Documentation of the Operation of an
Arc-Heated Hydrogen Atom Source*

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An arc-heated, high intensity source of multi-eV kinetic energy hydrogen atoms for atomic and molecular beam studies has been obtained. While the basic source is the unit of Knuth, et al^{1,2,3} with minor modifications described elsewhere^{4,5,6,7} the difficult part of the present work is the technique necessary to obtain a stable hydrogen arc. In order to thoroughly document the operation of this source, a motion picture⁸ and this report have been prepared.

Our method is to strike the arc with Ar (H_2 will not work), then changeover to pure H_2 to achieve a "standard" arc⁴, and finally decrease the H_2 flow to achieve a "pencil" arc⁵ (the arc of highest energy and intensity). It should be emphasized that no two experimental runs produce arcs with exactly the same characteristics. Further, and undoubtedly one reason for this, the operations are done freehand. Thus no two runs have precisely the same pattern of increasing hydrogen flow rate and decreasing argon flow rate. Nevertheless, use of similar combinations of flow rates usually results in a successful changeover. (Even the present authors do not succeed on every changeover attempt.)

During one particular, successful, and fairly typical changeover (May 21, 1975), a video tape recording was made of the flowmeters (rotameters) in the hydrogen and argon lines, voltmeter indicating arc voltage, transducer readout indicating source stagnation chamber pressure, and a clock. Later the flowmeters were directly calibrated by trapping the gases over water and the readings from from the video tape were transcribed. (Each of these sets of readings was taken from a single frame of the video tape. Thus, such things as the bouncing motion

of the rotameter balls do introduce scatter into the data.) The conversion from raw data to flow rates and pressure was done by computer. The flow rates obtained from the two balls within each rotameter were averaged where possible. A print out of the final values constitutes the table in this report.

At the same time as the video tape was being made, a motion picture was taken⁸ of the arc. Although this film strictly speaking, is not a part of this report, it can be closely related to the data herein. Therefore, comments pertaining to the film will be made wherever appropriate.

Establishment of an Argon Arc

Although there is nothing particularly difficult about obtaining an argon arc, it is the first step in obtaining the hydrogen arc and is included here for completeness. Time 0:00 (in min:sec, see table) was the instant the power was applied to the source head. In the film, this is the instant the title, "The Arc is First . . . ", ends and the film becomes black immediately before the arc is struck. At time 0:03, the arc was struck using 50 amps current. The flow was then lowered somewhat. Following this, the current was raised to 125 amps and attained this value at time 0:18. The current was left at this value for the duration of the run. The flow was then further reduced until, at time 1:07, a standard argon arc was obtained.

Changeover from Argon to Hydrogen

At time 1:47, the changeover to hydrogen began. First, a shut off valve, located in the hydrogen line downstream of the metering valve, was slowly opened. During this period, a small amount of hydrogen which had accumulated between the metering valve and the shut off valve entered the arc. However, we estimate this initial flow of hydrogen never exceeded 0.05 millimoles/second.

At time 2:06, the shut off valve was fully open; at time 2:11, opening of the metering valve began. The slight initial drop in flow is due to the interaction of the hydrogen with the argon. At time 2:21, closing of the argon valve was begun. Flashes and voltage spikes, such as occurred around time 2:58 are common at this stage of the changeover. The flow rates of 0.56 millimoles/second hydrogen and 0.22 millimoles/second argon constitute a target point through which most successful changeovers pass. At time 3:53, adjustment of the hydrogen valve was discontinued. Although the argon flow was too small to be measured, the valve was not completely closed until time 4:15. During this last few seconds of the changeover the argon valve was turned very slowly since the arc is quite likely to become unstable during this stage. This instability may be due to the effects of high energy argon seeded in a hydrogen beam.

The Hydrogen Arc

In this particular run, when the changeover was complete at time 4:15, the arc showed a slight "pencil" character, that is, there was a faint, narrow, white streak from the source to the skimmer. Some adjustments were subsequently made to display various appearances of the arc. From time 4:42 to time 5:01, the metering valve was slowly opened. Between time 5:01 and time 5:31, no adjustments were made; the arc was very close to a standard (nonpencil) hydrogen arc. Beginning at time 5:31, the hydrogen metering valve was slowly adjusted downward until at time 6:34 a moderate pencil was obtained. The valve was not adjusted again for over 8 minutes.

Although the arc is otherwise very stable, the voltage does decrease somewhat with time (to about 30 v in an extended run). This phenomena is quite useful since both voltage and hydrogen atom signal increase with decreasing hydrogen flow. If, as happened in this run, the voltage approaches 40 v (approximately the limit of our supply under 125 amps load) before the flow

rate is decreased to the desired level, the adjustment is discontinued until the voltage drops somewhat. During this period the camera was stopped to conserve film; the portion not shown in the motion picture was from time 7:02 to time 14:48.

After the titles, the picture of the arc resumes at time 14:48. Beginning at time 14:57, the hydrogen valve was adjusted downward until time 15:55 when adjustment was discontinued for 12 seconds. Then it was adjusted downward again until time 16:25 when the most intense pencil of this run was obtained. The arc continued without further adjustment until the power was turned off at time 17:13½. The final reported flow and pressure readings were taken without changing any other controls. Thus they reflect the effect of the arc on the source pressure.

Table of Arc Parameters

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
0: 0	****	0.0	488.7	75.0
0: 3	****	0.0	500.9	8.2
0: 4	****	0.0	689.9	16.9
0: 5	****	0.0	928.3	31.5
0: 6	****	0.0	796.1	24.1
0: 7	****	0.0	843.3	21.9
0: 8	****	0.0	833.9	20.5
0: 9	****	0.0	816.1	20.1
0: 10	****	0.0	800.5	20.1
0: 11	****	0.0	779.0	19.6
0: 12	****	0.0	748.3	19.7
0: 13	****	0.0	617.4	19.0
0: 14	****	0.0	586.2	18.9
0: 15	****	0.0	512.7	18.6
0: 16	****	0.0	508.4	18.6
0: 17	****	0.0	508.4	18.3
0: 18	****	0.0	561.5	16.2
0: 19	****	0.0	452.1	15.6
0: 20	****	0.0	625.9	15.4
0: 21	****	0.0	637.7	15.2
0: 22	****	0.0	641.8	15.2
0: 23	****	0.0	642.7	15.1
0: 24	****	0.0	642.4	15.1
0: 25	****	0.0	641.5	15.1
0: 26	****	0.0	641.2	15.0
0: 27	****	0.0	638.7	15.0
0: 28	****	0.0	614.9	15.1
0: 29	****	0.0	533.7	14.9
0: 30	****	0.0	473.4	15.2
0: 31	****	0.0	428.4	16.0
0: 32	****	0.0	412.4	16.3
0: 33	****	0.0	398.1	16.3
0: 34	****	0.0	390.6	16.1
0: 35	3.26	0.0	389.9	16.1
0: 36	3.23	0.0	385.6	16.2

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
0: 37	3.26	0.0	384.0	16.2
0: 38	3.23	0.0	381.8	16.3
0: 39	3.20	0.0	379.9	16.1
0: 40	3.20	0.0	379.3	16.1
0: 41	3.20	0.0	377.1	16.5
0: 42	3.20	0.0	377.1	16.3
0: 43	3.17	0.0	376.2	16.3
0: 44	3.14	0.0	373.4	16.2
0: 45	3.12	0.0	372.8	16.4
0: 46	3.09	0.0	371.2	16.4
0: 47	3.09	0.0	370.9	16.2
0: 48	3.00	0.0	370.3	16.4
0: 49	2.88	0.0	364.3	16.7
0: 50	2.81	0.0	360.0	16.7
0: 51	2.72	0.0	358.4	16.6
0: 52	2.69	0.0	357.1	16.5
0: 53	2.59	0.0	353.4	16.6
0: 54	2.52	0.0	350.6	16.5
0: 55	2.55	0.0	349.6	16.5
0: 56	2.52	0.0	349.0	16.5
0: 57	2.49	0.0	347.1	16.4
0: 58	2.49	0.0	345.6	16.3
0: 59	2.49	0.0	344.6	16.4
1: 0	2.45	0.0	344.0	16.4
1: 1	2.45	0.0	343.4	16.4
1: 2	2.45	0.0	343.1	16.2
1: 3	2.45	0.0	343.1	16.2
1: 4	2.45	0.0	342.8	16.4
1: 5	2.45	0.0	342.8	16.4
1: 6	2.45	0.0	340.6	16.4
1: 7	2.45	0.0	340.6	16.3
1: 8	2.45	0.0	340.3	16.2
1: 13	2.50	0.0	339.3	16.2
1: 18	2.50	0.0	338.7	16.2
1: 23	2.50	0.0	338.1	16.2

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
1: 28	2.50	0.0	337.8	16.2
1: 33	2.50	0.0	337.5	16.2
1: 38	2.50	0.0	337.1	16.2
1: 43	2.52	0.0	336.8	16.2
1: 44	2.52	0.0	336.8	16.2
1: 45	2.52	0.0	336.8	16.2
1: 46	2.52	0.0	336.8	16.2
1: 47	2.52	0.0	336.8	16.2
1: 48	2.52	0.0	336.8	16.2
1: 49	2.52	0.0	336.8	16.2
1: 50	2.52	0.0	336.8	16.1
1: 51	2.52	0.0	337.1	16.1
1: 52	2.52	0.0	337.1	16.1
1: 53	2.52	0.0	337.1	16.0
1: 54	2.52	0.0	337.8	16.1
1: 55	2.52	0.0	338.4	16.1
1: 56	2.52	0.0	343.4	16.5
1: 57	2.52	0.0	350.3	16.8
1: 58	2.52	0.0	355.6	16.6
1: 59	2.52	0.0	355.9	16.6
2: 0	2.52	0.0	360.6	16.3
2: 1	2.52	0.0	363.4	16.4
2: 2	2.52	0.0	371.2	16.4
2: 3	2.52	0.0	371.2	16.5
2: 4	2.52	0.0	361.2	16.2
2: 5	2.52	0.0	360.6	16.3
2: 6	2.52	0.0	358.4	16.0
2: 7	2.52	0.0	356.5	15.9
2: 8	2.52	0.0	355.0	15.9
2: 9	2.52	0.0	354.3	15.9
2: 10	2.52	0.0	354.3	15.8
2: 11	2.52	0.0	354.0	15.9
2: 12	2.52	0.0	354.0	15.9
2: 13	2.52	0.0	354.3	15.9
2: 14	2.52	0.0	356.2	15.9

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLINCHES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDEGEN		
2: 15	2.52	0.0	358.4	16.1
2: 16	2.52	0.0	361.2	16.4
2: 17	2.48	0.0	369.9	16.4
2: 18	2.48	0.02	374.6	16.9
2: 19	2.48	0.05	378.4	17.0
2: 20	2.48	0.05	378.7	17.0
2: 21	2.41	0.05	377.8	17.1
2: 22	2.45	0.06	378.1	17.2
2: 23	2.38	0.07	377.4	17.2
2: 24	2.34	0.09	378.1	17.5
2: 25	2.34	0.11	378.1	17.6
2: 26	2.27	0.13	378.7	17.9
2: 27	2.35	0.16	380.9	18.0
2: 28	2.22	0.20	384.3	18.5
2: 29	2.20	0.23	388.4	18.7
2: 30	2.17	0.24	393.1	18.8
2: 31	2.15	0.25	393.4	19.1
2: 32	2.15	0.26	393.1	19.2
2: 33	2.12	0.29	391.5	19.4
2: 34	2.05	0.30	386.2	19.4
2: 35	2.04	0.32	386.8	19.6
2: 36	2.00	0.32	387.4	19.7
2: 37	1.97	0.33	386.8	19.8
2: 38	1.91	0.34	387.4	20.0
2: 39	1.82	0.35	386.5	20.3
2: 40	1.77	0.35	382.4	20.3
2: 41	1.66	0.40	378.4	20.7
2: 42	1.66	0.35	376.8	20.8
2: 43	1.61	0.42	374.9	20.9
2: 44	1.57	0.45	373.4	21.0
2: 45	1.56	0.44	374.3	21.0
2: 46	1.54	0.43	377.1	21.0
2: 47	1.53	0.46	378.1	21.1
2: 48	1.49	0.46	376.5	21.2
2: 49	1.46	0.46	374.3	21.3

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
2: 50	1.45	0.46	371.2	21.4
2: 51	1.41	0.46	369.9	21.5
2: 52	1.40	0.46	369.9	21.5
2: 53	1.37	0.45	366.2	21.6
2: 54	1.29	0.46	359.3	21.8
2: 55	1.27	0.46	358.4	21.9
2: 56	1.16	0.47	347.5	22.0
2: 57	1.11	0.47	329.6	25.0
2: 58	1.03	0.47	282.5	26.5
2: 59	1.03	0.49	238.7	28.2
3: 0	0.97	0.47	184.7	24.4
3: 1	0.92	0.46	153.4	21.8
3: 2	0.88	0.49	141.2	20.9
3: 3	0.75	0.48	124.7	20.6
3: 4	0.69	0.50	115.0	20.6
3: 5	0.65	0.48	108.7	20.7
3: 6	0.57	0.50	100.9	21.0
3: 7	0.53	0.50	94.7	21.1
3: 8	0.50	0.50	89.4	21.3
3: 9	0.46	0.54	84.1	21.4
3: 10	0.46	0.51	82.2	21.7
3: 11	0.46	0.57	81.2	21.7
3: 12	0.45	0.53	77.8	21.9
3: 13	0.42	0.57	75.3	22.1
3: 14	0.42	0.52	72.2	22.4
3: 15	0.33	0.55	68.7	22.5
3: 16	0.35	0.57	66.9	22.6
3: 17	0.37	0.56	65.9	22.6
3: 18	0.34	0.57	65.0	22.7
3: 19	0.29	0.54	62.2	23.1
3: 20	0.26	0.55	60.3	23.5
3: 21	0.28	0.57	58.4	23.6
3: 22	0.25	0.55	56.2	24.0
3: 23	0.20	0.56	52.8	24.6
3: 24	0.22	0.59	50.9	24.8

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
3: 25	0.22	0.56	50.6	24.7
3: 26	0.20	0.56	50.0	24.8
3: 27	0.22	0.54	49.4	24.9
3: 28	0.22	0.57	49.1	25.0
3: 29	0.20	0.56	48.4	25.4
3: 30	0.18	0.56	47.5	25.7
3: 31	0.15	0.57	46.6	25.9
3: 32	0.16	0.55	46.2	26.1
3: 33	0.11	0.57	44.7	26.5
3: 34	0.15	0.57	43.4	26.9
3: 35	0.15	0.60	42.2	27.3
3: 36	0.12	0.56	41.6	27.6
3: 37	0.10	0.59	41.2	27.7
3: 38	0.10	0.56	40.6	28.1
3: 39	0.10	0.56	39.7	28.7
3: 40	0.08	0.58	39.1	28.8
3: 41	0.08	0.57	38.7	29.0
3: 42	0.08	0.58	38.4	29.1
3: 43	0.08	0.55	38.1	29.4
3: 44	0.08	0.55	37.8	29.6
3: 45	0.08	0.56	37.2	29.9
3: 46	0.08	0.59	36.9	30.2
3: 47	0.06	0.58	36.2	30.7
3: 48	0.08	0.59	35.6	31.3
3: 49	0.04	0.59	35.0	31.7
3: 50	0.02	0.59	34.4	32.2
3: 51	0.0	0.58	34.4	32.2
3: 52	0.0	0.57	34.1	32.6
3: 53	0.0	0.61	33.7	32.9
3: 54	0.0	0.60	33.4	33.3
3: 55	0.0	0.62	33.1	33.4
3: 56	0.0	0.61	32.8	33.6
3: 57	0.0	0.61	32.8	33.6
3: 58	0.0	0.55	32.5	33.9
3: 59	0.0	0.61	32.2	34.5

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
4: 0	0.0	0.59	31.9	34.6
4: 1	0.0	0.62	31.6	34.7
4: 2	0.0	0.61	31.2	35.1
4: 3	0.0	0.59	30.9	35.3
4: 4	0.0	0.63	30.6	35.6
4: 5	0.0	0.58	30.6	35.6
4: 6	0.0	0.60	30.6	35.7
4: 7	0.0	0.60	30.3	35.7
4: 8	0.0	0.63	30.3	36.0
4: 9	0.0	0.57	30.0	36.1
4: 10	0.0	0.60	30.0	36.1
4: 11	0.0	0.59	30.0	36.2
4: 12	0.0	0.58	30.0	36.2
4: 13	0.0	0.59	29.7	36.5
4: 14	0.0	0.59	29.7	36.7
4: 15	0.0	0.62	29.7	36.4
4: 16	0.0	0.59	29.7	36.3
4: 17	0.0	0.65	29.7	36.4
4: 18	0.0	0.64	29.4	36.5
4: 23	0.0	0.63	29.4	36.6
4: 28	0.0	0.59	29.4	36.6
4: 33	0.0	0.58	29.4	36.6
4: 38	0.0	0.59	29.1	36.6
4: 39	0.0	0.59	29.1	36.6
4: 40	0.0	0.62	29.1	36.6
4: 41	0.0	0.58	29.4	36.6
4: 42	0.0	0.60	29.4	36.4
4: 43	0.0	0.59	29.7	36.2
4: 44	0.0	0.61	30.0	36.1
4: 45	0.0	0.68	30.0	36.0
4: 46	0.0	0.67	30.3	36.0
4: 47	0.0	0.67	30.3	35.9
4: 48	0.0	0.69	30.6	35.8
4: 49	0.0	0.66	30.9	35.8
4: 50	0.0	0.69	30.9	35.7

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
4: 51	0.0	0.68	31.2	35.6
4: 52	0.0	0.69	31.2	35.6
4: 53	0.0	0.69	31.6	35.5
4: 54	0.0	0.71	31.6	35.4
4: 55	0.0	0.71	31.9	35.4
4: 56	0.0	0.71	31.9	35.3
4: 57	0.0	0.73	31.9	35.4
4: 58	0.0	0.73	32.2	35.2
4: 59	0.0	0.74	31.9	35.4
5: 0	0.0	0.74	31.9	35.4
5: 1	0.0	0.74	31.9	35.3
5: 2	0.0	0.71	31.9	35.4
5: 3	0.0	0.70	31.9	35.3
5: 8	0.0	0.73	31.9	35.3
5: 13	0.0	0.72	31.9	35.1
5: 18	0.0	0.71	31.6	35.1
5: 23	0.0	0.71	31.6	35.0
5: 28	0.0	0.71	31.6	35.0
5: 31	0.0	0.71	31.6	34.8
5: 33	0.0	0.71	31.2	34.9
5: 38	0.0	0.69	29.7	35.7
5: 43	0.0	0.60	28.1	36.4
5: 48	0.0	0.57	27.5	36.9
5: 53	0.0	0.57	26.9	36.9
5: 58	0.0	0.56	26.9	36.8
6: 3	0.0	0.56	26.9	36.9
6: 8	0.0	0.55	26.2	37.2
6: 13	0.0	0.50	25.6	37.7
6: 18	0.0	0.51	25.3	38.0
6: 23	0.0	0.51	25.0	38.0
6: 28	0.0	0.50	24.7	38.2
6: 33	0.0	0.51	24.4	38.4
6: 34	0.0	0.51	24.4	38.4
6: 38	0.0	0.48	24.4	38.4
6: 43	0.0	0.48	24.4	38.3

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
6: 48	0.0	0.49	24.4	38.3
6: 53	0.0	0.50	24.4	38.1
6: 58	0.0	0.48	24.4	38.2
7: 3	0.0	0.49	24.4	38.1
7: 8	0.0	0.51	24.4	38.1
7: 12	0.0	0.50	24.4	38.0
7: 13	0.0	0.50	24.4	38.1
7: 14	0.0	0.49	24.4	38.0
7: 18	0.0	0.50	24.4	38.0
7: 28	0.0	0.50	24.1	37.9
7: 43	0.0	0.49	24.4	37.9
7: 58	0.0	0.47	24.1	37.8
8: 13	0.0	0.50	24.1	37.5
8: 28	0.0	0.49	24.1	37.6
8: 43	0.0	0.49	24.1	37.5
8: 58	0.0	0.48	24.1	37.3
9: 13	0.0	0.48	24.1	37.2
9: 28	0.0	0.52	24.1	37.1
9: 43	0.0	0.48	23.7	37.0
9: 58	0.0	0.50	23.7	36.9
10: 13	0.0	0.51	23.7	36.8
10: 28	0.0	0.49	23.7	36.8
10: 43	0.0	0.48	23.7	36.6
10: 58	0.0	0.46	23.7	36.5
11: 13	0.0	0.51	23.4	36.4
11: 28	0.0	0.49	23.4	36.3
11: 43	0.0	0.49	23.4	36.2
11: 58	0.0	0.48	23.4	36.2
12: 13	0.0	0.50	23.4	36.0
12: 28	0.0	0.50	23.1	35.9
12: 43	0.0	0.49	23.1	35.8
12: 58	0.0	0.48	23.1	35.8
13: 13	0.0	0.48	23.1	35.7
13: 28	0.0	0.49	23.1	35.7
13: 43	0.0	0.49	23.1	35.6

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
13: 58	0.0	0.48	23.1	35.5
14: 13	0.0	0.49	22.8	35.5
14: 28	0.0	0.49	22.8	35.4
14: 43	0.0	0.48	22.8	35.4
14: 48	0.0	0.50	22.8	35.3
14: 53	0.0	0.50	22.8	35.3
14: 57	0.0	0.50	22.8	35.4
14: 58	0.0	0.49	22.8	35.3
15: 3	0.0	0.48	22.2	36.0
15: 8	0.0	0.45	21.6	36.3
15: 13	0.0	0.44	21.2	36.4
15: 18	0.0	0.45	20.9	36.7
15: 23	0.0	0.42	20.6	37.0
15: 28	0.0	0.40	20.3	37.4
15: 31	0.0	0.38	20.0	37.7
15: 33	0.0	0.39	20.0	37.7
15: 38	0.0	0.38	19.4	38.3
15: 40	0.0	0.38	19.1	38.5
15: 43	0.0	0.38	19.1	38.5
15: 48	0.0	0.37	18.7	38.8
15: 53	0.0	0.36	18.4	39.0
15: 55	0.0	0.36	18.4	38.9
15: 58	0.0	0.39	19.1	38.3
16: 3	0.0	0.38	19.1	38.2
16: 7	0.0	0.39	19.1	38.2
16: 8	0.0	0.40	19.1	38.2
16: 13	0.0	0.36	17.5	40.4
16: 18	0.0	0.35	17.8	39.9
16: 23	0.0	0.35	17.8	39.9
16: 25	0.0	0.34	17.8	39.8
16: 28	0.0	0.36	17.8	39.8
16: 33	0.0	0.34	17.8	39.7
16: 38	0.0	0.35	17.8	39.7
16: 43	0.0	0.35	17.8	39.6
16: 48	0.0	0.35	17.8	39.6

Table of Arc Parameters continued

TIME (MIN: SEC)	FLOW (MILLIMOLES/SEC)		SOURCE PRESSURE (TORR)	ARC VOLTAGE (V)
	ARGON	HYDROGEN		
16: 53	0.0	0.33	17.8	39.6
16: 58	0.0	0.35	17.8	39.5
17: 3	0.0	0.34	17.8	39.4
17: 8	0.0	0.35	17.8	39.5
17: 13	0.0	0.35	17.8	39.5
17: 18	0.0	0.35	2.8	0.0
17: 23	0.0	0.34	2.2	0.0
17: 28	0.0	0.35	1.9	0.0
17: 33	0.0	0.34	1.9	0.0
17: 43	0.0	0.35	1.9	0.0
17: 58	0.0	0.33	1.9	0.0
18: 13	0.0	0.34	1.9	0.0

Notes

1. E. I. Knuth, "Second Status Report on Development and Application of an Intermediate-Energy High-Intensity Molecular Beam", UCLA Department of Engineering Report #66-19 (April 1966).
2. Wen-Shean Young, "An Arc-Heated Ar-He Binary Supersonic Molecular Beam with Energies up to 21 eV" UCLA Department of Engineering Report #69-39 (July 1969).
3. M. S. Young, W. E. Rodgers, and E. I. Knuth, Rev. Sci. Instrum., 40 1346 (1969).
4. W. C. Stwalley, "The Distribution of Energy in Bimolecular Chemiluminescent Reactions Involving Hydrogen Atoms", United States Atomic Energy Commission Report COO-2326-3 (Progress Report for May 1, 1973 to April 30, 1974).
5. W. C. Stwalley, "The Distribution of Energy in Bimolecular Chemiluminescent Reactions Involving Hydrogen Atoms" United States Energy Research and Development Administration Report COO-2326-8 (Progress Report for May 1, 1974 to April 30, 1975).
6. K. R. Way, S. C. Yang, and W. C. Stwalley, "A High-Intensity Superthermal Source of Hydrogen Atoms", Abstracts of the IXth International Conference on the Physics of Electronic and Atomic Collisions, University of Washington Press (Seattle, Washington, 1975).
7. K. R. Way, S. C. Yang, and W. C. Stwalley, submitted to Rev. Sci. Instrum. (1976).
8. K. R. Way, S. C. Yang, and W. C. Stwalley, "Operation of a Superthermal Arc-Heated Hydrogen Atom Source". This film may be rented from Media Library, Audio Visual Center, University of Iowa, Iowa City, Iowa 52242, catalog number U-30354. The exposure was 1/50 sec at f-8 using Eastman Color Reversal, 16 mm, Type 7242 film, ASA 125. The nominal transport rate was 24 frames/sec; however, the actual rate was very close to 25 frames/sec. The source to skimmer tip distance was 8.9 cm.