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ABSOLUTE PHOTOIONIZATION CROSS-SECTION TABLES FOR HELIUM, NEON, ARGON, AND KRYPTON IN THE VUV SPECTRAL REGIONS

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Photoionization cross sections form part of the basic data for energy balance and radiation transfer processes in the fields of aeronomy, astrophysics, and plasma physics. Since considerable theoretical effort has now been invested in the development of calculations, there is a need for reliable absolute atomic cross sections for comparison in order to judge the desirability of calculations on atoms and ions which are difficult to study quantitatively in the laboratory. Experimental data are now available for the lighter inert gases. The present paper presents tabulations of recommended values based on critically evaluated results from a number of recent experiments.

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INTRODUCTION

Photoionization continuum cross-section measurements initially employed photographic recording techniques (Baker et al.,[1] Lowry et al.,[2] Marr.,[3] and Ederer and Tomboulian[4]) and also Geiger-counter detectors at the high-energy end of the spectrum. Samson[5] significantly improved the accuracy of the inert-gas absolute cross-section data by using a double ion chamber (Samson[6]). More recently synchrotron radiation has been used to provide an effective continuum for absorption measurements. Haensel et al.[7] reported data on krypton and xenon from Hamburg synchrotron measurements in the 100- to 130-Å region. Watson[8] reported cross-section data on helium, neon, and argon, while Lang and Watson[9] reported similar data for krypton and xenon in the 50- to 200-Å region from the Glasgow synchrotron. The National Bureau of Standards synchrotron has also been employed (Codling[10] and references therein) to study spectral regions of the inert gases where autoionization features are apparent, while Carlson et al.[11] used the Wisconsin storage ring to obtain cross-section data for argon between threshold and 170 Å. The present authors (West and Marr[12]) have obtained new data with the Daresbury synchrotron in the range 40–350 Å.

In the experiments of West and Marr[12] an attempt was made to examine the data for both random and systematic errors and to reduce these errors to a minimum consistent with the techniques available. For comparison with other published data, the following precautions were used:

(i) The intensity ratios of transmitted and incident fluxes were obtained from simultaneously measured values of I_0 and I corrected for dark current and averaged over a wide range of pressure for each wavelength step throughout the spectrum. Each individual intensity ratio was obtained within a stipulated accuracy of 1%.

(ii) The length of the absorption cell was precisely determined in the absence of end effects to an accuracy of 0.25%.

(iii) The cell was constructed to minimize pressure gradients along its length and was long enough to ensure that the Lambert-Beer law strictly applies.

(iv) The monochromator was designed to remove higher-order radiation. The low-intensity scattered light, most of which was accounted for automatically by the data processing, has $\leqslant 1\%$ effect on the final results.

(v) The absorption cell was located after the monochromator exit slit to minimize population variations due to photon excitation.

(vi) Contamination from impurity species was minimized by careful outgassing and the use of slow gas-flow techniques. The effect of extraneous absorption is $<0.5\%$ on the final results.

(vii) The gas pressure was kept constant throughout each experiment by an automatic needle valve system.

(viii) A stable, clean, and reproducible source of continuous radiation was available from the NINA synchrotron throughout the entire wavelength range of measurement.

While it is believed that the recent West-Marr data are reliable, it is possible to reduce systematic errors by combining the data of different workers and to obtain a best-value curve by fitting polynomials to the weighted data points. Reasonable weighting of the data is, in general, a difficult matter. The following points were considered:

(a) Number and consistency (that is, the freedom from scatter of data points),

(b) Amount of information given on the experimental technique,

(c) Characteristics of the source used,

(d) Performance and quality of the monochromator used, and
(e) The proportion of the features (i)–(viii) involved in the data determinations.

In the region between 50 Å and 350 Å the present authors' data[12] were given a weight of unity. In regions outside this wavelength range the best measurements from other workers, judged by points (a)–(e) above, were also given a weight of unity. When there was good agreement between West-Marr[12] and other-author data within a common wavelength region, it was assumed that other-author data were equally reliable in other regions. Thus, in the long wavelength region, the data of Samson,[5] and in the short wavelength region, the data of Henke et al.,[13] were given unit weight.

The polynomial curve-fitting procedure was used over sections of the continuum between edge discontinuities so that features such as the $2p$ threshold in argon at 50.6 Å were not smeared out. Regions containing autoionization structure were assumed to be continuous. These regions[10] of discrete Rydberg structure leading to the various ionization edges can cause local deviations from the photoionization cross-section curves. It is not the intention of the authors to include these variations in the tables and considerable care should be exercised in the interpretation of the cross sections where autoionization lines coincide with wavelengths of interest.

The best-value data from the analysis are collected in the Tables 1–4 for helium, neon, argon, and krypton, respectively. At the end of each Table a list of authors whose data have been used is presented, together with information on the spectral range of their experiments.

Uncertainties

The uncertainties in the final values of the cross sections derived from weighted means were calculated from the rms deviations in the polynomial coefficients and, in general, a probable error of between 2% and 3% resulted. This varied according to the scatter in published data and was most serious for all of the gases in the region between 350 Å and the onset of photoionization.

For helium the critically evaluated data may be compared with the calculated data of Bell and Kingston.[14] For energies below the onset of double ionization (79 eV) the calculated data, modified by the inclusion of oscillator strength sum considerations, are essentially within ±3% of the critically evaluated experimental data.

A set of abbreviated critically evaluated tables and a detailed comparison between theory and experiment is presented in West and Marr.[12]

Acknowledgment

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TABLE 1. The Total Photoionization Cross Section of Helium from 504 Å to 1.5 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
504.0	24.60	7.56	300.0	41.33	2.89	95.0	130.5	0.233
500.0	24.80	7.46	295.0	42.03	2.80	90.0	137.8	0.202
495.0	25.05	7.33	290.0	42.75	2.70	85.0	145.9	0.174
490.0	25.30	7.19	285.0	43.50	2.61	80.0	155.0	0.147
485.0	25.56	7.06	280.0	44.28	2.52	75.0	165.3	0.123
480.0	25.83	6.94	275.0	45.08	2.44	70.0	177.1	0.100
475.0	26.10	6.81	270.0	45.92	2.35	65.0	190.7	0.0795
470.0	26.38	6.68	265.0	46.78	2.26	60.0	206.6	0.0609
465.0	26.66	6.55	260.0	47.68	2.18	55.0	225.4	0.0443
460.0	26.95	6.43	255.0	48.62	2.10	50.0	248.0	0.0315
455.0	27.25	6.30	250.0	49.59	2.02	48.0	258.3	0.0282
450.0	27.55	6.18	245.0	50.60	1.94	46.0	269.5	0.0250
445.0	27.86	6.05	240.0	51.66	1.86	44.0	281.8	0.0220
440.0	28.18	5.93	235.0	52.76	1.78	42.0	295.2	0.0193
435.0	28.50	5.81	230.0	53.90	1.70	40.0	310.0	0.0168
430.0	28.83	5.69	225.0	55.10	1.63	38.0	326.3	0.0145
425.0	29.17	5.57	220.0	56.35	1.55	36.0	344.4	0.0124
420.0	29.52	5.45	215.0	57.67	1.48	34.0	364.7	0.0105
415.0	29.87	5.33	210.0	59.04	1.41	32.0	387.4	0.00885
410.0	30.24	5.21	205.0	60.48	1.34	30.0	413.3	0.00736
405.0	30.61	5.10	200.0	61.99	1.28	28.0	442.8	0.00604
400.0	30.99	4.98	195.0	63.58	1.21	26.0	476.9	0.00489
395.0	31.39	4.87	190.0	65.25	1.14	24.0	516.6	0.00389
390.0	31.79	4.76	185.0	67.02	1.08	22.0	563.6	0.00303
385.0	32.20	4.64	180.0	68.88	1.02	20.0	619.9	0.00231
380.0	32.63	4.53	175.0	70.85	0.961	19.0	652.5	0.00199
375.0	33.06	4.42	170.0	72.93	0.903	18.0	688.8	0.00171
370.0	33.51	4.31	165.0	75.14	0.847	17.0	729.3	0.00145
365.0	33.97	4.20	160.0	77.49	0.792	16.0	774.9	0.00122
360.0	34.44	4.09	155.0	79.99	0.738	15.0	826.5	0.00101
355.0	34.92	4.00	150.0	82.65	0.687	14.0	885.6	0.000832
350.0	35.42	3.88	145.0	85.50	0.637	13.0	953.7	0.000673
345.0	35.94	3.78	140.0	88.56	0.588	12.0	1033	0.000535
340.0	36.46	3.68	135.0	91.84	0.542	11.0	1127	0.000417
335.0	37.01	3.57	130.0	95.37	0.497	10.0	1240	0.000318
330.0	37.57	3.47	125.0	99.18	0.454	9.5	1305	0.000274
325.0	38.15	3.37	120.0	103.3	0.412	9.0	1378	0.000235
320.0	38.74	3.27	115.0	107.8	0.373	8.5	1459	0.000200
315.0	39.36	3.18	110.0	112.7	0.335	8.0	1550	0.000168
310.0	39.99	3.08	105.0	118.1	0.299	7.5	1653	0.000139
305.0	40.65	2.98	100.0	124.0	0.265	7.0	1771	0.000115

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TABLE 1. The Total Photoionization Cross Section of Helium from 504 Å to 1.5 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
6.5	1907	0.000093	4.5	2755	0.000032	3.0	4133	0.000010
6.0	2066	0.000074	4.0	3100	0.000023	2.5	4959	0.000006
5.5	2254	0.000057	3.5	3542	0.000016	2.0	6199	0.000003
5.0	2480	0.000044				1.5	8265	0.000001

Table 1. Helium

Wavelength range (Å)	Origin of experimental data
93 - 504	Baker et al[1]
	Lowry et al[2]
304 - 498	Cairns and Samson[15]
239 - 492	Lee and Weissler[16]
46 - 338	West and Marr[12]
44.6 - 113.8	Henke et al[13]
44,6	Dershem and Schein[17]
44.4 - 250.5	Lukirskii et al[18]
179 - 299	Axelrod and Givens[19]
53.1 - 186	Watson[8]
209.3 503	Samson[5]
1.54 - 4.15	Bearden[20]
1.0 - 17.67	Compton and Allison[21]

TABLE 2. The Total Photoionization Cross Section of Neon from 575 Å to 0.2 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
575.0	21.56	6.21	370.0	33.51	8.96	165.0	75.14	5.68
570.0	21.75	6.33	365.0	33.97	8.96	160.0	77.49	5.52
565.0	21.94	6.46	360.0	34.44	8.95	155.0	79.99	5.35
560.0	22.14	6.58	355.0	34.92	8.94	150.0	82.65	5.17
555.0	22.34	6.71	350.0	35.42	8.93	145.0	85.50	4.99
550.0	22.54	6.82	345.0	35.94	8.91	140.0	88.56	4.81
545.0	22.75	6.94	340.0	36.46	8.89	135.0	91.84	4.62
540.0	22.96	7.05	335.0	37.01	8.86	130.0	95.37	4.43
535.0	23.17	7.16	330.0	37.57	8.83	125.0	99.18	4.23
530.0	23.39	7.26	325.0	38.15	8.80	120.0	103.3	4.03
525.0	23.62	7.37	320.0	38.74	8.77	115.0	107.8	3.76
520.0	23.84	7.47	315.0	39.36	8.73	110.0	112.7	3.50
515.0	24.07	7.56	310.0	39.99	8.68	105.0	118.1	3.25
510.0	24.31	7.66	305.0	40.65	8.63	100.0	124.0	2.98
505.0	24.55	7.75	300.0	41.33	8.58	98.0	126.5	2.87
500.0	24.80	7.83	295.0	42.03	8.53	96.0	129.2	2.76
495.0	25.05	7.92	290.0	42.75	8.47	94.0	131.9	2.65
490.0	25.30	8.00	285.0	43.50	8.41	92.0	134.8	2.54
485.0	25.56	8.08	280.0	44.28	8.34	90.0	137.8	2.44
480.0	25.83	8.15	275.0	45.08	8.27	88.0	140.9	2.33
475.0	26.10	8.23	270.0	45.92	8.19	86.0	144.2	2.23
470.0	26.38	8.29	265.0	46.78	8.11	84.0	147.6	2.12
465.0	26.66	8.36	260.0	47.68	8.03	82.0	151.2	2.02
460.0	26.95	8.42	255.0	48.62	7.95	80.0	155.0	1.92
455.0	27.25	8.48	250.0	49.59	7.85	78.0	159.0	1.82
450.0	27.55	8.54	245.0	50.60	7.76	76.0	163.1	1.71
445.0	27.86	8.59	240.0	51.66	7.66	74.0	167.5	1.61
440.0	28.18	8.64	235.0	52.76	7.56	72.0	172.2	1.52
435.0	28.50	8.68	230.0	53.90	7.45	70.0	177.1	1.43
430.0	28.83	8.72	225.0	55.10	7.34	68.0	182.3	1.35
425.0	29.17	8.76	220.0	56.35	7.23	66.0	187.9	1.27
420.0	29.52	8.80	215.0	57.67	7.11	64.0	193.7	1.17
415.0	29.87	8.83	210.0	59.04	6.98	62.0	200.0	1.08
410.0	30.24	8.86	205.0	60.48	6.86	60.0	206.6	0.992
405.0	30.61	8.88	200.0	61.99	6.72	58.0	213.8	0.909
400.0	30.99	8.91	195.0	63.58	6.59	56.0	221.4	0.830
395.0	31.39	8.92	190.0	65.25	6.45	54.0	229.6	0.756
390.0	31.79	8.94	185.0	67.02	6.30	52.0	238.4	0.686
385.0	32.20	8.95	180.0	68.88	6.15	50.0	248.0	0.620
380.0	32.63	8.96	175.0	70.85	6.00	48.0	258.3	0.558
375.0	33.06	8.96	170.0	72.93	5.84	46.0	269.5	0.500

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TABLE 2. The Total Photoionization Cross Section of Neon from 575 Å to 0.2 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
44.0	281.8	0.445	9.8	1265	0.139	5.0	2480	0.0223
42.0	295.2	0.395	9.6	1291	0.131	4.8	2583	0.0199
40.0	310.0	0.348	9.4	1319	0.124	4.6	2695	0.0177
38.0	326.3	0.305	9.2	1348	0.117	4.4	2818	0.0157
36.0	344.4	0.265	9.0	1378	0.110	4.2	2952	0.0138
34.0	364.7	0.229	8.8	1409	0.104	4.0	3100	0.0121
32.0	387.4	0.196	8.6	1441	0.0974	3.8	3263	0.0105
30.0	413.3	0.166	8.4	1476	0.0913	3.6	3444	0.00910
28.0	442.8	0.139	8.2	1512	0.0855	3.4	3647	0.00779
26.0	476.9	0.115	8.0	1550	0.0800	3.2	3874	0.00661
24.0	516.6	0.0932	7.8	1589	0.0746	3.0	4133	0.00554
22.0	563.6	0.0745	7.6	1631	0.0695	2.8	4428	0.00459
20.0	619.9	0.0582	7.4	1675	0.0647	2.6	4769	0.00376
19.0	652.5	0.0510	7.2	1722	0.0600	2.4	5166	0.00302
18.0	688.8	0.0444	7.0	1771	0.0556	2.2	5636	0.00238
17.0	729.3	0.0383	6.8	1823	0.0514	2.0	6199	0.00184
16.0	774.9	0.0328	6.6	1878	0.0474	1.8	6888	0.00138
15.0	826.5	0.0277	6.4	1937	0.0436	1.6	7749	0.00100
14.3	867.0	0.0245	6.2	2000	0.0400	1.4	8856	0.000697
14.0	885.6	0.367	6.0	2066	0.0366	1.2	10330	0.000458
13.0	953.7	0.300	5.8	2138	0.0333	1.0	12400	0.000279
12.0	1033	0.241	5.6	2214	0.0303	0.8	15500	0.000152
11.0	1127	0.190	5.4	2296	0.0274	0.6	20670	0.000069
10.0	1240	0.147	5.2	2384	0.0248	0.4	31000	0.000023
						0.2	62000	0.000003

Table 2. Neon

Wavelength range (Å)	Origin of experimental data
243 - 575	Lee and Weissler[22]
83.5 - 558.5	Ederer and Tomboulian[4]
190 - 575	Samson[23]
192.9 - 573.5	Samson[5]
53.2 - 199	Watson[8]
211 - 575	Ditchburn[24]
45.4 - 338	West and Marr[12]
282 - 574	Comes and Elzer[25]
1 - 8	Wuilleumier[26]
8.34 - 113.8	Henke et al[13]
1.54 - 14.6	Bearden[20]

TABLE 3. The Total Photoionization Cross Section of Argon from 783 Å to 0.2 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
783.0	15.83	29.2	380.0	32.63	17.1	46.0	269.5	3.83
780.0	15.89	29.5	370.0	33.51	15.0	44.0	281.8	3.45
770.0	16.10	30.3	360.0	34.44	12.8	42.0	295.2	3.10
760.0	16.31	31.1	350.0	35.42	10.3	40.0	310.0	2.76
750.0	16.53	31.8	340.0	36.46	7.77	38.0	326.3	2.45
740.0	16.75	32.5	330.0	37.57	6.10	36.0	344.4	2.16
730.0	16.98	33.1	320.0	38.74	4.62	34.0	364.7	1.89
720.0	17.22	33.7	310.0	39.99	3.41	32.0	387.4	1.64
710.0	17.46	34.2	300.0	41.33	2.47	30.0	413.3	1.41
700.0	17.71	34.7	290.0	42.75	1.77	28.0	442.8	1.20
690.0	17.97	35.1	280.0	44.28	1.30	26.0	476.9	1.01
680.0	18.23	35.5	270.0	45.92	1.03	24.0	516.6	0.836
670.0	18.50	35.8	260.0	47.68	0.914	22.0	563.6	0.682
660.0	18.78	36.1	250.0	49.59	0.916	20.0	619.9	0.546
650.0	19.07	36.3	240.0	51.66	1.00	19.0	652.5	0.484
640.0	19.37	36.5	230.0	53.90	1.13	18.0	688.8	0.426
630.0	19.68	36.6	220.0	56.35	1.28	17.0	729.3	0.373
620.0	20.00	36.7	210.0	59.04	1.36	16.0	774.9	0.324
610.0	20.32	36.8	200.0	61.99	1.42	15.0	826.5	0.278
600.0	20.66	36.7	190.0	65.25	1.45	14.0	885.6	0.237
590.0	21.01	36.7	180.0	68.88	1.48	13.0	953.7	0.199
580.0	21.38	36.5	170.0	72.93	1.48	12.0	1033	0.165
570.0	21.75	36.3	160.0	77.49	1.47	11.0	1127	0.135
560.0	22.14	36.1	150.0	82.65	1.45	10.0	1240	0.108
550.0	22.54	35.7	140.0	88.56	1.41	9.5	1305	0.0955
540.0	22.96	35.4	130.0	95.37	1.36	9.0	1378	0.0842
530.0	23.39	34.9	120.0	103.3	1.29	8.5	1459	0.0736
520.0	23.84	34.4	110.0	112.7	1.20	8.0	1550	0.0639
510.0	24.31	33.8	100.0	124.0	1.10	7.5	1653	0.0549
500.0	24.80	33.1	95.0	130.5	1.05	7.0	1771	0.0467
490.0	25.30	32.3	90.0	137.8	0.987	6.5	1907	0.0393
480.0	25.83	31.4	85.0	145.9	0.923	6.0	2066	0.0326
470.0	26.38	30.5	80.0	155.0	0.856	5.5	2254	0.0266
460.0	26.95	29.5	75.0	165.3	0.785	5.0	2480	0.0213
450.0	27.55	28.3	70.0	177.1	0.709	4.5	2755	0.0166
440.0	28.18	27.1	65.0	190.7	0.630	4.0	3100	0.0126
430.0	28.83	25.7	60.0	206.6	0.547	3.87	3204	0.0117
420.0	29.52	24.3	55.0	225.4	0.461	3.80	3263	0.0959
410.0	30.24	22.7	50.6	245.0	0.381	3.60	3444	0.0827
400.0	30.99	21.0	50.0	248.0	4.66	3.40	3646	0.0706
390.0	31.79	19.1	48.0	258.3	4.23	3.20	3874	0.0598

TABLE 3. The Total Photoionization Cross Section of Argon from 783 Å to 0.2 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
3.00	4133	0.0501	2.00	6199	0.0164	1.00	12400	0.00244
2.80	4428	0.0414	1.80	6888	0.0123	0.80	15500	0.00132
2.60	4768	0.0338	1.60	7749	0.00889	0.60	20660	0.000599
2.40	5166	0.0271	1.40	8856	0.00616	0.40	31000	0.000196
2.20	5635	0.0213	1.20	10330	0.00403	0.20	61990	0.000029

Table 3. Argon

Wavelength range (Å)	Origin of experimental data
600 - 770	Huffman et al[27]
246 - 778	Rustgi[28]
600 - 780	Metzger and Cook[29]
304 - 780	Cairns and Samson[15]
450 - 781	Blackwell et al[30]
200 - 700	Carlson et al[11]
475 - 769	Wainfan et al[31]
454 - 329	West and Marr[12]
281 - 574	Comes and Elzer[25]
209.3 - 783.2	Samson[5]
57.1 - 199	Watson[8]
834 - 113.8	Henke et al[12]
44.6	Dershem and Schein[17]
4 - 251.5	Lukirskii and Zimkina[18]
0.59 - 8	Wuilleumier[26]
1.54 - 14.6	Bearden[20]

TABLE 4. The Total Photoionization Cross Section of Krypton from 884 Å to 1.6 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
884.0	14.02	29.6	480.0	25.83	25.8	85.0	145.9	4.49
880.0	14.09	30.8	470.0	26.38	24.5	80.0	155.0	4.88
870.0	14.25	33.5	460.0	26.95	23.2	75.0	165.3	5.16
860.0	14.42	35.8	450.0	27.55	21.9	70.0	177.1	5.31
850.0	14.59	37.6	440.0	28.18	20.6	65.0	190.7	5.31
840.0	14.76	39.1	430.0	28.83	19.2	60.0	206.6	5.16
830.0	14.94	40.2	420.0	29.52	17.8	55.0	225.4	4.88
820.0	15.12	41.2	410.0	30.24	16.5	50.0	248.0	4.47
810.0	15.31	41.8	400.0	30.99	15.1	48.0	258.3	4.28
800.0	15.50	42.3	390.0	31.79	13.8	46.0	269.5	4.08
790.0	15.69	42.6	380.0	32.63	12.5	44.0	281.8	3.87
780.0	15.89	42.8	370.0	33.51	11.2	42.0	295.1	3.64
770.0	16.10	42.9	360.0	34.44	9.96	40.0	310.0	3.41
760.0	16.31	42.9	350.0	35.42	8.78	38.0	326.3	3.18
750.0	16.53	42.8	340.0	36.46	7.67	36.0	344.4	2.94
740.0	16.75	42.7	330.0	37.57	6.62	34.0	364.7	2.70
730.0	16.98	42.5	320.0	38.74	5.66	32.0	387.4	2.47
720.0	17.22	42.2	310.0	39.99	4.78	30.0	413.3	2.24
710.0	17.46	42.0	300.0	41.33	3.98	28.0	442.8	2.01
700.0	17.71	41.7	290.0	42.75	3.43	26.0	476.9	1.79
690.0	17.97	41.4	280.0	44.28	2.93	24.0	516.6	1.58
680.0	18.23	41.0	270.0	45.92	2.47	22.0	563.6	1.37
670.0	18.50	40.6	260.0	47.68	2.05	20.0	619.9	1.17
660.0	18.78	40.2	250.0	49.59	1.68	18.0	688.8	0.933
650.0	19.07	39.8	240.0	51.66	1.36	16.0	774.9	0.709
640.0	19.37	39.3	230.0	53.90	1.11	14.0	885.6	0.520
630.0	19.68	38.8	220.0	56.35	0.943	12.0	1033	0.363
620.0	20.00	38.3	210.0	59.04	0.838	10.0	1240	0.238
610.0	20.32	37.7	200.0	61.99	0.789	9.0	1378	0.186
600.0	20.66	37.1	190.0	65.25	0.737	8.0	1550	0.142
590.0	21.01	36.4	180.0	68.88	0.697	7.3	1698	0.114
580.0	21.38	35.7	170.0	72.93	0.671	7.0	1771	0.756
570.0	21.75	35.0	160.0	77.49	0.652	6.8	1823	0.700
560.0	22.14	34.2	150.0	82.65	0.633	6.6	1878	0.646
550.0	22.54	33.3	140.0	88.56	0.607	6.4	1937	0.596
540.0	22.96	32.4	130.0	95.37	1.18	6.2	2000	0.548
530.0	23.39	31.4	120.0	103.3	1.55	6.0	2066	0.502
520.0	23.84	30.4	110.0	112.7	2.04	5.8	2138	0.459
510.0	24.31	29.3	100.0	124.0	2.97	5.6	2214	0.418
500.0	24.80	28.2	95.0	130.5	3.50	5.4	2296	0.380
490.0	25.30	27.0	90.0	137.8	4.01	5.2	2384	0.344

TABLE 4. The Total Photoionization Cross Section of Krypton from 884 Å to 1.6 Å in Megabarns, 10^{-18} cm^2

λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)	λ (Å)	E (eV)	σ (Mb)
5.0	2480	0.310	3.8	3263	0.150	2.6	4768	0.0548
4.8	2583	0.278	3.6	3444	0.130	2.4	5166	0.0443
4.6	2695	0.248	3.4	3646	0.111	2.2	5636	0.0352
4.4	2818	0.221	3.2	3874	0.0949	2.0	6199	0.0273
4.2	2952	0.195	3.0	4133	0.0800	1.8	6888	0.0207
4.0	3100	0.171	2.8	4428	0.0666	1.6	7749	0.0151

Table 4. Krypton

Wavelength range (Å)	Origin of experimental data
501 - 852	Blackwell et al[30]
600 - 840	Metzger and Cook[29]
504 - 842	Pery-Thorne and Garton[32]
230 - 786	Rustgi et al[33]
99 - 131	Haensel et al[7]
209.3 - 883.6	Samson[5]
39.5 - 343	West and Marr[12]
48.9 - 198	Lang and Watson[9]
44.6	Dershem and Schein[17]
8.34 - 113.8	Henke et al[13]
23.6 - 250.5	Lukirskii et al[34]
1.5 - 15	Wuilleumier[35]