1381
2D5/2	.0622	.0326
2D3/2	-.0107	.0264
2F7/2	.0227	.0034
2F5/2	.0163	.0028

LAB ENERGY	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION	LAB ENERGY	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
4.050	291/2	-41.9692	.0935	6.250	291/2	-49.0545	.1065
	293/2	-66.8316	.1212		293/2	-65.7632	.1293
	291/2	31.4541	.1395		291/2	40.2717	.1840
	205/2	.0644	.0330		205/2	.1504	.0611
	203/2	-.0184	.0271		203/2	.0068	.0094
	297/2	.0236	.0036		297/2	.0578	.0087
	295/2	.0169	.0029		295/2	.0414	.0072
4.000	291/2	-42.2436	.0940	6.500	291/2	-50.2003	.1092
	293/2	-66.7596	.1212		293/2	-67.0100	.1329
	291/2	33.9036	.1409		291/2	45.7360	.1900
	205/2	.0667	.0343		205/2	.1714	.0669
	203/2	-.0102	.0273		203/2	.0153	.0541
	297/2	.0244	.0037		297/2	.0663	.0100
	295/2	.0175	.0030		295/2	.0475	.0082
4.950	291/2	-42.5162	.0944	6.750	291/2	-51.3236	.1120
	293/2	-66.6952	.1211		293/2	-67.2993	.1372
	291/2	34.3090	.1423		291/2	47.1163	.2040
	205/2	.0690	.0351		205/2	.1942	.0730
	203/2	-.0049	.0285		203/2	.0231	.0540
	297/2	.0253	.0034		297/2	.0754	.0114
	295/2	.0162	.0031		295/2	.0542	.0090
5.000	291/2	-42.7871	.0949	7.000	291/2	-52.4136	.1151
	293/2	-66.5360	.1211		293/2	-67.6216	.1421
	291/2	34.7900	.1438		291/2	48.3778	.2140
	205/2	.0713	.0360		205/2	.2191	.0793
	203/2	-.0095	.0292		203/2	.0320	.0640
	297/2	.0263	.0040		297/2	.0858	.0130
	295/2	.0168	.0033		295/2	.0618	.0106
5.250	291/2	-44.1163	.0971	7.250	291/2	-53.4757	.1185
	293/2	-66.4478	.1215		293/2	-67.9704	.1478
	291/2	36.9278	.1511		291/2	49.5266	.2251
	205/2	.0840	.0405		205/2	.2461	.0858
	203/2	-.0075	.0320		203/2	.0423	.0693
	297/2	.0312	.0047		297/2	.0969	.0147
	295/2	.0224	.0030		295/2	.0690	.0120
5.500	291/2	-45.4054	.0990	7.500	291/2	-54.5110	.1221
	293/2	-66.3909	.1220		293/2	-68.3405	.1542
	291/2	38.9459	.1587		291/2	50.5692	.2362
	205/2	.0982	.0452		205/2	.2752	.0926
	203/2	-.0040	.0366		203/2	.0540	.0749
	297/2	.0369	.0055		297/2	.1089	.0165
	295/2	.0264	.0040		295/2	.0760	.0135
5.750	291/2	-46.6568	.1017	7.750	291/2	-55.5205	.1261
	293/2	-66.4383	.1241		293/2	-68.7271	.1612
	291/2	40.0376	.1660		291/2	51.5124	.2473
	205/2	.1130	.0503		205/2	.3067	.0996
	203/2	-.0012	.0407		203/2	.0612	.0800
	297/2	.0431	.0065		297/2	.1288	.0185
	295/2	.0309	.0053		295/2	.0873	.0151
6.000	291/2	-47.0725	.1040	8.000	291/2	-56.5852	.1304
	293/2	-66.5681	.1263		293/2	-69.1269	.1690
	291/2	42.5996	.1750		291/2	52.3631	.2590
	205/2	.1313	.0556		205/2	.3404	.1069
	203/2	.0033	.0450		203/2	.0862	.0862
	297/2	.0501	.0076		297/2	.1360	.0207
	295/2	.0359	.0062		295/2	.0973	.0169

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
8.250		
2S1/2	-57.4659	.1352
2P3/2	-69.5364	.1773
2P1/2	53.1281	.2708
2D5/2	.3766	.1143
2D3/2	.0985	.0922
2F7/2	.1511	.0230
2F5/2	.1081	.0187
8.500		
2S1/2	-58.4034	.1404
2P3/2	-69.9533	.1864
2P1/2	53.8137	.2827
2D5/2	.4154	.1220
2D3/2	.1168	.0984
2F7/2	.1672	.0254
2F5/2	.1196	.0207
8.750		
2S1/2	-59.3184	.1468
2P3/2	-70.3755	.1908
2P1/2	54.4263	.2949
2D5/2	.4567	.1300
2D3/2	.1369	.1008
2F7/2	.1845	.0281
2F5/2	.1320	.0229
9.000		
2S1/2	-60.2117	.1522
2P3/2	-70.8810	.2063
2P1/2	54.9717	.3072
2D5/2	.5087	.1381
2D3/2	.1589	.1113
2F7/2	.2030	.0309
2F5/2	.1451	.0252
9.250		
2S1/2	-61.0839	.1589
2P3/2	-71.2284	.2172
2P1/2	55.4554	.3197
2D5/2	.5475	.1464
2D3/2	.1830	.1188
2F7/2	.2227	.0340
2F5/2	.1592	.0276
9.500		
2S1/2	-61.9354	.1662
2P3/2	-71.6564	.2287
2P1/2	55.8826	.3324
2D5/2	.5971	.1549
2D3/2	.2092	.1249
2F7/2	.2436	.0372
2F5/2	.1741	.0303
9.750		
2S1/2	-62.7669	.1748
2P3/2	-72.0839	.2408
2P1/2	56.2582	.3454
2D5/2	.6496	.1637
2D3/2	.2375	.1319
2F7/2	.2658	.0406
2F5/2	.1899	.0330
10.000		
2S1/2	-63.5789	.1824
2P3/2	-72.5099	.2535
2P1/2	56.5864	.3585
2D5/2	.7051	.1726
2D3/2	.2682	.1391
2F7/2	.2893	.0442
2F5/2	.2066	.0359

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
10.250		
2S1/2	-64.3717	.1915
2P3/2	-72.9336	.2668
2P1/2	56.8715	.3719
2D5/2	.7637	.1817
2D3/2	.3012	.1465
2F7/2	.3141	.0481
2F5/2	.2243	.0390
10.500		
2S1/2	-65.1457	.2012
2P3/2	-73.3542	.2807
2P1/2	57.1173	.3856
2D5/2	.8254	.1911
2D3/2	.3366	.1541
2F7/2	.3403	.0521
2F5/2	.2430	.0423
10.750		
2S1/2	-65.9015	.2115
2P3/2	-73.7713	.2951
2P1/2	57.3271	.3996
2D5/2	.8900	.2006
2D3/2	.3745	.1618
2F7/2	.3679	.0564
2F5/2	.2626	.0458
11.000		
2S1/2	-66.6392	.2225
2P3/2	-74.1843	.3101
2P1/2	57.5043	.4139
2D5/2	.9586	.2103
2D3/2	.4151	.1697
2F7/2	.3970	.0609
2F5/2	.2833	.0490
11.250		
2S1/2	-67.3593	.2342
2P3/2	-74.5928	.3256
2P1/2	57.6519	.4285
2D5/2	1.0302	.2202
2D3/2	.4583	.1777
2F7/2	.4275	.0656
2F5/2	.3050	.0532
11.500		
2S1/2	-68.0621	.2466
2P3/2	-74.9963	.3417
2P1/2	57.7724	.4435
2D5/2	1.1052	.2303
2D3/2	.5043	.1860
2F7/2	.4595	.0706
2F5/2	.3277	.0572
11.750		
2S1/2	-68.7477	.2597
2P3/2	-75.3945	.3584
2P1/2	57.8680	.4588
2D5/2	1.1837	.2406
2D3/2	.5531	.1944
2F7/2	.4930	.0758
2F5/2	.3516	.0614
12.000		
2S1/2	-69.4166	.2736
2P3/2	-75.7871	.3756
2P1/2	57.9423	.4746
2D5/2	1.2658	.2512
2D3/2	.6048	.2030
2F7/2	.5281	.0813
2F5/2	.3765	.0658

LAB ENERGY	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION	LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
12.250	2S1/2	-70.0688	.2862	14.250	2S1/2	.4341
	2P3/2	-76.1739	.3933	2P3/2	-74.7117	.5509
	2P1/2	57.9962	.4908	2P1/2	-79.0395	.6390
	2D5/2	1.3515	.2619	2D5/2	2.1733	.3555
	2D3/2	.6594	.2117	2D3/2	1.2120	.2895
	2F7/2	.5648	.0871	2F7/2	.9178	.1426
12.500	2F5/2	.4025	.0704	2F5/2	.6527	.1147
	2S1/2	-70.7047	.3035	14.500	2S1/2	.4562
	2P3/2	-76.5548	.4116	2P3/2	-75.2224	.5776
	2P1/2	58.0321	.5074	2P1/2	-79.3675	.6603
	2D5/2	1.4408	.2728	2D5/2	57.8613	.3683
	2D3/2	.7171	.2207	2D3/2	2.2939	.3003
12.750	2F7/2	.6030	.0930	2F7/2	1.2965	.1508
	2F5/2	.4297	.0752	2F5/2	.9697	.1212
	2S1/2	-71.3243	.3197	14.750	2S1/2	.4793
	2P3/2	-76.9294	.4305	2P3/2	-75.7180	.6007
	2P1/2	58.0517	.5245	2P1/2	-79.6885	.6822
	2D5/2	1.5339	.2839	2D5/2	57.8024	.3814
13.000	2D3/2	.7760	.2299	2D3/2	2.4185	.3113
	2F7/2	.6429	.0993	2F7/2	1.3845	.1593
	2F5/2	.4580	.0802	2F5/2	1.0234	.1280
	2S1/2	-71.9280	.3367	15.000	2S1/2	.5034
	2P3/2	-77.2976	.4499	2P3/2	-76.1986	.6244
	2P1/2	58.0568	.5422	2P1/2	-80.0026	.7049
13.250	2D5/2	1.6307	.2952	2D5/2	57.7386	.3948
	2D3/2	.8420	.2393	2D3/2	2.5472	.3227
	2F7/2	.6845	.1058	2F7/2	1.4762	.1682
	2F5/2	.4874	.0854	2F5/2	1.0789	.1350
	2S1/2	-72.5159	.3544	15.250	2S1/2	.5284
	2P3/2	-77.6594	.4698	2P3/2	-76.6642	.6486
13.500	2P1/2	58.0489	.5604	2P1/2	-80.3097	.7284
	2D5/2	1.7314	.3068	2D5/2	57.6710	.4085
	2D3/2	.9092	.2488	2D3/2	2.6801	.3344
	2F7/2	.7277	.1126	2F7/2	1.5717	.1773
	2F5/2	.5181	.0908	2F5/2	1.1363	.1422
	2S1/2	-73.0880	.3731	15.500	2S1/2	.5544
13.750	2P3/2	-78.0145	.4903	2P3/2	-77.1149	.6733
	2P1/2	58.0294	.5791	2P1/2	-80.6099	.7527
	2D5/2	1.8359	.3186	2D5/2	57.6903	.4225
	2D3/2	.9798	.2586	2D3/2	2.8171	.3463
	2F7/2	.7726	.1197	2F7/2	1.6708	.1867
	2F5/2	.5499	.0964	2F5/2	1.1955	.1496
14.000	2S1/2	-73.6446	.3925	15.750	2S1/2	.5814
	2P3/2	-78.3630	.5113	2P3/2	-77.5508	.6986
	2P1/2	57.9997	.5985	2P1/2	-80.9031	.7777
	2D5/2	1.9444	.3306	2D5/2	57.5272	.4369
	2D3/2	1.0538	.2687	2D3/2	2.9584	.3507
	2F7/2	.8193	.1270	2F7/2	1.7738	.1965
14.250	2F5/2	.5829	.1023	2F5/2	1.2565	.1573
	2S1/2	-74.1858	.4120	16.000	2S1/2	.6094
	2P3/2	-78.7047	.5328	2P3/2	-77.9720	.7244
	2P1/2	57.9610	.6184	2P1/2	-81.1893	.8036
	2D5/2	2.0569	.3429	2D5/2	57.4526	.4516
	2D3/2	1.1312	.2700	2D3/2	3.1938	.3713
	2F7/2	.8676	.1347	2F7/2	1.8807	.2065
	2F5/2	.6172	.1080	2F5/2	1.3104	.1653

LAB ENERGY	PHASE SHIFT	STANDARD DEVIATION
16.250		
2S1/2	-78.3783	.6386
2P3/2	-81.4685	.7586
2P1/2	57.3772	.8384
2D5/2	3.2535	.4667
2D3/2	1.9914	.3844
2F7/2	1.3841	.2169
2F5/2	.9820	.1735
16.500		
2S1/2	-78.7700	.6688
2P3/2	-81.7408	.7774
2P1/2	57.3014	.8581
2D5/2	3.4074	.4822
2D3/2	2.1060	.3978
2F7/2	1.4500	.2275
2F5/2	1.0299	.1819
16.750		
2S1/2	-79.1471	.7000
2P3/2	-82.0062	.8047
2P1/2	57.2261	.8868
2D5/2	3.5656	.4981
2D3/2	2.2246	.4116
2F7/2	1.5193	.2385
2F5/2	1.0773	.1906
17.000		
2S1/2	-79.5095	.7325
2P3/2	-82.2648	.8325
2P1/2	57.1510	.9164
2D5/2	3.7280	.5145
2D3/2	2.3472	.4258
2F7/2	1.5897	.2499
2F5/2	1.1269	.1995