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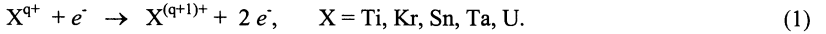
**ELECTRON-IMPACT IONIZATION CROSS SECTIONS
OF Ti, Kr, Sn, Ta, U ATOMS AND THEIR IONS
IN THE ELECTRON ENERGY RANGE
FROM THE THRESHOLD UP TO 200 keV
Part 2**

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Numerical calculations

In our previous paper [1], the electron-impact ionization cross sections are presented for H, He, N, O, Ar, Xe, Au, Pb atoms and their ions in the same energy range. Here, single-electron ionization cross sections for neutral atoms and positively charged ions X^{q+} are presented



The data have been calculated by the ATOM code using the CBE approximation in the partial-wave representation (see [1,2] for more details) in the electron-energy range from the ionization threshold up to 200 keV. This energy range is important for many problems in plasma physics.

In calculations, a contribution from *direct* ionization of five outermost target shell have been included that is necessary for ionization of heavy low-charged ions like Sn, Ta or U. Excitation-autoionization processes as well as resonant ionization have not been accounted for because the experimental and theoretical data on atomic and autoionization structure of many-electron systems are extremely scarce. Therefore, in the present calculations only direct ionization cross sections have been calculated. The accuracy of the data presented is within a factor of 2 as compared to experimental data. In many cases, such an accuracy is quite enough to solve the plasma kinetics problems.

Typical examples are shown in Figs. 1 and 2 where the calculated ionization cross sections are displayed for Kr and Ta ions. The curves clearly show the general decreasing behavior of the cross sections with the ion charge increasing and the opening of the inner shells, especially for Ta ions.

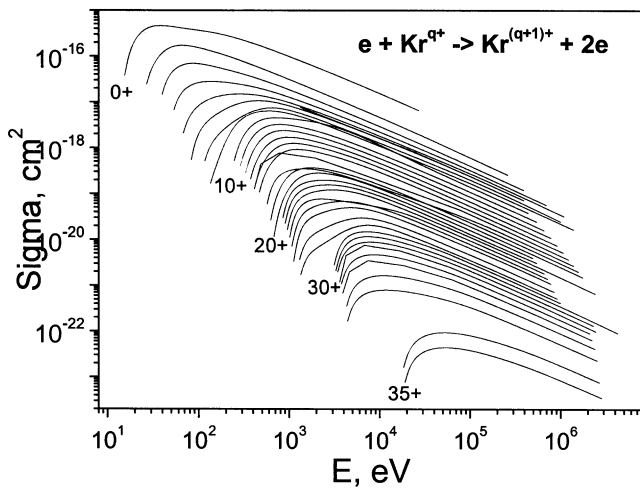


Fig. 1 Calculated electron-impact ionization cross sections for Kr ions: present work.

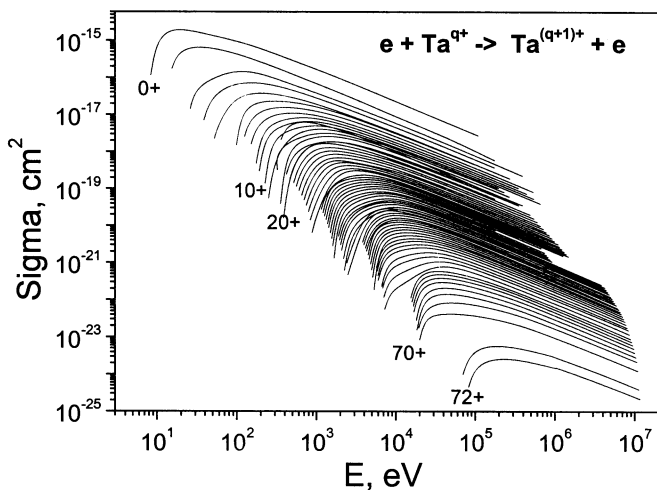


Fig. 2 Calculated electron-impact ionization cross sections for Ta ions: present work.

Figures 3 and 4 show the ionization cross sections for Uranium ions in comparison with experimental data. It is seen that in the near-threshold energy range, experimental data are

larger because of influence of the excitation-autoionization processes which are not accounted here. The inclusion of these processes strongly enhances the ionization cross sections. In the case of U^{16+} ions, excitation-autoionization leads to a 3-time enhancement and to an excellent agreement there of experiment from threshold up to 1500 eV (see the work [4] for details).

In general, experimental data for ionization cross sections can be found in the compilations [5,6]; the bibliography of electron-impact ionization and excitation cross sections of atoms and ions is given in [7]. Multi-electron atomic processes including excitation, ionization by charged particles, photoionization and other processes are considered in [8].

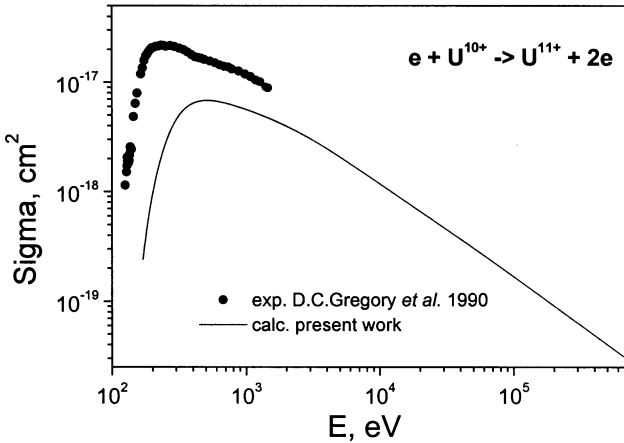


Fig. 3 Electron-impact ionization cross sections for U^{10+} ions: solid symbols – experiment [3], the curve – present calculations.

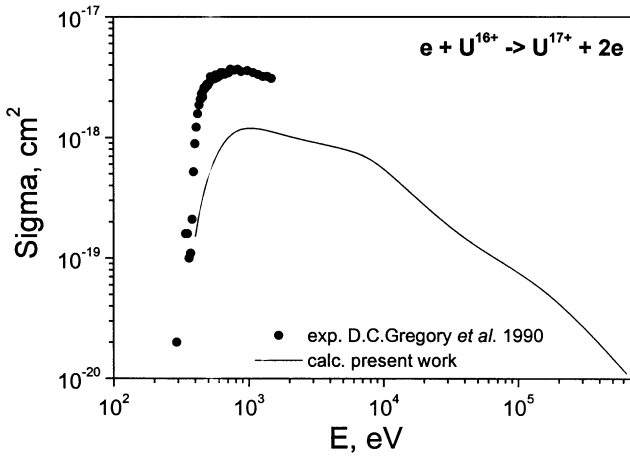


Fig. 4 Electron-impact ionization cross sections for U^{16+} ions: solid symbols – experiment [3], the curve – present calculations.

Fitting procedure

Calculated ionization cross sections in the energy range considered have been fitted by the usual $1/E$ -expansion formula with the Bethe logarithmic term:

$$\sigma(E) = 10^{-13} \text{ cm}^2 \left(\frac{eV^2}{IE} \right) \left[\sum_{i=1}^6 A_i (1 - I/E)^i + B \ln(E/I) \right], \quad (2)$$

where E is the incident electron energy and I is the *first* ionization potential, both in eV, A_i and B are the fit parameters. The Bethe constant B defines the high-energy behavior of the ionization cross section

$$\sigma(E) \propto \frac{1}{IE} [A_1 + B \ln(E/I)], \quad E \gg I. \quad (3)$$

In the present work, ionization cross sections in a wide energy range were approximated by eq. (2) with 7 parameters A_1, \dots, A_6 and B by the standard LSM method. The ionization cross sections calculated using the ATOM code in comparison with the 7-parametric fit, and the fit parameters for Ti, Kr, Sn, Ta and U atoms and ions are given in Tables 1 – 4. In general, the average accuracy of fitting is about 10%. These parameters can be used for estimating the ionization cross sections and solving the plasma kinetics problems.

Tables.

Table 1.1. Ionization cross sections of titanium and its ions.

Ti 0+				Ti 1+			
I = 6.8 eV				I = 13.6 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
7.24E+00	1.16E-16	1.06E-16	9.84	1.45E+01	6.41E-17	6.15E-17	4.25
8.52E+00	4.93E-16	5.00E-16	-1.37	1.70E+01	2.37E-16	2.52E-16	-6.1
1.36E+01	1.07E-15	1.12E-15	-4.43	2.73E+01	3.72E-16	3.82E-16	-2.73
3.41E+01	7.31E-16	7.10E-16	2.99	6.82E+01	4.38E-16	4.36E-16	0.42
1.16E+02	4.01E-16	4.24E-16	-5.53	2.32E+02	2.46E-16	2.44E-16	0.62
4.32E+02	1.50E-16	1.43E-16	5.13	1.71E+03	4.88E-17	4.78E-17	1.99
1.71E+03	4.57E-17	4.52E-17	1.18	6.81E+03	1.45E-17	1.47E-17	-1.44
6.81E+03	1.31E-17	1.32E-17	-0.63	2.72E+04	4.18E-18	4.31E-18	-3.1
2.72E+04	3.67E-18	3.73E-18	-1.56	1.09E+05	1.18E-18	1.23E-18	-4.48
1.09E+05	1.01E-18	1.00E-18	1.18	4.35E+05	3.29E-19	3.11E-19	5.91
Ti 2+				Ti 3+			
I = 25.0 eV				I = 41.5 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
2.65E+01	7.56E-18	7.71E-18	-1.98	4.41E+01	1.44E-18	1.46E-18	-1.63
3.13E+01	2.44E-17	2.47E-17	-1.14	5.16E+01	4.86E-18	4.78E-18	1.66
5.00E+01	5.17E-17	5.08E-17	1.76	8.29E+01	1.96E-17	1.92E-17	2.02
1.25E+02	9.82E-17	1.02E-16	-3.73	2.07E+02	3.21E-17	3.28E-17	-2.1
4.25E+02	4.49E-17	4.24E-17	6	7.05E+02	1.57E-17	1.53E-17	2.47
2.32E+03	1.07E-17	1.11E-17	-3.63	4.10E+03	3.74E-18	3.74E-18	-0.01
9.20E+03	3.32E-18	3.40E-18	-2.39	1.64E+04	1.13E-18	1.16E-18	-2.31
3.67E+04	9.99E-19	1.00E-18	-0.07	6.53E+04	3.34E-19	3.37E-19	-0.77
1.47E+05	2.92E-19	2.93E-19	-0.29	2.61E+05	9.62E-20	9.62E-20	-0.04
5.88E+05	8.37E-20	8.16E-20	2.63	1.04E+06	2.73E-20	2.68E-20	1.74
Ti 4+				Ti 5+			
I = 92.4 eV				I = 113 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
9.84E+01	2.62E-18	2.65E-18	-1.09	1.20E+02	1.37E-18	1.40E-18	-2.05
1.15E+02	7.38E-18	7.60E-18	-2.92	1.42E+02	3.99E-18	4.10E-18	-2.6
1.85E+02	1.29E-17	1.33E-17	-2.7	2.27E+02	7.01E-18	7.16E-18	-2.1
4.62E+02	9.92E-18	9.71E-18	2.16	5.67E+02	5.94E-18	5.83E-18	1.93
1.57E+03	4.81E-18	5.06E-18	-5.03	1.93E+03	3.00E-18	3.14E-18	-4.38
6.47E+03	1.59E-18	1.54E-18	3.43	9.29E+03	8.82E-19	8.56E-19	2.98
2.56E+04	4.77E-19	4.73E-19	0.9	3.68E+04	2.64E-19	2.60E-19	1.59
1.02E+05	1.36E-19	1.36E-19	0.02	1.47E+05	7.55E-20	7.60E-20	-0.7
4.08E+05	3.79E-20	3.85E-20	-1.54	5.88E+05	2.11E-20	2.14E-20	-1.25
Ti 6+				Ti 7+			
I = 135 eV				I = 159.0 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
1.44E+02	7.48E-19	7.47E-19	0.15	1.69E+02	4.00E-19	3.73E-19	7.29
1.69E+02	2.28E-18	2.35E-18	-3	1.98E+02	1.61E-18	1.75E-18	-7.95
2.71E+02	4.43E-18	4.54E-18	-2.47	3.17E+02	2.69E-18	2.75E-18	-2.26
6.77E+02	3.77E-18	3.71E-18	1.68	7.93E+02	2.36E-18	2.34E-18	0.93
2.30E+03	1.93E-18	2.00E-18	-3.63	2.70E+03	1.27E-18	1.34E-18	-5.05
8.45E+03	7.13E-19	6.94E-19	2.78	5.57E+03	7.46E-19	7.20E-19	3.54
3.34E+04	2.18E-19	2.17E-19	0.54	2.19E+04	2.39E-19	2.34E-19	2.03
1.33E+05	6.31E-20	6.33E-20	-0.25	8.72E+04	7.07E-20	7.13E-20	-0.8
5.33E+05	1.78E-20	1.79E-20	-0.72	3.48E+05	2.03E-20	2.05E-20	-0.93

Ti 8+ I = 207 eV				Ti 9+ I = 208 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.21E+02	1.67E-19	1.49E-19	12.25	2.20E+02	8.52E-20	7.16E-20	18.94
2.60E+02	7.42E-19	8.40E-19	-11.63	2.59E+02	4.63E-19	5.72E-19	-19.07
4.16E+02	1.32E-18	1.30E-18	1.86	4.14E+02	9.51E-19	9.00E-19	5.63
1.04E+03	1.49E-18	1.56E-18	-4.38	1.03E+03	1.11E-18	1.26E-18	-11.63
3.53E+03	7.58E-19	7.42E-19	2.21	3.52E+03	6.24E-19	5.89E-19	5.86
2.77E+04	1.40E-19	1.38E-19	1.06	3.42E+04	9.63E-20	9.38E-20	2.65
1.10E+05	4.13E-20	4.13E-20	-0.12	1.36E+05	2.78E-20	2.79E-20	-0.46
4.41E+05	1.18E-20	1.19E-20	-0.93	5.44E+05	7.79E-21	7.97E-21	-2.26
Ti 10+ I = 259 eV				Ti 11+ I = 293 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.76E+02	8.48E-20	8.40E-20	1	3.11E+02	3.14E-20	3.26E-20	-3.71
3.24E+02	2.33E-19	2.42E-19	-3.67	3.66E+02	9.34E-20	9.34E-20	0.02
5.19E+02	3.88E-19	3.74E-19	3.65	5.85E+02	2.24E-19	1.46E-19	53.09
1.32E+03	7.24E-19	7.61E-19	-4.89	1.40E+03	4.79E-19	5.04E-19	-4.94
4.47E+03	3.78E-19	3.68E-19	2.58	4.98E+03	2.42E-19	2.38E-19	1.83
4.14E+04	5.99E-20	5.90E-20	1.44	1.25E+04	1.17E-19	1.16E-19	0.43
1.65E+05	1.77E-20	1.80E-20	-1.84	4.93E+04	3.74E-20	3.80E-20	-1.72
6.58E+05	5.09E-21	5.08E-21	0.17	1.96E+05	1.15E-20	1.14E-20	0.76
Ti 12+ I = 787 eV				Ti 13+ I = 862 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
8.37E+02	3.72E-20	3.65E-20	2	9.16E+02	2.68E-20	2.63E-20	1.88
9.84E+02	1.28E-19	1.34E-19	-4.33	1.08E+03	9.34E-20	9.76E-20	-4.27
1.58E+03	2.29E-19	2.35E-19	-2.53	1.72E+03	1.67E-19	1.71E-19	-2.32
3.94E+03	1.87E-19	1.85E-19	0.83	4.31E+03	1.33E-19	1.32E-19	0.49
1.34E+04	7.91E-20	8.00E-20	-1.09	1.48E+04	5.70E-20	5.76E-20	-1.05
1.52E+04	7.16E-20	7.14E-20	0.25	1.76E+04	4.97E-20	4.92E-20	1.07
5.82E+04	2.35E-20	2.33E-20	0.74	6.75E+04	1.62E-20	1.63E-20	-0.42
2.31E+05	7.12E-21	7.14E-21	-0.31	2.67E+05	4.85E-21	4.84E-21	0.21
Ti 14+ I = 942 eV				Ti 15+ I = 1044 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.00E+03	1.84E-20	1.81E-20	1.36	1.11E+03	1.64E-20	1.57E-20	4.47
1.18E+03	6.73E-20	6.99E-20	-3.73	1.30E+03	5.85E-20	6.30E-20	-7.21
1.89E+03	1.17E-19	1.21E-19	-3.75	2.10E+03	7.87E-20	8.12E-20	-3.03
4.71E+03	9.38E-20	9.12E-20	2.8	5.22E+03	6.21E-20	6.17E-20	0.6
1.60E+04	3.94E-20	4.13E-20	-4.56	1.77E+04	2.84E-20	2.85E-20	-0.35
2.01E+04	3.30E-20	3.33E-20	-1.01	4.46E+04	1.32E-20	1.31E-20	0.61
7.74E+04	1.14E-20	1.07E-20	6.56	1.75E+05	4.00E-21	4.04E-21	-1.12
3.73E+05	3.18E-21	3.30E-21	-3.63	6.95E+05	1.17E-21	1.16E-21	0.59
Ti 16+ I = 1132 eV				Ti 17+ I = 1221 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.20E+03	1.02E-20	1.03E-20	-0.83	1.30E+03	6.21E-21	6.23E-21	-0.38
1.41E+03	3.00E-20	3.11E-20	-3.42	1.53E+03	1.81E-20	1.87E-20	-3.45
2.26E+03	5.23E-20	5.30E-20	-1.35	2.44E+03	3.14E-20	3.18E-20	-1.4
5.66E+03	4.07E-20	4.05E-20	0.47	6.10E+03	2.59E-20	2.58E-20	0.34
1.92E+04	1.83E-20	1.84E-20	-0.48	2.08E+04	1.21E-20	1.21E-20	-0.16
5.03E+04	8.68E-21	8.66E-21	0.23	5.65E+04	5.60E-21	5.61E-21	-0.25
1.98E+05	2.67E-21	2.66E-21	0.41	2.22E+05	1.74E-21	1.73E-21	0.55

7.87E+05	7.70E-22	7.72E-22	-0.22	8.83E+05	5.07E-22	5.08E-22	-0.26
Ti 18+ I = 1342 eV				Ti 19+ I = 1423 eV			
E_i eV	σ_{Fitt,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fitt,i} cm²	σ_{Atom,i} cm²	error, %
1.43E+03	3.00E-21	3.00E-21	0.03	1.51E+03	1.34E-21	1.35E-21	-0.98
1.68E+03	8.82E-21	9.14E-21	-3.56	1.78E+03	3.97E-21	4.10E-21	-3.21
2.68E+03	1.55E-20	1.58E-20	-1.76	2.85E+03	7.07E-21	7.18E-21	-1.57
6.73E+03	1.34E-20	1.33E-20	0.63	7.11E+03	6.37E-21	6.32E-21	0.82
2.28E+04	7.24E-21	7.27E-21	-0.42	2.42E+04	3.68E-21	3.75E-21	-1.85
6.28E+04	3.43E-21	3.48E-21	-1.52	6.94E+04	1.74E-21	1.72E-21	1.27
2.46E+05	1.07E-21	1.03E-21	3.18	2.74E+05	5.51E-22	5.47E-22	0.8
9.83E+05	3.06E-22	3.11E-22	-1.68	1.09E+06	1.62E-22	1.63E-22	-0.83
Ti 20+ I = 6231 eV				Ti 21+ I = 6631 eV			
E_i eV	σ_{Fitt,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fitt,i} cm²	σ_{Atom,i} cm²	error, %
6.63E+03	1.25E-22	1.25E-22	-0.18	7.05E+03	5.65E-23	5.67E-23	-0.44
7.79E+03	3.80E-22	3.91E-22	-2.89	8.29E+03	1.70E-22	1.75E-22	-2.88
1.25E+04	7.54E-22	7.65E-22	-1.39	1.33E+04	3.36E-22	3.40E-22	-1.25
3.12E+04	7.24E-22	7.21E-22	0.47	3.32E+04	3.16E-22	3.15E-22	0.31
1.06E+05	3.59E-22	3.61E-22	-0.61	1.13E+05	1.58E-22	1.58E-22	-0.15
3.06E+05	1.59E-22	1.58E-22	0.5	3.36E+05	6.80E-23	6.80E-23	-0.01
1.21E+06	4.91E-23	4.92E-23	-0.16	1.32E+06	2.08E-23	2.08E-23	0.05

Table 1.2. Fitting parameters for titanium and its ions.

Ti	A₁	A₂	A₃	A₄	A₅	A₆	B
0+	2.55350E-01	2.43690E+00	5.03600E+00	-1.2212E+01	-4.8469E+00	1.19140E+01	5.07880E-01
1+	1.25380E-01	6.78440E+00	1.63870E+00	-8.0254E+01	1.42660E+02	-6.6553E+01	1.45430E+00
2+	-2.78050E-01	-4.39650E-01	8.06680E+00	-5.4266E+01	1.11600E+02	-6.3817E+01	1.13690E+00
3+	-5.47720E-01	-2.96310E-01	9.12660E-01	-4.69920E-01	1.44810E+01	-1.2216E+01	9.77780E-01
4+	2.55190E+00	7.42900E+00	-5.5966E+01	1.65780E+02	-2.0658E+02	9.23240E+01	1.04360E+00
5+	1.97150E+00	3.76490E+00	-3.860E+01	1.24340E+02	-1.5809E+02	7.15400E+01	1.07280E+00
6+	1.01910E+00	5.54030E+00	-3.1447E+01	9.18020E+01	-1.1680E+02	5.41480E+01	1.03020E+00
7+	1.95240E-01	1.14270E+01	-3.1328E+01	2.85540E+01	-5.4356E+00	0.00000E+00	1.01840E+00
8+	-3.19880E-01	1.28490E+01	-4.4466E+01	5.98260E+01	-2.4599E+01	0.00000E+00	9.82920E-01
9+	-4.43680E-01	8.02200E+00	-2.1091E+01	2.14130E+01	-4.4360E+00	0.00000E+00	6.74830E-01
10+	-2.07890E-02	4.39810E+00	-2.9286E+01	5.37220E+01	-2.6471E+01	0.00000E+00	8.07540E-01
11+	-3.81590E-01	-1.0941E+00	7.29980E+00	-3.5301E+01	6.72610E+01	-3.7014E+01	8.93900E-01
12+	1.82900E+00	1.30760E+01	-4.2284E+01	6.13120E+01	-3.3598E+01	3.60460E+00	1.58410E+00
13+	1.80670E+00	1.17890E+01	-4.3095E+01	8.11000E+01	-7.2468E+01	2.52660E+01	1.18480E+00
14+	6.43300E-01	5.99680E+00	-8.22580E-01	-5.1476E+01	9.68680E+01	-5.1703E+01	1.94160E+00
15+	1.57120E+00	1.51760E+01	-4.1727E+01	1.03840E+01	5.42930E+01	-3.6704E+01	8.41790E-01
16+	1.62590E+00	5.96680E+00	-4.7668E+01	1.37880E+02	-1.6306E+02	6.83130E+01	5.85010E-01
17+	9.29240E-01	4.28150E+00	-3.0161E+01	8.28200E+01	-9.5242E+01	3.94950E+01	5.09650E-01
18+	4.85820E-01	2.62860E+00	-1.7561E+01	4.92960E+01	-6.0292E+01	2.72940E+01	3.33440E-01
19+	2.16990E-01	1.07330E+00	-9.2384E+00	2.81900E+01	-3.5923E+01	1.66160E+01	2.38210E-01
20+	3.45370E-01	2.04380E+00	-1.3381E+01	3.76950E+01	-4.3362E+01	1.82090E+01	4.15910E-01
21+	2.21320E-01	1.07160E+00	-7.7005E+00	2.28120E+01	-2.7337E+01	1.18450E+01	1.76290E-01

Table 2.1. Ionization cross sections of krypton and its ions.

Kr 0+ I = 14.5 eV				Kr 1+ I = 25.2 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
1.54E+01	3.92E-17	3.73E-17	5.05	2.68E+01	2.40E-17	2.42E-17	-0.96
1.81E+01	1.98E-16	2.04E-16	-2.76	3.15E+01	7.36E-17	7.44E-17	-1.09
2.90E+01	5.30E-16	5.61E-16	-5.46	5.04E+01	2.06E-16	2.09E-16	-1.69
7.25E+01	3.85E-16	3.78E-16	1.88	1.26E+02	1.42E-16	1.41E-16	0.87
2.47E+02	3.02E-16	3.13E-16	-3.68	4.28E+02	6.36E-17	6.44E-17	-1.33
6.81E+03	2.29E-17	2.18E-17	5.03	1.63E+04	3.20E-18	3.13E-18	2.23
2.72E+04	6.55E-18	6.52E-18	0.47	6.53E+04	9.06E-19	9.05E-19	0.13
1.09E+05	1.83E-18	1.90E-18	-3.59	2.61E+05	2.53E-19	2.57E-19	-1.57
Kr 2+ I = 37.3 eV				Kr 3+ I = 50.4 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
3.96E+01	1.43E-17	1.44E-17	-0.92	5.35E+01	6.46E-18	6.63E-18	-2.51
4.66E+01	4.23E-17	4.36E-17	-2.98	6.30E+01	1.72E-17	1.77E-17	-2.71
7.45E+01	8.10E-17	8.28E-17	-2.18	1.01E+02	3.03E-17	3.06E-17	-1
1.86E+02	5.39E-17	5.33E-17	1.03	2.52E+02	2.64E-17	2.63E-17	0.46
6.33E+02	2.82E-17	2.87E-17	-1.77	8.56E+02	1.62E-17	1.63E-17	-0.85
2.45E+04	1.45E-18	1.41E-18	3.13	4.36E+04	6.96E-19	6.84E-19	1.7
9.80E+04	4.12E-19	4.12E-19	-0.08	1.74E+05	2.00E-19	2.00E-19	-0.01
3.92E+05	1.15E-19	1.17E-19	-2.01	6.96E+05	5.63E-20	5.70E-20	-1.16
Kr 4+ I = 63.8 eV				Kr 5+ I = 78.1 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
6.78E+01	2.04E-18	2.08E-18	-2.16	8.30E+01	5.55E-19	5.45E-19	1.81
7.98E+01	5.76E-18	5.85E-18	-1.56	9.76E+01	2.42E-18	2.44E-18	-1.03
1.28E+02	1.32E-17	1.32E-17	-0.4	1.56E+02	5.87E-18	5.88E-18	-0.1
3.19E+02	1.65E-17	1.65E-17	0.08	3.90E+02	1.33E-17	1.33E-17	-0.05
1.09E+03	1.08E-17	1.08E-17	-0.09	1.33E+03	7.71E-18	7.65E-18	0.82
6.81E+04	3.95E-19	3.94E-19	0.33	2.46E+04	7.95E-19	8.08E-19	-1.66
2.72E+05	1.15E-19	1.15E-19	-0.41	9.80E+04	2.46E-19	2.47E-19	-0.42
1.09E+06	3.24E-20	3.24E-20	0.13	3.92E+05	7.32E-20	7.22E-20	1.41
Kr 6+ I = 110 eV				Kr 7+ I = 127 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
1.17E+02	4.90E-19	5.15E-19	-4.85	1.35E+02	1.63E-19	1.66E-19	-1.92
1.37E+02	1.40E-18	1.38E-18	1.62	1.59E+02	4.88E-19	4.66E-19	4.74
2.20E+02	3.60E-18	3.47E-18	3.6	2.54E+02	5.18E-18	4.94E-18	4.77
5.50E+02	9.51E-18	9.90E-18	-3.98	6.35E+02	7.38E-18	7.58E-18	-2.66
1.87E+03	5.01E-18	4.82E-18	3.86	2.16E+03	3.80E-18	3.75E-18	1.25
6.67E+04	2.77E-19	2.90E-19	-4.4	8.72E+04	1.95E-19	1.95E-19	0.04
2.67E+05	8.38E-20	8.64E-20	-3.06	3.48E+05	5.76E-20	5.76E-20	-0.07
1.00E+06	2.61E-20	2.48E-20	5.13	1.39E+06	1.66E-20	1.66E-20	-0.16
Kr 8+ I = 233 eV				Kr 9+ I = 270 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
2.47E+02	5.12E-19	5.23E-19	-2.15	2.87E+02	3.87E-19	3.89E-19	-0.64
2.91E+02	1.73E-18	1.72E-18	0.3	3.38E+02	1.27E-18	1.28E-18	-0.79
4.66E+02	4.82E-18	5.00E-18	-3.69	5.40E+02	3.63E-18	3.69E-18	-1.71
1.16E+03	4.56E-18	4.31E-18	5.86	1.35E+03	3.04E-18	3.00E-18	1.35
3.96E+03	2.44E-18	2.96E-18	-17.46	4.59E+03	1.40E-18	1.44E-18	-2.52
2.78E+04	4.85E-19	4.30E-19	12.83	3.43E+04	2.85E-19	2.78E-19	2.55

1.10E+05	1.34E-19	1.30E-19	2.73	1.36E+05	8.50E-20	8.45E-20	0.57
4.40E+05	3.54E-20	3.84E-20	-7.72	5.44E+05	2.43E-20	2.47E-20	-1.57
Kr 10+ I = 310 eV				Kr 11+ I = 353 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
3.30E+02	2.87E-19	2.88E-19	-0.52	3.75E+02	2.07E-19	2.09E-19	-1.2
3.88E+02	9.28E-19	9.34E-19	-0.69	4.42E+02	6.68E-19	6.71E-19	-0.45
6.21E+02	2.73E-18	2.78E-18	-1.88	7.07E+02	1.96E-18	2.00E-18	-1.94
1.55E+03	2.17E-18	2.14E-18	1.42	1.55E+03	1.55E-18	1.52E-18	1.88
5.28E+03	9.93E-19	1.02E-18	-2.63	6.01E+03	7.03E-19	7.30E-19	-3.65
4.15E+04	1.91E-19	1.86E-19	2.8	4.93E+04	1.30E-19	1.26E-19	3.45
1.65E+05	5.59E-20	5.57E-20	0.28	1.96E+05	3.80E-20	3.75E-20	1.38
6.59E+05	1.58E-20	1.60E-20	-1.45	7.84E+05	1.07E-20	1.10E-20	-2.65
Kr 12+ I = 396 eV				Kr 13+ I = 440 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
4.21E+02	1.50E-19	1.52E-19	-1.18	4.67E+02	1.06E-19	1.08E-19	-1.57
4.95E+02	4.78E-19	4.80E-19	-0.33	5.50E+02	3.40E-19	3.40E-19	-0.03
7.92E+02	1.44E-18	1.47E-18	-1.91	8.79E+02	1.08E-18	1.10E-18	-1.72
1.98E+03	1.14E-18	1.12E-18	1.87	2.20E+03	8.35E-19	8.20E-19	1.78
6.73E+03	5.20E-19	5.40E-19	-3.68	7.47E+03	3.78E-19	3.92E-19	-3.53
5.79E+04	9.10E-20	8.76E-20	3.84	6.71E+04	6.43E-20	6.20E-20	3.74
2.30E+05	2.61E-20	2.60E-20	0.56	2.67E+05	1.84E-20	1.83E-20	0.67
9.20E+05	7.27E-21	7.43E-21	-2.17	1.07E+06	5.10E-21	5.22E-21	-2.24
Kr 14+ I = 387 eV				Kr 15+ I = 536 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
4.12E+02	1.30E-19	1.27E-19	2.39	5.70E+02	6.20E-20	6.00E-20	3.4
4.85E+02	4.18E-19	4.40E-19	-4.91	6.70E+02	2.11E-19	2.23E-19	-5.56
7.75E+02	7.70E-19	7.75E-19	-0.67	1.07E+03	3.74E-19	3.76E-19	-0.51
1.94E+03	5.87E-19	6.00E-19	-2.1	2.68E+03	3.23E-19	3.33E-19	-2.91
6.59E+03	2.71E-19	2.60E-19	4.4	9.12E+03	1.54E-19	1.45E-19	6.2
7.69E+04	4.18E-20	4.50E-20	-7.04	8.76E+04	3.90E-20	3.24E-20	-10.57
3.06E+05	1.30E-20	1.32E-20	-1.58	3.49E+05	9.34E-21	9.50E-21	-1.65
1.22E+06	3.88E-21	3.70E-21	4.72	1.39E+06	2.87E-21	2.70E-21	6.25
Kr 16+ I = 587 eV				Kr 17+ I = 639 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
6.24E+02	2.75E-20	2.68E-20	2.59	6.78E+02	1.21E-20	1.16E-20	4.32
7.34E+02	1.23E-19	1.23E-19	-0.13	7.98E+02	7.21E-20	7.10E-20	1.58
1.17E+03	4.12E-19	4.25E-19	-3	1.28E+03	2.99E-19	3.08E-19	-2.82
2.94E+03	3.49E-19	3.43E-19	1.73	3.19E+03	2.86E-19	2.83E-19	1.15
9.99E+03	1.65E-19	1.70E-19	-2.73	1.09E+04	1.28E-19	1.29E-19	-0.94
9.88E+04	2.49E-20	2.42E-20	2.91	1.11E+05	1.82E-20	1.81E-20	0.72
3.94E+05	7.09E-21	7.10E-21	-0.14	4.41E+05	5.29E-21	5.30E-21	-0.15
1.57E+06	1.98E-21	2.00E-21	-1.23	1.76E+06	1.50E-21	1.50E-21	-0.17
Kr 18+ I = 801 eV				Kr 19+ I = 848 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
8.51E+02	3.08E-20	3.00E-20	2.57	9.01E+02	2.32E-20	2.26E-20	2.76
1.00E+03	1.12E-19	1.17E-19	-4.47	1.06E+03	8.79E-20	9.20E-20	-4.44
1.60E+03	2.00E-19	2.04E-19	-2.07	1.70E+03	1.55E-19	1.59E-19	-2.5
4.00E+03	2.03E-19	2.02E-19	0.24	4.24E+03	1.65E-19	1.63E-19	0.97

1.36E+04	8.78E-20	8.72E-20	0.66	1.44E+04	7.07E-20	7.10E-20	-0.41		
3.15E+04	4.33E-20	4.35E-20	-0.4	3.48E+04	3.32E-20	3.35E-20	-1.04		
1.24E+05	1.34E-20	1.35E-20	-0.82	1.37E+05	1.02E-20	1.00E-20	1.93		
4.92E+05	4.03E-21	4.00E-21	0.63	5.45E+05	3.07E-21	3.10E-21	-0.99		
Kr 20+				I = 893 eV	Kr 21+				I = 948 eV
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %		
9.52E+02	1.72E-20	1.66E-20	3.87	1.01E+03	1.20E-20	1.14E-20	5.18		
1.12E+03	6.64E-20	7.00E-20	-5.09	1.18E+03	4.85E-20	5.18E-20	-6.31		
1.79E+03	1.17E-19	1.20E-19	-2.28	1.90E+03	8.34E-20	8.80E-20	-5.2		
4.48E+03	1.30E-19	1.30E-19	-0.38	4.74E+03	6.68E-20	6.53E-20	2.34		
1.52E+04	5.79E-20	5.68E-20	1.99	1.61E+04	4.23E-20	4.50E-20	-6.09		
1.51E+05	7.95E-21	8.14E-21	-2.31	4.21E+04	2.09E-20	2.00E-20	4.33		
6.01E+05	2.36E-21	2.38E-21	-1	1.66E+05	6.36E-21	6.30E-21	1		
2.40E+06	6.83E-22	6.70E-22	1.89	6.59E+05	1.80E-21	1.83E-21	-1.46		
Kr 22+				I = 1010 eV	Kr 23+				I = 1057 eV
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %		
1.07E+03	7.54E-21	7.20E-21	4.7	1.12E+03	3.56E-21	3.32E-21	7.16		
1.26E+03	3.41E-20	3.60E-20	-5.29	1.32E+03	2.18E-20	2.32E-20	-6.02		
2.02E+03	5.86E-20	6.00E-20	-2.42	2.11E+03	3.71E-20	3.85E-20	-3.54		
5.00E+03	7.90E-20	7.90E-20	-0.01	5.28E+03	6.13E-20	6.12E-20	0.21		
1.72E+04	3.58E-20	3.50E-20	2.19	1.80E+04	2.80E-20	2.71E-20	3.34		
4.60E+04	1.53E-20	1.55E-20	-1.42	5.00E+04	1.14E-20	1.17E-20	-2.21		
1.81E+05	4.70E-21	4.80E-21	-2	2.00E+05	3.57E-21	3.70E-21	-3.49		
7.20E+05	1.42E-21	1.40E-21	1.66	7.84E+05	1.13E-21	1.10E-21	2.94		
Kr 24+				I = 1226 eV	Kr 25+				I = 1266 eV
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %		
1.30E+03	3.60E-21	3.70E-21	-2.67	1.34E+03	1.64E-21	1.72E-21	-4.51		
1.53E+03	1.08E-20	1.10E-20	-1.54	1.58E+03	5.17E-21	5.16E-21	0.24		
2.45E+03	1.85E-20	1.83E-20	1.26	2.53E+03	8.80E-21	8.53E-21	3.19		
6.10E+03	3.81E-20	3.87E-20	-1.56	6.33E+03	2.79E-20	2.90E-20	-3.84		
2.08E+04	1.77E-20	1.73E-20	2.52	2.15E+04	1.32E-20	1.26E-20	4.48		
5.44E+04	7.80E-21	7.84E-21	-0.55	5.87E+04	5.51E-21	5.60E-21	-1.66		
2.14E+05	2.43E-21	2.50E-21	-2.99	2.31E+05	1.72E-21	1.78E-21	-3.13		
8.51E+05	7.39E-22	7.25E-22	1.95	9.21E+05	5.32E-22	5.20E-22	2.21		
Kr 26+				I = 2945 eV	Kr 27+				I = 3090 eV
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %		
3.13E+03	2.85E-21	2.80E-21	1.72	3.28E+03	2.17E-21	2.13E-21	1.98		
3.68E+03	9.56E-21	1.00E-20	-4.41	3.86E+03	7.54E-21	7.90E-21	-4.59		
5.89E+03	1.66E-20	1.70E-20	-2.3	6.18E+03	1.30E-20	1.33E-20	-2.47		
1.46E+04	1.31E-20	1.30E-20	0.6	1.54E+04	1.01E-20	1.00E-20	0.66		
5.00E+04	5.53E-21	5.60E-21	-1.29	5.25E+04	4.40E-21	4.43E-21	-0.72		
6.50E+04	4.48E-21	4.43E-21	1.13	2.70E+05	1.12E-21	1.10E-21	1.48		
2.50E+05	1.43E-21	1.43E-21	-0.22	1.10E+06	3.17E-22	3.24E-22	-2.05		
9.94E+05	4.17E-22	4.17E-22	0.09	4.27E+06	9.18E-23	9.10E-23	0.91		
Kr 28+				I = 3242 eV	Kr 29+				I = 3391 eV
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %		
3.44E+03	2.01E-21	2.00E-21	0.23	3.60E+03	1.23E-21	1.20E-21	2.11		
4.00E+03	5.88E-21	6.12E-21	-3.99	4.24E+03	4.29E-21	4.50E-21	-4.64		

6.50E+03	9.81E-21	1.00E-20	-1.88	6.78E+03	7.42E-21	7.60E-21	-2.43								
1.60E+04	7.84E-21	7.76E-21	0.97	1.70E+04	5.78E-21	5.75E-21	0.52								
5.50E+04	3.42E-21	3.48E-21	-1.74	5.76E+04	2.59E-21	2.60E-21	-0.38								
1.46E+05	1.56E-21	1.54E-21	1.2	1.56E+05	1.16E-21	1.15E-21	0.51								
5.75E+05	4.68E-22	4.66E-22	0.45	6.15E+05	3.48E-22	3.50E-22	-0.69								
2.30E+06	1.32E-22	1.33E-22	-0.51	2.45E+06	9.93E-23	9.90E-23	0.35								
Kr 30+				I = 3550 eV				Kr 31+				I = 3689 eV			
E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
3.77E+03	1.08E-21	1.10E-21	-1.59	3.90E+03	6.65E-22	6.82E-22	-2.57	4.44E+03	3.07E-21	3.17E-21	-3.03	4.62E+03	1.95E-21	2.00E-21	-2.77
7.10E+03	5.25E-21	5.33E-21	-1.56	7.40E+03	3.45E-21	3.50E-21	-1.42	1.77E+04	4.15E-21	4.11E-21	0.98	1.85E+04	2.77E-21	2.74E-21	1.01
6.00E+04	1.89E-21	1.93E-21	-2.21	6.30E+04	1.32E-21	1.36E-21	-2.64	1.34E+05	1.01E-21	1.00E-21	1.39	1.43E+05	7.14E-22	7.00E-22	1.99
5.26E+05	3.13E-22	3.10E-22	0.9	5.62E+05	2.21E-22	2.20E-22	0.64	2.10E+06	8.93E-23	9.00E-23	-0.77	2.23E+06	6.35E-23	6.40E-23	-0.74
Kr 32+				I = 4020 eV				Kr 33+				I = 4130 eV			
E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
4.30E+03	3.51E-22	3.50E-22	0.27	4.40E+03	1.66E-22	1.67E-22	-0.68	5.00E+03	9.66E-22	1.00E-21	-3.37	5.20E+03	4.84E-22	5.00E-22	-3.24
8.00E+03	1.77E-21	1.80E-21	-1.8	8.30E+03	8.47E-22	8.60E-22	-1.51	2.00E+04	1.57E-21	1.56E-21	0.9	2.10E+04	7.75E-22	7.70E-22	0.66
6.80E+04	8.04E-22	8.20E-22	-1.95	7.00E+04	4.34E-22	4.40E-22	-1.29	1.50E+05	4.49E-22	4.43E-22	1.33	1.60E+05	2.42E-22	2.40E-22	0.7
6.00E+05	1.41E-22	1.40E-22	0.59	6.33E+05	7.75E-23	7.70E-23	0.69	2.40E+06	4.12E-23	4.14E-23	-0.57	2.52E+06	2.29E-23	2.30E-23	-0.53
Kr 34+				I = 17310 eV				Kr 35+				I = 17950 eV			
E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_e, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
1.84E+04	1.65E-23	1.65E-23	-0.26	1.91E+04	7.84E-24	7.85E-24	-0.1	2.16E+04	4.97E-23	5.12E-23	-2.95	2.24E+04	2.35E-23	2.42E-23	-3.01
3.46E+04	9.87E-23	9.98E-23	-1.15	3.59E+04	4.64E-23	4.70E-23	-1.19	8.65E+04	9.36E-23	9.35E-23	0.06	8.97E+04	4.35E-23	4.35E-23	0.05
2.94E+05	4.66E-23	4.63E-23	0.71	3.00E+05	2.17E-23	2.15E-23	0.73	6.84E+05	2.46E-23	2.49E-23	-1.05	7.23E+05	1.12E-23	1.13E-23	-1.09
2.68E+06	7.75E-24	7.72E-24	0.37	2.84E+06	3.54E-24	3.53E-24	0.4								

Table 2.2. Fitting parameters for krypton and its ions.

Kr	A₁	A₂	A₃	A₄	A₅	A₆	B
0+	-1.0382E+00	3.5816E+00	1.2240E+01	2.1709E+01	-1.3708E+02	1.0979E+02	2.2141E+00
1+	1.2429E+00	6.1741E+00	-6.4213E+01	2.7815E+02	-4.0913E+02	1.9299E+02	1.2360E+00
2+	2.0797E+00	8.4646E+00	-7.5062E+01	2.5716E+02	-3.5300E+02	1.6577E+02	1.2268E+00
3+	1.2784E+00	4.3836E+00	-6.1836E+01	2.0889E+02	-2.7618E+02	1.2801E+02	1.5973E+00
4+	-5.1168E-01	1.4907E+00	-2.6520E+01	9.6604E+01	-1.3177E+02	6.4451E+01	1.9306E+00
5+	-2.0510E+00	-1.4043E+00	2.5784E+01	-1.1853E+02	1.9025E+02	-9.3757E+01	2.5956E+00
6+	-1.9550E+00	-4.4481E+00	3.0187E+01	-1.3686E+02	2.4446E+02	-1.3093E+02	3.0970E+00
7+	-2.3233E+00	1.1393E+00	-4.2593E+01	2.0096E+02	-2.6868E+02	1.1517E+02	2.7529E+00
8+	3.7976E+00	9.3644E-01	-1.9729E+01	2.2171E+02	-4.0968E+02	2.2932E+02	1.3333E+00
9+	1.4509E+00	9.5738E+00	-8.6857E+01	3.9576E+02	-5.8167E+02	2.7338E+02	3.1700E+00

10+	1.8432E+00	1.0261E+01	-9.2258E+01	4.2832E+02	-6.4068E+02	3.0528E+02	2.5427E+00
11+	2.0202E+00	7.8390E+00	-8.4850E+01	4.0825E+02	-6.1347E+02	2.9197E+02	2.3251E+00
12+	2.0749E+00	7.4827E+00	-8.0354E+01	3.9012E+02	-5.8922E+02	2.8209E+02	1.8492E+00
13+	1.9232E+00	6.2069E+00	-8.0393E+01	4.0155E+02	-6.1061E+02	2.9257E+02	1.6444E+00
14+	6.2305E-01	1.4972E+01	-8.7599E+01	2.2646E+02	-2.5691E+02	1.0388E+02	2.0944E+00
15+	-3.7672E-01	1.4691E+01	-7.4084E+01	1.5670E+02	-1.4693E+02	4.9183E+01	2.8224E+00
16+	1.6602E-01	3.5548E+00	-2.8726E-01	7.2329E+01	-1.5568E+02	8.8120E+01	1.2703E+00
17+	-6.2158E-01	6.6173E-01	2.3592E+01	-1.2737E+01	-2.8466E+01	2.3500E+01	1.3784E+00
18+	1.0075E+00	1.1061E+01	-1.7661E+01	-4.1731E+01	1.2708E+02	-7.6264E+01	1.9218E+00
19+	7.0112E-01	8.1516E+00	5.5499E+00	-1.1215E+02	2.1449E+02	-1.1412E+02	1.7823E+00
20+	4.2807E-01	6.5793E+00	1.6333E+01	-1.3462E+02	2.2974E+02	-1.1527E+02	1.4485E+00
21+	6.4069E-01	6.2306E+00	1.2653E+01	-7.9333E+01	9.0899E+01	-2.4947E+01	7.9115E-01
22+	-2.0361E-01	3.9803E+00	2.4404E+01	-1.5587E+02	2.5879E+02	-1.2961E+02	1.3423E+00
23+	-8.7231E-01	-2.9033E-01	5.8741E+01	-2.5776E+02	3.8251E+02	-1.8259E+02	1.4513E+00
24+	-3.1732E-02	-7.9522E-01	1.0247E+01	-6.6958E+01	1.3102E+02	-7.2550E+01	1.0326E+00
25+	-2.5211E-01	-1.3428E+00	1.0579E+01	-4.8267E+01	8.8226E+01	-4.8006E+01	7.8670E-01
26+	2.5456E+00	1.5047E+01	-6.2232E+01	1.2404E+02	-1.1385E+02	3.9926E+01	1.1642E+00
27+	2.1962E+00	1.3436E+01	-5.3091E+01	1.0284E+02	-9.5603E+01	3.5434E+01	9.5645E-01
28+	2.6328E+00	1.2067E+01	-7.9470E+01	2.0136E+02	-2.1719E+02	-2.4947E+01	7.9115E-01
29+	1.4367E+00	9.2555E+00	-3.5864E+01	6.9344E+01	-6.5534E+01	2.5092E+01	6.8978E-01
30+	1.7856E+00	4.6416E+00	-4.1533E+01	1.2413E+02	-1.4875E+02	6.3044E+01	5.2863E-01
31+	1.3154E+00	1.7697E+00	-2.5152E+01	8.6708E+01	-1.1200E+02	5.0020E+01	4.0519E-01
32+	4.2256E-01	2.6608E+00	-1.6912E+01	4.5355E+01	-5.2573E+01	2.2586E+01	3.8287E-01
33+	2.0624E-01	1.1375E+00	-8.6110E+00	2.4749E+01	-3.0273E+01	1.3677E+01	2.3475E-01
34+	4.0124E-01	2.2393E+00	-1.5803E+01	4.6022E+01	-5.4401E+01	2.3253E+01	3.8564E-01
35+	1.7982E-01	1.1602E+00	-7.9783E+00	2.2749E+01	-2.6481E+01	1.1114E+01	2.1445E-01

Table 3.1. Ionization cross sections of stannum and its ions.

Sn 0+				Sn 1+			
I = 7.3 eV				I = 15.1 eV			
E, eV	$\sigma_{\text{Fitt.}}$, cm ²	σ_{Atoms} , cm ²	error, %	E, eV	$\sigma_{\text{Fitt.}}$, cm ²	σ_{Atoms} , cm ²	error, %
7.80E+00	1.50E-15	1.39E-15	8.18	1.56E+01	2.44E-17	2.60E-17	-6.06
9.17E+00	5.79E-15	6.45E-15	-10.28	1.84E+01	8.60E-17	8.61E-17	-0.07
1.47E+01	7.62E-15	7.68E-15	-0.77	2.94E+01	3.22E-16	3.28E-16	-1.7
3.67E+01	5.05E-15	5.23E-15	-3.43	7.36E+01	3.12E-16	3.06E-16	1.94
1.25E+02	2.37E-15	2.24E-15	5.63	2.50E+02	2.05E-16	2.18E-16	-5.85
4.32E+02	8.64E-16	8.33E-16	3.7	1.71E+03	5.16E-17	4.87E-17	5.98
1.71E+03	2.54E-16	2.62E-16	-3.09	6.91E+03	1.56E-17	1.55E-17	0.66
6.83E+03	7.13E-17	7.86E-17	-9.31	2.72E+04	4.61E-18	4.64E-18	-0.63
2.72E+04	1.98E-17	2.27E-17	-13.01	1.09E+05	1.31E-18	1.34E-18	-2.23
1.09E+05	5.39E-18	4.74E-18	13.61	4.35E+05	3.68E-19	3.68E-19	-0.02
Sn 2+				Sn 3+			
I = 30.7 eV				I = 41.6 eV			
E, eV	$\sigma_{\text{Fitt.}}$, cm ²	σ_{Atoms} , cm ²	error, %	E, eV	$\sigma_{\text{Fitt.}}$, cm ²	σ_{Atoms} , cm ²	error, %
3.26E+01	8.15E-18	8.41E-18	-3.13	4.21E+01	8.06E-18	2.32E-18	-10.18
3.83E+01	2.37E-17	2.30E-17	3.08	4.96E+01	6.27E-18	6.01E-18	4.36
6.14E+01	1.51E-16	1.48E-16	1.97	7.93E+01	8.72E-17	8.80E-17	-0.94
1.53E+02	1.60E-16	1.60E-16	0.13	1.98E+02	9.12E-17	9.28E-17	-1.77
5.21E+02	7.58E-17	7.78E-17	-2.54	6.74E+02	3.93E-17	3.81E-17	3.02

1.56E+03	3.46E-17	3.38E-17	2.33	1.40E+03	2.17E-17	2.14E-17	1.39
6.15E+03	1.14E-17	1.14E-17	0.36	5.48E+03	7.05E-18	7.35E-18	-4.03
2.45E+04	3.51E-18	3.50E-18	0.17	2.18E+04	2.20E-18	2.25E-18	-2.26
9.80E+04	1.03E-18	1.03E-18	0.23	8.71E+04	6.61E-19	6.60E-19	0.13
3.92E+05	2.97E-19	3.00E-19	-1.05	3.48E+05	1.93E-19	1.88E-19	2.81
Sn 4+ I = 73.8 eV				Sn 5+ I = 98.7 eV			
E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %	E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %
7.84E+01	6.87E-18	7.00E-18	-1.87	1.05E+02	2.88E-18	2.91E-18	-1.21
9.22E+01	2.19E-17	2.20E-17	-0.66	1.23E+02	9.25E-18	9.30E-18	-0.54
1.25E+02	4.14E-17	4.20E-17	-1.41	1.97E+02	2.45E-17	2.55E-17	-4
3.69E+02	3.50E-17	3.46E-17	1.18	4.83E+02	1.62E-17	1.56E-17	3.6
1.25E+03	1.46E-17	1.50E-17	-2.82	1.68E+03	7.04E-18	7.66E-18	-8.13
4.32E+03	5.33E-18	5.21E-18	2.35	6.22E+03	2.59E-18	2.46E-18	5.2
1.71E+04	1.61E-18	1.61E-18	0.26	2.46E+04	7.76E-19	7.58E-19	2.32
6.81E+04	4.68E-19	4.70E-19	-0.43	9.80E+04	2.19E-19	2.19E-19	-0.06
2.72E+05	1.33E-19	1.33E-19	-0.33	3.92E+05	6.03E-20	6.18E-20	-2.39
Sn 6+ I = 123 eV				Sn 7+ I = 139 eV			
E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %	E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %
1.30E+02	1.68E-18	1.72E-18	-2.46	1.43E+02	1.45E-18	1.56E-18	-7.07
1.53E+02	5.43E-18	5.46E-18	-0.63	1.68E+02	4.53E-18	4.69E-18	-3.38
2.45E+02	1.39E-17	1.44E-17	-3.49	2.68E+02	1.01E-17	1.05E-17	-3.64
6.14E+02	9.60E-18	9.27E-18	3.6	6.71E+02	7.34E-18	7.16E-18	2.48
2.09E+03	4.54E-18	4.97E-18	-8.72	2.28E+03	3.72E-18	4.00E-18	-7.01
8.45E+03	1.57E-18	1.49E-18	5.57	5.57E+03	1.89E-18	1.80E-18	4.81
3.34E+04	4.72E-19	4.60E-19	2.51	2.19E+04	5.90E-19	5.84E-19	1.02
1.33E+05	1.33E-19	1.33E-19	0.26	8.72E+04	1.73E-19	1.73E-19	-0.29
5.33E+05	3.68E-20	3.79E-20	-3	3.48E+05	4.91E-20	4.96E-20	-1.03
Sn 8+ I = 163 eV				Sn 9+ I = 180 eV			
E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %	E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %
1.66E+02	9.10E-19	1.04E-18	-12.47	1.91E+02	6.45E-19	6.64E-19	-2.85
1.96E+02	2.83E-18	3.00E-18	-5.61	2.25E+02	1.86E-18	1.87E-18	-0.66
3.13E+02	6.91E-18	6.77E-18	2	3.59E+02	4.87E-18	4.93E-18	-1.26
7.83E+02	5.18E-18	5.18E-18	0.01	8.99E+02	4.27E-18	4.20E-18	1.65
2.66E+03	2.77E-18	2.92E-18	-5.07	3.06E+03	2.11E-18	2.20E-18	-3.95
1.39E+04	7.81E-19	7.33E-19	6.55	1.72E+04	5.52E-19	5.31E-19	3.93
5.52E+04	2.28E-19	2.25E-19	1.13	6.82E+04	1.64E-19	1.63E-19	0.54
2.20E+05	6.33E-20	6.57E-20	-3.62	2.72E+05	4.66E-20	4.75E-20	-1.94
Sn 10+ I = 214 eV				Sn 11+ I = 228 eV			
E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %	E_γ eV	σ_{FIT,γ} cm²	σ_{Atom,γ} cm²	error, %
2.17E+02	3.75E-19	4.00E-19	-6.27	2.43E+02	2.21E-19	2.26E-19	-2.45
2.55E+02	1.25E-18	1.12E-18	11.87	2.86E+02	6.41E-19	6.34E-19	1.1
4.08E+02	3.43E-18	3.44E-18	-0.26	4.57E+02	2.46E-18	2.46E-18	0.05
1.02E+03	3.05E-18	3.21E-18	-4.94	1.14E+03	2.50E-18	2.48E-18	0.94
3.47E+03	1.65E-18	1.68E-18	-1.98	3.88E+03	1.24E-18	1.28E-18	-3.32
2.08E+04	4.13E-19	3.90E-19	5.76	1.25E+04	5.15E-19	5.00E-19	3.09
8.25E+04	1.21E-19	1.20E-19	0.54	4.92E+04	1.61E-19	1.60E-19	0.59
3.29E+05	3.38E-20	3.50E-20	-3.37	1.96E+05	4.70E-20	4.76E-20	-1.3

Sn 12+ I = 253 eV				Sn 13+ I = 282 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.69E+02	1.12E-19	1.15E-19	-2.66	2.99E+02	4.30E-20	4.39E-20	-2.1
3.17E+02	3.32E-19	3.24E-19	2.5	3.52E+02	1.32E-19	1.26E-19	4.57
5.07E+02	1.83E-18	1.80E-18	1.37	5.64E+02	1.34E-18	1.29E-18	4.09
1.27E+03	1.95E-18	1.95E-18	0.12	1.41E+03	1.70E-18	1.72E-18	-1.39
4.31E+03	9.79E-19	1.00E-18	-2.07	4.79E+03	7.96E-19	8.06E-19	-1.21
1.46E+04	3.96E-19	3.88E-19	2.18	1.36E+04	3.60E-19	3.52E-19	2.22
5.77E+04	1.24E-19	1.23E-19	0.71	5.36E+04	1.14E-19	1.14E-19	-0.08
2.30E+05	3.63E-20	3.67E-20	-1.2	2.14E+05	3.38E-20	3.40E-20	-0.71
Sn 14+ I = 388 eV				Sn 15+ I = 416 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
4.12E+02	1.29E-19	1.28E-19	0.97	4.42E+02	9.76E-20	9.22E-20	5.87
4.85E+02	4.56E-19	4.69E-19	-2.85	5.20E+02	3.27E-19	3.50E-19	-6.57
7.75E+02	9.33E-19	9.40E-19	-0.74	8.31E+02	5.69E-19	5.47E-19	4.02
1.94E+03	1.21E-18	1.22E-18	-0.54	2.08E+03	9.48E-19	1.01E-18	-6.14
6.59E+03	5.49E-19	5.63E-19	-2.44	7.07E+03	4.60E-19	4.65E-19	-1.06
8.04E+03	4.68E-19	4.45E-19	5.07	9.12E+03	3.77E-19	3.58E-19	5.23
3.10E+04	1.53E-19	1.57E-19	-2.87	3.52E+04	1.23E-19	1.24E-19	-0.77
1.23E+05	4.75E-20	4.83E-20	-1.75	1.40E+05	3.75E-20	3.78E-20	-0.87
4.90E+05	1.43E-20	1.40E-20	2.11				
Sn 16+ I = 448 eV				Sn 17+ I = 474 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
4.76E+02	6.35E-20	6.25E-20	1.57	5.03E+02	4.11E-20	4.03E-20	1.9
5.60E+02	2.41E-19	2.50E-19	-3.68	5.92E+02	1.72E-19	1.77E-19	-2.72
8.95E+02	3.40E-19	3.40E-19	0.05	9.48E+02	3.00E-19	3.00E-19	0.02
2.24E+03	8.37E-19	8.40E-19	-0.35	2.37E+03	7.06E-19	7.08E-19	-0.3
7.61E+03	3.83E-19	3.84E-19	-0.31	8.06E+03	3.21E-19	3.21E-19	0.12
1.03E+04	2.94E-19	2.86E-19	2.8	1.15E+04	2.36E-19	2.31E-19	2.17
3.98E+04	9.43E-20	9.86E-20	-4.36	4.45E+04	7.55E-20	7.87E-20	-4.02
1.58E+05	3.06E-20	3.00E-20	2.13	1.77E+05	2.43E-20	2.38E-20	2.01
Sn 18+ I = 506 eV				Sn 19+ I = 535 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
5.37E+02	2.36E-20	2.29E-20	2.89	5.69E+02	1.04E-20	9.85E-21	5.17
6.32E+02	1.17E-19	1.19E-19	-1.58	6.69E+02	7.44E-20	7.48E-20	-0.48
1.01E+03	2.50E-19	2.50E-19	-0.05	1.07E+03	1.78E-19	1.78E-19	-0.17
2.53E+03	5.99E-19	6.00E-19	-0.2	2.68E+03	5.01E-19	5.00E-19	0.15
8.60E+03	2.71E-19	2.70E-19	0.35	9.10E+03	2.27E-19	2.25E-19	0.88
1.28E+04	1.91E-19	1.88E-19	1.83	1.41E+04	1.54E-19	1.52E-19	1.38
4.96E+04	6.09E-20	6.34E-20	-3.94	5.49E+04	4.87E-20	5.10E-20	-4.46
1.97E+05	1.95E-20	1.91E-20	2.02	2.18E+05	1.57E-20	1.53E-20	2.42
Sn 20+ I = 612 eV				Sn 21+ I = 650 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
6.50E+02	1.21E-20	1.25E-20	-3.55	6.88E+02	5.34E-21	5.56E-21	-3.91
7.65E+02	4.03E-20	3.91E-20	2.98	8.10E+02	1.83E-20	1.75E-20	4.59
1.22E+03	1.72E-19	1.65E-19	4.3	1.30E+03	1.39E-19	1.30E-19	7.01
3.06E+03	3.78E-19	3.92E-19	-3.53	3.24E+03	3.10E-19	3.30E-19	-6.16

1.04E+04	1.80E-19	1.76E-19	2.26	1.10E+04	1.52E-19	1.48E-19	2.71
6.06E+04	4.06E-20	4.10E-20	-1.06	6.65E+04	3.31E-20	3.30E-20	0.38
2.41E+05	1.22E-20	1.22E-20	0.29	2.64E+05	9.77E-21	9.84E-21	-0.74
Sn 22+ I = 1128 eV				Sn 23+ I = 1199 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.20E+03	1.04E-20	9.90E-21	5.13	1.27E+03	8.46E-21	8.16E-21	3.68
1.40E+03	3.64E-20	3.89E-20	-6.46	1.50E+03	3.12E-20	3.30E-20	-5.54
2.26E+03	6.82E-20	6.80E-20	0.28	2.40E+03	5.85E-20	5.80E-20	0.79
5.64E+03	6.34E-20	6.72E-20	-5.65	6.00E+03	5.48E-20	5.82E-20	-5.9
1.92E+04	3.42E-20	3.00E-20	13.98	2.04E+04	2.92E-20	2.56E-20	13.93
7.31E+04	1.85E-20	2.88E-20	-35.75	7.95E+04	1.52E-20	2.32E-20	-34.29
2.89E+05	7.95E-21	8.70E-21	-8.63	3.15E+05	6.43E-21	7.00E-21	-8.18
1.15E+06	2.89E-21	2.48E-21	16.4	1.25E+06	2.32E-21	2.00E-21	15.84
Sn 24+ I = 1271 eV				Sn 25+ I = 1324 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.35E+03	6.78E-21	6.52E-21	4.05	1.40E+03	1.87E-20	1.88E-20	-0.62
1.60E+03	2.57E-20	2.72E-20	-5.61	1.65E+03	6.37E-20	6.50E-20	-1.96
2.54E+03	4.78E-20	4.76E-20	0.46	2.65E+03	1.50E-19	1.53E-19	-1.93
6.35E+03	4.61E-20	4.90E-20	-5.92	6.62E+03	1.24E-19	1.22E-19	1.37
2.16E+04	2.46E-20	2.16E-20	14.07	2.25E+04	5.15E-20	5.28E-20	-2.48
8.63E+04	1.24E-20	1.90E-20	-34.68	9.33E+04	1.57E-20	1.54E-20	2.1
3.41E+05	5.18E-21	5.63E-21	-7.92	3.69E+05	4.59E-21	4.58E-21	0.2
1.36E+06	1.85E-21	1.60E-21	15.77	1.47E+06	1.29E-21	1.30E-21	-0.76
Sn 26+ I = 1428 eV				Sn 27+ I = 1501 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.52E+03	1.42E-20	1.40E-20	1.19	1.60E+03	1.13E-20	1.07E-20	5.93
1.78E+03	4.89E-20	5.00E-20	-2.29	1.88E+03	4.98E-20	5.32E-20	-6.4
2.86E+03	1.19E-19	1.22E-19	-2.37	3.00E+03	8.82E-20	9.13E-20	-3.44
7.14E+03	9.99E-20	9.87E-20	1.19	7.50E+03	7.66E-20	7.70E-20	-0.47
2.43E+04	4.20E-20	4.27E-20	-1.77	2.55E+04	3.25E-20	3.17E-20	2.41
1.01E+05	1.27E-20	1.25E-20	1.41	2.15E+05	5.37E-21	5.64E-21	-4.83
3.98E+05	3.71E-21	3.71E-21	0.12	8.54E+05	1.67E-21	1.62E-21	2.9
1.59E+06	1.05E-21	1.05E-21	-0.49				
Sn 28+ I = 1590 eV				Sn 29+ I = 1668 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.70E+03	8.58E-21	7.70E-21	11.42	1.77E+03	5.88E-21	5.27E-21	11.64
2.00E+03	3.84E-20	4.30E-20	-10.78	2.10E+03	3.19E-20	3.55E-20	-10.14
3.20E+03	8.22E-20	8.14E-20	0.95	3.30E+03	6.65E-20	6.60E-20	0.7
8.00E+03	6.76E-20	7.00E-20	-3.39	8.30E+03	5.65E-20	5.80E-20	-2.55
2.70E+04	2.98E-20	2.93E-20	1.61	2.83E+04	2.64E-20	2.64E-20	0
2.30E+05	4.65E-21	4.60E-21	0.99	2.46E+05	3.93E-21	3.80E-21	3.51
9.17E+05	1.31E-21	1.32E-21	-1	9.81E+05	1.06E-21	1.09E-21	-2.49
Sn 30+ I = 1757 eV				Sn 31+ I = 1834 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
1.87E+03	3.74E-21	3.17E-21	17.94	1.95E+03	1.75E-21	1.45E-21	20.36
2.20E+03	2.28E-20	2.80E-20	-18.46	2.30E+03	1.56E-20	2.16E-20	-27.74
3.50E+03	5.56E-20	5.30E-20	4.98	3.70E+03	4.58E-20	4.16E-20	10.09
8.80E+03	4.41E-20	4.80E-20	-8.23	9.20E+03	3.35E-20	4.00E-20	-16.22

3.00E+04	2.08E-20	2.00E-20	3.73	3.12E+04	1.80E-20	1.68E-20	7.13
2.63E+05	3.19E-21	3.11E-21	2.62	2.80E+05	2.69E-21	2.55E-21	5.49
1.05E+06	8.77E-22	9.00E-22	-2.58	1.12E+06	6.96E-22	7.35E-22	-5.25
Sn 32+ I = 2111 eV				Sn 33+ I = 2198 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %
2.24E+03	4.83E-21	4.74E-21	1.96	2.34E+03	3.81E-21	3.70E-21	2.94
2.64E+03	1.73E-20	1.81E-20	-4.33	2.75E+03	1.38E-20	1.45E-20	-4.77
4.22E+03	3.00E-20	3.05E-20	-1.8	4.40E+03	2.38E-20	2.43E-20	-2.09
1.06E+04	3.05E-20	3.04E-20	0.18	1.10E+04	2.54E-20	2.54E-20	0.11
3.60E+04	1.30E-20	1.29E-20	0.52	3.74E+04	1.09E-20	1.08E-20	0.88
2.98E+05	2.08E-21	2.10E-21	-1.16	3.17E+05	1.70E-21	1.73E-21	-1.85
1.19E+06	6.10E-22	6.06E-22	0.72	1.26E+06	5.06E-22	5.00E-22	1.14
Sn 34+ I = 2262 eV				Sn 35+ I = 2361 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %
2.40E+03	2.81E-21	2.82E-21	-0.35	2.50E+03	2.23E-21	2.22E-21	0.31
2.80E+03	8.22E-21	8.50E-21	-3.28	3.00E+03	8.41E-21	8.70E-21	-3.33
4.50E+03	1.43E-20	1.43E-20	0.17	4.72E+03	1.44E-20	1.45E-20	-0.95
1.13E+04	1.70E-20	1.73E-20	-1.59	1.18E+04	1.75E-20	1.75E-20	-0.3
3.85E+04	7.39E-21	7.16E-21	3.21	4.01E+04	7.59E-21	7.50E-21	1.18
3.35E+05	1.34E-21	1.43E-21	-6.47	3.55E+05	1.15E-21	1.17E-21	-2.12
1.34E+06	4.28E-22	4.12E-22	3.85	1.41E+06	3.41E-22	3.37E-22	1.28
Sn 36+ I = 2431 eV				Sn 37+ I = 2506 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %
2.58E+03	1.56E-21	1.49E-21	4.41	2.66E+03	7.97E-22	7.00E-22	13.85
3.00E+03	5.95E-21	6.32E-21	-5.8	3.13E+03	3.66E-21	4.18E-21	-12.55
4.86E+03	9.81E-21	1.00E-20	-1.87	5.00E+03	7.19E-21	6.90E-21	4.21
1.22E+04	1.42E-20	1.42E-20	-0.05	1.25E+04	1.02E-20	1.12E-20	-9.2
4.13E+04	6.27E-21	6.17E-21	1.68	4.26E+04	5.26E-21	5.00E-21	5.12
3.75E+05	9.17E-22	9.50E-22	-3.45	3.95E+05	7.70E-22	7.60E-22	1.36
1.49E+06	2.79E-22	2.73E-22	2.13	1.57E+06	2.16E-22	2.20E-22	-1.95
Sn 38+ I = 2715 eV				Sn 39+ I = 2796 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %
2.88E+03	7.12E-22	7.33E-22	-2.83	3.00E+03	3.33E-22	3.42E-22	-2.57
3.40E+03	2.18E-21	2.21E-21	-1.31	3.50E+03	1.01E-21	1.00E-21	0.49
5.43E+03	3.75E-21	3.70E-21	1.38	5.60E+03	1.79E-21	1.73E-21	3.27
1.36E+04	8.18E-21	8.30E-21	-1.43	1.40E+04	6.18E-21	6.40E-21	-3.51
4.61E+04	3.88E-21	3.80E-21	2	4.75E+04	2.99E-21	2.90E-21	3.26
4.16E+05	5.93E-22	6.10E-22	-2.85	4.38E+05	4.47E-22	4.64E-22	-3.65
1.66E+06	1.80E-22	1.77E-22	1.67	1.74E+06	1.38E-22	1.35E-22	2.03
Sn 40+ I = 6480 eV				Sn 41+ I = 6909 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atoms}, cm²	error, %
6.88E+03	5.93E-22	5.84E-22	1.56	7.34E+03	4.46E-22	4.37E-22	1.96
8.10E+03	2.01E-21	2.10E-21	-4.42	8.64E+03	1.54E-21	1.61E-21	-4.57
1.30E+04	3.45E-21	3.53E-21	-2.39	1.38E+04	2.63E-21	2.70E-21	-2.57
3.24E+04	2.65E-21	2.63E-21	0.73	3.45E+04	2.02E-21	2.00E-21	0.75
1.10E+05	1.14E-21	1.15E-21	-0.8	1.17E+05	8.79E-22	8.86E-22	-0.8
4.64E+05	3.40E-22	3.38E-22	0.72	4.87E+05	2.65E-22	2.63E-22	0.69
1.84E+06	9.87E-23	9.90E-23	-0.29	1.93E+06	7.66E-23	7.68E-23	-0.27

Sn 42+ I = 6912 eV				Sn 43+ I = 7126 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
7.34E+03	3.67E-22	3.60E-22	2.04	7.60E+03	2.69E-22	2.60E-22	3.42
8.64E+03	1.28E-21	1.34E-21	-4.6	8.90E+03	9.48E-22	1.00E-21	-5.23
1.38E+04	2.19E-21	2.25E-21	-2.51	1.43E+04	1.67E-21	1.72E-21	-3.15
3.46E+04	1.71E-21	1.70E-21	0.68	3.56E+04	1.31E-21	1.30E-21	0.78
1.17E+05	7.53E-22	7.58E-22	-0.62	1.21E+05	5.91E-22	5.94E-22	-0.52
5.10E+05	2.19E-22	2.18E-22	0.47	5.34E+05	1.70E-22	1.70E-22	0.23
2.02E+06	6.37E-23	6.38E-23	-0.17	2.11E+06	5.00E-23	5.00E-23	-0.05
Sn 44+ I = 7379 eV				Sn 45+ I = 7603 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
7.84E+03	1.86E-22	1.80E-22	3.5	8.08E+03	1.63E-22	1.64E-22	-0.59
9.22E+03	7.01E-22	7.40E-22	-5.32	9.50E+03	4.73E-22	4.90E-22	-3.48
1.48E+04	1.20E-21	1.24E-21	-3.04	1.52E+04	8.19E-22	8.30E-22	-1.33
3.69E+04	9.66E-22	9.60E-22	0.64	3.80E+04	6.72E-22	6.70E-22	0.29
1.25E+05	4.49E-22	4.50E-22	-0.18	1.29E+05	3.23E-22	3.24E-22	-0.18
5.58E+05	1.30E-22	1.30E-22	-0.23	5.83E+05	9.51E-23	9.50E-23	0.06
2.21E+06	3.81E-23	3.80E-23	0.17				
Sn 46+ I = 7940 eV				Sn 47+ I = 8313 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
8.44E+03	9.12E-23	9.16E-23	-0.43	8.83E+03	4.15E-23	4.19E-23	-0.88
9.90E+03	2.63E-22	2.72E-22	-3.51	1.04E+04	1.21E-22	1.25E-22	-3.29
1.60E+04	4.64E-22	4.70E-22	-1.38	1.66E+04	2.12E-22	2.15E-22	-1.24
4.00E+04	4.01E-22	4.00E-22	0.34	4.20E+04	1.97E-22	1.96E-22	0.34
1.35E+05	2.16E-22	2.16E-22	-0.23	1.41E+05	1.14E-22	1.14E-22	-0.35
6.09E+05	6.61E-23	6.60E-23	0.08	6.35E+05	3.71E-23	3.70E-23	0.26
				2.52E+06	1.13E-23	1.13E-23	-0.09
Sn 48+ I = 34220 eV				Sn 49+ I = 35160 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
3.64E+04	4.27E-24	4.30E-24	-0.74	3.74E+04	2.00E-24	2.00E-24	-0.01
4.30E+04	1.30E-23	1.33E-23	-2.62	4.40E+04	6.21E-24	6.40E-24	-2.94
6.84E+04	2.59E-23	2.62E-23	-1.15	7.00E+04	1.23E-23	1.25E-23	-1.4
1.71E+05	2.44E-23	2.43E-23	0.27	1.76E+05	1.15E-23	1.15E-23	0.35
5.82E+05	1.20E-23	1.20E-23	-0.17	5.98E+05	5.66E-24	5.67E-24	-0.22
2.65E+06	3.70E-24	3.70E-24	0.06	2.76E+06	1.70E-24	1.70E-24	0.07

Table 3.2. Fitting parameters for stannum and its ions.

Sn	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	B
0+	6.5483E+00	1.1393E+02	-4.3410E+02	6.6941E+02	-4.9014E+02	1.5219E+02	2.6275E+00
1+	2.3259E-01	-1.2054E+01	4.0078E+01	-2.4681E+00	-9.1379E+01	7.0485E+01	1.8771E+00
2+	-1.9901E+00	1.6518E+00	-6.8113E+01	3.4622E+02	-4.9587E+02	2.2207E+02	3.3593E+00
3+	8.0391E-01	-6.0562E+01	3.5648E+02	-7.4975E+02	7.0987E+02	-2.5525E+02	2.9218E+00
4+	4.3349E+00	3.2548E+00	-1.5717E+01	1.1283E+02	-1.9093E+02	9.4663E+01	2.2139E+00
5+	3.1638E+00	5.8842E+00	-4.9232E+01	2.9334E+02	-4.9441E+02	2.5201E+02	1.5212E+00
6+	3.3454E+00	1.3249E+00	-4.3076E+01	2.7741E+02	-4.6644E+02	2.3811E+02	1.6058E+00
7+	1.0386E+01	-8.7031E+01	4.0402E+02	-7.8941E+02	6.7751E+02	-2.0754E+02	2.0219E+00
8+	1.4126E+01	-1.1713E+02	4.1873E+02	-5.7233E+02	2.6876E+02	0.0000E+00	1.4734E+00

9+	1.9385E+00	2.9192E+00	-6.4010E+01	2.9480E+02	-4.2919E+02	2.0285E+02	1.8493E+00
10+	1.2373E+01	-1.1349E+02	3.9917E+02	-5.3229E+02	2.4561E+02	0.0000E+00	1.7025E+00
11+	-1.0593E-01	2.7617E+00	-5.4746E+01	2.6451E+02	-3.8147E+02	1.7658E+02	2.0016E+00
12+	-8.2822E-01	2.2540E+00	-5.7511E+01	2.8733E+02	-4.1700E+02	1.9288E+02	2.0593E+00
13+	-1.6039E+00	1.9252E+00	-5.4016E+01	2.6504E+02	-3.6277E+02	1.5727E+02	2.1965E+00
14+	-2.4694E-01	6.5504E+00	-4.1282E+00	-7.6305E+01	1.9582E+02	-1.1838E+02	3.3379E+00
15+	-8.2225E-01	2.3399E+01	-1.2620E+02	2.2261E+02	-1.1350E+02	0.0000E+00	2.8038E+00
16+	-2.1025E+00	-3.6997E-01	7.1348E+01	-4.0924E+02	7.0625E+02	-3.6870E+02	4.1274E+00
17+	-2.1962E+00	-1.5697E+00	7.2081E+01	-3.7133E+02	6.2503E+02	-3.2379E+02	3.6988E+00
18+	-2.4559E+00	-3.2184E+00	8.1830E+01	-3.7603E+02	6.1055E+02	-3.1199E+02	3.4404E+00
19+	-2.8237E+00	-5.9529E+00	-4.3677E+02	-4.3677E+02	6.7939E+02	-3.3966E+02	3.3176E+00
20+	-1.4247E+00	-2.7092E+00	1.9291E+01	-8.1397E+01	1.7151E+02	-1.0092E+02	2.2824E+00
21+	-1.3165E+00	-1.5327E+00	3.3654E+00	-1.0560E+01	6.2369E+01	-4.6224E+01	1.7738E+00
22+	-6.8687E+00	9.4031E+00	-5.3462E+01	7.2124E+01	-1.7161E+01	-2.5998E+01	8.5620E+00
23+	-6.0058E+00	8.7591E+00	-5.8498E+01	1.0446E+02	-6.6545E+01	-1.4554E+00	7.7603E+00
24+	-5.5595E+00	6.4792E+00	-3.5041E+01	3.8288E+01	8.3712E+00	-2.9888E+01	7.0666E+00
25+	4.0148E+00	1.1976E+01	-8.2084E+01	3.0690E+02	-4.0829E+02	1.7960E+02	1.8586E+00
26+	2.5555E+00	1.2903E+01	-4.6579E+01	1.6410E+02	-2.2026E+02	9.8239E+01	1.8237E+00
27+	1.7558E-01	1.2336E+01	8.2045E+01	-4.1981E+02	6.0839E+02	-2.8176E+02	3.1359E+00
28+	6.0633E-01	2.6542E+01	-4.6854E+01	3.7109E+01	-7.2002E+00	0.0000E+00	1.3992E+00
29+	9.3579E-01	2.5027E+01	-3.8804E+01	1.6741E+01	8.8529E+00	0.0000E+00	7.3966E-01
30+	-3.1372E-02	1.9802E+01	-8.1682E+00	-3.3676E+01	3.2718E+01	0.0000E+00	8.7680E-01
31+	3.7112E-01	6.9305E+00	6.0828E+01	-1.5380E+02	9.9599E+01	0.0000E+00	7.9265E-02
32+	1.6141E+00	1.2111E+01	-2.9004E+01	-1.2269E+01	8.946E+01	-6.6882E+01	1.7030E+00
33+	9.5863E-01	9.6069E+00	-2.3674E+00	-9.6497E+01	2.0220E+02	-1.1050E+02	1.6615E+00
34+	2.3075E-01	6.1059E+00	-4.1864E+01	7.3764E+01	-2.6645E+01	-1.2276E+01	2.1322E+00
35+	7.7027E-01	4.0067E+00	-3.4297E-01	-5.7949E+01	1.3249E+02	-7.6222E+01	1.3421E+00
36+	-4.7921E-02	5.6192E+00	9.1601E+00	-1.2382E+02	2.3705E+02	-1.2665E+02	1.3627E+00
37+	-1.5753E-01	1.0359E+01	-3.8149E+01	5.5692E+01	-2.2941E+01	0.0000E+00	5.7540E-01
38+	-1.1382E-01	-1.1790E+00	1.4179E+01	-8.0797E+01	1.5037E+02	-8.1365E+01	1.0881E+00
39+	-5.3867E-01	-1.7017E+00	2.2188E+01	-1.0563E+02	1.7860E+02	-9.2412E+01	9.5821E-01
40+	2.8503E+00	1.5409E+01	-6.6687E+01	1.4039E+02	-1.3826E+02	5.2646E+01	9.7200E-01
41+	2.3771E+00	1.3315E+01	-4.9987E+01	9.3910E+01	-8.6428E+01	3.2479E+01	8.1835E-01
42+	1.8927E+00	1.1177E+01	-4.1468E+01	7.5432E+01	-6.6327E+01	2.3943E+01	7.5547E-01
43+	1.1627E+00	8.2952E+00	-1.4838E+01	-1.4881E+00	2.1876E+01	-1.1392E+01	6.9008E-01
44+	8.7763E-01	7.0205E+00	-1.4637E+01	3.9477E+00	1.3436E+01	-7.6873E+00	5.7454E-01
45+	1.2368E+00	4.5931E+00	-3.4430E+01	9.8954E+01	-1.1817E+02	5.1033E+01	2.8095E-01
46+	6.8079E-01	2.9396E+00	-2.2453E+01	6.5672E+01	-8.0580E+01	3.6104E+01	2.3557E-01
47+	2.2732E-01	1.2214E+00	-1.0316E+01	3.0627E+01	-3.8062E+01	1.7298E+01	2.4406E-01
48+	3.2331E-01	1.8504E+00	-1.4132E+01	4.2938E+01	-5.1509E+01	2.1884E+01	4.8069E-01
49+	1.6963E-01	1.0735E+00	-6.7644E+00	1.9114E+01	-2.2242E+01	9.3892E+00	2.1876E-01

Table 4.1. Ionization cross sections of tantalum and its ions.

Ta 0+				Ta 1+			
I = 7.9 eV				I = 14.4 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
8.39E+00	1.21E-16	1.16E-16	4.55	1.54E+01	1.81E-16	1.74E-16	4.02

9.87E+00	9.47E-16	1.00E-15	-5.29	1.81E+01	4.52E-16	4.60E-16	-1.67
1.58E+01	2.18E-15	2.36E-15	-7.47	2.90E+01	7.32E-16	7.30E-16	0.23
3.95E+01	1.55E-15	1.52E-15	1.72	7.24E+01	5.63E-16	5.60E-16	0.54
1.34E+02	8.24E-16	8.46E-16	-2.58	2.46E+02	2.28E-16	2.30E-16	-0.68
4.33E+02	3.37E-16	3.30E-16	2.11	6.94E+02	9.80E-17	9.40E-17	4.27
1.71E+03	1.08E-16	1.10E-16	-2.21	2.73E+03	2.94E-17	3.00E-17	-2
6.81E+03	3.26E-17	3.23E-17	0.83	1.00E+04	9.02E-18	8.86E-18	1.78
2.72E+04	9.55E-18	9.47E-18	0.8	4.35E+04	2.32E-18	2.52E-18	-8.01
1.09E+05	2.73E-18	2.76E-18	-1.07	1.74E+05	6.36E-19	6.00E-19	6.06

Ta 2+ I = 24.2 eV				Ta 3+ I = 36.3 eV			
E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %
2.60E+01	1.46E-17	1.43E-17	1.89	3.86E+01	7.15E-18	7.24E-18	-1.19
3.00E+01	4.48E-17	4.61E-17	-2.76	4.54E+01	2.30E-17	2.31E-17	-0.62
4.84E+01	9.71E-17	9.65E-17	0.62	7.26E+01	6.22E-17	6.22E-17	-0.07
1.21E+02	1.81E-16	1.88E-16	-3.97	1.81E+02	8.28E-17	8.27E-17	0.1
4.11E+02	8.19E-17	7.62E-17	7.48	6.17E+02	4.18E-17	4.20E-17	-0.39
1.55E+03	2.70E-17	2.77E-17	-2.5	2.76E+03	1.33E-17	1.32E-17	0.88
6.14E+03	8.69E-18	9.12E-18	-4.77	1.09E+04	4.27E-18	4.30E-18	-0.63
2.45E+04	2.71E-18	2.78E-18	-2.71	4.36E+04	1.30E-18	1.30E-18	-0.35
9.79E+04	8.13E-19	8.15E-19	-0.22	1.74E+05	3.82E-19	3.80E-19	0.39
3.92E+05	2.38E-19	2.26E-19	5.08				

Ta 4+ I = 49.0 eV				Ta 5+ I = 92.8 eV			
E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %
5.20E+01	2.19E-18	2.27E-18	-3.62	9.86E+01	1.76E-18	1.51E-18	16.21
6.12E+01	6.96E-18	6.84E-18	1.72	1.16E+02	1.05E-17	1.24E-17	-14.97
9.80E+01	3.53E-17	3.50E-17	0.84	1.86E+02	2.46E-17	2.40E-17	2.34
2.45E+02	4.21E-17	4.20E-17	0.18	4.64E+02	2.25E-17	2.37E-17	-5
8.32E+02	2.26E-17	2.32E-17	-2.42	1.58E+03	1.34E-17	1.35E-17	-1.09
4.30E+03	6.81E-18	6.65E-18	2.39	6.21E+03	4.91E-18	4.64E-18	5.76
1.70E+04	2.16E-18	2.15E-18	0.64	2.46E+04	1.54E-18	1.52E-18	1.38
6.80E+04	6.47E-19	6.50E-19	-0.48	9.80E+04	4.56E-19	4.60E-19	-0.78
2.72E+05	1.88E-19	1.90E-19	-1.13	3.92E+05	1.31E-19	1.35E-19	-2.87

Ta 6+ I = 118 eV				Ta 7+ I = 142 eV			
E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %
1.25E+02	2.55E-18	2.60E-18	-1.87	1.51E+02	1.61E-18	1.62E-18	-0.66
1.47E+02	7.66E-18	7.82E-18	-2.05	1.77E+02	4.90E-18	5.00E-18	-2.1
2.36E+02	1.59E-17	1.61E-17	-1.29	2.84E+02	1.09E-17	1.10E-17	-1.13
5.89E+02	1.65E-17	1.63E-17	1.35	7.10E+02	1.18E-17	1.17E-17	0.67
2.00E+03	8.92E-18	9.20E-18	-3.09	2.41E+03	6.37E-18	6.44E-18	-1.03
8.45E+03	3.06E-18	3.00E-18	1.98	2.19E+04	1.17E-18	1.15E-18	1.31
3.34E+04	9.66E-19	9.50E-19	1.7	8.72E+04	3.56E-19	3.56E-19	-0.13
1.33E+05	2.88E-19	2.90E-19	-0.63	3.48E+05	1.05E-19	1.05E-19	-0.5
5.33E+05	8.31E-20	8.40E-20	-1.04				

Ta 8+ I = 164 eV				Ta 9+ I = 180 eV			
E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{FHL} , cm ²	σ_{Atom} , cm ²	error, %
1.75E+02	5.23E-19	4.90E-19	6.79	1.91E+02	3.22E-19	3.00E-19	7.17
2.06E+02	3.33E-18	3.47E-18	-4.18	2.25E+02	2.36E-18	2.45E-18	-3.65
3.29E+02	7.06E-18	7.40E-18	-4.57	3.59E+02	5.26E-18	5.50E-18	-4.44
8.23E+02	9.61E-18	9.50E-18	1.12	8.99E+02	7.79E-18	7.71E-18	1.01

2.80E+03	4.94E-18	4.90E-18	0.76	3.06E+03	3.99E-18	3.94E-18	1.26
2.77E+04	7.90E-19	8.10E-19	-2.53	3.42E+04	5.80E-19	6.00E-19	-3.41
1.10E+05	2.50E-19	2.50E-19	-0.21	1.36E+05	1.83E-19	1.84E-19	-0.4
4.41E+05	7.53E-20	7.42E-20	1.53	5.44E+05	5.55E-20	5.43E-20	2.22
Ta 10+ I = 213 eV				Ta 11+ I = 236 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
2.26E+02	1.54E-19	1.42E-19	8.71	2.50E+02	5.98E-20	5.64E-20	6
2.66E+02	1.70E-18	1.77E-18	-3.94	2.94E+02	6.07E-19	5.80E-19	4.66
4.26E+02	3.77E-18	4.00E-18	-5.71	4.71E+02	3.06E-18	3.10E-18	-1.25
1.06E+03	6.08E-18	6.00E-18	1.39	1.18E+03	4.96E-18	4.93E-18	0.69
3.62E+03	3.05E-18	3.00E-18	1.78	4.00E+03	2.45E-18	2.43E-18	0.85
4.14E+04	4.25E-19	4.45E-19	-4.56	1.25E+04	1.02E-18	1.03E-18	-1.06
1.65E+05	1.35E-19	1.37E-19	-1.28	4.92E+04	3.38E-19	3.42E-19	-1.06
6.58E+05	4.14E-20	4.00E-20	3.5	1.96E+05	1.06E-19	1.05E-19	1.19
Ta 12+ I = 304 eV				Ta 13+ I = 332 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
3.23E+02	3.23E-19	3.30E-19	-2.05	3.54E+02	4.45E-20	4.00E-20	11.27
3.88E+02	1.07E-18	1.08E-18	-0.58	4.16E+02	8.76E-19	9.20E-19	-4.78
6.07E+02	2.71E-18	2.70E-18	0.41	6.66E+02	2.11E-18	2.26E-18	-6.71
1.52E+03	3.69E-18	3.70E-18	-0.36	1.66E+03	3.06E-18	3.00E-18	2.05
5.16E+03	1.81E-18	1.80E-18	0.32	5.66E+03	1.51E-18	1.50E-18	0.84
1.47E+04	8.13E-19	8.10E-19	0.37	1.70E+04	6.08E-19	6.20E-19	-1.88
5.78E+04	2.67E-19	2.70E-19	-1.16	6.70E+04	1.99E-19	2.00E-19	-0.76
2.30E+05	8.25E-20	8.20E-20	0.65	2.67E+05	6.28E-20	6.20E-20	1.3
Ta 14+ I = 339 eV				Ta 15+ I = 363 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
3.60E+02	2.06E-18	2.17E-18	-5.04	3.86E+02	1.76E-20	1.64E-20	7.4
4.23E+02	4.90E-18	5.00E-18	-1.97	4.54E+02	2.69E-19	2.52E-19	6.72
6.77E+02	7.09E-18	7.23E-18	-1.94	7.26E+02	1.62E-18	1.65E-18	-2.08
1.69E+03	4.69E-18	4.60E-18	2.04	1.81E+03	2.22E-18	2.20E-18	0.74
5.76E+03	1.65E-18	1.72E-18	-3.82	6.17E+03	1.01E-18	1.00E-18	1.35
1.95E+04	5.57E-19	5.42E-19	2.8	2.21E+04	3.68E-19	3.74E-19	-1.72
7.68E+04	1.54E-19	1.53E-19	0.62	8.74E+04	1.19E-19	1.20E-19	-1.14
3.06E+05	4.10E-20	4.14E-20	-1.02	3.49E+05	3.65E-20	3.60E-20	1.47
Ta 16+ I = 394 eV				Ta 17+ I = 439 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
4.19E+02	2.47E-19	2.48E-19	-0.53	4.66E+02	1.90E-19	1.92E-19	-0.81
4.93E+02	7.84E-19	8.00E-19	-2	5.49E+02	6.15E-19	6.20E-19	-0.75
7.88E+02	1.71E-18	1.72E-18	-0.74	8.78E+02	1.88E-18	1.90E-18	-0.94
1.97E+03	2.11E-18	2.10E-18	0.31	2.20E+03	1.60E-18	1.60E-18	0.13
6.70E+03	1.05E-18	1.05E-18	-0.37	7.50E+03	7.59E-19	7.60E-19	-0.11
2.50E+04	3.76E-19	3.74E-19	0.58	4.45E+04	1.76E-19	1.76E-19	0
9.90E+04	1.19E-19	1.20E-19	-0.66				
3.93E+05	3.61E-20	3.60E-20	0.29				
Ta 18+ I = 487 eV				Ta 19+ I = 525 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
5.17E+02	1.45E-19	1.47E-19	-1.13	5.58E+02	1.15E-19	1.16E-19	-1.24
6.08E+02	4.68E-19	4.70E-19	-0.36	6.57E+02	3.70E-19	3.70E-19	-0.01

9.74E+02	1.46E-18	1.48E-18	-1.38	1.05E+03	1.18E-18	1.20E-18	-1.59												
2.43E+03	1.26E-18	1.24E-18	1.23	2.63E+03	1.02E-18	1.00E-18	1.84												
8.30E+03	6.14E-19	6.33E-19	-3	8.93E+03	4.95E-19	5.20E-19	-4.82												
3.12E+04	2.26E-19	2.20E-19	2.54	3.45E+04	1.78E-19	1.70E-19	4.57												
1.23E+05	6.88E-20	6.83E-20	0.75	1.37E+05	5.40E-20	5.40E-20	0												
4.90E+05	1.97E-20	2.00E-20	-1.32	5.45E+05	1.56E-20	1.58E-20	-1.51												
Ta 20+				I = 568 eV				Ta 21+				I = 615 eV							
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %				
6.04E+02	8.89E-20	9.00E-20	-1.26	6.53E+02	6.62E-20	6.72E-20	-1.54	7.11E+02	2.85E-19	2.84E-19	0.24	7.68E+02	2.13E-19	2.12E-19	0.66				
7.11E+02	2.85E-19	2.84E-19	0.24	7.68E+02	2.13E-19	2.12E-19	0.66	1.14E+03	9.67E-19	9.80E-19	-1.35	1.23E+03	7.81E-19	7.90E-19	-1.11				
1.14E+03	9.67E-19	9.80E-19	-1.35	1.23E+03	7.81E-19	7.90E-19	-1.11	2.84E+03	8.44E-19	8.30E-19	1.66	3.10E+03	6.82E-19	6.70E-19	1.73				
2.84E+03	8.44E-19	8.30E-19	1.66	3.10E+03	6.82E-19	6.70E-19	1.73	9.66E+03	4.13E-19	4.30E-19	-4.05	1.00E+04	3.39E-19	3.54E-19	-4.23				
9.66E+03	4.13E-19	4.30E-19	-4.05	1.00E+04	3.39E-19	3.54E-19	-4.23	3.81E+04	1.45E-19	1.40E-19	3.27	4.18E+04	1.14E-19	1.10E-19	3.89				
3.81E+04	1.45E-19	1.40E-19	3.27	4.18E+04	1.14E-19	1.10E-19	3.89	1.50E+05	4.36E-20	4.30E-20	1.45	1.65E+05	3.46E-20	3.44E-20	0.46				
1.50E+05	4.36E-20	4.30E-20	1.45	1.65E+05	3.46E-20	3.44E-20	0.46	6.00E+05	1.24E-20	1.26E-20	-2.01	6.59E+05	9.84E-21	1.00E-20	-1.59				
6.00E+05	1.24E-20	1.26E-20	-2.01	6.59E+05	9.84E-21	1.00E-20	-1.59												
Ta 22+				I = 658 eV				Ta 23+				I = 701 eV							
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %				
6.99E+02	4.92E-20	5.00E-20	-1.58	7.45E+02	3.55E-20	3.60E-20	-1.27	8.22E+02	1.60E-19	1.57E-19	1.7	8.76E+02	1.14E-19	1.12E-19	1.99				
8.22E+02	1.60E-19	1.57E-19	1.7	8.76E+02	1.14E-19	1.12E-19	1.99	1.32E+03	7.05E-19	7.20E-19	-2.07	1.40E+03	5.85E-19	5.85E-19	0.04				
1.32E+03	7.05E-19	7.20E-19	-2.07	1.40E+03	5.85E-19	5.85E-19	0.04	3.29E+03	5.16E-19	5.00E-19	3.1	3.50E+03	5.02E-19	5.00E-19	0.43				
3.29E+03	5.16E-19	5.00E-19	3.1	3.50E+03	5.02E-19	5.00E-19	0.43	1.12E+04	2.74E-19	3.00E-19	-8.77	1.20E+04	2.47E-19	2.50E-19	-1.12				
1.12E+04	2.74E-19	3.00E-19	-8.77	1.20E+04	2.47E-19	2.50E-19	-1.12	4.56E+04	9.80E-20	9.14E-20	7.23	2.00E+05	2.36E-20	2.30E-20	2.73				
4.56E+04	9.80E-20	9.14E-20	7.23	2.00E+05	2.36E-20	2.30E-20	2.73	1.80E+05	2.88E-20	2.80E-20	2.95	7.80E+05	6.58E-21	6.70E-21	-1.78				
1.80E+05	2.88E-20	2.80E-20	2.95	7.80E+05	6.58E-21	6.70E-21	-1.78	7.20E+05	7.88E-21	8.22E-21	-4.18								
7.20E+05	7.88E-21	8.22E-21	-4.18																
Ta 24+				I = 744 eV				Ta 25+				I = 788 eV							
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %				
7.91E+02	2.39E-20	2.42E-20	-1.1	8.37E+02	1.43E-20	1.45E-20	-1.12	9.31E+02	7.82E-20	7.60E-20	2.85	9.84E+02	4.68E-20	4.50E-20	4.05				
7.91E+02	2.39E-20	2.42E-20	-1.1	8.37E+02	1.43E-20	1.45E-20	-1.12	9.31E+02	7.82E-20	7.60E-20	2.85	9.84E+02	4.68E-20	4.50E-20	4.05				
9.31E+02	7.82E-20	7.60E-20	2.85	9.84E+02	4.68E-20	4.50E-20	4.05	1.50E+03	4.82E-19	4.80E-19	0.32	1.60E+03	3.89E-19	3.85E-19	1.14				
1.50E+03	4.82E-19	4.80E-19	0.32	1.60E+03	3.89E-19	3.85E-19	1.14	3.70E+03	4.33E-19	4.30E-19	0.7	3.94E+03	3.69E-19	3.64E-19	1.31				
3.70E+03	4.33E-19	4.30E-19	0.7	3.94E+03	3.69E-19	3.64E-19	1.31	1.30E+04	2.08E-19	2.13E-19	-2.22	1.34E+04	1.71E-19	1.80E-19	-4.87				
1.30E+04	2.08E-19	2.13E-19	-2.22	1.34E+04	1.71E-19	1.80E-19	-4.87	2.13E+05	1.99E-20	1.90E-20	4.65	5.83E+04	5.45E-20	5.20E-20	4.75				
2.13E+05	1.99E-20	1.90E-20	4.65	5.83E+04	5.45E-20	5.20E-20	4.75	8.50E+05	5.42E-21	5.60E-21	-3.3	2.30E+05	1.61E-20	1.60E-20	0.73				
8.50E+05	5.42E-21	5.60E-21	-3.3	2.30E+05	1.61E-20	1.60E-20	0.73					9.20E+05	4.50E-21	4.60E-21	-2.18				
												9.20E+05	4.50E-21	4.60E-21	-2.18				
Ta 26+				I = 831 eV				Ta 27+				I = 1080 eV							
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %				
8.83E+02	6.57E-21	6.62E-21	-0.71	1.15E+03	2.81E-20	2.84E-20	-0.9	1.00E+03	2.11E-20	2.00E-20	5.39	1.35E+03	8.80E-20	8.90E-20	-1.08				
1.00E+03	2.11E-20	2.00E-20	5.39	1.35E+03	8.80E-20	8.90E-20	-1.08	1.70E+03	3.34E-19	3.24E-19	2.96	2.20E+03	2.29E-19	2.30E-19	-0.47				
1.70E+03	3.34E-19	3.24E-19	2.96	2.20E+03	2.29E-19	2.30E-19	-0.47	4.20E+03	3.32E-19	3.33E-19	-0.26	5.40E+03	2.61E-19	2.60E-19	0.29				
4.20E+03	3.32E-19	3.33E-19	-0.26	5.40E+03	2.61E-19	2.60E-19	0.29	1.40E+04	1.51E-19	1.55E-19	-2.65	1.83E+04	1.10E-19	1.10E-19	-0.44				
1.40E+04	1.51E-19	1.55E-19	-2.65	1.83E+04	1.10E-19	1.10E-19	-0.44	6.30E+04	4.53E-20	4.40E-20	3.02	6.80E+04	3.61E-20	3.60E-20	0.37				
6.30E+04	4.53E-20	4.40E-20	3.02	6.80E+04	3.61E-20	3.60E-20	0.37	2.50E+05	1.33E-20	1.32E-20	0.89	2.70E+05	1.10E-20	1.10E-20	0.01				
2.50E+05	1.33E-20	1.32E-20	0.89	2.70E+05	1.10E-20	1.10E-20	0.01	9.92E+05	3.76E-21	3.83E-21	-1.75	1.10E+06	3.20E-21	3.20E-21	-0.11				
9.92E+05	3.76E-21	3.83E-21	-1.75	1.10E+06	3.20E-21	3.20E-21	-0.11												
Ta 28+				I = 1136 eV				Ta 29+				I = 1187 eV							
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %				
1.21E+03	2.38E-20	2.28E-20	4.41	1.26E+03	1.92E-20	1.84E-20	4.48	1.42E+03	1.00E-19	1.05E-19	-4.78	1.48E+03	8.48E-20	8.90E-20	-4.69				
1.21E+03	2.38E-20	2.28E-20	4.41	1.26E+03	1.92E-20	1.84E-20	4.48	1.42E+03	1.00E-19	1.05E-19	-4.78	1.48E+03	8.48E-20	8.90E-20	-4.69				
1.42E+03	1.00E-19	1.05E-19	-4.78	1.48E+03	8.48E-20	8.90E-20	-4.69												

2.27E+03	1.89E-19	1.94E-19	-2.69	2.37E+03	1.62E-19	1.66E-19	-2.6
5.68E+03	2.27E-19	2.27E-19	0.17	5.93E+03	2.00E-19	2.00E-19	0.19
1.93E+04	9.93E-20	9.80E-20	1.33	2.03E+04	8.71E-20	8.60E-20	1.33
7.26E+04	3.10E-20	3.13E-20	-0.97	7.77E+04	2.67E-20	2.70E-20	-1.05
2.87E+05	9.36E-21	9.50E-21	-1.49	3.07E+05	8.04E-21	8.15E-21	-1.32
1.14E+06	2.79E-21	2.75E-21	1.31	1.23E+06	2.37E-21	2.34E-21	1.23
Ta 30+ I = 1239 eV				Ta 31+ I = 1295 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
1.32E+03	1.55E-20	1.47E-20	5.22	1.38E+03	1.22E-20	1.15E-20	5.63
1.55E+03	7.13E-20	7.50E-20	-4.93	1.62E+03	5.93E-20	6.24E-20	-4.9
2.48E+03	1.37E-19	1.41E-19	-2.97	2.59E+03	1.16E-19	1.20E-19	-3.2
6.19E+03	1.75E-19	1.75E-19	0.07	6.47E+03	1.54E-19	1.54E-19	0.09
2.11E+04	7.69E-20	7.53E-20	2.1	2.20E+04	6.78E-20	6.63E-20	2.25
8.28E+04	2.29E-20	2.32E-20	-1.48	8.83E+04	1.96E-20	2.00E-20	-1.92
3.28E+05	6.87E-21	7.00E-21	-1.84	3.49E+05	5.91E-21	6.00E-21	-1.49
1.31E+06	2.04E-21	2.00E-21	1.82	1.39E+06	1.76E-21	1.73E-21	1.71
Ta 32+ I = 1340 eV				Ta 33+ I = 1404 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
1.42E+03	9.37E-21	8.90E-21	5.25	1.49E+03	6.93E-21	6.53E-21	6.19
1.68E+03	5.01E-20	5.23E-20	-4.23	1.76E+03	4.14E-20	4.33E-20	-4.34
2.68E+03	9.73E-20	1.00E-19	-2.75	2.81E+03	8.20E-20	8.48E-20	-3.26
6.70E+03	1.36E-19	1.36E-19	-0.09	7.00E+03	1.20E-19	1.20E-19	0.18
2.28E+04	6.00E-20	5.86E-20	2.42	2.39E+04	5.27E-20	5.12E-20	2.83
9.39E+04	1.70E-20	1.74E-20	-2.25	8.00E+04	1.77E-20	1.80E-20	-1.56
3.72E+05	5.10E-21	5.17E-21	-1.33	3.16E+05	5.36E-21	5.50E-21	-2.63
1.48E+06	1.51E-21	1.49E-21	1.64	1.26E+06	1.61E-21	1.57E-21	2.48
Ta 34+ I = 1458 eV				Ta 35+ I = 1510 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
1.55E+03	4.91E-21	4.57E-21	7.47	1.60E+03	3.10E-21	2.87E-21	7.96
1.82E+03	3.34E-20	3.52E-20	-5.06	1.89E+03	2.78E-20	2.90E-20	-4.2
2.92E+03	6.68E-20	7.00E-20	-4.53	3.02E+03	5.57E-20	5.84E-20	-4.61
7.30E+03	1.01E-19	1.00E-19	1.17	7.55E+03	9.39E-20	9.23E-20	1.2
2.48E+04	4.49E-20	4.46E-20	0.69	2.56E+04	4.08E-20	4.00E-20	2.07
4.31E+04	2.72E-20	2.70E-20	0.79	4.56E+04	2.39E-20	2.40E-20	-0.54
1.68E+05	8.27E-21	8.64E-21	-4.25	1.78E+05	7.21E-21	7.52E-21	-4.1
6.68E+05	2.56E-21	2.50E-21	2.29	7.07E+05	2.26E-21	2.20E-21	2.49
Ta 36+ I = 1561 eV				Ta 37+ I = 1781 eV			
E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %	E, eV	$\sigma_{\text{FHL}, \text{cm}^2}$	$\sigma_{\text{Atom}, \text{cm}^2}$	error, %
1.66E+03	1.49E-21	1.35E-21	10.04	1.89E+03	5.31E-21	5.25E-21	1.16
1.95E+03	2.17E-20	2.30E-20	-5.46	2.23E+03	2.02E-20	2.07E-20	-2.48
3.12E+03	4.56E-20	4.84E-20	-5.82	3.56E+03	4.16E-20	4.17E-20	-0.3
7.85E+03	8.21E-20	8.20E-20	0.14	8.90E+03	6.63E-20	6.70E-20	-1.07
2.65E+04	3.68E-20	3.50E-20	5	3.03E+04	2.91E-20	2.83E-20	2.65
1.88E+05	6.10E-21	6.50E-21	-6.18	1.98E+05	5.47E-21	5.60E-21	-2.34
7.46E+05	1.86E-21	1.90E-21	-2.26	7.87E+05	1.61E-21	1.63E-21	-1.07
2.98E+06	5.57E-22	5.35E-22	4.11	3.14E+06	4.68E-22	4.60E-22	1.73

Ta 38+ I = 1836 eV				Ta 39+ I = 1890 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
1.95E+03	4.18E-21	4.11E-21	1.67	2.01E+03	3.18E-21	3.11E-21	2.2
2.30E+03	1.66E-20	1.70E-20	-2.39	2.36E+03	1.32E-20	1.34E-20	-1.53
3.67E+03	3.50E-20	3.51E-20	-0.28	3.78E+03	3.41E-20	3.43E-20	-0.61
9.18E+03	5.92E-20	6.00E-20	-1.38	9.45E+03	5.26E-20	5.31E-20	-0.98
3.12E+04	2.60E-20	2.52E-20	3.29	3.21E+04	2.30E-20	2.24E-20	2.67
2.09E+05	4.76E-21	4.90E-21	-2.82	2.19E+05	4.19E-21	4.30E-21	-2.62
8.29E+05	1.41E-21	1.43E-21	-1.53	8.72E+05	1.23E-21	1.24E-21	-0.8
3.31E+06	4.09E-22	4.00E-22	2.27	3.48E+06	3.56E-22	3.50E-22	1.66
Ta 40+ I = 1946 eV				Ta 41+ I = 2066 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
2.07E+03	2.28E-21	2.20E-21	3.46	2.20E+03	1.37E-21	1.32E-21	3.76
2.43E+03	1.08E-20	1.10E-20	-1.55	2.58E+03	7.29E-21	7.30E-21	-0.14
3.89E+03	2.84E-20	2.87E-20	-1.05	4.13E+03	2.24E-20	2.26E-20	-0.7
9.73E+03	4.67E-20	4.71E-20	-0.81	1.04E+04	3.96E-20	4.00E-20	-0.96
3.31E+04	2.06E-20	2.00E-20	2.85	3.51E+04	1.75E-20	1.70E-20	3.04
2.31E+05	3.64E-21	3.73E-21	-2.33	2.42E+05	3.13E-21	3.22E-21	-2.92
9.16E+05	1.08E-21	1.10E-21	-2.04	9.62E+05	9.22E-22	9.33E-22	-1.21
3.66E+06	3.13E-22	3.05E-22	2.48	3.84E+06	2.68E-22	2.62E-22	2.1
Ta 42+ I = 2122 eV				Ta 43+ I = 2282 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
2.25E+03	6.61E-22	6.28E-22	5.19	2.42E+03	9.96E-22	1.00E-21	-0.42
2.65E+03	5.12E-21	5.03E-21	1.69	2.85E+03	3.41E-21	3.25E-21	4.81
4.24E+03	1.83E-20	1.84E-20	-0.76	4.56E+03	3.25E-20	3.20E-20	1.53
1.06E+04	3.47E-20	3.50E-20	-0.83	1.14E+04	3.03E-20	3.00E-20	1.11
3.61E+04	1.55E-20	1.50E-20	3.12	3.88E+04	1.35E-20	1.40E-20	-3.82
2.54E+05	2.71E-21	2.80E-21	-3.23	2.66E+05	2.80E-21	2.70E-21	3.87
1.01E+06	7.98E-22	8.10E-22	-1.53	1.06E+06	7.88E-22	7.80E-22	0.98
4.03E+06	2.31E-22	2.26E-22	2.34	4.22E+06	2.15E-22	2.20E-22	-2.36
Ta 44+ I = 2342 eV				Ta 45+ I = 3593 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
2.49E+03	4.94E-22	4.80E-22	2.83	3.82E+03	3.64E-21	3.67E-21	-0.77
2.93E+03	1.68E-21	1.55E-21	8.18	4.49E+03	1.11E-20	1.13E-20	-2.13
4.68E+03	2.96E-20	2.94E-20	0.69	7.19E+03	2.48E-20	2.52E-20	-1.42
1.17E+04	2.66E-20	2.60E-20	2.35	1.80E+04	2.01E-20	2.00E-20	0.67
3.98E+04	1.17E-20	1.23E-20	-4.8	6.11E+04	8.16E-21	8.23E-21	-0.81
2.78E+05	2.45E-21	2.34E-21	4.49	2.91E+05	2.14E-21	2.14E-21	0.2
1.10E+06	6.89E-22	6.80E-22	1.26	1.15E+06	6.06E-22	6.00E-22	1.05
4.42E+06	1.85E-22	1.90E-22	-2.6	4.61E+06	1.65E-22	1.66E-22	-0.71
Ta 46+ I = 3723 eV				Ta 47+ I = 3884 eV			
E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{FHL}}, \text{cm}^2$	$\sigma_{\text{Atom}}, \text{cm}^2$	error, %
3.96E+03	3.07E-21	3.10E-21	-0.83	4.13E+03	2.47E-21	2.51E-21	-1.51
4.65E+03	9.45E-21	9.63E-21	-1.85	4.85E+03	7.44E-21	7.53E-21	-1.23
7.45E+03	2.16E-20	2.20E-20	-1.88	7.77E+03	1.84E-20	1.87E-20	-1.76
1.86E+04	1.77E-20	1.74E-20	1.46	1.94E+04	1.50E-20	1.47E-20	1.69
6.33E+04	7.05E-21	7.23E-21	-2.55	6.60E+04	6.04E-21	6.23E-21	-3

3.00E+05	1.85E-21	1.81E-21	2.32	3.17E+05	1.59E-21	1.55E-21	2.27
1.21E+06	5.19E-22	5.20E-22	-0.12	1.26E+06	4.47E-22	4.42E-22	1.08
4.81E+06	1.44E-22	1.45E-22	-0.65	5.02E+06	1.22E-22	1.24E-22	-1.37
Ta 48+ I = 4017 eV				Ta 49+ I = 4152 eV			
E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %
4.27E+03	2.10E-21	2.10E-21	-0.21	4.47E+03	1.85E-21	1.65E-21	11.79
5.05E+03	6.99E-21	7.13E-21	-1.95	5.20E+03	6.89E-21	7.83E-21	-12.01
8.00E+03	1.60E-20	1.63E-20	-1.82	8.30E+03	1.41E-20	1.40E-20	0.88
2.00E+04	1.34E-20	1.33E-20	1.04	2.10E+04	1.13E-20	1.16E-20	-2.37
6.83E+04	5.44E-21	5.53E-21	-1.69	7.10E+04	4.84E-21	4.86E-21	-0.45
3.31E+05	1.40E-21	1.38E-21	1.48	3.44E+05	1.23E-21	1.20E-21	2.33
1.31E+06	4.00E-22	4.00E-22	-0.09	1.36E+06	3.48E-22	3.48E-22	0.1
5.23E+06	1.11E-22	1.11E-22	-0.44	5.44E+06	9.59E-23	9.70E-23	-1.16
Ta 50+ I = 4320 eV				Ta 51+ I = 4524 eV			
E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %
4.59E+03	1.38E-21	1.27E-21	8.87	4.81E+03	1.04E-21	9.30E-22	11.8
5.40E+03	6.08E-21	6.63E-21	-8.31	5.66E+03	4.93E-21	5.53E-21	-10.88
8.64E+03	1.19E-20	1.20E-20	-0.71	9.10E+03	9.96E-21	9.90E-21	0.61
2.16E+04	9.96E-21	1.00E-20	-0.4	2.26E+04	8.41E-21	8.64E-21	-2.62
7.34E+04	4.13E-21	4.22E-21	-2.25	7.69E+04	3.62E-21	3.61E-21	0.4
3.58E+05	1.04E-21	1.00E-21	3.82	3.72E+05	9.25E-22	9.10E-22	1.61
1.42E+06	2.99E-22	3.03E-22	-1.41	1.48E+06	2.62E-22	2.63E-22	-0.23
5.66E+06	8.41E-23	8.45E-23	-0.54	5.89E+06	7.30E-23	7.35E-23	-0.68
Ta 52+ I = 4665 eV				Ta 53+ I = 4807 eV			
E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %
4.96E+03	7.51E-22	6.53E-22	14.97	5.11E+03	4.93E-22	4.13E-22	19.26
5.83E+03	3.96E-21	4.61E-21	-14.06	6.00E+03	3.04E-21	3.81E-21	-20.21
9.33E+03	8.63E-21	8.44E-21	2.28	9.61E+03	7.38E-21	7.00E-21	5.42
2.33E+04	7.20E-21	7.56E-21	-4.76	2.40E+04	5.94E-21	6.45E-21	-7.96
7.93E+04	3.21E-21	3.16E-21	1.51	8.17E+04	2.77E-21	2.73E-21	1.32
3.87E+05	8.10E-22	7.91E-22	2.42	4.00E+05	7.19E-22	6.89E-22	4.33
1.53E+06	2.26E-22	2.30E-22	-1.63	1.60E+06	2.00E-22	2.00E-22	0.03
6.12E+06	6.12E-23	6.13E-23	-0.17	6.35E+06	5.47E-23	5.60E-23	-2.37
Ta 54+ I = 4986 eV				Ta 55+ I = 5364 eV			
E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %
5.31E+03	2.33E-22	1.91E-22	21.73	5.71E+03	7.81E-22	7.57E-22	3.15
6.23E+03	2.05E-21	3.10E-21	-33.9	6.73E+03	2.66E-21	2.80E-21	-5.18
9.97E+03	6.43E-21	5.70E-21	12.88	1.07E+04	4.57E-21	4.60E-21	-0.65
2.49E+04	4.62E-21	5.55E-21	-16.76	2.68E+04	4.65E-21	4.68E-21	-0.67
8.48E+04	2.40E-21	2.34E-21	2.69	9.12E+04	2.01E-21	2.00E-21	0.66
4.16E+05	6.43E-22	5.93E-22	8.42	4.32E+05	5.22E-22	5.23E-22	-0.14
1.65E+06	1.75E-22	1.72E-22	1.81	1.71E+06	1.51E-22	1.52E-22	-0.45
6.59E+06	4.57E-23	4.86E-23	-5.92	6.83E+06	4.27E-23	4.26E-23	0.26
Ta 56+ I = 5476 eV				Ta 57+ I = 5629 eV			
E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{Fit}, cm²	σ_{Atom}, cm²	error, %
5.81E+03	6.21E-22	6.07E-22	2.24	5.98E+03	4.76E-22	4.60E-22	3.39
6.83E+03	2.19E-21	2.30E-21	-4.61	7.00E+03	1.74E-21	1.83E-21	-5.22
1.10E+04	3.75E-21	3.80E-21	-1.41	1.13E+04	2.95E-21	3.00E-21	-1.76

2.74E+04	4.08E-21	4.10E-21	-0.49	2.81E+04	3.42E-21	3.44E-21	-0.49
9.31E+04	1.75E-21	1.72E-21	1.82	9.57E+04	1.50E-21	1.47E-21	2.03
4.47E+05	4.42E-22	4.47E-22	-1.11	4.63E+05	3.75E-22	3.80E-22	-1.44
1.77E+06	1.30E-22	1.32E-22	-1.74	1.84E+06	1.10E-22	1.12E-22	-1.92
7.08E+06	3.72E-23	3.66E-23	1.58	7.33E+06	3.17E-23	3.12E-23	1.74
Ta 58+				Ta 59+			
I = 5738 eV				I = 6247 eV			
E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %
6.00E+03	3.37E-22	3.40E-22	-0.79	6.64E+03	2.42E-22	2.34E-22	3.27
7.17E+03	1.38E-21	1.43E-21	-3.65	7.81E+03	9.37E-22	9.83E-22	-4.73
1.15E+04	2.35E-21	2.36E-21	-0.45	1.25E+04	1.60E-21	1.62E-21	-1.56
2.87E+04	2.88E-21	2.90E-21	-0.82	3.12E+04	2.23E-21	2.24E-21	-0.47
9.75E+04	1.27E-21	1.24E-21	2.06	1.06E+05	1.01E-21	9.84E-22	2.65
4.79E+05	3.17E-22	3.22E-22	-1.56	4.96E+05	2.59E-22	2.65E-22	-2.2
1.90E+06	9.33E-23	9.44E-23	-1.2	1.96E+06	7.70E-23	7.78E-23	-1.06
7.58E+06	2.69E-23	2.65E-23	1.36	7.84E+06	2.24E-23	2.20E-23	1.65
Ta 60+				Ta 61+			
I = 6410 eV				I = 6670 eV			
E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %
6.84E+03	2.14E-22	2.14E-22	0.04	7.09E+03	1.19E-22	1.21E-22	-1.87
8.01E+03	6.43E-22	6.63E-22	-2.96	8.34E+03	3.67E-22	3.73E-22	-1.62
1.28E+04	1.12E-21	1.12E-21	0.03	1.34E+04	6.33E-22	6.25E-22	1.25
3.21E+04	1.78E-21	1.80E-21	-1.21	3.33E+04	1.39E-21	1.42E-21	-1.84
1.09E+05	8.24E-22	8.00E-22	2.98	1.13E+05	6.75E-22	6.55E-22	3.09
5.12E+05	2.15E-22	2.20E-22	-2.33	5.29E+05	1.79E-22	1.83E-22	-2.42
2.03E+06	6.36E-23	6.44E-23	-1.3	2.10E+06	5.37E-23	5.44E-23	-1.23
8.10E+06	1.84E-23	1.81E-23	1.72	8.37E+06	1.58E-23	1.56E-23	1.56
Ta 62+				Ta 63+			
I = 6838 eV				I = 14600 eV			
E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %
7.27E+03	5.54E-23	5.75E-23	-3.59	1.55E+04	1.17E-22	1.15E-22	1.4
8.55E+03	1.77E-22	1.76E-22	0.4	1.83E+04	3.98E-22	4.16E-22	-4.41
1.37E+04	3.10E-22	3.00E-22	3.4	2.92E+04	6.63E-22	6.80E-22	-2.44
3.24E+04	1.06E-21	1.11E-21	-4.29	7.31E+04	5.04E-22	5.00E-22	0.78
1.16E+05	5.34E-22	5.10E-22	4.71	2.48E+05	2.17E-22	2.20E-22	-1.53
5.47E+05	1.39E-22	1.43E-22	-2.97	5.72E+05	1.09E-22	1.07E-22	1.42
2.17E+06	4.16E-23	4.25E-23	-2.13	2.24E+06	3.23E-23	3.25E-23	-0.72
8.64E+06	1.23E-23	1.20E-23	2.17	8.93E+06	9.06E-24	9.05E-24	0.09
Ta 64+				Ta 65+			
I = 15050 eV				I = 15500 eV			
E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %
1.60E+04	9.33E-23	9.15E-23	1.96	1.66E+04	7.12E-23	6.86E-23	3.84
1.88E+04	3.18E-22	3.33E-22	-4.57	1.94E+04	2.49E-22	2.63E-22	-5.52
3.00E+04	5.40E-22	5.55E-22	-2.69	3.10E+04	4.26E-22	4.42E-22	-3.65
7.53E+04	4.18E-22	4.14E-22	0.97	7.75E+04	3.36E-22	3.32E-22	1.15
2.56E+05	1.80E-22	1.83E-22	-1.56	2.63E+05	1.51E-22	1.53E-22	-1.65
5.90E+05	8.99E-23	8.90E-23	1.05	6.10E+05	7.40E-23	7.30E-23	1.32
2.31E+06	2.67E-23	2.67E-23	0.15	2.39E+06	2.18E-23	2.19E-23	-0.34
9.21E+06	7.53E-24	7.55E-24	-0.26	9.49E+06	6.18E-24	6.18E-24	0.01
Ta 66+				Ta 67+			
I = 15950 eV				I = 17080 eV			
E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %	E, eV	σ_{FHL}, cm²	σ_{Atom}, cm²	error, %
1.69E+04	5.00E-23	4.86E-23	2.91	1.81E+04	3.01E-23	2.86E-23	5.21

1.99E+04	1.90E-22	2.00E-22	-4.92	2.13E+04	1.32E-22	1.41E-22	-6.08
3.19E+04	3.32E-22	3.42E-22	-2.91	3.42E+04	2.28E-22	2.37E-22	-3.7
7.97E+04	2.60E-22	2.58E-22	0.79	8.54E+04	1.85E-22	1.84E-22	0.64
2.71E+05	1.16E-22	1.17E-22	-0.93	2.90E+05	8.56E-23	8.56E-23	-0.03
6.26E+05	5.84E-23	5.80E-23	0.75	6.46E+05	4.42E-23	4.40E-23	0.48
2.46E+06	1.76E-23	1.76E-23	-0.31	2.53E+06	1.34E-23	1.36E-23	-1.44
9.78E+06	5.00E-24	5.00E-24	0.09	1.00E+07	3.90E-24	3.87E-24	0.83
Ta 68+ I = 17450 eV				Ta 69+ I = 18370 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	σ_{Atom}, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	σ_{Atom}, cm²	error, %
1.85E+04	1.67E-23	1.56E-23	6.93	1.95E+04	1.80E-23	1.80E-23	-0.09
2.18E+04	8.90E-23	9.53E-23	-6.66	2.28E+04	5.32E-23	5.53E-23	-3.73
3.49E+04	1.54E-22	1.62E-22	-4.95	3.67E+04	9.05E-23	9.20E-23	-1.61
8.73E+04	1.30E-22	1.29E-22	0.81	9.18E+04	8.16E-23	8.10E-23	0.71
2.97E+05	6.30E-23	6.30E-23	0.03	3.12E+05	4.24E-23	4.30E-23	-1.35
6.65E+05	3.24E-23	3.26E-23	-0.61	6.85E+05	2.37E-23	2.36E-23	0.59
2.61E+06	9.94E-24	1.00E-23	-0.65	2.68E+06	7.53E-24	7.47E-24	0.82
1.04E+07	2.93E-24	2.92E-24	0.36	1.07E+07	2.19E-24	2.20E-24	-0.61
Ta 70+ I = 18810 eV				Ta 71+ I = 66000 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	σ_{Atom}, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	σ_{Atom}, cm²	error, %
2.00E+04	9.02E-24	8.62E-24	4.62	7.00E+04	9.89E-25	1.00E-24	-1.12
2.35E+04	3.18E-23	3.43E-23	-7.16	8.35E+04	3.15E-24	3.24E-24	-2.7
3.76E+04	4.31E-23	4.40E-23	-2.08	1.32E+05	6.18E-24	6.25E-24	-1.1
9.41E+04	4.11E-23	4.10E-23	0.31	3.31E+05	5.61E-24	5.60E-24	0.09
3.20E+05	2.33E-23	2.34E-23	-0.61	1.12E+06	2.77E-24	2.80E-24	-1.14
7.00E+05	1.31E-23	1.30E-23	0.8	7.71E+05	3.56E-24	3.52E-24	0.99
2.76E+06	4.20E-24	4.22E-24	-0.38	2.89E+06	1.32E-24	1.32E-24	0.33
1.10E+07	1.25E-24	1.25E-24	0.08	1.13E+07	4.00E-25	4.00E-25	0.03
Ta 72+ I = 77700 eV							
E, eV	$\sigma_{\text{Fit.}}$, cm²	σ_{Atom}, cm²	error, %				
8.25E+04	4.54E-25	4.58E-25	-0.89				
9.71E+04	1.38E-24	1.42E-24	-2.59				
1.55E+05	2.74E-24	2.78E-24	-1.45				
3.88E+05	2.61E-24	2.57E-24	1.4				
1.32E+06	1.29E-24	1.26E-24	2.46				
8.00E+05	1.79E-24	1.85E-24	-3.12				
2.98E+06	6.98E-25	7.00E-25	-0.34				
1.17E+07	2.20E-25	2.20E-25	-0.06				

Table 4.2. Fitting parameters for tantalum and its ions.

Ta	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	B
0+	-1.0299E+00	-4.8908E+00	1.6505E+02	-5.2086E+02	5.8822E+02	-2.2357E+02	2.1603E+00
1+	4.6399E+00	1.4610E+01	-1.3355E+02	3.8386E+02	-4.3788E+02	1.7465E+02	1.0232E+00
2+	-1.2277E+00	4.5304E-01	2.5343E+01	-1.5001E+02	2.7243E+02	-1.4731E+02	2.3572E+00
3+	-1.0199E+00	8.8762E-01	-9.1902E+00	2.7880E+01	-1.3419E+01	-3.0417E+00	2.5957E+00
4+	-1.5705E+00	6.8704E-01	-3.2096E+01	1.6550E+02	-2.3936E+02	1.1033E+02	2.4997E+00
5+	-3.1614E+00	2.3369E+01	-9.6717E+00	-6.0786E+01	6.1017E+01	0.0000E+00	4.4260E+00
6+	1.3586E+00	6.8074E+00	-8.3892E+01	2.8103E+02	-3.5067E+02	1.5516E+02	5.0502E+00
7+	-1.8263E-01	1.0077E+01	-8.1391E+01	2.5309E+02	-3.0493E+02	1.3252E+02	5.4419E+00
8+	-4.9135E+00	-1.0140E+01	2.6217E+02	-9.6131E+02	1.2901E+03	-5.7592E+02	6.8970E+00

9+	-5.3381E+00	-8.5230E+00	2.3614E+02	-8.8902E+02	1.2200E+03	-5.5435E+02	6.9146E+00
10+	-6.5055E+00	-1.8897E+01	3.6303E+02	-1.3192E+03	1.7834E+03	-8.0561E+02	7.6853E+00
11+	-6.7179E+00	-7.9538E+00	1.1054E+02	-3.4927E+02	4.9707E+02	-2.4361E+02	7.2910E+00
12+	-2.6859E+00	4.4740E-01	-2.6227E+01	8.2829E+01	-2.2270E+01	-2.6701E+01	7.8881E+00
13+	-7.7461E+00	-3.7950E+01	5.9235E+02	-2.0086E+03	2.5985E+03	-1.1401E+03	8.8170E+00
14+	4.4159E+01	-3.1658E+01	-2.9082E+02	1.2166E+03	-1.5644E+03	6.5842E+02	1.5168E+00
15+	-5.9422E+00	-9.7100E+00	1.2332E+02	-3.1527E+02	4.0020E+02	-1.9007E+02	6.3615E+00
16+	-6.0188E-01	9.2167E+00	-4.7915E+01	8.3391E+01	-6.4277E+00	-2.8836E+01	6.8183E+00
17+	4.4141E+00	1.6266E+01	-1.6058E+02	7.1945E+02	-1.0555E+03	5.0405E+02	1.7265E+00
18+	1.9065E+00	1.1433E+01	-1.3164E+02	6.2450E+02	-9.3466E+02	4.4840E+02	3.9488E+00
19+	1.4373E+00	9.3822E+00	-1.1370E+02	5.6338E+02	-8.5179E+02	4.0916E+02	3.8555E+00
20+	1.4967E+00	9.3949E+00	-1.1776E+02	5.8464E+02	-8.8334E+02	4.2506E+02	3.2626E+00
21+	1.0730E+00	7.4757E+00	-1.1026E+02	5.6932E+02	-8.6409E+02	4.1394E+02	3.2309E+00
22+	1.7630E+00	9.3278E+00	-1.4917E+02	8.0700E+02	-1.2887E+03	6.4430E+02	1.8572E+00
23+	1.1314E+00	9.9935E+00	-1.5206E+02	7.7896E+02	-1.1902E+03	5.7604E+02	1.7514E+00
24+	4.8662E-01	9.0899E+00	-1.4422E+02	7.4010E+02	-1.1211E+03	5.3835E+02	1.6599E+00
25+	-7.9172E-01	7.2629E+00	-1.3196E+02	6.7396E+02	-9.9662E+02	4.6504E+02	2.2420E+00
26+	-1.5519E+00	3.6942E+00	-8.3051E+01	4.9852E+02	-7.5326E+02	3.5606E+02	2.2785E+00
27+	1.0376E+00	6.9812E+00	-3.7924E+01	1.0207E+02	-4.0154E+01	-2.3595E+01	4.2629E+00
28+	4.6695E-02	1.0738E+01	1.1184E+02	-5.7527E+02	8.9857E+02	-4.3905E+02	4.2136E+00
29+	-2.6043E-02	1.1790E+01	9.3371E+01	-5.1596E+02	8.2724E+02	-4.0943E+02	3.9639E+00
30+	-6.1911E-01	4.9577E+00	1.5305E+02	-6.8650E+02	1.0236E+03	-4.8855E+02	3.8815E+00
31+	-9.7461E-01	1.5427E+00	1.7618E+02	-7.4723E+02	1.0922E+03	-5.1647E+02	3.7738E+00
32+	-9.7796E-01	3.7823E+00	1.3603E+02	-6.1557E+02	9.3108E+02	-4.4888E+02	3.4954E+00
33+	-1.6316E+00	-1.4949E+00	1.8512E+02	-7.6557E+02	1.1157E+03	-5.2853E+02	3.6404E+00
34+	-2.3446E+00	-7.1126E+00	2.3325E+02	-9.0738E+02	1.2779E+03	-5.9337E+02	3.8698E+00
35+	-2.8561E+00	-9.8334E+00	2.5250E+02	-9.7437E+02	1.3782E+03	-6.4436E+02	3.9846E+00
36+	-2.5467E+00	-1.7599E+01	3.1748E+02	-1.1491E+03	1.5651E+03	-7.1194E+02	3.2365E+00
37+	8.3032E-02	3.6637E+00	3.7224E+01	-2.3875E+02	4.4341E+02	-2.3925E+02	2.6433E+00
38+	-3.1237E-01	2.1546E+00	5.1095E+01	-2.7974E+02	4.9144E+02	-2.5888E+02	2.5437E+00
39+	-5.6003E-01	1.0813E+00	5.0375E+01	-2.3060E+02	3.8768E+02	-2.0197E+02	2.3108E+00
40+	-9.5419E-01	-8.7979E-01	7.4171E+01	-3.1068E+02	4.8785E+02	-2.4432E+02	2.2614E+00
41+	-1.2572E+00	-2.7902E+00	7.8510E+01	-3.0666E+02	4.7345E+02	-2.3626E+02	2.1526E+00
42+	-1.4930E+00	-3.7056E+00	8.0817E+01	-3.0445E+02	4.6193E+02	-2.2836E+02	1.9892E+00
43+	-2.4430E-01	5.8733E+00	-1.0058E+02	5.1298E+02	-7.5911E+02	3.5368E+02	1.0814E+00
44+	-5.8528E-01	7.5120E+00	-1.2146E+02	5.9602E+02	-8.7692E+02	4.0778E+02	9.0950E-01
45+	6.1389E+00	1.8852E+01	-1.4244E+02	4.9526E+02	-6.3505E+02	2.7377E+02	1.5118E+00
46+	5.2758E+00	1.4582E+01	-1.0208E+02	3.6721E+02	-4.7432E+02	2.0323E+02	1.6659E+00
47+	4.9133E+00	1.0607E+01	-9.6809E+01	3.9710E+02	-5.4402E+02	2.4252E+02	1.3372E+00
48+	3.9456E+00	1.2784E+01	-7.1999E+01	2.5999E+02	-3.3828E+02	1.4591E+02	1.5193E+00
49+	1.2329E+00	3.4926E+01	-7.3583E+01	7.1084E+01	-2.1963E+01	0.0000E+00	1.3899E+00
50+	1.2889E+00	3.4390E+01	-9.2591E+01	1.1550E+02	-4.9500E+01	0.0000E+00	1.5976E+00
51+	7.2163E-01	3.3271E+01	-8.1605E+01	9.1850E+01	-3.4335E+01	0.0000E+00	1.3336E+00
52+	4.5918E-01	2.8814E+01	-5.4237E+01	4.3321E+01	-7.3413E+00	0.0000E+00	9.0268E-01
53+	-1.0925E-01	2.2220E+01	-2.0506E+01	-1.3144E+01	2.1938E+01	0.0000E+00	8.7947E-01
54+	8.6984E-02	6.0824E+00	6.5891E+01	-1.5920E+02	9.9849E+01	0.0000E+00	3.2970E-01
55+	1.7912E+00	1.7895E+01	-7.2673E+01	1.1537E+02	-5.5835E+01	0.0000E+00	1.2730E+00

56+	1.4781E+00	1.1611E+01	-3.1520E+01	-3.9353E+00	9.1249E+01	-6.4169E+01	1.3524E+00
57+	8.9727E-01	9.7065E+00	-1.1475E+01	-6.6968E+01	1.6673E+02	-9.4935E+01	1.2728E+00
58+	1.3789E+00	4.0791E+00	-1.7132E+01	1.6372E+00	5.7002E+01	-4.3266E+01	1.1099E+00
59+	2.3841E-01	4.3284E+00	1.4331E+01	-1.2244E+02	2.2108E+02	-1.1471E+02	1.1365E+00
60+	3.7578E-01	2.4281E+00	-1.9726E+00	-4.2628E+01	1.0772E+02	-6.3159E+01	9.5025E-01
61+	-6.2848E-02	-5.1145E-01	1.3119E+01	-8.1409E+01	1.5249E+02	-8.1784E+01	9.7989E-01
62+	-3.1083E-01	-1.7797E+00	2.1087E+01	-9.9367E+01	1.6830E+02	-8.6411E+01	7.9997E-01
63+	3.0056E+00	1.4783E+01	-6.1768E+01	1.2476E+02	-1.1955E+02	4.5219E+01	8.4043E-01
64+	2.3682E+00	1.2755E+01	-4.4593E+01	7.4444E+01	-5.9189E+01	1.9693E+01	7.7657E-01
65+	1.4734E+00	8.3134E+00	6.4705E+00	-8.2669E+01	1.2725E+02	-5.6295E+01	7.1017E-01
66+	1.3077E+00	9.1795E+00	-2.6011E+01	3.3021E+01	-1.8916E+01	5.1806E+00	6.3272E-01
67+	6.2355E-01	6.8315E+00	2.0782E+00	-5.9061E+01	9.5583E+01	-4.3381E+01	6.2678E-01
68+	1.1690E-01	2.7693E+00	2.8961E+01	-1.3021E+02	1.7519E+02	-7.5261E+01	5.8614E-01
69+	5.9571E-01	3.0981E+00	-2.1441E+01	5.6252E+01	-6.3492E+01	2.6843E+01	3.8652E-01
70+	1.4127E-01	2.9697E+00	-1.0883E+01	1.2484E+01	-3.8977E+00	0.0000E+00	2.7951E-01
71+	5.1663E-01	1.5785E+00	-1.2635E+01	4.1477E+01	-5.2893E+01	2.3867E+01	2.2018E-01
72+	2.3591E-01	9.6375E-01	-7.2951E+00	2.2047E+01	-2.6404E+01	1.1368E+01	2.2204E-01

Table 5.1. Ionization cross sections of uranium and its ions.

U 0+				I = 5.4 eV				U 1+				I = 11.4 eV			
E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %
5.75E+00	2.76E-16	2.53E-16	9.24	1.21E+01	4.74E-17	4.61E-17	2.85	1.21E+01	4.74E-17	4.61E-17	2.85	1.21E+01	4.74E-17	4.61E-17	2.85
6.76E+00	51-E23.1	51-E73.1	-3.81	1.42E+01	2.27E-16	2.62E-16	-13.35	1.42E+01	2.27E-16	2.62E-16	-13.35	1.42E+01	2.27E-16	2.62E-16	-13.35
1.08E+01	2.32E-15	2.50E-15	-7.18	2.27E+01	5.59E-16	5.56E-16	0.58	2.27E+01	5.59E-16	5.56E-16	0.58	2.27E+01	5.59E-16	5.56E-16	0.58
2.70E+01	1.31E-15	1.27E-15	3.44	5.68E+01	7.25E-17	7.37E-17	-1.7	5.68E+01	7.25E-17	7.37E-17	-1.7	5.68E+01	7.25E-17	7.37E-17	-1.7
9.19E+01	8.21E-16	8.94E-16	-8.16	1.93E+02	6.89E-17	7.37E-17	-6.49	1.93E+02	6.89E-17	7.37E-17	-6.49	1.93E+02	6.89E-17	7.37E-17	-6.49
4.30E+02	2.70E-16	2.59E-16	4.2	1.71E+03	3.97E-17	6.32E-17	-37.27	1.71E+03	3.97E-17	6.32E-17	-37.27	1.71E+03	3.97E-17	6.32E-17	-37.27
1.71E+03	8.45E-17	8.23E-17	2.65	6.83E+03	1.51E-17	1.92E-17	-21.2	6.83E+03	1.51E-17	1.92E-17	-21.2	6.83E+03	1.51E-17	1.92E-17	-21.2
6.83E+03	2.50E-17	2.45E-17	2.09	2.72E+04	5.09E-18	5.56E-18	-8.37	2.72E+04	5.09E-18	5.56E-18	-8.37	2.72E+04	5.09E-18	5.56E-18	-8.37
2.72E+04	7.23E-18	7.13E-18	1.36	1.09E+05	1.60E-18	1.58E-18	0.97	1.09E+05	1.60E-18	1.58E-18	0.97	1.09E+05	1.60E-18	1.58E-18	0.97
1.09E+05	2.04E-18	2.15E-18	-5.14	4.35E+05	4.81E-19	3.82E-19	25.83	4.35E+05	4.81E-19	3.82E-19	25.83	4.35E+05	4.81E-19	3.82E-19	25.83
U 2+				I = 18.0 eV				U 3+				I = 32.0 eV			
E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %
1.91E+01	1.77E-17	1.77E-17	-0.14	3.39E+01	1.15E-17	1.15E-17	-0.07	3.39E+01	1.15E-17	1.15E-17	-0.07	3.39E+01	1.15E-17	1.15E-17	-0.07
2.24E+01	5.60E-17	5.54E-17	1.15	3.99E+01	3.75E-17	3.76E-17	-0.39	3.99E+01	3.75E-17	3.76E-17	-0.39	3.99E+01	3.75E-17	3.76E-17	-0.39
3.60E+01	1.84E-16	1.81E-16	1.89	6.39E+01	1.79E-16	1.78E-16	0.73	6.39E+01	1.79E-16	1.78E-16	0.73	6.39E+01	1.79E-16	1.78E-16	0.73
8.90E+01	2.96E-16	3.02E-16	-1.92	1.60E+02	1.14E-16	1.18E-16	-3.03	1.60E+02	1.14E-16	1.18E-16	-3.03	1.60E+02	1.14E-16	1.18E-16	-3.03
3.05E+02	1.54E-16	1.50E-16	2.88	5.43E+02	6.99E-17	6.74E-17	3.67	5.43E+02	6.99E-17	6.74E-17	3.67	5.43E+02	6.99E-17	6.74E-17	3.67
1.55E+03	4.06E-17	3.95E-17	2.74	2.75E+03	1.86E-17	1.55E-17	19.81	2.75E+03	1.86E-17	1.55E-17	19.81	2.75E+03	1.86E-17	1.55E-17	19.81
6.14E+03	1.19E-17	1.22E-17	-2.31	1.09E+04	4.24E-18	4.61E-18	-8.11	1.09E+04	4.24E-18	4.61E-18	-8.11	1.09E+04	4.24E-18	4.61E-18	-8.11
2.45E+04	3.38E-18	3.54E-18	-4.5	4.36E+04	8.38E-19	1.32E-18	-36.53	4.36E+04	8.38E-19	1.32E-18	-36.53	4.36E+04	8.38E-19	1.32E-18	-36.53
9.79E+04	9.43E-19	1.00E-18	-5.7	1.74E+05	1.47E-19	1.47E-19	0.22	1.74E+05	1.47E-19	1.47E-19	0.22	1.74E+05	1.47E-19	1.47E-19	0.22
3.92E+05	2.60E-19	2.41E-19	7.74	6.96E+05	2.07E-20	1.96E-20	5.56	6.96E+05	2.07E-20	1.96E-20	5.56	6.96E+05	2.07E-20	1.96E-20	5.56
U 4+				I = 46.7 eV				U 5+				I = 62.5 eV			
E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %	E _i , eV	σ _{FIL} , cm ²	σ _{Atom} , cm ²	error, %
5.00E+01	4.19E-18	4.23E-18	-1.02	6.64E+01	1.06E-18	1.06E-18	-0.46	6.64E+01	1.06E-18	1.06E-18	-0.46	6.64E+01	1.06E-18	1.06E-18	-0.46
5.87E+01	1.29E-17	1.31E-17	-1.71	7.81E+01	3.41E-18	3.26E-18	4.65	7.81E+01	3.41E-18	3.26E-18	4.65	7.81E+01	3.41E-18	3.26E-18	4.65

9.40E+01	2.93E-17	2.93E-17	-0.14	1.25E+02	2.96E-17	2.83E-17	4.43
2.35E+02	4.35E-17	4.38E-17	-0.66	3.12E+02	3.58E-17	3.72E-17	-3.64
8.00E+02	1.98E-17	1.96E-17	1.19	1.06E+03	1.48E-17	1.42E-17	3.98
6.42E+03	3.11E-18	3.13E-18	-0.64	3.12E+03	6.24E-18	6.27E-18	-0.41
2.55E+04	8.82E-19	8.89E-19	-0.83	1.23E+04	1.99E-18	2.06E-18	-3.48
1.02E+05	2.45E-19	2.46E-19	-0.24	4.90E+04	6.02E-19	6.05E-19	-0.58
4.08E+05	6.76E-20	6.71E-20	0.78	1.96E+05	1.76E-19	1.72E-19	2.35
U 6+ I = 88.9 eV				U 7+ I = 102.3 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
1.01E+02	2.57E-18	2.48E-18	3.81	1.15E+02	1.58E-18	1.55E-18	2.03
1.19E+02	7.05E-18	7.27E-18	-3.08	1.35E+02	4.45E-18	4.51E-18	-1.39
1.91E+02	1.42E-17	1.41E-17	0.73	2.16E+02	1.05E-17	1.05E-17	-0.65
4.77E+02	2.03E-17	2.18E-17	-7.1	5.40E+02	1.51E-17	1.51E-17	-0.17
1.62E+03	8.29E-18	7.33E-18	13.08	1.84E+03	6.58E-18	6.55E-18	0.5
4.26E+03	3.60E-18	3.89E-18	-7.37	5.55E+03	2.55E-18	2.51E-18	1.46
1.68E+04	1.17E-18	1.28E-18	-8.44	2.19E+04	7.82E-19	8.02E-19	-2.53
6.67E+04	3.75E-19	3.80E-19	-1.23	8.71E+04	2.35E-19	2.37E-19	-0.85
2.67E+05	1.15E-19	1.08E-19	6.49	3.48E+05	6.88E-20	6.76E-20	1.73
U 8+ I = 116.0 eV				U 9+ I = 139 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
1.29E+02	9.41E-19	9.26E-19	1.59	1.44E+02	5.01E-19	5.32E-19	-5.79
1.52E+02	2.72E-18	2.72E-18	-0.09	1.69E+02	1.65E-18	1.65E-18	-0.27
2.43E+02	9.15E-18	9.12E-18	0.38	2.70E+02	6.65E-18	6.48E-18	2.61
6.07E+02	1.01E-17	1.06E-17	-4.81	6.75E+02	7.14E-18	7.60E-18	-6.02
2.07E+03	4.48E-18	4.00E-18	12.07	2.30E+03	3.40E-18	3.00E-18	13.29
3.56E+03	3.01E-18	3.25E-18	-7.51	4.39E+03	2.20E-18	2.46E-18	-10.54
1.39E+04	1.06E-18	1.15E-18	-7.63	1.71E+04	8.04E-19	8.66E-19	-7.17
5.52E+04	3.49E-19	3.54E-19	-1.51	6.81E+04	2.64E-19	2.65E-19	-0.47
2.20E+05	1.08E-19	1.03E-19	5.25	2.72E+05	8.16E-20	7.78E-20	4.89
U 10+ I = 157.6 eV				U 11+ I = 174.1 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
1.70E+02	2.50E-19	2.42E-19	3.41	1.85E+02	1.06E-19	1.00E-19	5.47
2.01E+02	1.31E-18	1.25E-18	5.09	2.18E+02	8.01E-19	7.55E-19	6.14
3.21E+02	7.75E-18	8.00E-18	-3.15	3.48E+02	5.39E-18	5.60E-18	-3.7
8.02E+02	6.68E-18	6.45E-18	3.52	8.70E+02	4.05E-18	4.00E-18	1.29
2.73E+03	3.22E-18	3.51E-18	-8.14	3.84E+03	2.21E-18	2.25E-18	-1.85
1.04E+04	1.20E-18	1.13E-18	5.9	1.49E+04	8.50E-19	8.41E-19	1.1
4.13E+04	3.71E-19	3.66E-19	1.37	5.89E+04	2.68E-19	2.66E-19	0.67
1.65E+05	1.08E-19	1.09E-19	-0.7	2.35E+05	7.87E-20	7.92E-20	-0.67
6.58E+05	3.08E-20	3.14E-20	-1.78				
U 12+ I = 210.0 eV				U 13+ I = 228.1 eV			
E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %	E_i, eV	σ_{Fitt.}, cm²	σ_{Atom.}, cm²	error, %
2.23E+02	1.21E-19	1.21E-19	-0.17	2.42E+02	5.21E-20	5.11E-20	1.89
2.62E+02	3.99E-19	3.84E-19	3.88	2.85E+02	1.71E-19	1.60E-19	6.76
4.19E+02	3.25E-18	3.24E-18	0.42	4.56E+02	2.58E-18	2.54E-18	1.47
1.00E+03	2.85E-18	2.84E-18	0.23	1.14E+03	2.23E-18	2.23E-18	-0.22
3.80E+03	1.83E-18	1.86E-18	-1.73	8.56E+03	7.69E-19	7.70E-19	-0.13
1.46E+04	7.48E-19	7.34E-19	1.97	3.35E+04	2.67E-19	2.66E-19	0.28
5.77E+04	2.37E-19	2.34E-19	1.09	1.34E+05	8.08E-20	8.08E-20	0.01

2.30E+05	6.90E-20	7.00E-20	-1.43	5.33E+05	2.36E-20	2.36E-20	-0.17
U 14+ I = 324.3 eV				U 15+ I = 350.2 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
3.47E+02	2.96E-19	3.00E-19	-1.26	3.94E+02	1.95E-19	1.92E-19	1.58
4.08E+02	8.26E-19	8.38E-19	-1.41	4.64E+02	5.45E-19	5.49E-19	-0.65
6.53E+02	1.97E-18	1.96E-18	0.24	7.42E+02	1.39E-18	1.39E-18	-0.02
1.63E+03	2.36E-18	2.39E-18	-1.35	1.86E+03	2.15E-18	2.16E-18	-0.41
5.55E+03	1.19E-18	1.15E-18	3.6	6.31E+03	1.02E-18	1.04E-18	-2.16
1.56E+04	5.59E-19	5.77E-19	-3.1	9.08E+03	7.63E-19	7.30E-19	4.5
6.15E+04	1.86E-19	1.89E-19	-1.59	3.52E+04	2.53E-19	2.61E-19	-3.05
2.45E+05	5.78E-20	5.67E-20	1.85	1.40E+05	7.97E-20	8.07E-20	-1.26
				5.57E+05	2.42E-20	2.38E-20	1.81
U 16+ I = 376.5 eV				U 17+ I = 403.3 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
4.03E+02	1.52E-19	1.53E-19	-0.97	4.31E+02	1.13E-19	1.14E-19	-1
4.75E+02	4.52E-19	4.52E-19	-0.06	5.07E+02	3.44E-19	3.43E-19	0.35
7.59E+02	1.48E-18	1.47E-18	0.56	8.11E+02	1.23E-18	1.22E-18	0.83
1.90E+03	1.71E-18	1.74E-18	-1.88	2.03E+03	1.47E-18	1.50E-18	-2.11
6.45E+03	8.81E-19	8.34E-19	5.61	6.89E+03	7.65E-19	7.22E-19	5.95
1.02E+04	6.43E-19	6.67E-19	-3.62	1.14E+04	5.41E-19	5.61E-19	-3.64
3.97E+04	2.26E-19	2.32E-19	-2.63	4.45E+04	1.88E-19	1.94E-19	-3
1.58E+05	7.12E-20	7.15E-20	-0.38	1.77E+05	5.91E-20	5.92E-20	-0.24
6.29E+05	2.14E-20	2.11E-20	1.63	7.05E+05	1.77E-20	1.74E-20	1.77
U 18+ I = 430.5 eV				U 19+ I = 458.2 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
4.62E+02	1.16E-19	1.22E-19	-4.84	4.94E+02	6.17E-20	6.21E-20	-0.59
5.44E+02	2.60E-19	2.56E-19	1.64	5.81E+02	1.93E-19	1.89E-19	1.89
8.70E+02	1.03E-18	1.00E-18	2.66	9.29E+02	8.40E-19	8.30E-19	1.17
2.17E+03	1.27E-18	1.30E-18	-2.59	2.32E+03	1.11E-18	1.12E-18	-0.88
7.39E+03	6.52E-19	6.18E-19	5.57	7.90E+03	5.37E-19	5.31E-19	1.14
1.27E+04	4.52E-19	4.74E-19	-4.62	1.41E+04	3.49E-19	3.50E-19	-0.32
4.95E+04	1.60E-19	1.62E-19	-1.37	5.49E+04	1.17E-19	1.18E-19	-0.84
1.97E+05	5.06E-20	5.00E-20	1.26	2.18E+05	3.63E-20	3.61E-20	0.49
U 20+ I = 498.1 eV				U 21+ I = 527.1 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
5.29E+02	4.28E-20	4.34E-20	-1.3	5.60E+02	2.93E-20	2.95E-20	-0.65
6.22E+02	1.37E-19	1.32E-19	3.6	6.58E+02	9.37E-20	8.95E-20	4.66
9.96E+02	1.04E-18	1.02E-18	1.71	1.05E+03	9.14E-19	8.94E-19	2.24
2.49E+03	9.72E-19	9.77E-19	-0.53	2.63E+03	8.54E-19	8.56E-19	-0.21
8.46E+03	4.57E-19	4.60E-19	-0.63	8.95E+03	3.95E-19	4.00E-19	-1.22
1.55E+04	3.01E-19	3.00E-19	0.2	1.70E+04	2.53E-19	2.50E-19	1.19
6.05E+04	1.01E-19	1.00E-19	0.88	6.64E+04	8.41E-20	8.31E-20	1.25
2.40E+05	3.03E-20	3.05E-20	-0.79	2.64E+05	2.50E-20	2.52E-20	-0.85
U 22+ I = 556.4 eV				U 23+ I = 586.2 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
5.91E+02	1.78E-20	1.77E-20	0.6	6.23E+02	8.44E-21	8.06E-21	4.73
6.95E+02	5.70E-20	5.37E-20	6.23	7.33E+02	3.06E-20	2.78E-20	10.06
1.11E+03	8.13E-19	7.91E-19	2.78	1.17E+03	7.01E-19	7.00E-19	0.2

2.78E+03	8.18E-19	8.15E-19	0.37	2.93E+03	7.31E-19	7.16E-19	2.08
9.45E+03	3.62E-19	3.76E-19	-3.69	9.96E+03	3.19E-19	3.28E-19	-2.67
1.85E+04	2.22E-19	2.15E-19	3.3	2.02E+04	1.91E-19	1.88E-19	1.32
7.25E+04	7.21E-20	7.12E-20	1.23	7.89E+04	6.25E-20	6.20E-20	0.74
2.88E+05	2.12E-20	2.15E-20	-1.21	3.14E+05	1.86E-20	1.87E-20	-0.47
U 24+ I = 718.6 eV				U 25+ I = 750.8 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
8.13E+02	2.63E-20	2.55E-20	3	8.26E+02	2.05E-20	2.00E-20	2.65
9.57E+02	1.04E-19	1.00E-19	4.09	9.73E+02	8.66E-20	8.28E-20	4.59
1.53E+03	5.54E-19	5.63E-19	-1.64	1.56E+03	5.16E-19	5.23E-19	-1.27
3.83E+03	5.65E-19	5.59E-19	1.1	3.89E+03	5.19E-19	5.13E-19	1.07
1.30E+04	2.44E-19	2.48E-19	-1.69	1.32E+04	2.23E-19	2.27E-19	-1.83
2.20E+04	1.62E-19	1.60E-19	1.07	2.38E+04	1.41E-19	1.39E-19	1.28
8.58E+04	5.23E-20	5.23E-20	0.07	9.27E+04	4.53E-20	4.52E-20	0.11
3.41E+05	1.58E-20	1.58E-20	-0.12	3.69E+05	1.35E-20	1.35E-20	-0.18
U 26+ I = 783.2 eV				U 27+ I = 804.0 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
8.67E+02	1.52E-20	1.47E-20	3.09	9.19E+02	1.04E-20	9.95E-21	4.3
1.02E+03	6.95E-20	6.58E-20	5.68	1.08E+03	6.58E-20	6.27E-20	4.99
1.63E+03	4.53E-19	4.60E-19	-1.58	1.73E+03	4.19E-19	4.28E-19	-2.07
4.08E+03	4.54E-19	4.48E-19	1.31	4.32E+03	3.97E-19	3.90E-19	1.68
1.39E+04	1.94E-19	1.98E-19	-1.96	1.47E+04	1.85E-19	1.93E-19	-4.09
2.56E+04	1.21E-19	1.19E-19	1.34	2.75E+04	1.15E-19	1.12E-19	2.94
1.00E+05	3.86E-20	3.86E-20	-0.05	1.07E+05	3.61E-20	3.60E-20	0.38
3.97E+05	1.15E-20	1.15E-20	-0.09	4.27E+05	1.02E-20	1.03E-20	-0.59
U 28+ I = 918.2 eV				U 29+ I = 955.5 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
9.77E+02	7.86E-21	7.52E-21	4.57	1.01E+03	5.05E-21	4.77E-21	5.79
1.15E+03	5.61E-20	5.27E-20	6.42	1.19E+03	4.89E-20	4.58E-20	6.71
1.84E+03	3.94E-19	4.03E-19	-2.35	1.91E+03	3.07E-19	3.23E-19	-4.93
4.60E+03	3.92E-19	3.78E-19	3.63	4.77E+03	2.72E-19	2.58E-19	5.24
1.56E+04	1.71E-19	1.86E-19	-7.99	1.62E+04	1.41E-19	1.57E-19	-10.21
2.95E+04	1.04E-19	1.02E-19	1.78	3.16E+04	8.72E-20	9.16E-20	-4.8
1.15E+05	3.25E-20	3.03E-20	7.1	1.23E+05	2.76E-20	2.33E-20	18.4
4.58E+05	9.36E-21	9.83E-21	-4.74	4.91E+05	7.78E-21	8.94E-21	-13.01
U 30+ I = 1053 eV				U 31+ I = 1095 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
1.12E+03	5.55E-21	4.53E-21	22.51	1.16E+03	2.45E-21	2.09E-21	17.38
1.32E+03	7.83E-20	1.49E-19	-47.44	1.36E+03	5.64E-20	1.34E-19	-57.93
2.11E+03	4.40E-19	3.89E-19	13.02	2.18E+03	4.08E-19	3.56E-19	14.5
5.26E+03	3.83E-19	3.30E-19	15.92	5.45E+03	3.55E-19	2.95E-19	20.3
1.79E+04	1.33E-19	1.50E-19	-11.18	1.85E+04	1.17E-19	1.35E-19	-13.09
3.37E+04	7.90E-20	8.63E-20	-8.42	3.60E+04	6.73E-20	7.56E-20	-10.93
1.32E+05	2.68E-20	2.74E-20	-2.21	1.40E+05	2.34E-20	2.40E-20	-2.72
5.24E+05	8.76E-21	8.10E-21	8.12	5.58E+05	7.76E-21	7.05E-21	10
U 32+ I = 1295 eV				U 33+ I = 1358 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
1.38E+03	3.64E-20	3.66E-20	-0.6	1.44E+03	3.08E-20	3.14E-20	-1.77

1.62E+03	1.14E-19	1.15E-19	-1.01	1.70E+03	9.73E-20	9.80E-20	-0.67
2.60E+03	3.13E-19	3.19E-19	-1.88	2.72E+03	2.74E-19	2.78E-19	-1.51
6.50E+03	2.47E-19	2.43E-19	1.59	6.80E+03	2.16E-19	2.13E-19	1.5
2.21E+04	1.04E-19	1.08E-19	-4.09	2.31E+04	9.00E-20	9.40E-20	-4.27
3.83E+04	6.75E-20	6.57E-20	2.75	4.10E+04	5.75E-20	5.61E-20	2.54
1.49E+05	2.11E-20	2.08E-20	1.58	1.59E+05	1.79E-20	1.76E-20	1.73
5.94E+05	6.02E-21	6.08E-21	-1.02	6.30E+05	5.07E-21	5.14E-21	-1.3
U 34+ I = 1424 eV				U 35+ I = 1486 eV			
E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %
1.51E+03	2.64E-20	2.68E-20	-1.49	1.58E+03	2.23E-20	2.26E-20	-1.4
1.77E+03	8.28E-20	8.34E-20	-0.68	1.86E+03	6.97E-20	7.00E-20	-0.45
2.84E+03	2.37E-19	2.41E-19	-1.65	2.98E+03	2.05E-19	2.08E-19	-1.57
7.10E+03	1.87E-19	1.84E-19	1.7	7.45E+03	1.64E-19	1.61E-19	1.64
2.41E+04	7.78E-20	8.15E-20	-4.54	2.53E+04	6.73E-20	7.06E-20	-4.65
4.31E+04	4.94E-20	4.80E-20	2.88	4.56E+04	4.23E-20	4.11E-20	2.9
1.68E+05	1.53E-20	1.50E-20	1.86	1.78E+05	1.30E-20	1.28E-20	1.63
6.68E+05	4.31E-21	4.37E-21	-1.27	7.07E+05	3.67E-21	3.72E-21	-1.29
U 36+ I = 1552 eV				U 37+ I = 1619 eV			
E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %
1.65E+03	1.90E-20	1.91E-20	-0.76	1.72E+03	1.56E-20	1.58E-20	-1.35
1.94E+03	6.08E-20	6.12E-20	-0.65	2.02E+03	4.85E-20	4.86E-20	-0.24
3.10E+03	1.82E-19	1.85E-19	-1.46	3.24E+03	1.56E-19	1.58E-19	-1.23
7.75E+03	1.43E-19	1.41E-19	1.17	8.10E+03	1.21E-19	1.20E-19	1
2.63E+04	5.97E-20	6.19E-20	-3.54	2.75E+04	5.09E-20	5.30E-20	-4.06
4.81E+04	3.69E-20	3.56E-20	3.72	5.07E+04	3.13E-20	3.02E-20	3.77
1.88E+05	1.09E-20	1.10E-20	-0.66	1.98E+05	9.24E-21	9.33E-21	-0.99
U 38+ I = 1687 eV				U 39+ I = 1757 eV			
E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %
1.81E+03	1.31E-20	1.28E-20	2.07	1.86E+03	1.09E-20	1.06E-20	3.08
2.12E+03	4.71E-20	4.78E-20	-1.38	2.19E+03	4.83E-20	4.96E-20	-2.59
3.40E+03	1.35E-19	1.39E-19	-2.92	3.50E+03	1.19E-19	1.23E-19	-3.29
8.50E+03	1.08E-19	1.06E-19	1.45	8.75E+03	9.63E-20	9.49E-20	1.42
2.89E+04	4.48E-20	4.65E-20	-3.61	2.97E+04	3.99E-20	4.12E-20	-3.09
5.34E+04	2.71E-20	2.62E-20	3.26	5.61E+04	2.34E-20	2.28E-20	2.67
2.09E+05	8.03E-21	8.08E-21	-0.67	2.19E+05	6.97E-21	7.01E-21	-0.57
U 40+ I = 1849 eV				U 41+ I = 1921 eV			
E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %
1.96E+03	8.29E-21	8.22E-21	0.87	2.04E+03	6.55E-21	6.36E-21	3.01
2.31E+03	3.21E-20	3.23E-20	-0.55	2.40E+03	2.88E-20	2.93E-20	-1.69
3.70E+03	1.02E-19	1.04E-19	-2.06	3.84E+03	8.08E-20	8.25E-20	-2.08
9.24E+03	8.25E-20	8.14E-20	1.3	9.60E+03	7.90E-20	7.90E-20	-0.04
3.14E+04	3.39E-20	3.52E-20	-3.8	3.26E+04	3.19E-20	3.12E-20	2.31
5.90E+04	2.02E-20	1.95E-20	3.54	6.19E+04	1.87E-20	1.93E-20	-2.95
2.30E+05	5.95E-21	6.00E-21	-0.81	2.42E+05	6.00E-21	5.95E-21	0.8
U 42+ I = 1993 eV				U 43+ I = 2067 eV			
E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$ cm²	$\sigma_{\text{Atom.}}$ cm²	error, %
2.12E+03	5.01E-21	4.75E-21	5.44	2.20E+03	3.57E-21	3.32E-21	7.56
2.49E+03	2.83E-20	2.90E-20	-2.26	2.58E+03	2.76E-20	2.86E-20	-3.6

4.00E+03	7.64E-20	7.92E-20	-3.48	4.13E+03	6.50E-20	6.90E-20	-5.75
1.00E+04	8.06E-20	8.04E-20	0.3	1.03E+04	7.36E-20	7.20E-20	2.17
3.40E+04	3.19E-20	3.10E-20	2.92	3.51E+04	3.05E-20	3.08E-20	-1.14
6.50E+04	1.82E-20	1.90E-20	-4	6.80E+04	1.67E-20	1.67E-20	0.18
2.53E+05	5.98E-21	5.91E-21	1.13	2.65E+05	5.24E-21	5.23E-21	0.27
U 44+ I = 2141 eV				U 45+ I = 2217 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.27E+03	2.24E-21	2.07E-21	7.96	2.40E+03	1.11E-21	9.65E-22	14.6
2.68E+03	2.31E-20	2.37E-20	-2.45	2.80E+03	1.79E-20	1.94E-20	-7.96
4.28E+03	5.56E-20	5.92E-20	-6.02	4.43E+03	4.86E-20	5.11E-20	-4.81
1.07E+04	6.54E-20	6.38E-20	2.46	1.11E+04	5.74E-20	5.70E-20	0.71
3.64E+04	2.68E-20	2.71E-20	-0.99	3.77E+04	2.40E-20	2.41E-20	-0.33
7.10E+04	1.46E-20	1.46E-20	0.11	7.42E+04	1.29E-20	1.30E-20	-0.55
2.78E+05	4.61E-21	4.59E-21	0.45	2.90E+05	4.04E-21	4.04E-21	-0.07
U 46+ I = 2582 eV				U 47+ I = 2652 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.80E+03	5.14E-21	4.90E-21	4.96	2.83E+03	4.24E-21	4.21E-21	0.7
3.26E+03	2.04E-20	2.14E-20	-4.83	3.33E+03	1.49E-20	1.51E-20	-1.55
5.22E+03	3.95E-20	4.11E-20	-3.81	5.33E+03	3.60E-20	3.64E-20	-1.06
1.30E+04	4.88E-20	4.80E-20	1.56	1.33E+04	4.41E-20	4.38E-20	0.7
4.44E+04	1.97E-20	2.00E-20	-1.48	4.53E+04	1.79E-20	1.81E-20	-1.35
7.80E+04	1.18E-20	1.17E-20	0.51	8.10E+04	1.07E-20	1.06E-20	1.19
3.03E+05	3.68E-21	3.68E-21	-0.07	3.16E+05	3.30E-21	3.31E-21	-0.2
U 48+ I = 2723 eV				U 49+ I = 2795 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
2.92E+03	3.71E-21	3.56E-21	4.12	3.00E+03	3.14E-21	3.00E-21	4.7
3.44E+03	1.62E-20	1.68E-20	-3.78	3.52E+03	1.40E-20	1.46E-20	-4.12
5.50E+03	3.14E-20	3.24E-20	-2.97	5.64E+03	2.76E-20	2.85E-20	-3.23
1.37E+04	4.05E-20	4.00E-20	1.28	1.41E+04	3.66E-20	3.61E-20	1.39
4.67E+04	1.62E-20	1.63E-20	-0.6	4.80E+04	1.48E-20	1.48E-20	-0.22
8.44E+04	9.47E-21	9.47E-21	0.02	8.80E+04	8.48E-21	8.50E-21	-0.29
3.29E+05	3.01E-21	3.00E-21	0.17	3.43E+05	2.65E-21	2.64E-21	0.36
U 50+ I = 2867 eV				U 51+ I = 2940 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
3.06E+03	2.58E-21	2.47E-21	4.59	3.15E+03	2.06E-21	1.95E-21	5.66
3.60E+03	1.22E-20	1.27E-20	-3.82	3.71E+03	1.05E-20	1.10E-20	-4.83
5.80E+03	2.44E-20	2.52E-20	-3	5.94E+03	1.89E-20	1.96E-20	-3.36
1.44E+04	3.33E-20	3.28E-20	1.47	1.48E+04	2.78E-20	2.76E-20	0.83
4.90E+04	1.34E-20	1.35E-20	-0.62	5.05E+04	1.15E-20	1.12E-20	2.87
9.10E+04	7.62E-21	7.61E-21	0.07	9.50E+04	6.55E-21	6.82E-21	-3.89
3.57E+05	2.38E-21	2.37E-21	0.24	3.71E+05	2.16E-21	2.13E-21	1.27
U 52+ I = 3077 eV				U 53+ I = 3153 eV			
E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %	E, eV	$\sigma_{\text{Fit.}}, \text{cm}^2$	$\sigma_{\text{Atom.}}, \text{cm}^2$	error, %
3.27E+03	1.56E-21	1.47E-21	6.17	3.35E+03	1.13E-21	1.06E-21	6.79
3.84E+03	9.05E-21	9.46E-21	-4.36	3.94E+03	7.61E-21	7.94E-21	-4.12
6.15E+03	1.81E-20	1.88E-20	-3.71	6.30E+03	1.54E-20	1.61E-20	-4.07
1.54E+04	2.67E-20	2.63E-20	1.42	1.58E+04	2.41E-20	2.37E-20	1.79
5.23E+04	1.08E-20	1.08E-20	0.05	5.36E+04	9.76E-21	9.75E-21	0.06

9.86E+04	6.02E-21	6.10E-21	-1.37	1.02E+05	5.36E-21	5.43E-21	-1.31
3.85E+05	1.91E-21	1.90E-21	0.31	4.00E+05	1.70E-21	1.69E-21	0.48
U 54+ I = 3229 eV				U 55+ I = 3305 eV			
E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
3.43E+03	7.02E-22	6.77E-22	3.69	3.51E+03	3.40E-22	3.23E-22	5.26
4.03E+03	2.86E-21	6.80E-21	-57.88	4.13E+03	3.35E-21	5.20E-21	-35.65
6.45E+03	1.45E-20	1.35E-20	7.63	6.61E+03	9.14E-21	9.29E-21	-1.62
1.61E+04	2.08E-20	2.22E-20	-6.54	1.65E+04	1.67E-20	1.67E-20	0.01
2.89E+04	1.35E-20	1.23E-20	9.84	5.62E+04	7.00E-21	6.71E-21	4.26
1.06E+05	4.47E-21	4.88E-21	-8.32	1.10E+05	3.87E-21	4.10E-21	-5.61
4.15E+05	1.57E-21	1.52E-21	3.23	4.30E+05	1.29E-21	1.27E-21	1.62
U 56+ I = 3607 eV				U 57+ I = 3681 eV			
E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
3.98E+03	1.30E-21	1.25E-21	3.85	3.91E+03	1.09E-21	1.07E-21	2.03
4.69E+03	4.89E-21	5.05E-21	-3.13	4.60E+03	4.36E-21	4.48E-21	-2.77
7.50E+03	8.87E-21	9.00E-21	-1.48	7.35E+03	8.82E-21	8.92E-21	-1.17
1.87E+04	1.59E-20	1.58E-20	0.9	1.84E+04	1.43E-20	1.42E-20	0.42
6.37E+04	6.58E-21	6.58E-21	0.04	6.25E+04	6.50E-21	6.45E-21	0.7
1.14E+05	3.86E-21	3.88E-21	-0.65	1.18E+05	3.75E-21	3.80E-21	-1.21
4.46E+05	1.20E-21	1.20E-21	0.23	4.61E+05	1.15E-21	1.15E-21	0.35
U 58+ I = 3756 eV				U 59+ I = 3832 eV			
E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
4.12E+03	8.12E-22	7.80E-22	4.1	4.14E+03	5.95E-22	5.74E-22	3.72
4.84E+03	3.46E-21	3.51E-21	-1.52	4.87E+03	2.80E-21	2.83E-21	-0.9
7.75E+03	8.63E-21	8.80E-21	-1.88	7.80E+03	7.41E-21	7.53E-21	-1.64
1.94E+04	1.31E-20	1.30E-20	0.94	1.95E+04	1.19E-20	1.18E-20	1
6.59E+04	5.41E-21	5.42E-21	-0.22	6.63E+04	4.98E-21	5.00E-21	-0.47
1.22E+05	3.11E-21	3.12E-21	-0.4	1.26E+05	2.80E-21	2.80E-21	-0.17
4.77E+05	9.65E-22	9.63E-22	0.18	4.93E+05	8.63E-22	8.62E-22	0.11
U 60+ I = 4221 eV				U 61+ I = 4307 eV			
E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
4.54E+03	5.29E-22	5.23E-22	1.18	4.58E+03	4.32E-22	4.34E-22	-0.39
5.34E+03	2.03E-21	2.01E-21	0.76	5.38E+03	1.50E-21	1.45E-21	3.38
8.55E+03	6.82E-21	6.82E-21	-0.03	8.61E+03	1.01E-20	1.00E-20	0.76
2.14E+04	9.93E-21	9.91E-21	0.22	2.15E+04	8.90E-21	8.87E-21	0.35
7.27E+04	4.17E-21	4.20E-21	-0.74	7.32E+04	3.69E-21	3.80E-21	-2.84
1.31E+05	2.50E-21	2.48E-21	0.7	1.35E+05	2.27E-21	2.20E-21	3.15
5.17E+05	7.61E-22	7.62E-22	-0.16	5.27E+05	6.65E-22	6.70E-22	-0.75
U 62+ I = 4521 eV				U 63+ I = 4606 eV			
E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %	E, eV	$\sigma_{\text{Filt.}}$, cm²	$\sigma_{\text{Atom.}}$, cm²	error, %
4.80E+03	2.79E-22	2.80E-22	-0.4	4.89E+03	1.39E-22	1.35E-22	2.59
5.65E+03	9.29E-22	8.88E-22	4.56	5.76E+03	4.59E-22	4.26E-22	7.73
9.04E+03	8.67E-21	8.52E-21	1.71	9.21E+03	8.02E-21	7.92E-21	1.29
2.26E+04	7.65E-21	7.64E-21	0.18	2.30E+04	6.89E-21	6.82E-21	0.96
7.70E+04	3.18E-21	3.30E-21	-3.57	7.83E+04	2.82E-21	2.94E-21	-3.93
1.39E+05	2.01E-21	1.93E-21	3.92	1.44E+05	1.77E-21	1.70E-21	3.93
5.44E+05	5.89E-22	5.95E-22	-1.01	5.62E+05	5.18E-22	5.23E-22	-0.88

U 64+ I = 7404 eV				U 65+ I = 7573 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
9.31E+03	3.46E-21	3.56E-21	-2.89	8.09E+03	7.81E-22	7.52E-22	3.81
1.49E+04	5.93E-21	6.19E-21	-4.17	9.52E+03	3.01E-21	3.17E-21	-4.97
3.72E+04	4.84E-21	4.90E-21	-1.21	1.52E+04	5.33E-21	5.52E-21	-3.49
1.27E+05	1.78E-21	2.00E-21	-11.15	3.81E+04	4.46E-21	4.41E-21	1.1
1.51E+05	1.53E-21	1.40E-21	9.39	1.29E+05	1.76E-21	1.81E-21	-2.65
5.82E+05	5.11E-22	5.16E-22	-0.88	1.56E+05	1.49E-21	1.46E-21	2.08
				6.00E+05	4.62E-22	4.62E-22	-0.03

U 66+ I = 7744 eV				U 67+ I = 7916 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
8.28E+03	6.65E-22	6.37E-22	4.33	8.77E+03	5.71E-22	5.05E-22	13.13
9.74E+03	2.66E-21	2.81E-21	-5.2	1.03E+04	1.98E-21	2.37E-21	-16.44
1.56E+04	4.71E-21	4.90E-21	-3.83	1.65E+04	4.30E-21	4.11E-21	4.6
3.89E+04	4.02E-21	3.97E-21	1.25	4.13E+04	3.09E-21	3.37E-21	-8.27
1.32E+05	1.59E-21	1.64E-21	-3.01	1.40E+05	1.38E-21	1.38E-21	-0.29
1.60E+05	1.34E-21	1.31E-21	2.35	1.65E+05	1.20E-21	1.13E-21	6.52
6.18E+05	4.14E-22	4.14E-22	-0.03	6.37E+05	3.51E-22	3.60E-22	-2.59

U 68+ I = 8090 eV				U 69+ I = 8265 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
8.65E+03	4.76E-22	4.35E-22	9.34	8.84E+03	3.88E-22	3.47E-22	11.68
1.02E+04	1.95E-21	2.15E-21	-9.24	1.04E+04	1.68E-21	1.89E-21	-11.38
1.63E+04	3.79E-21	3.78E-21	0.17	1.66E+04	3.37E-21	3.33E-21	1.17
4.07E+04	3.09E-21	3.16E-21	-2.27	4.16E+04	2.75E-21	2.85E-21	-3.52
1.38E+05	1.28E-21	1.30E-21	-1.49	1.41E+05	1.16E-21	1.18E-21	-1.45
1.70E+05	1.08E-21	1.04E-21	3.38	1.75E+05	9.71E-22	9.31E-22	4.27
6.56E+05	3.27E-22	3.30E-22	-0.93	6.75E+05	2.92E-22	2.96E-22	-1.33

U 70+ I = 8661 eV				U 71+ I = 8845 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
9.16E+03	2.89E-22	2.60E-22	11.08	9.42E+03	2.14E-22	1.84E-22	16.19
1.08E+04	1.47E-21	1.63E-21	-9.9	1.11E+04	1.15E-21	1.37E-21	-16.25
1.72E+04	2.86E-21	2.85E-21	0.25	1.77E+04	2.56E-21	2.43E-21	5.21
4.31E+04	2.44E-21	2.50E-21	-2.35	4.43E+04	2.10E-21	2.18E-21	-3.73
1.47E+05	1.02E-21	1.04E-21	-1.88	1.51E+05	8.94E-22	9.04E-22	-1.11
1.80E+05	8.60E-22	8.28E-22	3.92	1.85E+05	7.55E-22	7.19E-22	5
6.94E+05	2.60E-22	2.63E-22	-0.98	7.14E+05	2.26E-22	2.30E-22	-1.79

U 72+ I = 9030 eV				U 73+ I = 9217 eV			
E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %	E, eV	$\sigma_{\text{Fit.}}$, cm ²	$\sigma_{\text{Atom.}}$, cm ²	error, %
9.61E+03	1.58E-22	1.18E-22	33.66	9.81E+03	1.64E-22	1.33E-22	23.29
1.02E+04	4.57E-22	6.66E-22	-31.4	1.04E+04	4.32E-22	5.49E-22	-21.36
1.13E+04	1.05E-21	1.16E-21	-9.75	1.15E+04	9.50E-22	9.62E-22	-1.24
1.36E+04	1.88E-21	1.82E-21	3.53	1.38E+04	1.62E-21	1.53E-21	5.53
1.81E+04	2.41E-21	2.08E-21	15.64	1.85E+04	1.82E-21	1.77E-21	3.04
2.71E+04	2.31E-21	2.00E-21	15.34	2.77E+04	1.70E-21	1.73E-21	-1.57
4.52E+04	1.82E-21	1.95E-21	-6.77	4.62E+04	1.62E-21	1.72E-21	-5.79
8.14E+04	1.29E-21	1.31E-21	-1.31	8.31E+04	1.26E-21	1.17E-21	7.27
1.54E+05	8.73E-22	8.09E-22	7.92	1.57E+05	7.03E-22	7.22E-22	-2.63

U 74+ I = 9730 eV				U 75+ I = 9892 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
1.05E+04	2.39E-22	2.31E-22	3.6	1.05E+04	1.13E-22	9.56E-23	18.47
1.11E+04	4.37E-22	4.33E-22	0.89	1.11E+04	2.96E-22	3.47E-22	-14.77
1.24E+04	8.10E-22	8.51E-22	-4.85	1.23E+04	6.93E-22	7.30E-22	-5.1
1.48E+04	1.22E-21	1.21E-21	0.55	1.48E+04	1.19E-21	1.04E-21	14.03
1.98E+04	1.44E-21	1.40E-21	3.07	1.98E+04	1.43E-21	1.20E-21	19.09
2.97E+04	1.47E-21	1.48E-21	-0.71	1.96E+04	1.42E-21	1.30E-21	9.52
4.96E+04	1.37E-21	1.43E-21	-4.42	4.94E+04	1.39E-21	1.30E-21	6.94
8.91E+04	1.02E-21	9.73E-22	4.97	8.89E+04	8.79E-22	8.80E-22	-0.08
1.68E+05	5.90E-22	6.00E-22	-1.72	1.68E+05	5.29E-22	5.45E-22	-2.87

U 76+ I = 10054 eV				U 77+ I = 10217 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
1.06E+04	1.44E-22	1.49E-22	-3.16	1.14E+04	1.27E-22	1.00E-22	26.5
1.12E+04	2.90E-22	2.70E-22	7.37	1.20E+04	2.13E-22	2.63E-22	-19.13
1.25E+04	5.51E-22	5.94E-22	-7.31	1.34E+04	3.93E-22	4.42E-22	-11.08
1.50E+04	8.45E-22	8.48E-22	-0.39	1.61E+04	6.15E-22	6.28E-22	-2.06
2.00E+04	1.02E-21	9.84E-22	3.63	2.14E+04	7.94E-22	7.27E-22	9.2
3.00E+04	1.08E-21	1.09E-21	-0.58	3.21E+04	8.77E-22	8.46E-22	3.64
5.00E+04	1.05E-21	1.11E-21	-5.24	5.35E+04	8.12E-22	8.96E-22	-9.38
9.00E+04	8.01E-22	7.58E-22	5.66	9.64E+04	6.13E-22	6.09E-22	0.6
1.70E+05	4.61E-22	4.70E-22	-1.93	1.82E+05	3.91E-22	3.85E-22	1.64

U 78+ I = 11438 eV				U 79+ I = 11629 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
1.17E+04	6.95E-23	7.04E-23	-1.27	1.18E+04	3.58E-23	3.73E-23	-4.17
1.23E+04	1.92E-22	1.96E-22	-1.83	1.25E+04	1.62E-22	1.34E-22	1.43
1.37E+04	3.20E-22	3.27E-22	-2.08	1.39E+04	2.11E-22	2.24E-22	-5.63
1.65E+04	4.75E-22	4.65E-22	2.12	1.67E+04	3.34E-22	3.19E-22	4.72
2.19E+04	8.63E-22	5.41E-22	59.5	2.22E+04	6.60E-22	3.73E-22	76.99
3.29E+04	9.65E-22	9.23E-22	4.54	3.33E+04	7.82E-22	7.52E-22	3.96
5.50E+04	7.15E-22	7.45E-22	-4	5.56E+04	5.99E-22	6.14E-22	-2.39
9.87E+04	5.20E-22	5.09E-22	2.23	1.00E+05	4.25E-22	4.21E-22	0.99
1.87E+05	3.23E-22	3.25E-22	-0.62	1.89E+05	2.71E-22	2.72E-22	-0.28

U 80+ I = 12012 eV				U 81+ I = 12191 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
1.26E+04	3.96E-23	4.06E-23	-2.37	1.28E+04	1.91E-23	1.96E-23	-2.72
1.34E+04	7.84E-23	7.44E-23	5.42	1.36E+04	3.74E-23	3.60E-23	3.85
1.49E+04	1.11E-22	1.23E-22	-10.01	1.51E+04	5.62E-23	6.00E-23	-6.32
1.79E+04	1.93E-22	1.76E-22	9.48	1.81E+04	1.06E-22	8.56E-23	23.86
2.38E+04	4.40E-22	2.08E-22	111.74	2.41E+04	2.82E-22	1.02E-22	175.94
3.57E+04	5.90E-22	5.64E-22	4.59	3.62E+04	4.52E-22	4.50E-22	0.45
5.95E+04	4.71E-22	4.70E-22	0.26	6.03E+04	3.84E-22	3.70E-22	3.83
1.07E+05	3.20E-22	3.25E-22	-1.57	1.08E+05	2.45E-22	2.53E-22	-3.31
2.02E+05	2.13E-22	2.12E-22	0.49	2.05E+05	1.69E-22	1.67E-22	1.09

U 82+ I = 24021 eV				U 83+ I = 25747 eV			
E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %	E, eV	σ_{Fit} , cm ²	σ_{Atom} , cm ²	error, %
2.89E+04	3.89E-23	3.49E-23	11.4	2.92E+04	3.02E-23	2.84E-23	6.35

3.06E+04	6.43E-23	6.71E-23	-4.23	3.09E+04	5.35E-23	5.51E-23	-2.95
3.40E+04	1.18E-22	1.26E-22	-6.76	3.44E+04	1.03E-22	1.06E-22	-2.64
4.08E+04	1.87E-22	1.79E-22	4.67	4.13E+04	1.58E-22	1.50E-22	5.31
5.44E+04	2.14E-22	2.09E-22	2.21	5.50E+04	1.72E-22	1.76E-22	-2.34
8.16E+04	1.91E-22	1.97E-22	-3.25	8.25E+04	1.65E-22	1.66E-22	-0.44
1.36E+05	1.58E-22	1.55E-22	1.61	1.38E+05	1.34E-22	1.32E-22	1.44
2.45E+05	1.09E-22	1.10E-22	-0.5	2.48E+05	9.31E-23	9.40E-23	-0.96
U 84+ I = 26182 eV				U 85+ I = 26621 eV			
E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %
2.96E+04	2.36E-23	2.22E-23	6.32	3.02E+04	1.71E-23	1.60E-23	6.56
3.13E+04	4.27E-23	4.38E-23	-2.46	3.20E+04	3.20E-23	3.24E-23	-1.36
3.48E+04	8.42E-23	8.70E-23	-3.21	3.56E+04	6.47E-23	6.80E-23	-4.93
4.18E+04	1.30E-22	1.23E-22	5.67	4.27E+04	1.03E-22	9.67E-23	6.33
5.57E+04	1.41E-22	1.45E-22	-2.86	5.69E+04	1.12E-22	1.13E-22	-1.25
8.35E+04	1.37E-22	1.37E-22	0.28	8.53E+04	1.05E-22	1.08E-22	-2.58
1.39E+05	1.11E-22	1.10E-22	0.8	1.42E+05	8.99E-23	8.70E-23	3.35
2.51E+05	7.77E-23	7.82E-23	-0.62	2.56E+05	6.16E-23	6.29E-23	-2
U 86+ I = 29792 eV				U 87+ I = 30722 eV			
E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %
3.04E+04	9.06E-24	1.05E-23	-13.74	3.08E+04	1.02E-24	5.13E-24	-80.2
3.22E+04	2.62E-23	2.27E-23	15.37	3.26E+04	1.63E-23	1.29E-23	26.06
3.58E+04	4.51E-23	5.17E-23	-12.7	3.62E+04	2.87E-23	3.53E-23	-18.74
4.29E+04	7.20E-23	7.36E-23	-2.17	4.34E+04	4.77E-23	5.04E-23	-5.33
5.72E+04	9.27E-23	8.67E-23	6.87	5.79E+04	6.76E-23	6.00E-23	12.64
8.58E+04	8.16E-23	8.31E-23	-1.75	8.69E+04	6.05E-23	5.80E-23	4.32
1.43E+05	6.51E-23	6.78E-23	-3.97	1.45E+05	4.72E-23	4.83E-23	-2.22
2.57E+05	5.19E-23	5.00E-23	3.71	2.61E+05	3.80E-23	3.67E-23	3.57
U 88+ I = 31588 eV				U 89+ I = 32099 eV			
E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %
3.40E+04	6.33E-24	6.25E-24	1.28	3.45E+04	3.09E-24	3.05E-24	1.22
3.60E+04	1.11E-23	1.13E-23	-1.64	3.65E+04	5.42E-24	5.52E-24	-1.75
4.00E+04	1.87E-23	1.87E-23	-0.01	4.06E+04	9.14E-24	9.12E-24	0.2
4.80E+04	2.71E-23	2.70E-23	0.51	4.87E+04	1.32E-23	1.32E-23	0.19
6.41E+04	3.23E-23	3.25E-23	-0.5	6.49E+04	1.58E-23	1.58E-23	-0.27
9.61E+04	3.26E-23	3.25E-23	0.31	9.74E+04	1.58E-23	1.58E-23	0.19
1.60E+05	2.86E-23	2.86E-23	-0.14	1.62E+05	1.46E-23	1.46E-23	-0.08
2.88E+05	2.30E-23	2.30E-23	0.03	2.92E+05	1.27E-23	1.27E-23	0.03
U 90+ I = 127161 eV				U 91+ I = 129087 eV			
E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %	E_i eV	σ_{Fit,i} cm²	σ_{Atom,i} cm²	error, %
1.34E+05	3.26E-25	3.33E-25	-2.19	1.36E+05	1.61E-25	1.65E-25	-2.65
1.42E+05	6.19E-25	6.13E-25	1	1.44E+05	3.04E-25	3.00E-25	1.2
1.58E+05	1.03E-24	1.04E-24	-1.16	1.60E+05	5.03E-25	5.11E-25	-1.51
1.89E+05	1.60E-24	1.59E-24	0.54	1.92E+05	7.78E-25	7.75E-25	0.44
2.52E+05	2.05E-24	2.05E-24	-0.02	2.56E+05	9.98E-25	1.00E-24	-0.25
3.79E+05	2.18E-24	2.18E-24	0.2	3.85E+05	1.09E-24	1.09E-24	-0.1
6.31E+05	1.85E-24	1.85E-24	0.23	6.41E+05	9.32E-25	9.34E-25	-0.17

Table 5.2. Fitting parameters for uranium and its ions.

U	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	B
0+	1.1709E-01	2.3656E+00	4.0174E+01	-1.4486E+02	1.5445E+02	-5.0142E+01	9.9877E-01
1+	-1.7329E+00	6.4339E+00	-1.5031E+01	4.6196E+01	-8.9909E+01	5.1039E+01	2.4438E+00
2+	-1.9938E-01	2.9350E-02	-3.9985E+00	1.9190E+01	-7.8120E+00	-1.1321E+00	1.2258E+00
3+	4.4864E+00	1.4364E+01	-1.5647E+02	7.3863E+02	-1.1544E+03	5.8416E+02	-2.6184E+00
4+	4.7741E-01	1.5567E+00	4.4695E+00	-4.3868E+01	9.9886E+01	-5.7467E+01	8.6269E-01
5+	-1.5824E+00	1.9797E+00	-4.9508E+01	2.4220E+02	-3.1683E+02	1.2705E+02	2.2677E+00
6+	-1.9421E+00	-1.1468E+01	1.4007E+02	-4.9077E+02	6.9564E+02	-3.3391E+02	3.7026E+00
7+	-1.0633E+00	-6.8308E+00	9.2163E+01	-3.1612E+02	4.5293E+02	-2.1764E+02	2.5860E+00
8+	-2.7465E+00	1.4018E-01	-5.0959E-01	3.0916E+01	-2.8717E+01	-8.3173E-01	3.8952E+00
9+	-9.8384E-01	-1.3885E+01	1.8930E+01	9.2622E+01	-1.8768E+02	8.9615E+01	4.2530E+00
10+	-1.9977E+00	2.3133E+00	-3.6655E+01	3.0335E+02	-5.1584E+02	2.5803E+02	2.7347E+00
11+	-2.7851E+00	1.3950E+00	-2.9486E+01	2.9779E+02	-5.6443E+02	3.0652E+02	3.2285E+00
12+	-2.2565E+00	5.3609E+00	-1.0539E+02	5.3722E+02	-8.4877E+02	4.2573E+02	3.0821E+00
13+	-2.4037E+00	5.5357E+00	-1.0787E+02	5.3045E+02	-8.0299E+02	3.8450E+02	2.7673E+00
14+	-1.6816E+00	7.5623E+00	-7.6426E+01	2.2862E+02	-2.3452E+02	8.0368E+01	6.3330E+00
15+	-2.8309E+00	-1.0449E-01	-1.2352E+02	-4.3096E+02	-6.3523E+02	-3.1070E+02	6.0250E+00
16+	-2.8742E+00	5.6632E+00	-7.5811E+01	3.1139E+02	-4.0767E+02	1.7531E+02	6.0368E+00
17+	-3.0956E+00	4.4638E+00	-6.7863E+01	2.9399E+02	-3.9077E+02	1.6980E+02	5.8727E+00
18+	-2.8501E+00	2.4515E+00	-1.1591E+02	4.8284E+02	-6.2806E+02	2.6630E+02	6.2453E+00
19+	-3.1601E+00	1.9442E+00	-3.4957E+01	1.7232E+02	-2.0564E+02	7.5637E+01	4.8849E+00
20+	-1.9559E+00	7.5592E+00	-1.4800E+02	7.4590E+02	-1.1027E+03	5.1273E+02	3.7029E+00
21+	-2.0904E+00	8.6669E+00	-1.6241E+02	8.0999E+02	-1.1943E+03	5.5426E+02	3.3611E+00
22+	-2.3916E+00	9.2959E+00	-1.6978E+02	8.2737E+02	-1.1907E+03	5.4057E+02	3.1801E+00
23+	-3.2518E+00	9.1610E+00	-1.6677E+02	8.0698E+02	-1.1501E+03	5.1608E+02	3.5525E+00
24+	-3.4671E+00	4.8564E-01	-3.5407E+01	3.1151E+02	-4.6435E+02	2.0212E+02	4.5175E+00
25+	-2.9323E+00	2.9933E+00	-5.2312E+01	3.8339E+02	-5.7761E+02	2.5883E+02	4.0445E+00
26+	-2.9839E+00	2.5117E+00	-5.4415E+01	3.9473E+02	-5.9511E+02	2.6735E+02	3.8104E+00
27+	-1.5080E+00	3.0175E+00	-2.0301E+01	3.4452E+02	-6.2838E+02	3.2437E+02	2.6290E+00
28+	-2.4036E+00	1.4885E+00	-1.2076E+01	3.2031E+02	-5.6847E+02	2.7981E+02	3.3619E+00
29+	-1.5680E+00	5.6777E-02	2.3411E+01	2.0287E+02	-4.9039E+02	2.8801E+02	2.3068E+00
30+	-8.0632E+00	-1.1773E+00	1.2589E+02	-1.2158E+02	0.0000E+00	0.0000E+00	8.5372E+00
31+	-8.5980E+00	-1.0046E+01	1.5684E+02	-1.4713E+02	0.0000E+00	0.0000E+00	8.9888E+00
32+	6.1752E+00	2.2481E+01	-1.8068E+02	7.8736E+02	-1.1328E+03	5.2319E+02	3.4031E+00
33+	7.2669E+00	1.5709E+01	-1.8793E+02	8.7089E+02	-1.2635E+03	5.8405E+02	2.8088E+00
34+	6.7397E+00	1.5648E+01	-1.6782E+02	7.8189E+02	-1.1412E+03	5.2965E+02	2.6686E+00
35+	5.7228E+00	1.5423E+01	-1.6174E+02	7.5252E+02	-1.0913E+03	5.0277E+02	2.5038E+00
36+	6.6159E+00	1.9080E+01	-1.7079E+02	7.8489E+02	-1.1545E+03	5.4380E+02	8.4911E-01
37+	6.4363E+00	1.6110E+01	-1.7492E+02	8.2733E+02	-1.2240E+03	5.7785E+02	4.4515E-01
38+	3.2339E+00	1.2401E+01	-5.9676E+00	1.5078E+02	-3.0466E+02	1.6484E+02	1.7194E+00
39+	3.1636E+00	1.8662E+01	8.7055E+00	-2.7115E+01	5.8290E-01	1.2658E+01	2.1668E+00
40+	3.6124E+00	1.3687E+01	-7.2993E+01	3.9520E+02	-6.1423E+02	2.9568E+02	1.0560E+00
41+	-1.1370E+00	8.1424E+00	3.9308E+01	-1.3009E+02	1.9246E+02	-1.0444E+02	4.8071E+00
42+	-3.9051E+00	-3.1386E+00	2.1463E+02	-7.5915E+02	1.0335E+03	-4.8584E+02	6.7937E+00
43+	-3.8838E+00	-1.7139E+01	4.2138E+02	-1.4803E+03	1.9532E+03	-8.7586E+02	6.1733E+00

44+	-4.6115E+00	-1.8971E+01	4.2292E+02	-1.4781E+03	1.9530E+03	-8.7888E+02	6.3004E+00
45+	-4.6082E+00	-4.1740E+01	5.6532E+02	-1.7939E+03	2.2472E+03	-9.7577E+02	5.7659E+00
46+	-2.4322E+00	-1.3627E+01	3.3953E+02	-1.2705E+03	1.7669E+03	-8.2360E+02	6.4817E+00
47+	-2.7423E-02	5.2595E+00	3.3628E+01	-1.9020E+02	3.7396E+02	-2.1718E+02	4.5158E+00
48+	-2.6350E+00	-3.9474E+00	2.2139E+02	-9.0759E+02	1.3363E+03	-6.4821E+02	6.2918E+00
49+	-2.4445E+00	-5.8048E+00	2.3647E+02	-9.4707E+02	1.3753E+03	-6.5963E+02	5.6617E+00
50+	-2.4758E+00	-2.2656E+00	1.9393E+02	-8.1597E+02	1.2181E+03	-5.9455E+02	5.4474E+00
51+	-3.9175E+00	-8.3674E+00	2.4293E+02	-9.7708E+02	1.4152E+03	-6.7713E+02	6.3005E+00
52+	-3.4121E+00	-4.7317E+00	2.2483E+02	-9.2793E+02	1.3647E+03	-6.5917E+02	5.5724E+00
53+	-3.8372E+00	-8.5348E+00	2.4983E+02	-9.9488E+02	1.4411E+03	-6.9043E+02	5.5249E+00
54+	-4.7838E+00	2.9002E+00	-2.3346E+01	6.1751E+01	2.6890E+01	-7.1579E+01	5.8303E+00
55+	-4.3043E+00	-1.0888E+01	1.8074E+02	-6.7730E+02	9.7760E+02	-4.7275E+02	4.9718E+00
56+	-2.5833E+00	-1.6642E+01	2.3173E+02	-8.5609E+02	1.2226E+03	-5.8240E+02	4.4863E+00
57+	-7.6129E-01	2.3844E+00	5.4394E+01	-2.9380E+02	5.0081E+02	-2.5873E+02	3.0774E+00
58+	-2.1139E+00	-1.1342E+01	1.6087E+02	-5.6113E+02	7.9031E+02	-3.7679E+02	3.4608E+00
59+	-1.9667E+00	-6.8687E+00	1.2086E+02	-4.4683E+02	6.5575E+02	-3.2042E+02	3.1208E+00
60+	-1.3154E+00	-1.5943E+00	4.2113E+01	-1.5113E+02	2.5622E+02	-1.4060E+02	2.6128E+00
61+	1.1519E+00	6.6406E+00	-9.2079E+01	4.8406E+02	-7.2382E+02	3.3931E+02	1.1295E-01
62+	9.2566E-01	7.1830E+00	-1.0996E+02	5.5651E+02	-8.2355E+02	3.8431E+02	-2.9681E-02
63+	6.2120E-01	8.6111E+00	-1.2993E+02	6.3805E+02	-9.3939E+02	4.3752E+02	-2.5288E-01
64+	2.1086E+00	2.3439E+01	-3.5639E+01	-9.4685E+01	2.7482E+02	-1.7519E+02	5.9164E+00
65+	2.1510E+00	1.8112E+01	7.5758E+01	-4.3826E+02	6.6336E+02	-3.1783E+02	3.8416E+00
66+	1.3293E+00	1.3366E+01	1.1672E+02	-5.6105E+02	8.1111E+02	-3.7980E+02	3.9054E+00
67+	2.8158E+00	1.3928E+01	5.7955E+01	-1.5277E+02	9.8964E+01	0.0000E+00	-4.9073E-01
68+	1.6151E+00	3.5818E+01	-8.7384E+01	1.0131E+02	-4.0405E+01	0.0000E+00	1.4961E+00
69+	1.3162E+00	3.4502E+01	-7.5903E+01	7.8175E+01	-2.6151E+01	0.0000E+00	1.0569E+00
70+	1.0365E+00	3.9043E+01	-1.0819E+02	1.3414E+02	-5.5951E+01	0.0000E+00	1.3056E+00
71+	5.6228E-01	2.9451E+01	-5.1760E+01	4.1267E+01	-8.0594E+00	0.0000E+00	7.1903E-01
72+	-5.5486E+00	3.3542E+01	-7.1577E+01	6.4786E+01	-2.7232E+01	0.0000E+00	5.8546E+00
73+	1.1869E+01	3.3066E+01	-2.0058E+01	-5.8812E+01	8.6261E+01	0.0000E+00	-1.0984E+01
74+	8.7462E+00	1.4560E+01	-1.6789E+00	-3.7158E+01	4.9676E+01	0.0000E+00	-6.2179E+00
75+	-1.0084E+01	1.0003E+01	5.3906E+01	-3.7159E+02	6.2042E+02	-3.3599E+02	1.1087E+01
76+	8.4933E+00	6.2922E+00	1.0040E+01	-3.9142E+01	4.4421E+01	0.0000E+00	-5.7016E+00
77+	2.1059E-01	1.2051E+01	-2.1966E+01	1.8061E+01	0.0000E+00	0.0000E+00	1.6584E-01
78+	1.2603E+01	6.0082E+00	-1.1985E+02	5.5168E+02	-8.1276E+02	4.0413E+02	-8.4337E+00
79+	6.8745E+00	-6.8012E+00	-3.3879E+01	2.7329E+02	-4.4455E+02	2.2615E+02	-3.3603E+00
80+	-6.3829E-01	4.9773E+00	-7.5877E+01	2.7666E+02	-3.5072E+02	1.4603E+02	1.7873E+00
81+	-5.9559E+00	-1.6565E+00	-2.3775E+01	6.8284E+01	-4.5071E+01	-1.1080E+01	6.5459E+00
82+	6.7421E+00	-2.0150E+01	1.9070E+02	-4.2131E+02	3.7296E+02	-1.0298E+02	-4.9653E+00
83+	-1.5303E+01	-2.6917E+01	2.2520E+02	-7.3057E+02	9.3106E+02	-4.3764E+02	1.7189E+01
84+	-1.8107E+01	-2.7038E+01	2.0998E+02	-7.0027E+02	9.1117E+02	-4.3958E+02	1.9705E+01
85+	-3.3546E+00	-1.6127E+01	1.6216E+02	-4.8751E+02	5.8504E+02	-2.5210E+02	4.5536E+00
86+	5.2729E+00	-2.0638E+01	9.0277E+01	-1.4547E+02	8.0763E+01	0.0000E+00	-7.8573E-01
87+	4.7610E+00	-2.2337E+01	9.5611E+01	-1.4962E+02	8.0763E+01	0.0000E+00	-9.0934E-01
88+	-1.8457E+00	7.9654E-01	-3.7340E+00	-4.5368E+00	1.3880E+01	-1.0128E+01	2.6546E+00
89+	-8.8456E-01	5.7828E-01	-4.0471E+00	6.0371E+00	-6.0307E+00	2.1538E+00	1.3056E+00
90+	5.0073E+01	2.6142E+01	-8.8114E+00	1.4230E+02	-2.4946E+02	1.9667E+02	-4.9019E+01
91+	2.2173E+01	1.1394E+01	-2.8809E+00	5.9068E+01	-1.0381E+02	8.3335E+01	-2.1628E+01

Conclusion

In the previous [1] and present papers, electron-impact ionization cross sections for H, He, N, O, Ar, Xe, Au, Pb, Ti, Kr, Sn, Ta and U atoms and all their ionization stages are presented in the electron-energy range from threshold up to 200 keV and fitted by seven parameters using the LSM method. These atoms and ions are of a particular interest for plasma and acceleration physics. Most of the data have been calculated in the Coulomb-Born approximation with exchange. The accuracy of the data is within a factor of 2 compared to experimental data.

To get more precise data on ionization cross sections, the information about autoionization atomic structure of atoms and ions are required. However, in many cases, especially, for heavy atoms and ions, this information is very limited. New developments of the free-electron lasers (FEL, DESY, Hamburg) operating in the wavelengths of $\lambda = 6 - 100$ nm with the resolution $\Delta\lambda/\lambda = 10^{-4} - 10^{-5}$, will open a new era for measurements of these and many other data on atomic structure and atomic collisions including highly charged ions.

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Сечение ионизации электронным ударом атомов и ионов Ti, Kr, Sn, Ta, U в диапазоне энергий от порога ионизации до 200 кэВ.
Часть 2

Данная работа, являющаяся продолжением [1], посвящена исследованию сечений ионизации электронным ударом атомов и ионов некоторых элементов, представляющих интерес в физике плазмы и физике ускорителей. Приведены сечения однократной ионизации атомов Ti, Kr, Sn, Ta, U и всех их положительных ионов. Данные рассчитаны для энергий электронов от порога ионизации до 200 кэВ по компьютерной программе АТОМ в кулон-боровском приближении с обменами и фитированы методом наименьших квадратов. Приводятся также значения параметров фитирования. Точность представленных данных по сечениям — фактор 2.

Работа выполнена в Лаборатории физики частиц ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна, 2002

Philippov A. V. et al.

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Electron-Impact Ionization Cross Sections of Ti, Kr, Sn, Ta, U
Atoms and Their Ions in the Electron Energy Range
from the Threshold up to 200 keV.
Part 2

This work is a continuation of the paper [1] devoted to investigation of electron-impact ionization cross sections of atoms and ions which are of interest in plasma and acceleration physics. Single-electron ionization cross sections are presented for Ti, Kr, Sn, Ta, U atoms and all their positive ions. The data have been calculated for the electron energy range from the ionization threshold up to 200 keV using the computer code ATOM in the Coulomb–Born approximation with exchange (CBE) and are fitted by the LSM method. The tables of the fit parameters are given as well. The accuracy of the data presented is within a factor of 2.

The investigation has been performed at the Laboratory of Particle Physics, JINR.

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