LBL-26259
UC-411

Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

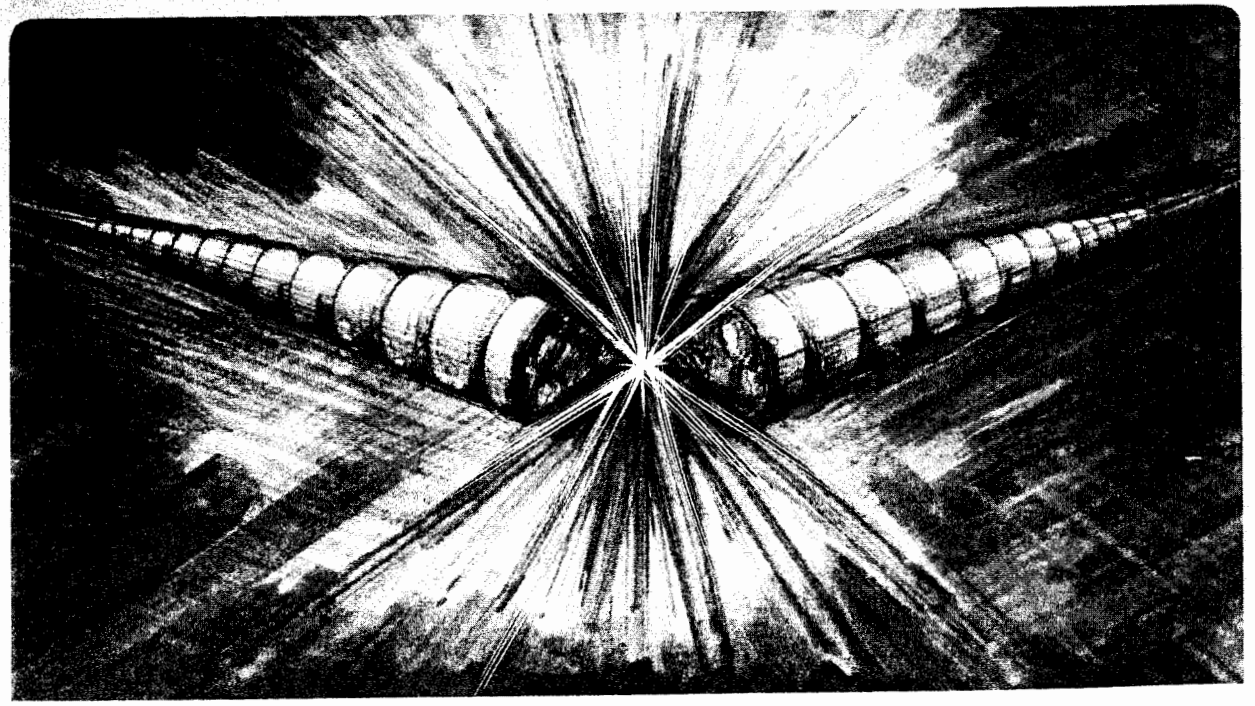
Accelerator & Fusion
Research Division

Center for X-Ray Optics

A Preliminary Report on X-Ray Photoabsorption Coefficients and Atomic Scattering Factors for 92 Elements in the 10–10,000 eV Region

B.L. Henke, J.C. Davis, E.M. Gullikson,
and R.C.C. Perera

November 1988



Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098.

A Preliminary Report on X-ray Photoabsorption Coefficients and Atomic Scattering Factors for 92 Elements in the 10-10,000 eV Region

B. L. Henke, J. C. Davis, E. M. Gullikson, and R. C. C. Perera
Center for X-Ray Optics
Accelerator and Fusion Research Division
Lawrence Berkeley Laboratory
1 Cyclotron Rd.
Berkeley, California 94720

Abstract

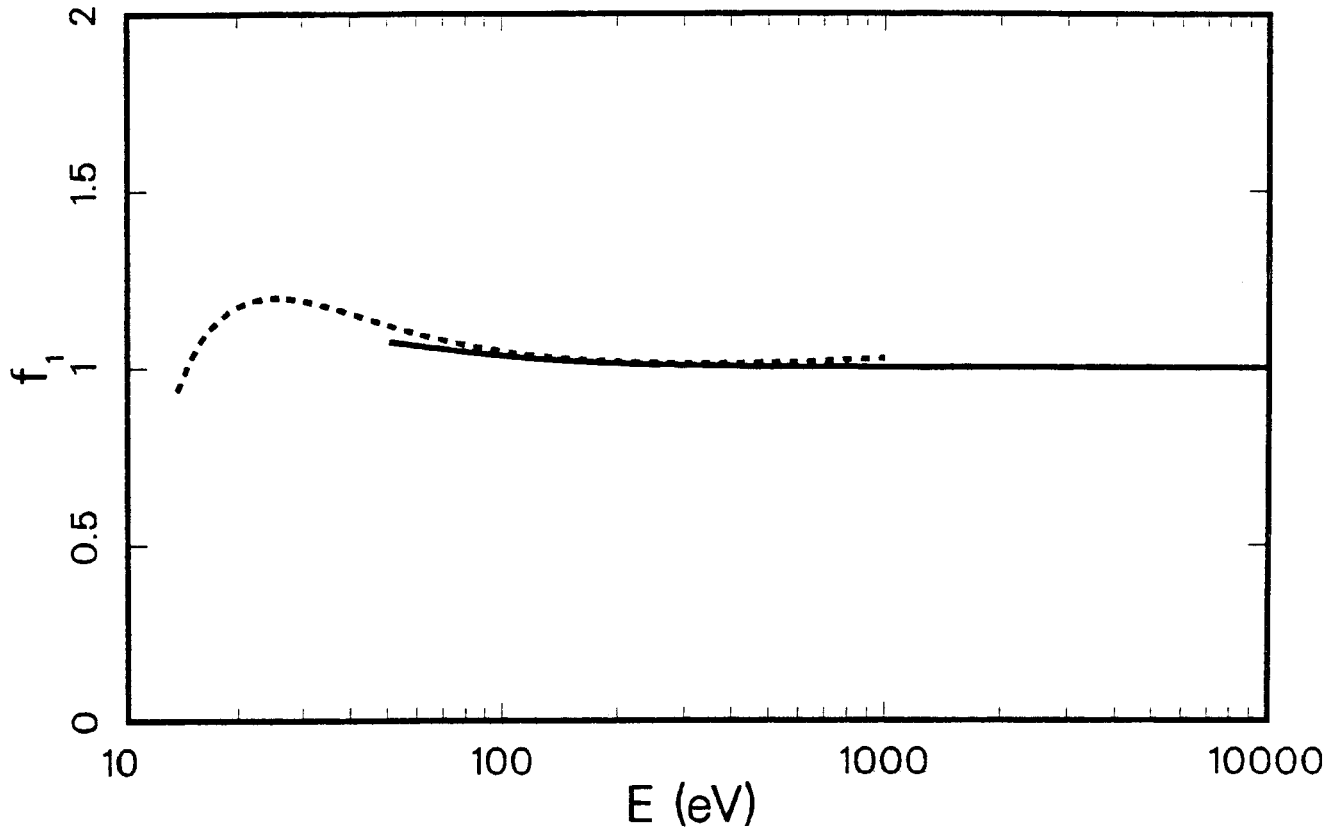
Based on currently available photoabsorption measurements and recent theoretical calculations by Doolen and Liberman (Physica Scripta **36**, 77 (1987)), a revised (from ADNDT **27**, 1 (1982)) best-fit determination of the photoabsorption cross sections is presented here for the elements Z=1 to Z=92 in the 10–10,000 eV range. The photoabsorption data used include those described in the Lockheed and DOE listings of research abstracts for the past ten years and those which have been recently added to the comprehensive NBS Measured Data Base (NBSIR 86-3461, Hubbell *et al.*). The best-fit curves are compared with both the compilation of measurements and the calculations by Doolen and Liberman. Using the photoabsorption curves, the atomic scattering factors have been calculated for the energy range 50–10,000 eV and are also presented in this report.

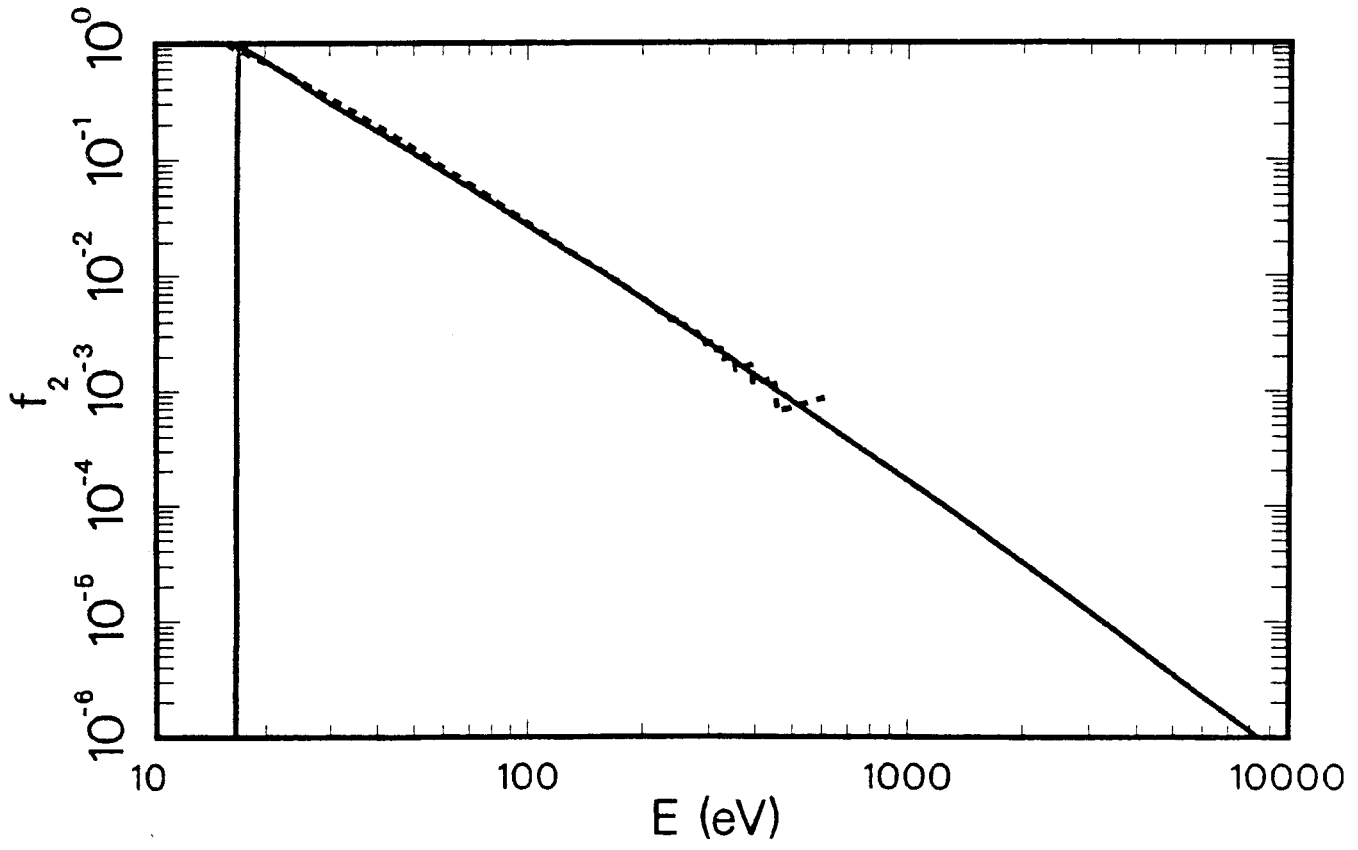
Explanation of Tables

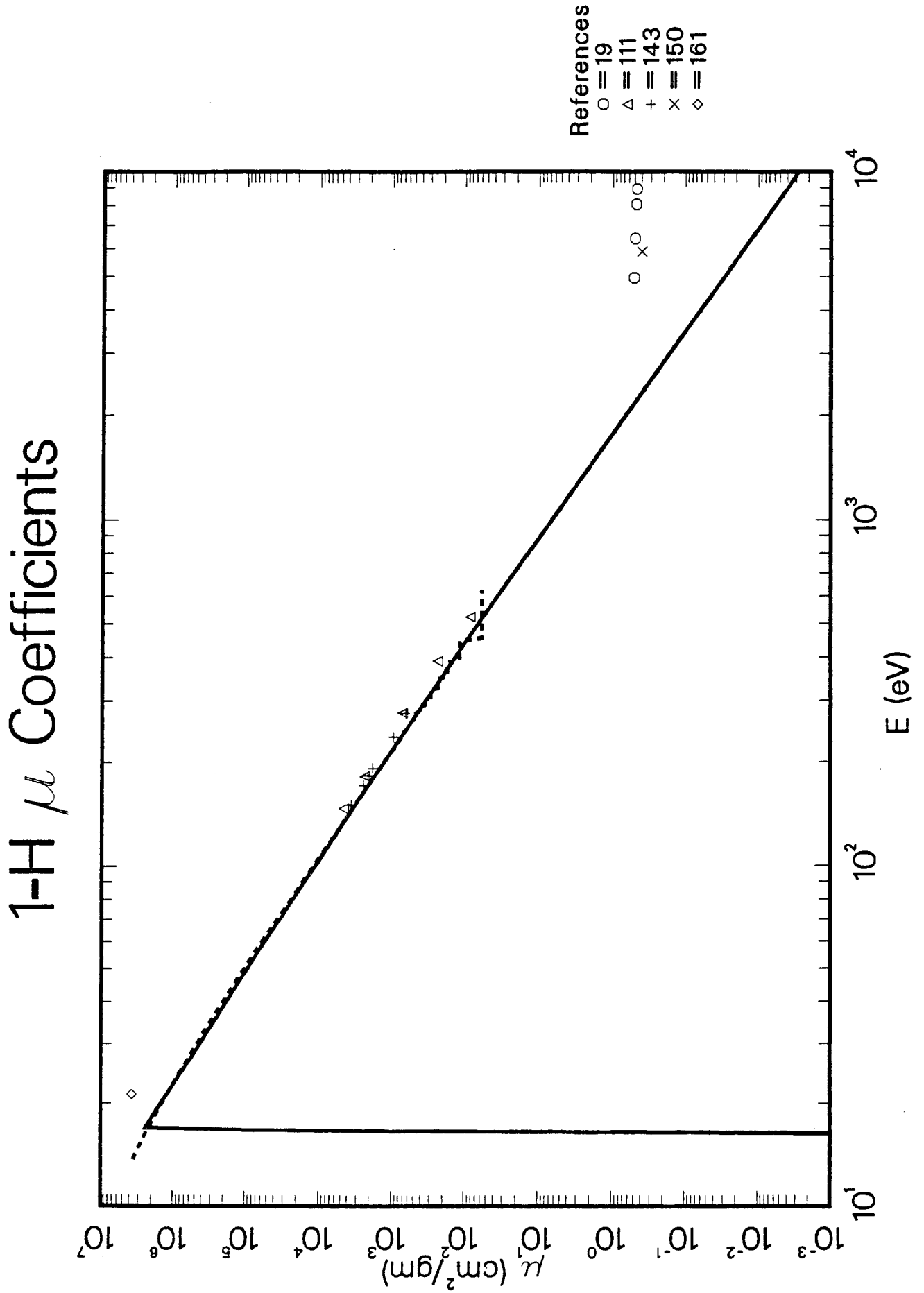
In the following tables are presented the atomic scattering factors, f_1 and f_2 , and the mass absorption coefficient, μ, as a function of photon energy for 92 elements. The dashed curves, extending from 10 eV to 1000 eV, are the results of theoretical calculations by Doolen and Liberman and the solid curves represent our empirically determined best fits. Starting with the mass absorption coefficient the best fit curves were determined by relying on both the theoretical calculations and, when available, the experimental data. Following the plots, the experimental data are tabulated with their references and the percent error from our best fit curve, defined by: Percent Error $= 100 \times (\mu_{exp} - \mu_{fit})/\mu_{fit}$. The imaginary part of the atomic scattering factor, f_2, was determined from the best fit curves for μ using the relationship $f_2 =$ constant times $E\mu(E)$.[1] The real part of the atomic scattering factor, f_1, was determined from f_2 using the Kramers-Kronig relations[1].

[1]B. L. Henke, P. Lee, T. J. Tanaka, R. L. Shimabukuro, and B. K. Fujikawa, Atomic Data and Nuclear Data Tables Vol. 27, 1 (1982).

Atomic Scattering Factors, f_1+if_2
1 - Hydrogen (H)






1-H μ Coefficients
References
○ = 19
△ = 111
+ = 143
× = 150
◇ = 161
μ (cm²/gm)
E (eV)
10⁻³
10⁻²
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10⁷
10¹
10²
10³
10⁴

Hydrogen (H) — 1

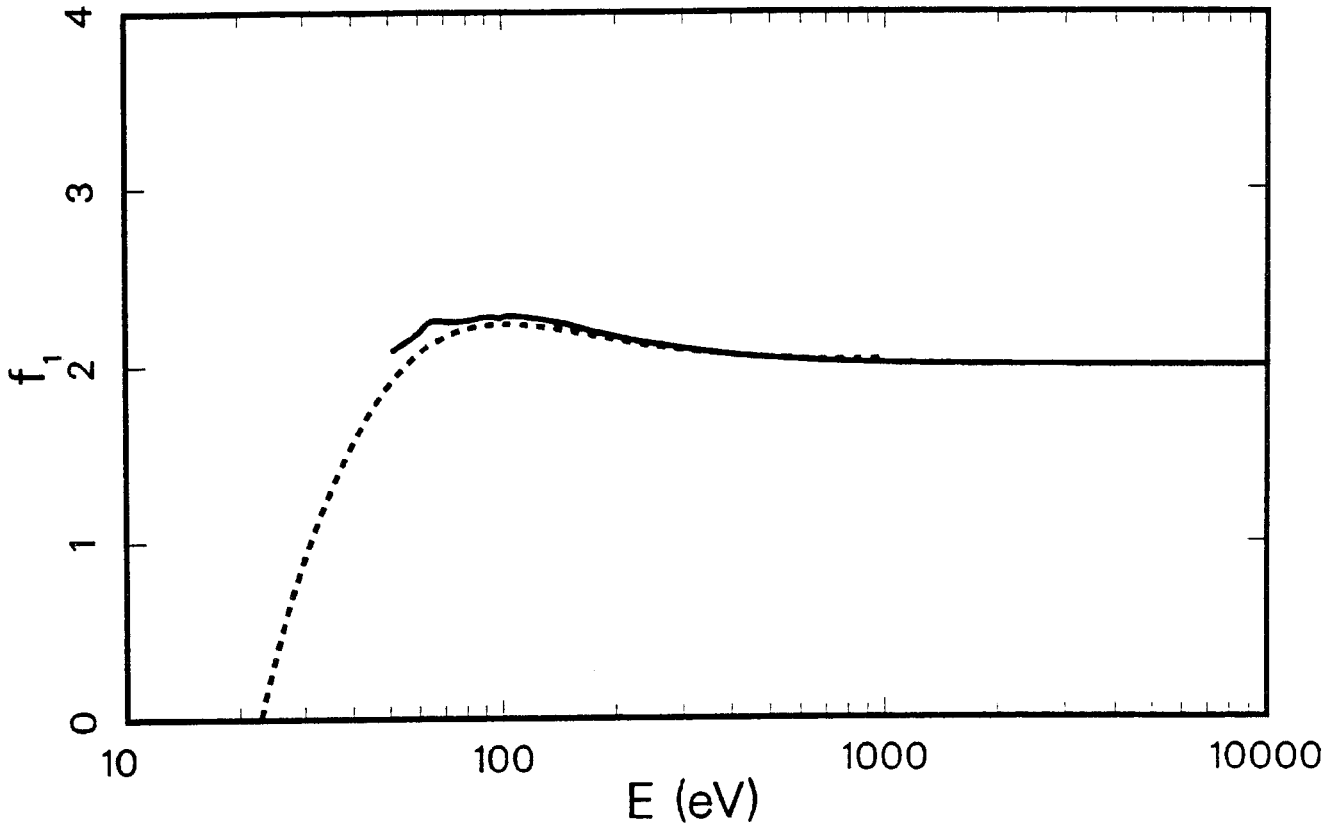
Atomic Weight = 1.01

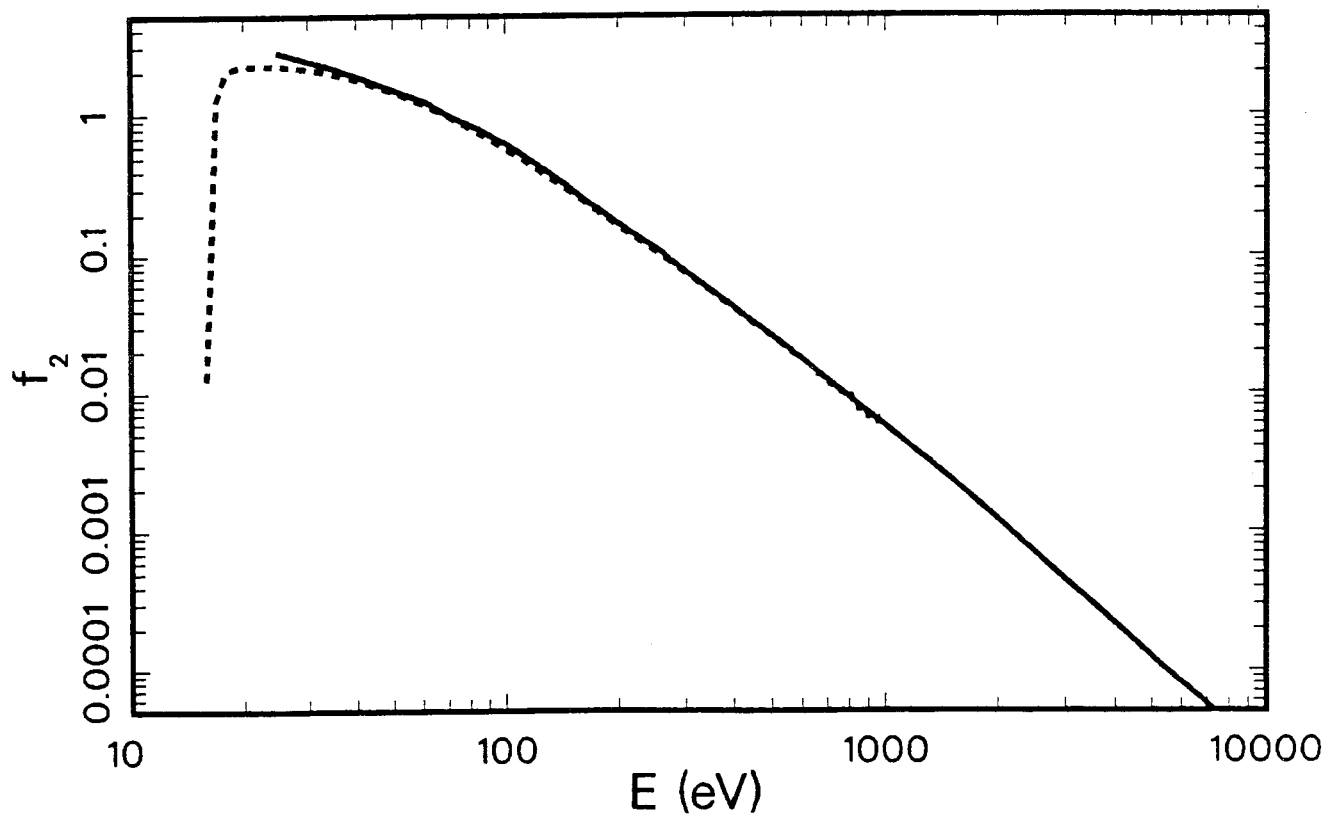
μ (barns/atom) = $\mu(\mathrm{cm}^2/\mathrm{g}) \times 1.67$

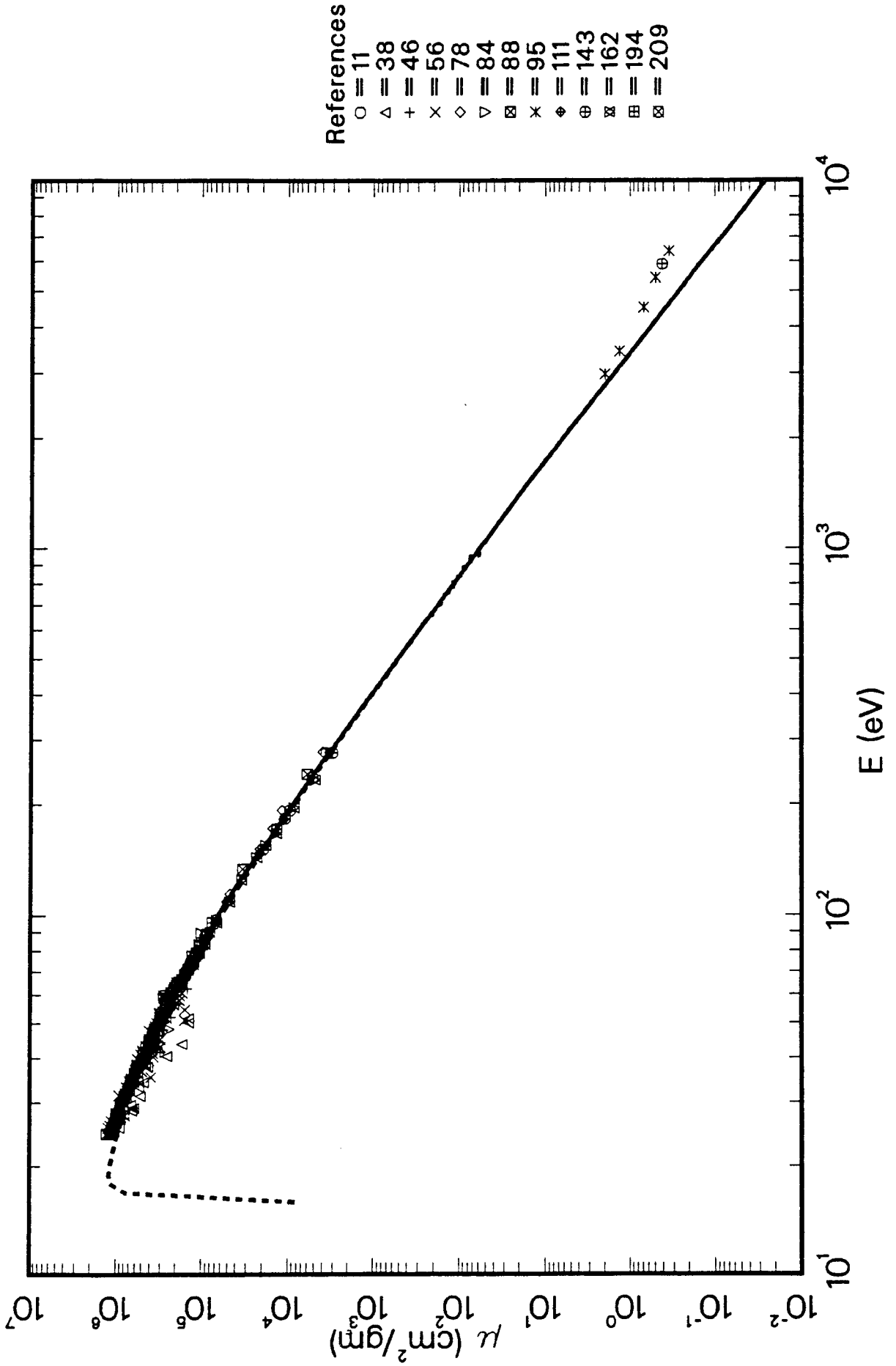
$\mathrm{E}\mu(\mathrm{E}) = 41745.5\,\mathrm{f}_2$ keV cm^2/g

E(eV)	$\mu(\mathrm{cm}^2/\mathrm{g})$	% Error	Ref.
4960.0	5.20e-1	1639.6	19
6420.0	5.00e-1	3924.4	19
8060.0	4.80e-1	8267.4	19
8930.0	4.70e-1	11529.0	19
147.2	4.61e+3	33.3	111
182.6	2.38e+3	35.9	111
278.0	7.29e+2	59.8	111
391.4	2.41e+2	60.5	111
525.0	8.48e+1	48.1	111
151.0	3.64e+3	14.2	143
171.7	2.45e+3	15.1	143
183.4	2.15e+3	24.8	143
192.6	1.85e+3	25.6	143
236.9	9.56e+2	25.7	143
277.0	6.57e+2	42.4	143
5895.0	4.00e-1	2307.1	150
21.2	3.70e+6	201.7	161

Atomic Scattering Factors, f_1+if_2
2 - Helium (He)






2-He μ Coefficients
References
○ = 11
△ = 38
+ = 46
× = 56
◇ = 78
▷ = 84
⊠ = 88
✳ = 95
⊕ = 111
⊠ = 143
⊞ = 162
⊠ = 194
= 209
μ (cm²/gm)
E (eV)
10⁻²
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10⁷
10¹
10²
10³
10⁴

Helium (He) — 2

Atomic Weight = 4.00

μ (barns/atom) = μ(cm^2/g) × 6.65

Eμ(E) = 10512.7 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
277.0	3.60e+3	7.9	11
25.0	1.04e+6	-9.7	38
25.5	9.07e+5	-18.5	38
27.4	8.96e+5	-8.6	38
27.8	7.95e+5	-16.8	38
28.5	6.44e+5	-29.6	38
29.0	6.16e+5	-30.5	38
29.6	6.72e+5	-21.4	38
31.3	5.15e+5	-33.6	38
33.2	5.32e+5	-24.0	38
34.2	4.70e+5	-29.0	38
34.6	5.49e+5	-15.3	38
37.8	4.20e+5	-23.2	38
38.3	4.48e+5	-15.9	38
40.5	2.52e+5	-47.3	38
43.7	1.68e+5	-59.1	38
50.2	1.40e+5	-54.8	38
51.7	1.40e+5	-52.1	38
41.5	2.99e+5	-34.5	46
44.5	3.11e+5	-21.6	46
48.0	2.74e+5	-19.3	46
52.0	2.24e+5	-22.5	46
56.8	1.83e+5	-24.7	46
62.4	1.47e+5	-26.1	46
69.7	1.43e+5	-3.6	46
24.7	1.16e+6	-1.8	56
25.5	1.20e+6	8.1	56
25.9	1.15e+6	6.4	56
26.1	1.03e+6	-3.7	56
26.7	1.12e+6	9.2	56
27.0	8.64e+5	-14.2	56
27.1	8.64e+5	-13.6	56
27.4	8.73e+5	-11.0	56
27.6	7.79e+5	-19.5	56
27.7	9.88e+5	2.8	56
27.8	9.22e+5	-3.5	56
28.4	8.79e+5	-4.5	56
31.4	9.15e+5	18.6	56
32.3	7.31e+5	-0.4	56
33.1	7.48e+5	6.3	56
34.2	6.77e+5	2.2	56
34.5	6.92e+5	6.2	56
35.3	3.85e+5	-38.2	56
36.7	4.93e+5	-14.7	56
37.0	5.90e+5	3.6	56
37.8	4.39e+5	-19.6	56
38.4	5.60e+5	5.6	56
38.6	4.50e+5	-14.3	56
39.4	4.06e+5	-19.5	56
39.7	5.54e+5	11.4	56

E(eV)	μ(cm^2/g)	% Error	Ref.
39.8	4.47e+5	-9.7	56
40.2	3.63e+5	-25.3	56
40.4	4.87e+5	1.4	56
40.6	4.90e+5	3.0	56
40.7	4.47e+5	-5.7	56
40.8	5.06e+5	7.2	56
41.2	3.66e+5	-21.0	56
41.4	4.18e+5	-8.8	56
41.6	4.80e+5	5.7	56
41.9	4.80e+5	7.2	56
42.2	3.70e+5	-16.1	56
42.6	3.16e+5	-27.0	56
42.8	2.98e+5	-30.5	56
42.9	2.98e+5	-30.2	56
43.4	3.19e+5	-23.4	56
44.3	3.91e+5	-2.1	56
45.0	2.98e+5	-23.0	56
45.5	3.42e+5	-9.7	56
46.5	3.63e+5	0.1	56
47.0	3.19e+5	-10.0	56
47.6	4.03e+5	16.8	56
49.1	2.89e+5	-10.9	56
50.1	3.33e+5	6.9	56
50.9	1.55e+5	-48.6	56
51.6	2.51e+5	-14.3	56
52.0	3.08e+5	6.8	56
53.1	3.08e+5	11.3	56
53.6	3.08e+5	13.4	56
54.5	1.55e+5	-41.1	56
55.1	2.48e+5	-3.6	56
56.3	2.09e+5	-15.2	56
57.6	2.57e+5	9.1	56
57.9	1.79e+5	-23.3	56
59.2	2.62e+5	17.2	56
59.8	1.79e+5	-18.2	56
60.8	1.69e+5	-20.4	56
61.3	2.06e+5	-1.1	56
114.1	4.66e+4	3.0	78
151.2	2.13e+4	5.6	78
171.7	1.51e+4	8.9	78
192.7	1.17e+4	17.4	78
279.2	3.97e+3	21.8	78
24.8	1.10e+6	-5.8	84
24.9	1.06e+6	-8.5	84
25.3	1.08e+6	-4.4	84
25.4	1.07e+6	-4.2	84
25.7	1.06e+6	-3.9	84
26.1	1.03e+6	-4.1	84
26.3	1.02e+6	-3.2	84
26.6	9.97e+5	-3.5	84

Helium (He) — 2

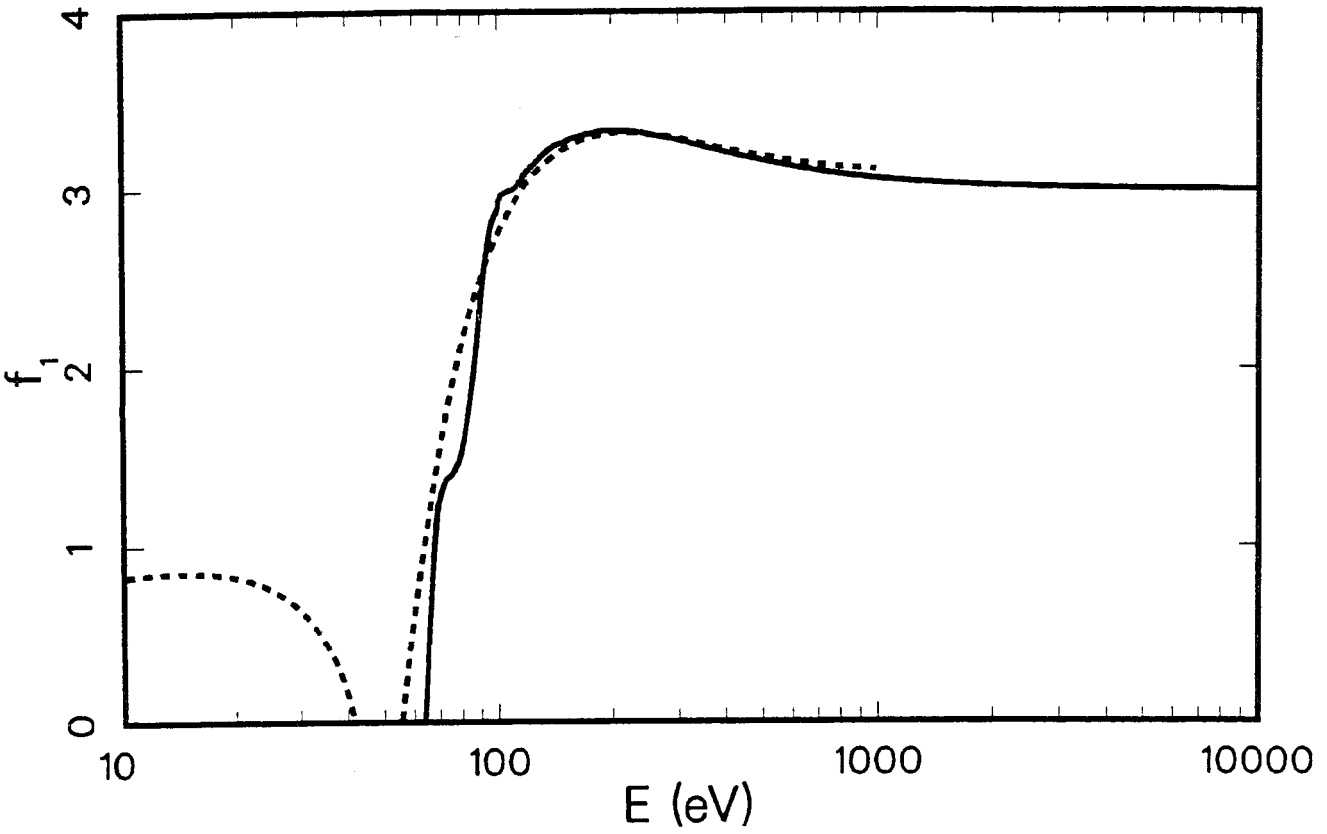
E(eV)	μ(cm^2/g)	% Error	Ref.
27.2	9.63e+5	-3.0	84
28.1	9.17e+5	-2.2	84
28.8	8.81e+5	-1.9	84
29.4	8.68e+5	0.3	84
29.6	8.65e+5	1.2	84
30.1	8.24e+5	-0.8	84
30.7	7.90e+5	-1.5	84
30.9	7.75e+5	-2.3	84
31.5	7.41e+5	-3.5	84
31.8	7.38e+5	-2.2	84
32.2	7.20e+5	-2.5	84
33.0	6.86e+5	-3.1	84
33.5	6.66e+5	-3.4	84
34.3	6.39e+5	-3.1	84
34.6	6.23e+5	-3.9	84
35.4	5.90e+5	-4.8	84
35.6	5.78e+5	-5.8	84
37.4	5.20e+5	-6.8	84
38.4	5.00e+5	-5.6	84
39.0	4.67e+5	-9.2	84
39.7	4.62e+5	-7.1	84
40.9	4.34e+5	-7.6	84
42.3	3.77e+5	-14.0	84
42.8	3.20e+5	-25.3	84
44.6	3.49e+5	-11.4	84
48.2	2.37e+5	-29.7	84
53.0	2.65e+5	-4.9	84
54.4	2.36e+5	-10.7	84
56.0	2.22e+5	-11.1	84
57.0	2.06e+5	-14.5	84
58.1	2.06e+5	-11.3	84
59.3	2.15e+5	-3.3	84
63.0	1.79e+5	-7.3	84
64.2	1.82e+5	-1.3	84
66.0	1.61e+5	-5.8	84
69.0	1.55e+5	2.4	84
73.7	1.32e+5	0.2	84
77.6	1.28e+5	9.3	84
83.4	1.07e+5	7.2	84
89.5	1.00e+5	18.6	84
24.6	1.26e+6	6.1	88
28.0	9.87e+5	4.6	88
31.4	7.90e+5	2.4	88
34.8	6.47e+5	0.9	88
38.1	5.36e+5	-0.5	88
45.1	3.76e+5	-2.4	88
51.9	2.77e+5	-4.5	88
65.6	1.69e+5	-2.9	88
79.0	1.16e+5	2.6	88
133.3	3.31e+4	12.9	88
242.1	6.02e+3	17.6	88
2984.0	2.00e+0	26.9	95
3444.0	1.33e+0	39.5	95
4510.0	6.85e-1	82.8	95
5414.0	4.93e-1	146.0	95

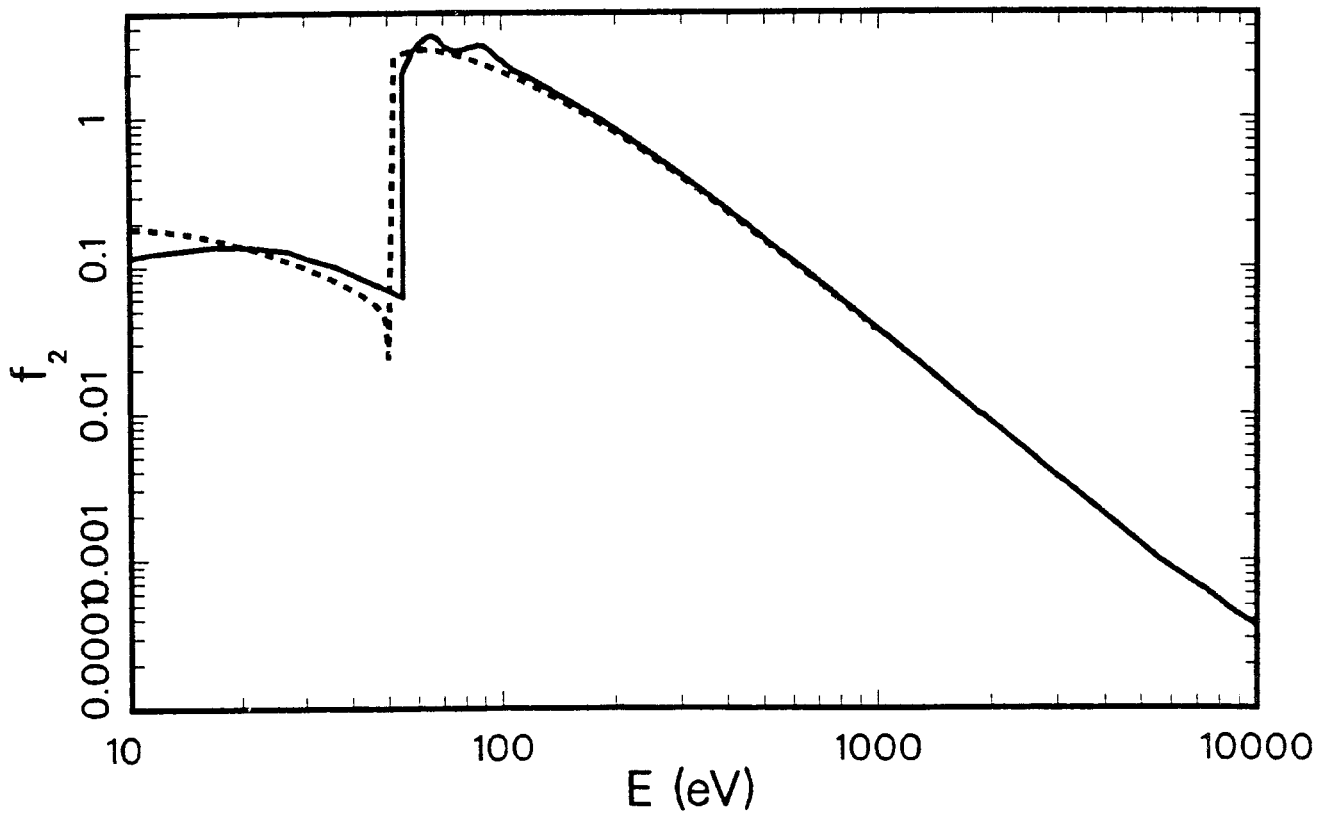
E(eV)	μ(cm^2/g)	% Error	Ref.
6400.0	3.45e-1	203.0	95
108.9	5.10e+4	-0.8	111
147.2	2.15e+4	-1.8	111
182.6	1.13e+4	-3.1	111
278.0	3.32e+3	0.6	111
151.0	1.96e+4	-3.4	143
171.7	1.34e+4	-3.0	143
183.4	1.09e+4	-5.5	143
192.6	9.58e+3	-4.0	143
236.9	5.25e+3	-3.7	143
277.0	3.07e+3	-8.0	143
5895.0	4.16e-1	176.9	143
66.8	1.67e+5	1.0	162
70.7	1.42e+5	-1.1	162
74.9	1.25e+5	-1.1	162
79.3	1.05e+5	-6.0	162
84.3	9.24e+4	-5.7	162
95.5	6.66e+4	-6.8	162
108.6	4.72e+4	-8.8	162
124.5	3.42e+4	-4.2	162
143.6	2.31e+4	-2.3	162
154.9	1.83e+4	-2.5	162
167.0	1.37e+4	-8.7	162
196.3	8.62e+3	-8.7	162
233.5	4.87e+3	-14.3	162
24.6	1.14e+6	-4.2	194
24.8	1.12e+6	-4.1	194
25.8	1.04e+6	-4.3	194
27.0	9.67e+5	-3.9	194
28.2	8.92e+5	-4.2	194
29.5	8.20e+5	-4.7	194
31.0	7.49e+5	-5.0	194
32.6	6.82e+5	-5.7	194
34.4	6.15e+5	-6.1	194
36.5	5.54e+5	-5.3	194
38.7	4.92e+5	-5.8	194
41.3	4.35e+5	-5.6	194
42.8	4.06e+5	-5.2	194
44.3	3.79e+5	-5.1	194
45.9	3.54e+5	-4.9	194
47.7	3.28e+5	-4.6	194
49.6	3.04e+5	-4.3	194
51.7	2.80e+5	-4.2	194
53.9	2.56e+5	-4.9	194
56.4	2.33e+5	-5.1	194
59.0	2.12e+5	-5.6	194
62.0	1.93e+5	-4.7	194
65.3	1.72e+5	-2.3	194
68.9	1.53e+5	0.8	194
72.9	1.36e+5	1.0	194
77.5	1.19e+5	1.2	194
82.7	1.03e+5	1.2	194
88.6	8.85e+4	2.1	194
95.4	7.48e+4	4.3	194
25.0	1.12e+6	-2.7	209

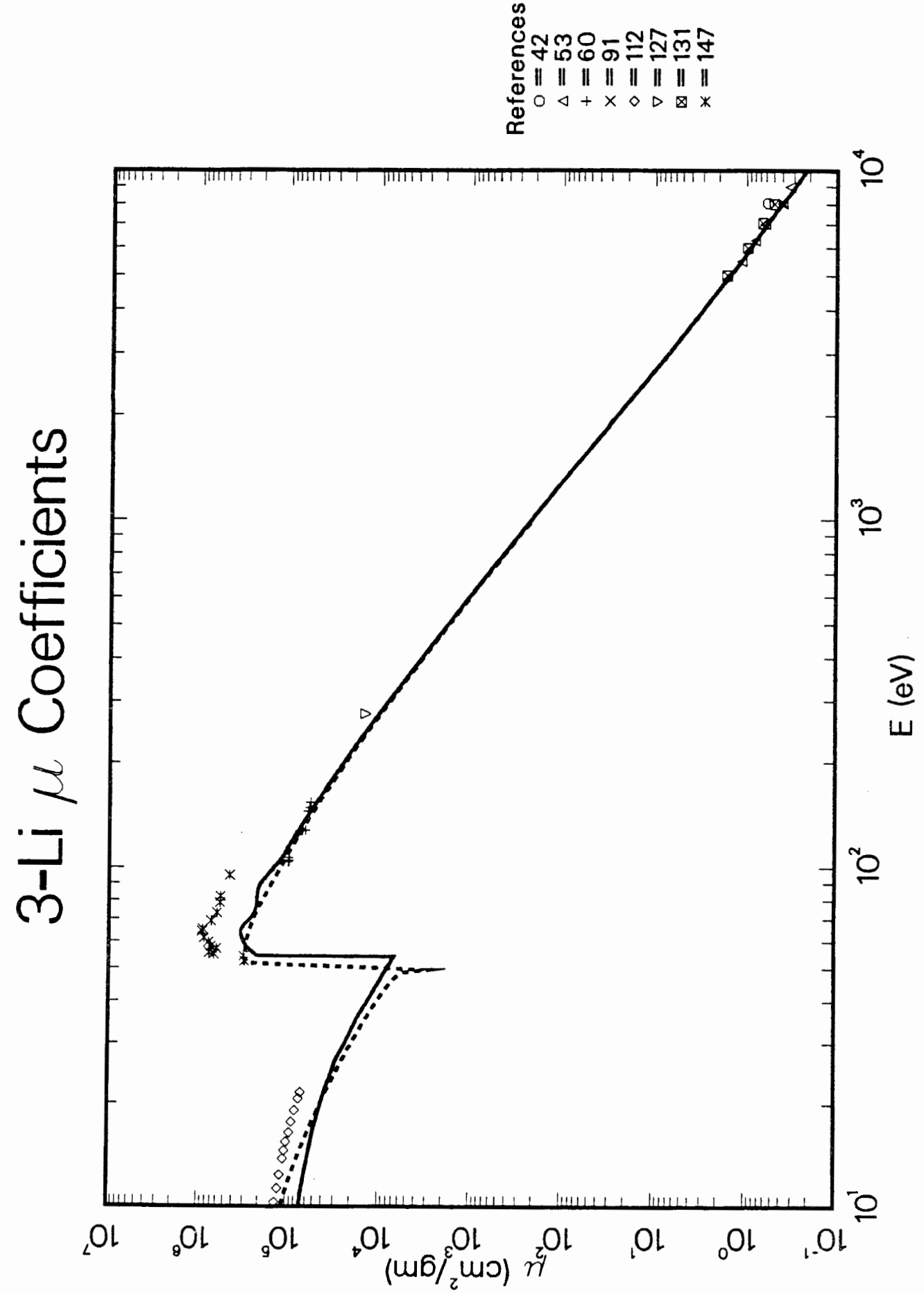
Helium (He) — 2

E(eV)	μ(cm^2/g)	% Error	Ref.
25.4	1.09e+6	-3.0	209
26.1	1.03e+6	-3.3	209
27.0	9.94e+5	-1.2	209
27.9	9.38e+5	-1.2	209
29.0	8.91e+5	0.5	209
30.1	8.33e+5	0.3	209
31.2	7.94e+5	1.8	209
31.9	7.64e+5	1.7	209
33.0	7.09e+5	0.3	209
34.1	6.76e+5	1.4	209
34.9	6.55e+5	2.8	209
35.0	6.54e+5	3.2	209
36.1	6.06e+5	1.6	209
36.3	6.02e+5	1.9	209
36.9	5.80e+5	1.4	209
38.0	5.68e+5	5.0	209
39.1	5.08e+5	-0.7	209
40.1	4.88e+5	0.0	209
41.1	4.71e+5	1.3	209
41.6	4.72e+5	3.9	209
43.2	4.40e+5	4.6	209
44.0	4.11e+5	1.3	209
45.1	4.02e+5	4.5	209
46.0	3.74e+5	1.1	209
47.1	3.64e+5	3.1	209
48.3	3.52e+5	5.1	209
49.0	3.43e+5	5.3	209
51.1	3.08e+5	3.1	209
52.1	2.92e+5	1.5	209
53.2	3.01e+5	9.0	209
54.1	2.84e+5	6.2	209
55.1	2.67e+5	3.7	209
56.2	2.61e+5	5.6	209
57.0	2.49e+5	3.4	209
58.0	2.38e+5	2.5	209
59.1	2.73e+5	22.0	209
60.0	2.76e+5	27.0	209
61.1	2.26e+5	8.0	209
62.2	2.11e+5	5.3	209
63.2	2.06e+5	7.3	209
64.1	1.95e+5	5.7	209
65.2	1.94e+5	9.8	209
65.6	1.80e+5	3.8	209
66.3	1.69e+5	0.1	209
68.2	1.58e+5	0.9	209
69.7	1.50e+5	1.2	209
71.3	1.44e+5	1.7	209
71.8	1.39e+5	-0.1	209
73.3	1.34e+5	0.8	209
73.5	1.23e+5	-6.7	209
75.5	1.24e+5	-0.3	209
77.9	1.15e+5	-1.0	209
78.9	1.06e+5	-6.8	209
80.5	1.07e+5	-1.7	209
83.2	9.83e+4	-2.5	209
83.7	9.04e+4	-9.1	209
85.8	9.14e+4	-2.8	209
89.3	8.47e+4	-0.2	209
90.0	8.06e+4	-3.1	209
97.1	6.73e+4	-2.4	209

Atomic Scattering Factors, f_1+if_2
3 - Lithium (Li)



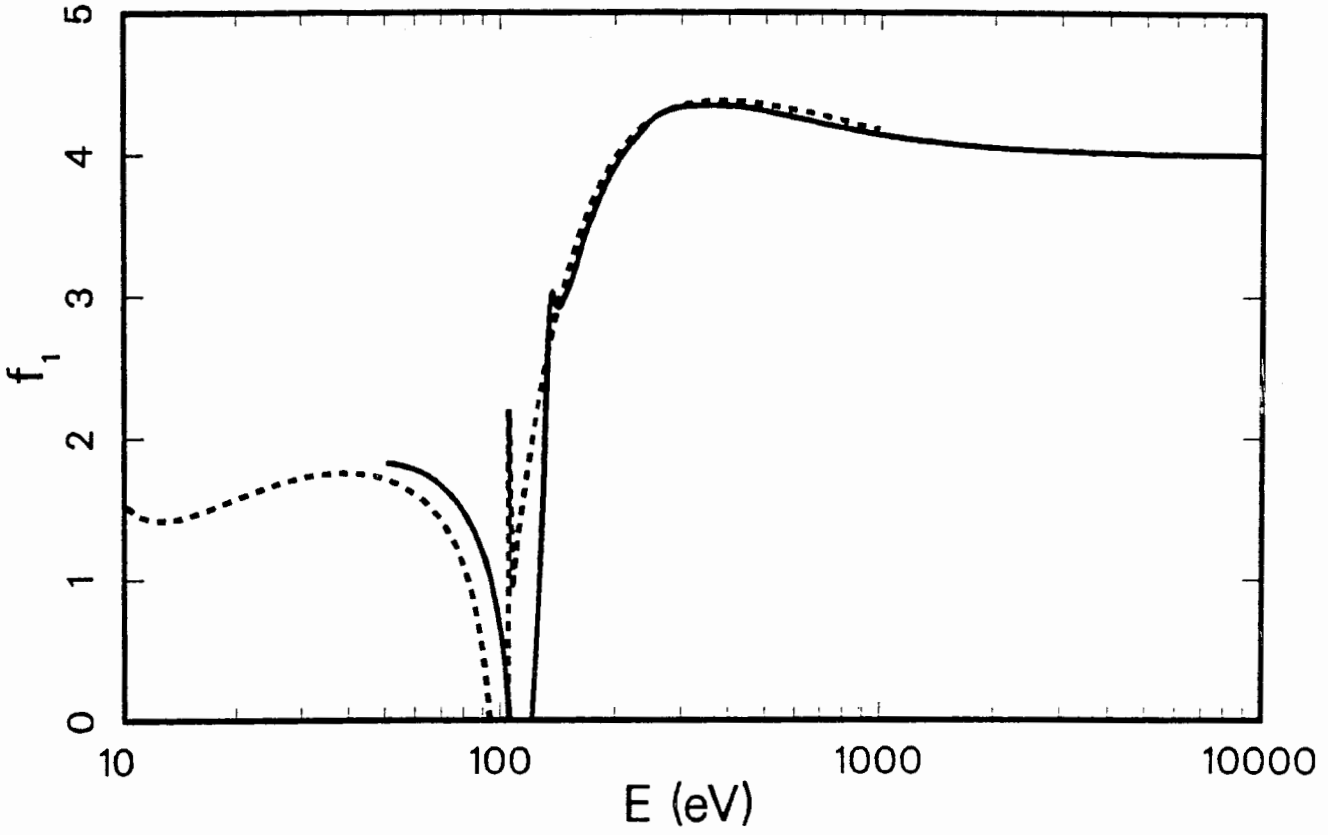


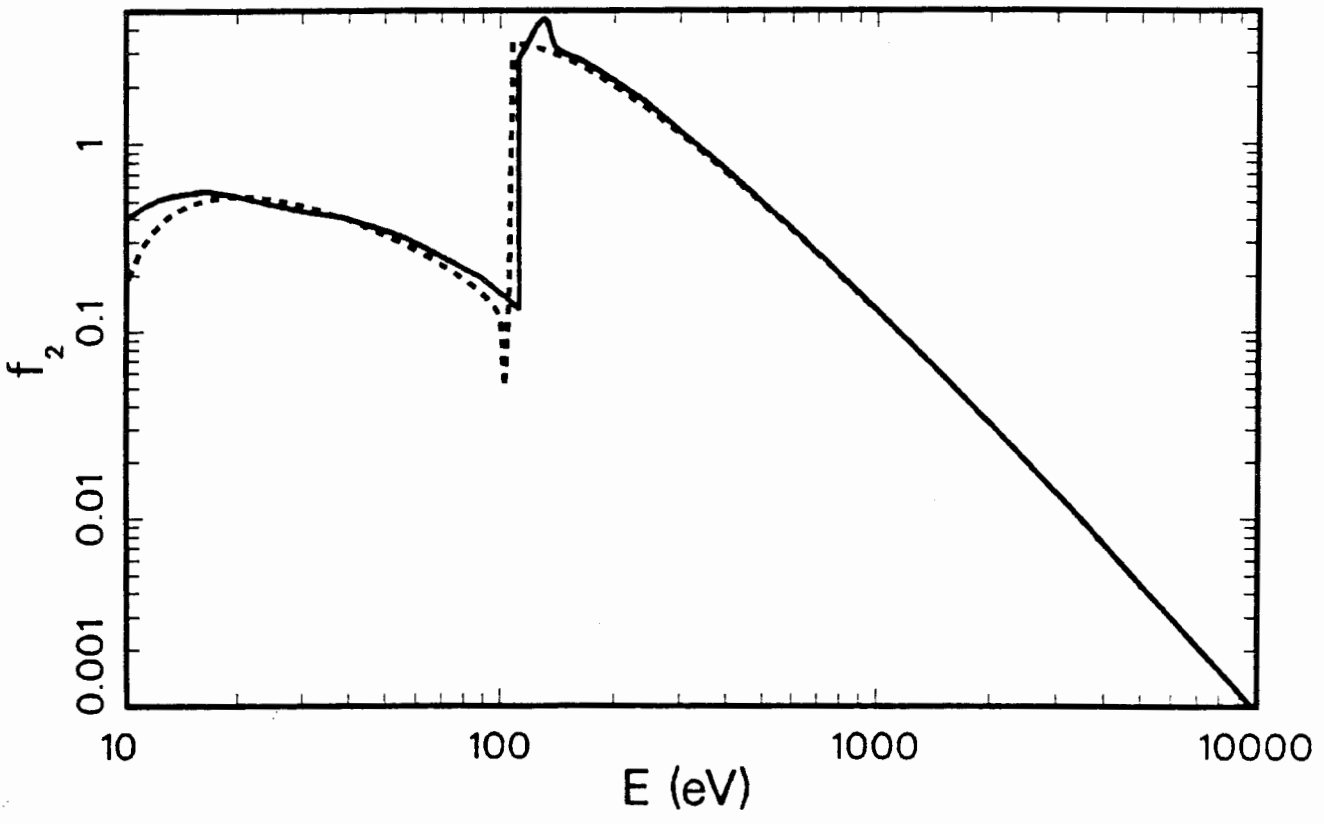

3-Li μ Coefficients
References
○ = 42
△ = 53
+ = 60
× = 91
◇ = 112
▽ = 127
⊠ = 131
✳ = 147
μ (cm²/gm)
E (eV)
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10⁷
10¹
10²
10³
10⁴

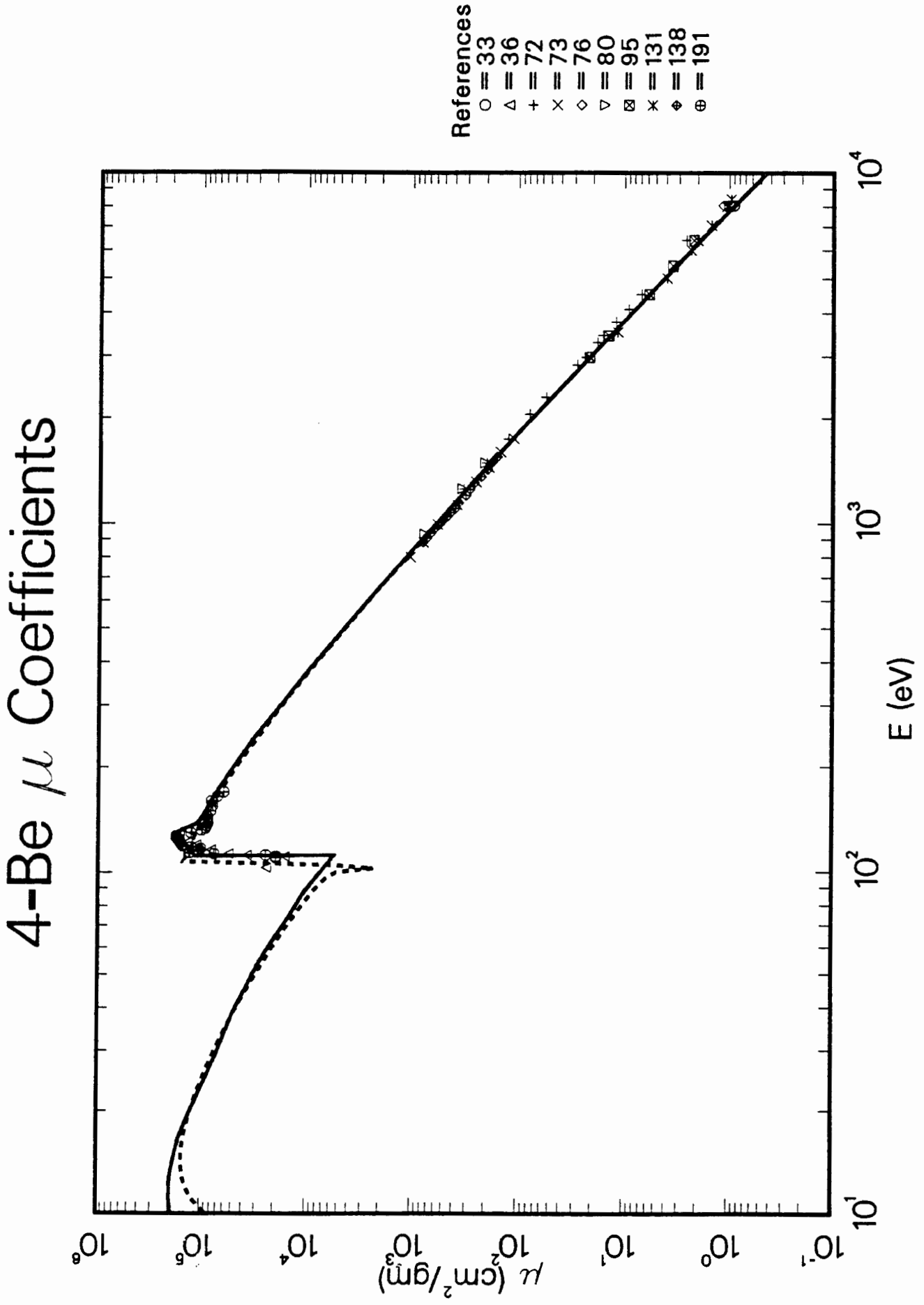
Lithium (Li) — 3
Atomic Weight = 6.94
μ (barns/atom) = μ(cm^2/g) × 11.53
Eμ(E) = 6062.3 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
8050.0	5.81e-1	46.7	42
5500.0	1.14e+0	-0.6	53
6300.0	8.07e-1	2.4	53
7000.0	6.25e-1	5.6	53
8048.0	3.99e-1	0.6	53
8977.0	3.30e-1	14.4	53
104.2	9.98e+4	-20.8	60
105.2	9.72e+4	-20.8	60
107.0	9.80e+4	-16.1	60
124.5	7.72e+4	-6.4	60
127.4	7.46e+4	-4.4	60
128.4	6.42e+4	-16.2	60
145.3	5.99e+4	6.6	60
148.8	5.81e+4	9.7	60
153.9	5.64e+4	15.3	60
8047.0	3.95e-1	-0.5	91
10.3	1.31e+5	88.2	112
11.3	1.22e+5	83.6	112
12.4	1.15e+5	85.0	112
13.8	1.08e+5	86.1	112
14.6	1.04e+5	87.6	112
15.5	9.89e+4	86.1	112
16.5	9.20e+4	81.0	112
17.7	8.68e+4	82.7	112
19.1	7.98e+4	82.4	112
20.7	7.29e+4	81.8	112
21.6	6.94e+4	81.4	112
277.0	1.43e+4	39.0	127
5000.0	1.65e+0	7.7	131
6000.0	9.76e-1	8.5	131
7058.0	6.59e-1	13.8	131
8000.0	4.94e-1	22.3	131
9962.0	3.45e-1	58.1	131
52.6	2.99e+5	3937.8	147
54.4	3.05e+5	4193.9	147
55.1	6.67e+5	3796.2	147
55.6	7.56e+5	2277.1	147
57.3	6.25e+5	148.4	147
58.2	7.22e+5	151.6	147
59.9	7.67e+5	150.4	147
61.6	8.61e+5	168.9	147
64.5	9.06e+5	174.8	147
65.5	8.92e+5	175.1	147
69.2	7.17e+5	161.6	147
73.2	6.20e+5	164.8	147
78.7	5.72e+5	162.0	147
82.5	5.65e+5	160.9	147
95.2	4.45e+5	163.6	147

Atomic Scattering Factors, f_1+if_2
4 - Berylium (Be)





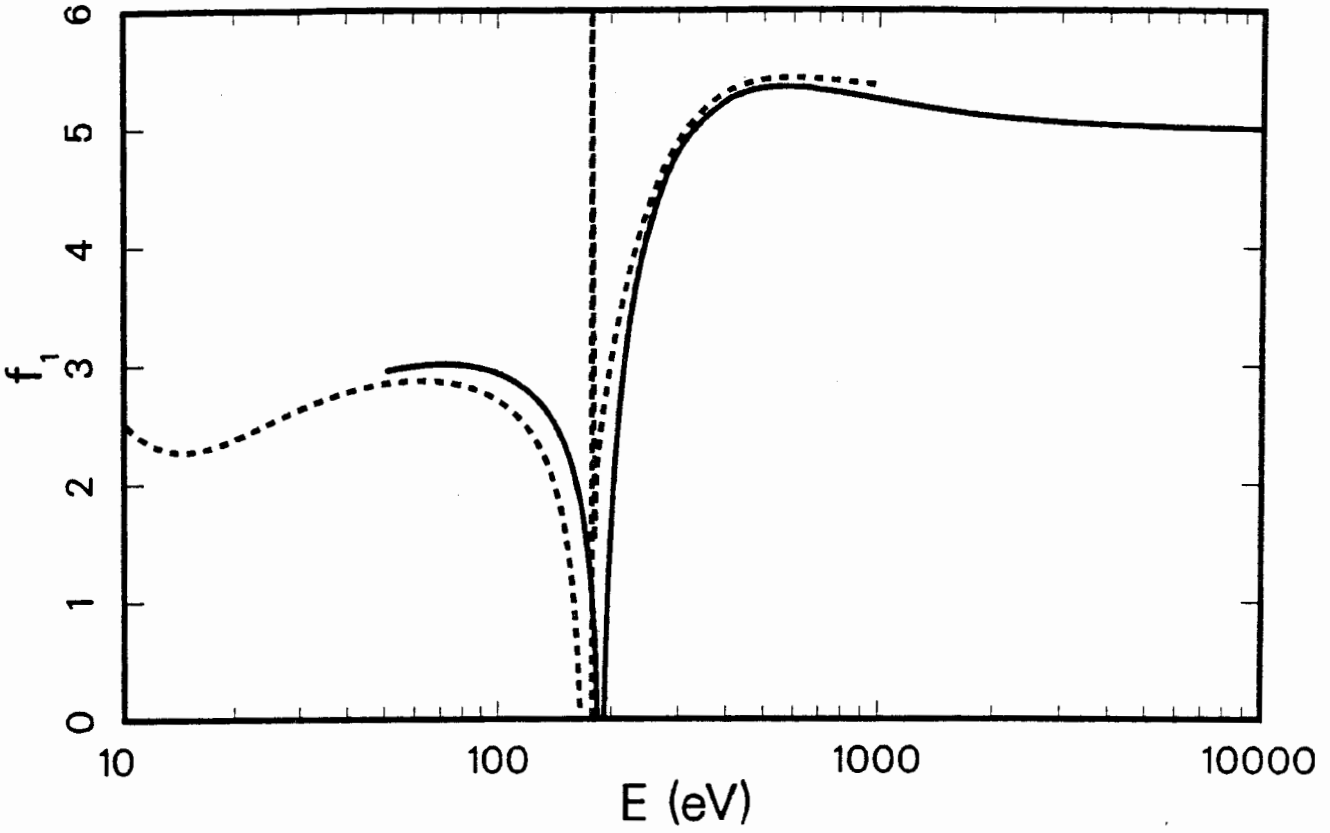

4-Be μ Coefficients
References
○ = 33
△ = 36
+ = 72
× = 73
◇ = 76
▽ = 80
⊠ = 95
✳ = 131
◆ = 138
⊕ = 191
μ (cm²/gm)
E (eV)
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

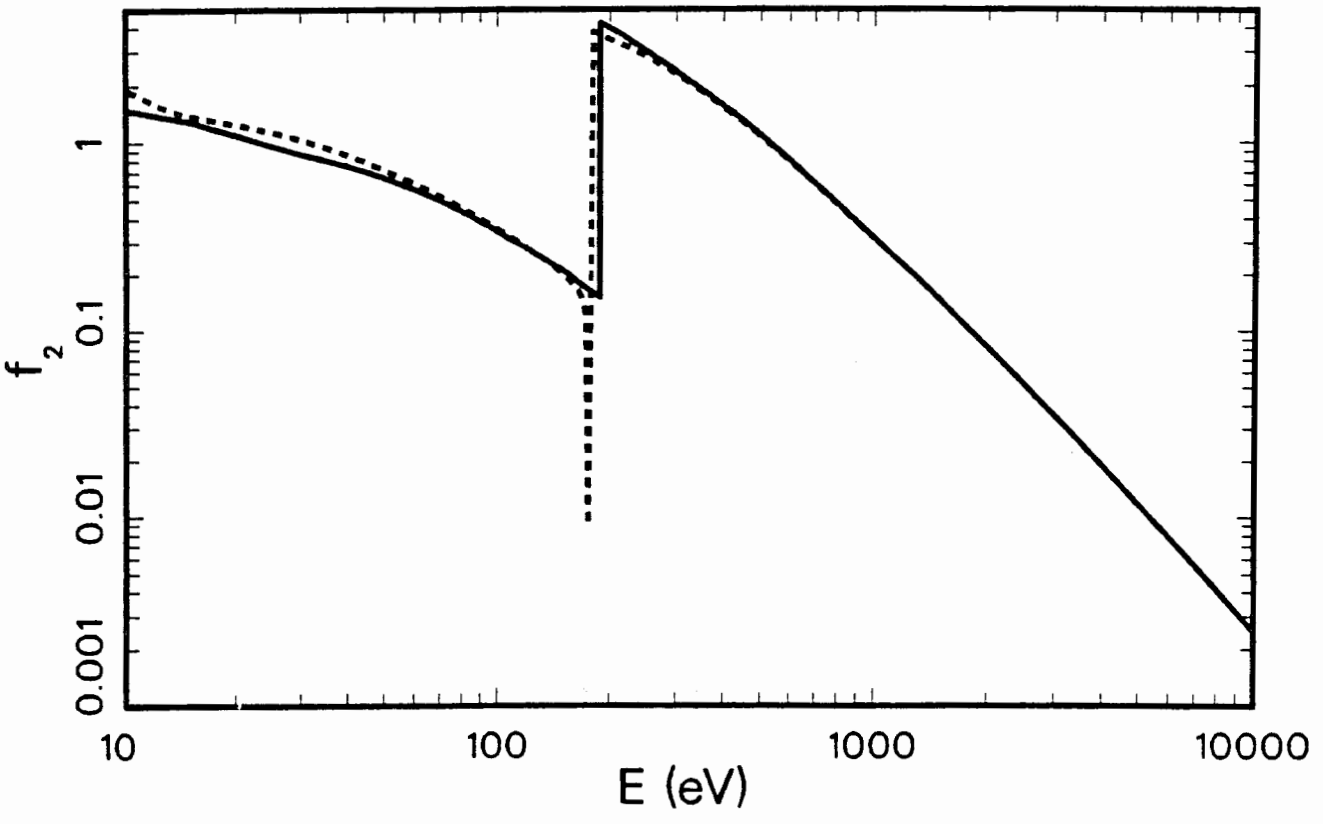
Berylium (Be) — 4
Atomic Weight = 9.01
μ (barns/atom) = $\mu(cm^2/g) \times 14.97$
$E\mu(E) = 4669.0\, f_2$ keV cm^2/g

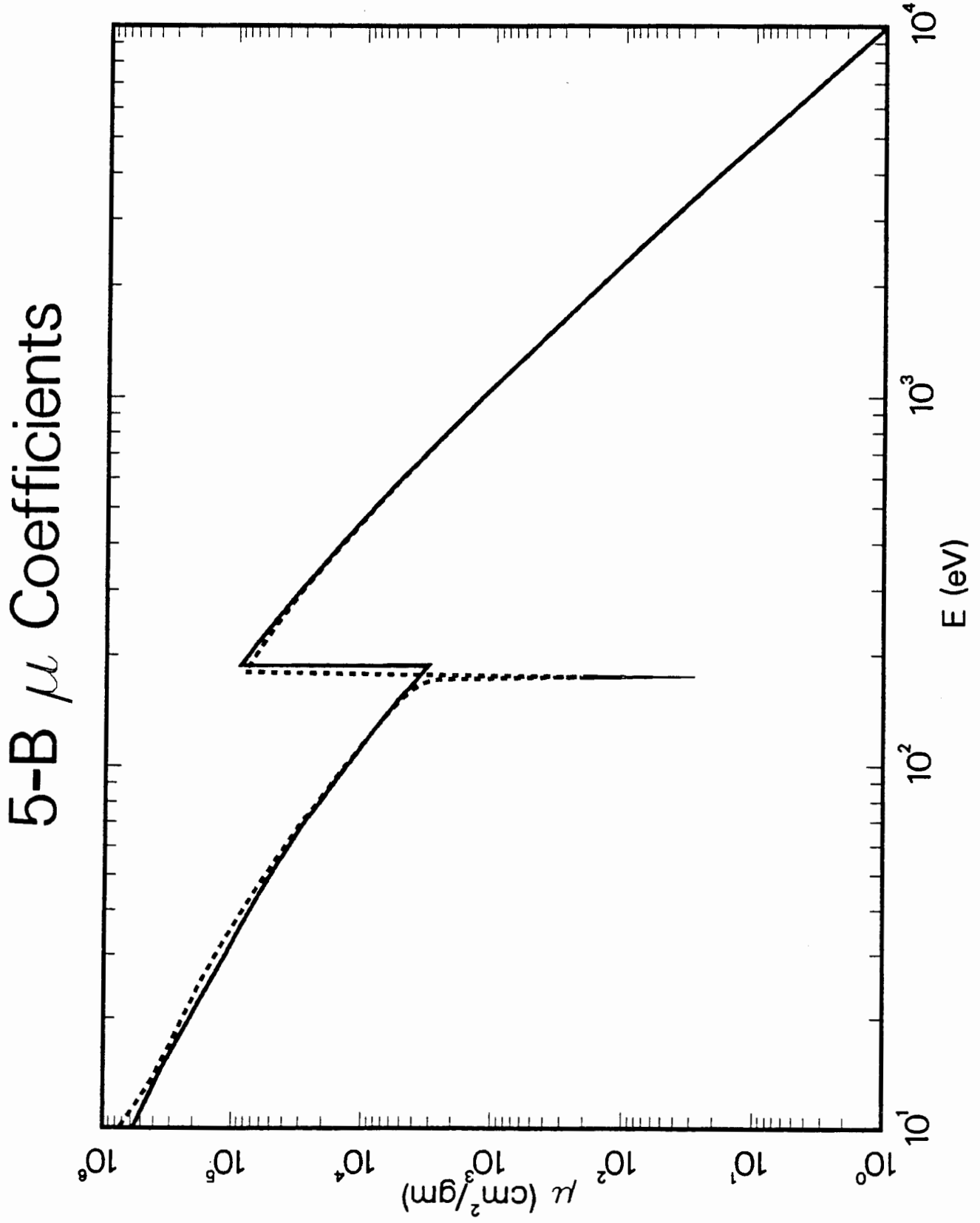
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	9.09e-1	-10.2	33
103.0	2.40e+4	249.1	36
111.0	1.60e+4	-47.9	36
112.0	3.68e+4	0.2	36
113.0	5.48e+4	25.1	36
116.0	8.09e+4	9.3	36
120.0	1.12e+5	-20.9	36
122.0	1.36e+5	-8.2	36
132.0	1.36e+5	-14.4	36
1254.0	3.27e+2	8.9	72
1487.0	1.99e+2	11.5	72
1740.0	1.26e+2	4.5	72
2050.0	7.82e+1	2.1	72
2293.0	5.55e+1	0.2	72
2839.0	2.81e+1	-3.0	72
2984.0	2.34e+1	-5.2	72
3287.0	1.82e+1	0.4	72
3444.0	1.61e+1	3.2	72
3769.0	1.20e+1	2.9	72
4091.0	9.15e+0	1.0	72
4511.0	6.95e+0	3.5	72
6404.0	2.57e+0	13.7	72
800.0	1.05e+3	-9.4	73
882.0	7.92e+2	-8.9	73
992.0	5.79e+2	-5.6	73
1127.0	3.79e+2	-8.9	73
1312.0	2.52e+2	-3.7	73
1442.0	1.89e+2	-3.7	73
1597.0	1.48e+2	-0.7	73
1739.0	1.10e+2	-8.7	73
8040.0	1.15e+0	13.2	76
932.0	7.70e+2	4.2	80
1256.0	3.40e+2	13.8	80
1487.0	2.06e+2	15.4	80
2984.0	2.16e+1	-12.2	95
3444.0	1.42e+1	-8.7	95
4511.0	5.86e+0	-12.7	95
5415.0	3.50e+0	-8.3	95
6404.0	2.18e+0	-3.4	95
8048.0	1.01e+0	-0.3	95
3520.0	1.16e+1	-19.9	131
5000.0	3.97e+0	-19.0	131
6000.0	2.32e+0	-16.4	131
6404.0	2.00e+0	-11.8	131
7058.0	1.48e+0	-7.6	131
8000.0	1.06e+0	2.4	131
8398.0	9.64e-1	9.3	131
9962.0	5.94e-1	17.4	131
883.6	7.97e+2	-7.8	138
909.6	7.34e+2	-7.6	138

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
937.2	6.76e+2	-7.0	138
966.4	6.18e+2	-6.8	138
989.6	5.72e+2	-7.4	138
1006.0	5.42e+2	-7.8	138
1022.0	5.19e+2	-7.4	138
1048.0	4.72e+2	-9.1	138
1076.0	4.35e+2	-9.2	138
1104.0	3.95e+2	-10.8	138
1145.0	3.65e+2	-7.9	138
1201.0	3.14e+2	-8.3	138
1250.0	2.87e+2	-5.4	138
1302.0	2.60e+2	-2.9	138
1359.0	2.26e+2	-3.8	138
1422.0	1.96e+2	-4.3	138
1490.0	1.78e+2	0.2	138
1546.0	1.60e+2	-1.1	138
110.0	1.94e+4	-24.0	191
111.0	1.94e+4	-36.6	191
112.0	2.43e+4	-33.7	191
113.0	7.55e+4	72.4	191
113.5	1.32e+5	175.1	191
114.0	1.28e+5	145.6	191
115.0	1.09e+5	75.1	191
116.0	1.06e+5	42.7	191
117.0	1.01e+5	14.9	191
118.0	1.26e+5	20.7	191
119.0	1.50e+5	22.0	191
120.0	1.54e+5	8.6	191
121.0	1.57e+5	8.4	191
122.0	1.60e+5	7.8	191
123.0	1.60e+5	5.4	191
124.0	1.65e+5	6.6	191
125.0	1.71e+5	8.9	191
126.0	1.76e+5	10.6	191
127.0	1.74e+5	8.6	191
128.0	1.61e+5	-0.8	191
130.0	1.26e+5	-22.5	191
132.0	9.96e+4	-37.3	191
134.0	9.09e+4	-37.3	191
136.0	8.89e+4	-27.8	191
138.0	8.69e+4	-23.1	191
140.0	8.55e+4	-18.8	191
142.0	8.62e+4	-15.6	191
144.0	8.62e+4	-13.1	191
150.0	8.09e+4	-11.1	191
155.0	7.75e+4	-9.8	191
160.0	8.02e+4	-1.3	191
165.0	7.02e+4	-7.9	191
170.0	6.11e+4	-14.5	191
10000.0	9.22e-1	84.4	191

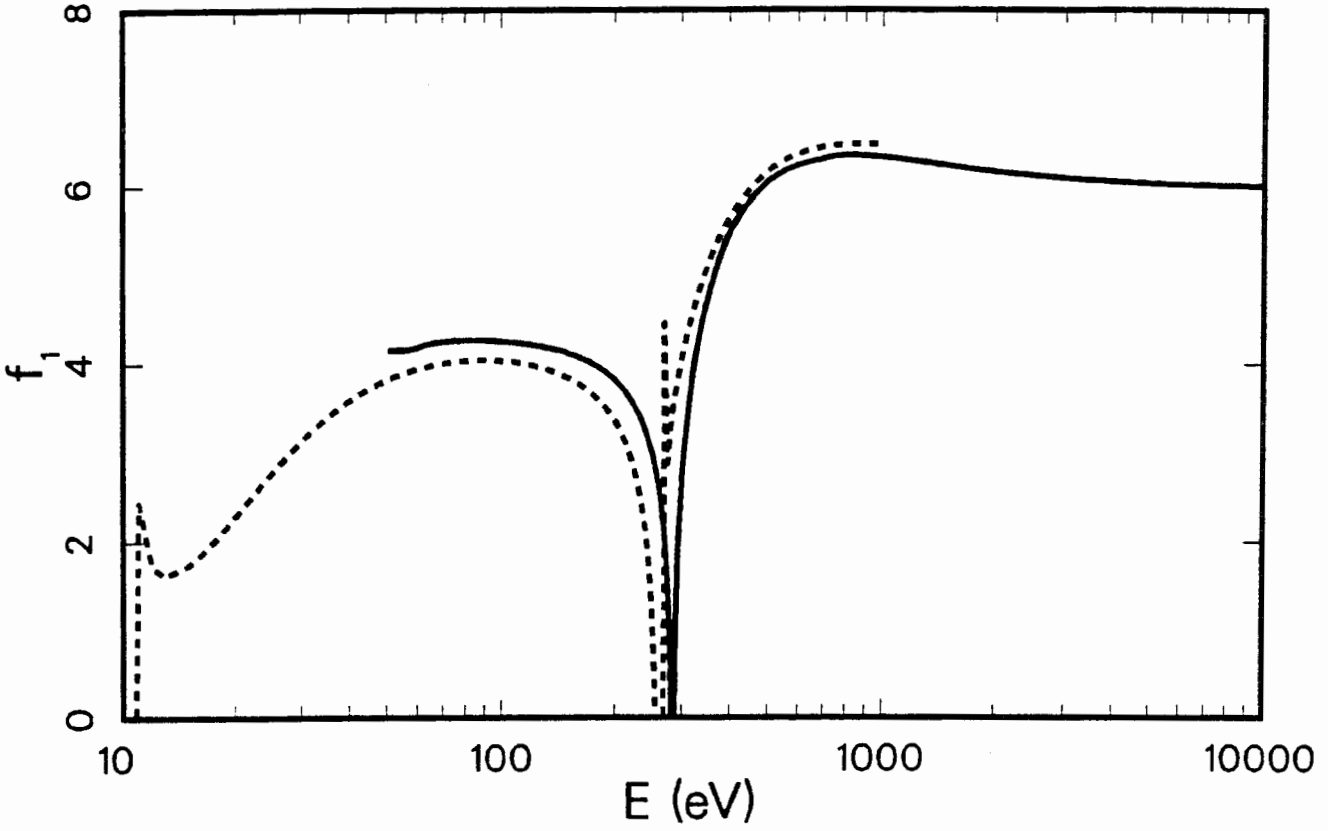
Atomic Scattering Factors, f_1+if_2
5 - Boron (B)

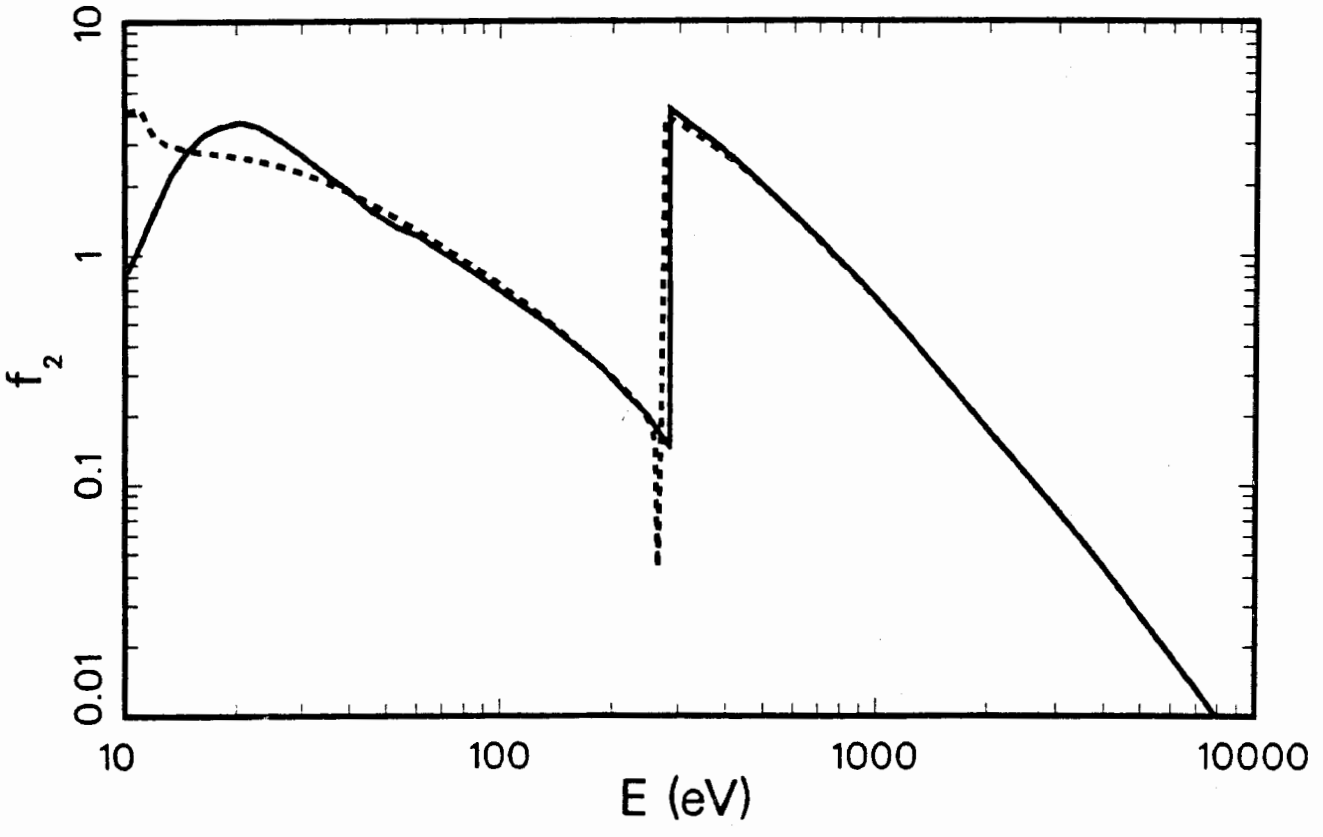




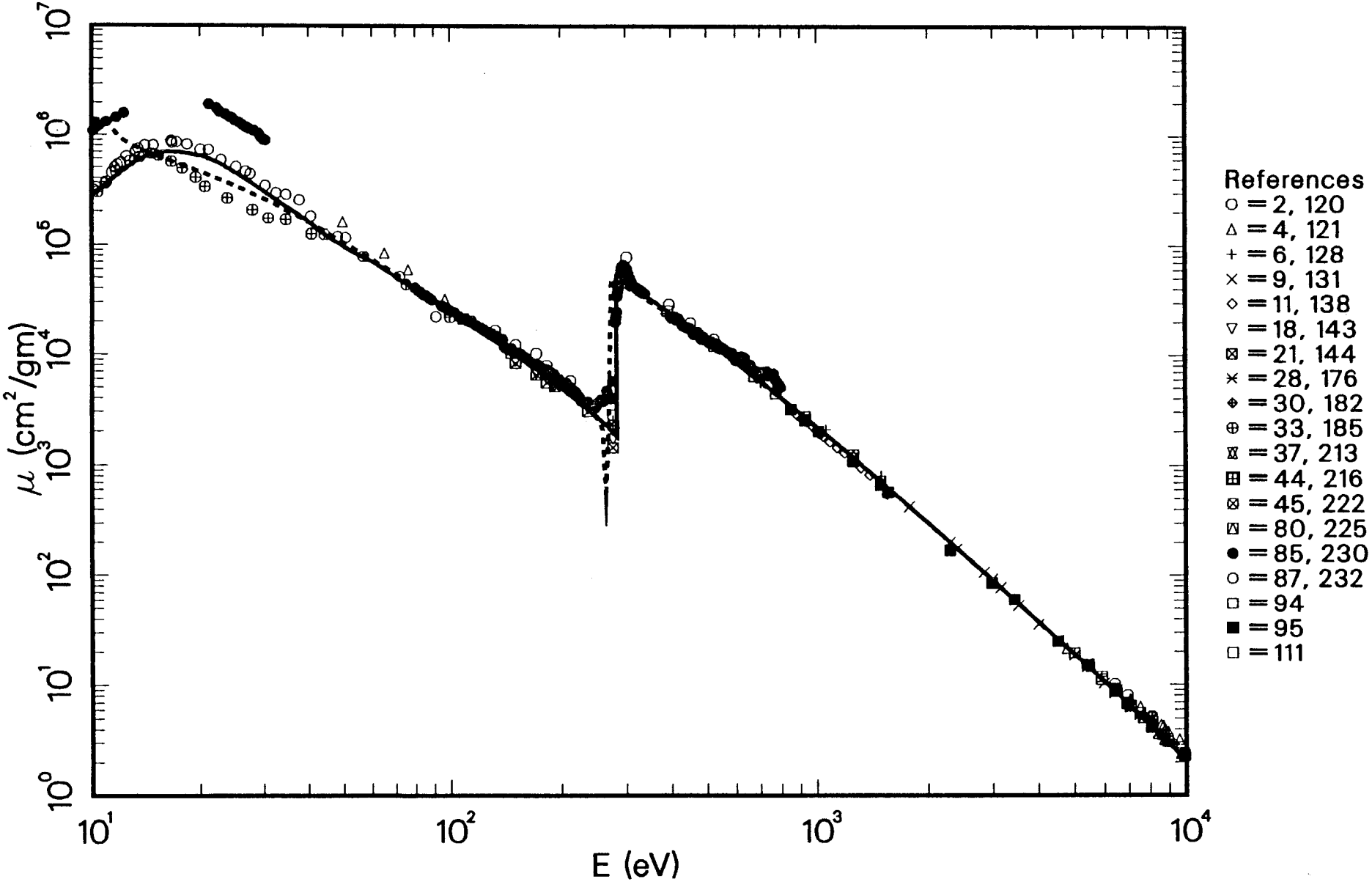

5-B μ Coefficients
μ (cm²/gm)
E (eV)
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
6 - Carbon (C)





6-C μ Coefficients



Carbon (C) — 6
Atomic Weight = 12.01
μ (barns/atom) = $\mu(cm^2/g) \times 19.95$
$E\mu(E) = 3503.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5410.0	1.53e+1	3.6	2
6400.0	1.01e+1	16.2	2
6930.0	7.96e+0	18.0	2
8050.0	5.22e+0	25.0	2
4770.0	2.15e+1	-1.6	4
5530.0	1.47e+1	6.6	4
6410.0	9.18e+0	6.1	4
7040.0	7.32e+0	14.1	4
7490.0	6.42e+0	21.9	4
8070.0	4.91e+0	18.6	4
8550.0	4.41e+0	28.4	4
8660.0	4.31e+0	30.7	4
8930.0	3.81e+0	27.6	4
9590.0	3.21e+0	35.6	4
277.0	2.11e+3	-30.9	6
1254.0	1.16e+3	-1.4	9
1487.0	7.13e+2	-0.7	9
1778.0	4.23e+2	-0.9	9
2293.0	2.01e+2	-0.4	9
2395.0	1.74e+2	-1.7	9
2838.0	1.07e+2	-0.2	9
2984.0	9.23e+1	0.4	9
3151.0	7.78e+1	-0.2	9
3444.0	6.00e+1	0.8	9
3520.0	5.34e+1	-4.2	9
277.0	2.21e+3	-27.7	11
277.0	1.72e+3	-43.6	18
6417.0	8.61e+0	0.0	21
7493.0	5.57e+0	5.9	21
8656.0	3.51e+0	6.4	21
5414.0	1.55e+1	5.2	28
6403.0	9.38e+0	8.1	28
7477.0	5.65e+0	6.6	28
8047.0	4.87e+0	16.5	28
8638.0	3.53e+0	6.2	30
9251.0	2.93e+0	10.0	30
9885.0	2.40e+0	11.8	30
6930.0	6.71e+0	-0.5	33
8047.0	4.41e+0	5.4	33
8048.0	4.15e+0	-0.7	37
8048.0	4.30e+0	2.9	44
8048.0	5.07e+0	21.3	45
279.0	2.28e+3	-33.4	80
932.0	2.58e+3	-4.2	80
1256.0	1.23e+3	5.8	80
1487.0	7.25e+2	1.0	80
10.1	1.10e+6	278.7	85
10.2	1.16e+6	291.4	85
10.3	1.18e+6	289.3	85
10.5	1.23e+6	287.9	85

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
11.0	1.33e+6	274.8	85
11.7	1.46e+6	248.8	85
12.3	1.61e+6	237.8	85
21.2	1.95e+6	222.9	85
22.3	1.79e+6	218.2	85
22.7	1.67e+6	204.9	85
23.6	1.58e+6	208.0	85
24.3	1.49e+6	207.1	85
24.7	1.46e+6	211.8	85
25.2	1.36e+6	203.1	85
25.8	1.32e+6	206.6	85
26.3	1.26e+6	204.4	85
26.9	1.20e+6	203.4	85
27.1	1.19e+6	206.1	85
27.5	1.15e+6	205.1	85
28.3	1.11e+6	213.9	85
29.2	1.04e+6	215.8	85
29.7	9.58e+5	201.0	85
30.2	9.10e+5	197.0	85
30.5	9.00e+5	200.2	85
277.0	2.30e+3	-24.6	87
5898.0	1.12e+1	-0.6	94
9885.0	2.29e+0	6.9	94
852.0	3.19e+3	-7.6	95
930.0	2.54e+3	-6.2	95
1012.0	2.03e+3	-5.6	95
1254.0	1.09e+3	-6.8	95
1487.0	6.67e+2	-7.1	95
1557.0	5.72e+2	-9.0	95
2293.0	1.70e+2	-15.6	95
2984.0	8.52e+1	-7.3	95
3444.0	6.07e+1	1.9	95
4511.0	2.50e+1	-3.8	95
5415.0	1.52e+1	3.2	95
6404.0	8.77e+0	1.2	95
8048.0	4.33e+0	3.5	95
108.9	2.13e+4	4.6	111
147.2	1.04e+4	-1.6	111
182.6	6.55e+3	1.4	111
278.0	2.29e+3	-29.1	111
391.4	2.54e+4	1.0	111
526.0	1.21e+4	0.4	111
676.8	6.40e+3	0.4	111
774.4	4.47e+3	-0.2	111
928.7	2.74e+3	0.7	111
1254.0	1.17e+3	-0.6	111
1487.0	7.19e+2	0.2	111
114.0	2.05e+4	11.1	120
132.8	1.67e+4	25.1	120
151.1	1.24e+4	24.5	120

E(eV)	μ(cm^2/g)	% Error	Ref.
171.7	1.03e+4	38.3	120
183.3	7.97e+3	24.5	120
212.2	5.77e+3	34.0	120
277.0	2.81e+3	-7.9	120
302.7	7.82e+4	513.3	120
395.3	2.90e+4	18.1	120
452.2	1.96e+4	11.4	120
524.9	1.39e+4	14.7	120
705.0	6.97e+3	20.6	120
50.0	1.62e+5	63.3	121
65.4	8.50e+4	41.5	121
76.6	5.96e+4	38.8	121
96.8	3.19e+4	22.1	121
182.0	6.59e+3	1.3	128
277.0	2.54e+3	-16.9	128
387.0	2.38e+4	-8.0	128
517.0	1.30e+4	3.2	128
704.0	5.59e+3	-3.6	128
925.0	2.76e+3	0.2	128
1060.0	2.08e+3	10.5	128
1490.0	8.06e+2	12.9	128
3520.0	5.34e+1	-4.2	131
4000.0	3.57e+1	-5.2	131
5000.0	1.86e+1	-1.6	131
6000.0	1.03e+1	-3.2	131
6404.0	8.41e+0	-3.0	131
7058.0	6.34e+0	-0.4	131
8000.0	4.31e+0	1.3	131
8398.0	3.72e+0	2.2	131
9962.0	2.25e+0	7.9	131
883.6	2.85e+3	-8.8	138
909.6	2.65e+3	-8.0	138
937.2	2.47e+3	-6.8	138
966.4	2.29e+3	-6.0	138
997.6	2.05e+3	-8.1	138
1006.0	2.00e+3	-8.2	138
1014.0	1.94e+3	-9.0	138
1022.0	1.90e+3	-9.0	138
1040.0	1.83e+3	-8.2	138
1085.0	1.62e+3	-8.2	138
1135.0	1.43e+3	-8.0	138
1190.0	1.29e+3	-5.2	138
1250.0	1.12e+3	-5.5	138
1316.0	9.58e+2	-6.2	138
1390.0	8.22e+2	-5.7	138
1546.0	5.52e+2	-14.0	138
151.0	8.82e+3	-11.4	143
171.7	6.82e+3	-8.2	143
183.4	6.07e+3	-5.1	143
192.6	5.26e+3	-6.3	143
236.9	3.23e+3	0.4	143
277.0	2.05e+3	-32.8	143
523.0	1.20e+4	-1.6	143
151.0	8.42e+3	-15.4	144
171.7	6.57e+3	-11.6	144

E(eV)	μ(cm^2/g)	% Error	Ref.
183.4	5.57e+3	-13.0	144
192.6	5.14e+3	-8.6	144
236.9	3.05e+3	-5.2	144
277.0	1.43e+3	-53.1	144
4508.0	2.55e+1	-2.2	176
5411.0	1.46e+1	-1.3	176
6400.0	8.60e+0	-1.0	176
7472.0	5.39e+0	1.7	176
8041.0	4.34e+0	3.6	176
8631.0	3.54e+0	6.2	176
9876.0	2.41e+0	12.0	176
8048.0	4.08e+0	-2.4	182
10.4	2.99e+5	-3.6	185
11.0	3.69e+5	3.6	185
11.7	4.62e+5	10.0	185
12.8	5.69e+5	8.8	185
13.6	6.22e+5	4.7	185
14.7	6.69e+5	1.3	185
15.4	6.44e+5	-5.5	185
16.7	5.69e+5	-18.6	185
17.9	4.96e+5	-28.1	185
19.5	4.09e+5	-37.6	185
20.7	3.35e+5	-46.3	185
23.9	2.65e+5	-47.1	185
28.1	2.06e+5	-42.6	185
31.1	1.74e+5	-39.4	185
34.8	1.69e+5	-24.0	185
40.9	1.27e+5	-18.2	185
44.5	1.25e+5	-0.7	185
57.2	7.89e+4	1.9	185
75.4	4.37e+4	-1.6	185
100.0	2.21e+4	-9.3	185
8050.0	4.12e+0	-1.3	213
8390.0	3.58e+0	-1.9	213
8730.0	3.20e+0	-0.3	213
8910.0	3.06e+0	1.8	213
9690.0	2.40e+0	5.0	213
5000.0	1.95e+1	3.0	216
5900.0	1.18e+1	5.3	216
6400.0	9.18e+0	5.6	216
8100.0	4.66e+0	13.9	216
5470.0	1.51e+1	6.2	222
6470.0	8.92e+0	6.3	222
6404.0	8.73e+0	0.6	225
6903.0	6.81e+0	-0.4	225
7058.0	6.48e+0	1.8	225
7649.0	5.06e+0	2.8	225
8048.0	4.34e+0	3.9	225
8905.0	3.22e+0	6.9	225
80.0	4.08e+4	4.1	230
81.5	3.86e+4	2.4	230
83.0	3.73e+4	2.9	230
84.5	3.53e+4	1.3	230
86.0	3.45e+4	2.8	230
87.5	3.29e+4	1.6	230

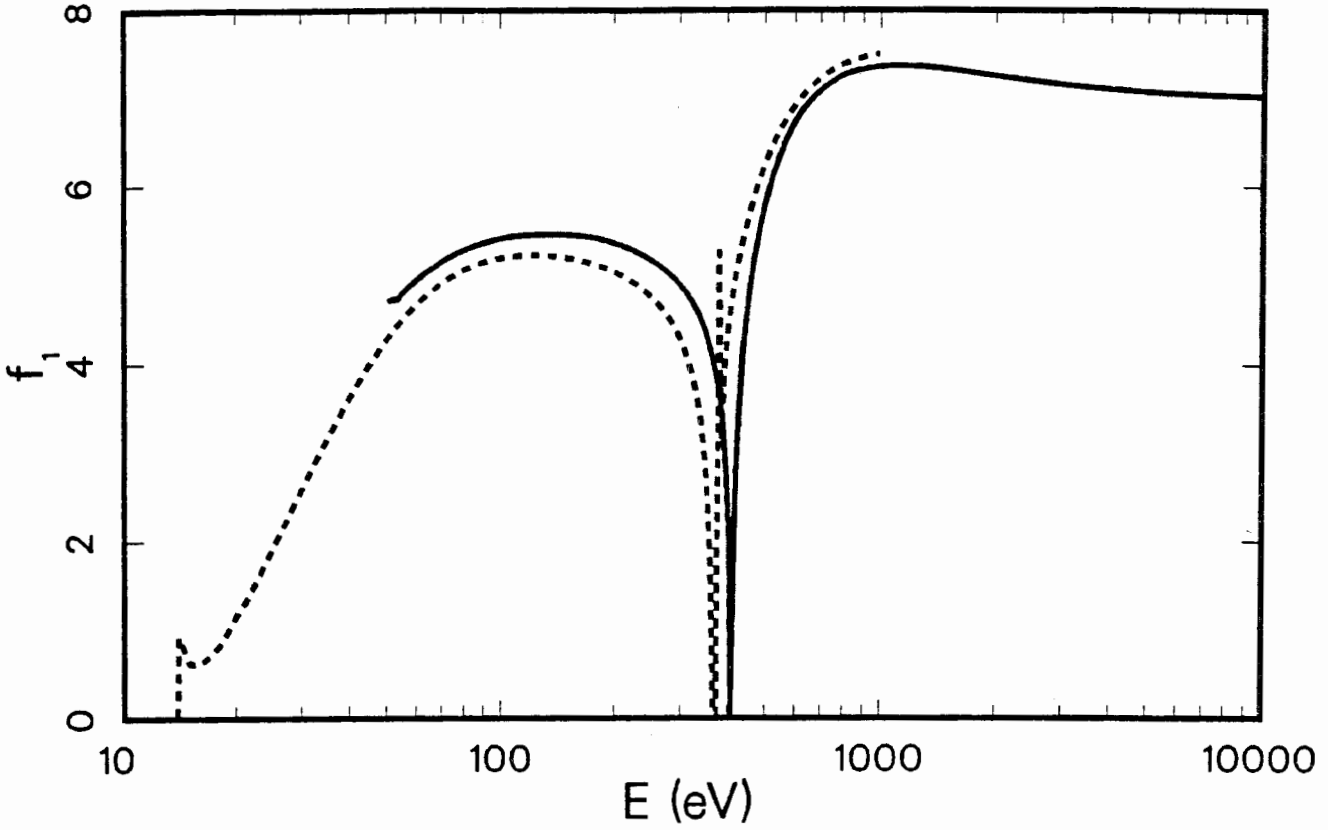
E(eV)	μ(cm^2/g)	% Error	Ref.
89.0	3.17e+4	1.4	230
95.0	2.79e+4	2.7	230
96.5	2.72e+4	3.2	230
98.0	2.63e+4	3.4	230
99.5	2.56e+4	3.9	230
103.0	2.43e+4	5.9	230
106.0	2.23e+4	3.7	230
109.0	2.11e+4	4.0	230
112.0	2.03e+4	5.7	230
115.0	1.96e+4	8.2	230
118.0	1.86e+4	8.2	230
121.0	1.78e+4	9.4	230
124.0	1.69e+4	9.4	230
127.0	1.61e+4	10.0	230
130.0	1.56e+4	11.5	230
133.0	1.49e+4	12.0	230
136.0	1.43e+4	13.0	230
139.0	1.39e+4	15.6	230
141.0	1.18e+4	1.2	230
144.0	1.12e+4	0.9	230
147.0	1.14e+4	7.8	230
150.0	1.04e+4	3.1	230
153.0	1.05e+4	8.1	230
156.0	1.02e+4	9.8	230
159.0	9.66e+3	9.1	230
162.0	9.24e+3	8.9	230
165.0	8.72e+3	7.2	230
168.0	8.36e+3	7.1	230
171.0	8.32e+3	10.9	230
174.0	8.10e+3	12.4	230
177.0	7.73e+3	11.4	230
180.0	7.49e+3	12.2	230
183.0	7.38e+3	14.8	230
186.0	6.83e+3	10.3	230
189.0	6.88e+3	16.1	230
192.0	6.69e+3	17.9	230
195.0	6.09e+3	12.0	230
198.0	6.00e+3	15.3	230
201.0	5.51e+3	10.3	230
204.0	5.39e+3	12.4	230
207.0	5.56e+3	20.7	230
210.0	5.20e+3	17.4	230
213.0	5.03e+3	18.1	230
216.0	4.59e+3	12.0	230
219.0	4.64e+3	17.5	230
222.0	4.40e+3	15.6	230
225.0	4.11e+3	11.8	230
228.0	3.78e+3	6.5	230
231.0	3.68e+3	7.3	230
234.0	3.67e+3	10.5	230
237.0	3.72e+3	15.8	230
242.0	3.50e+3	15.2	230
245.0	3.31e+3	12.3	230
249.0	3.31e+3	17.9	230
254.0	3.74e+3	42.4	230

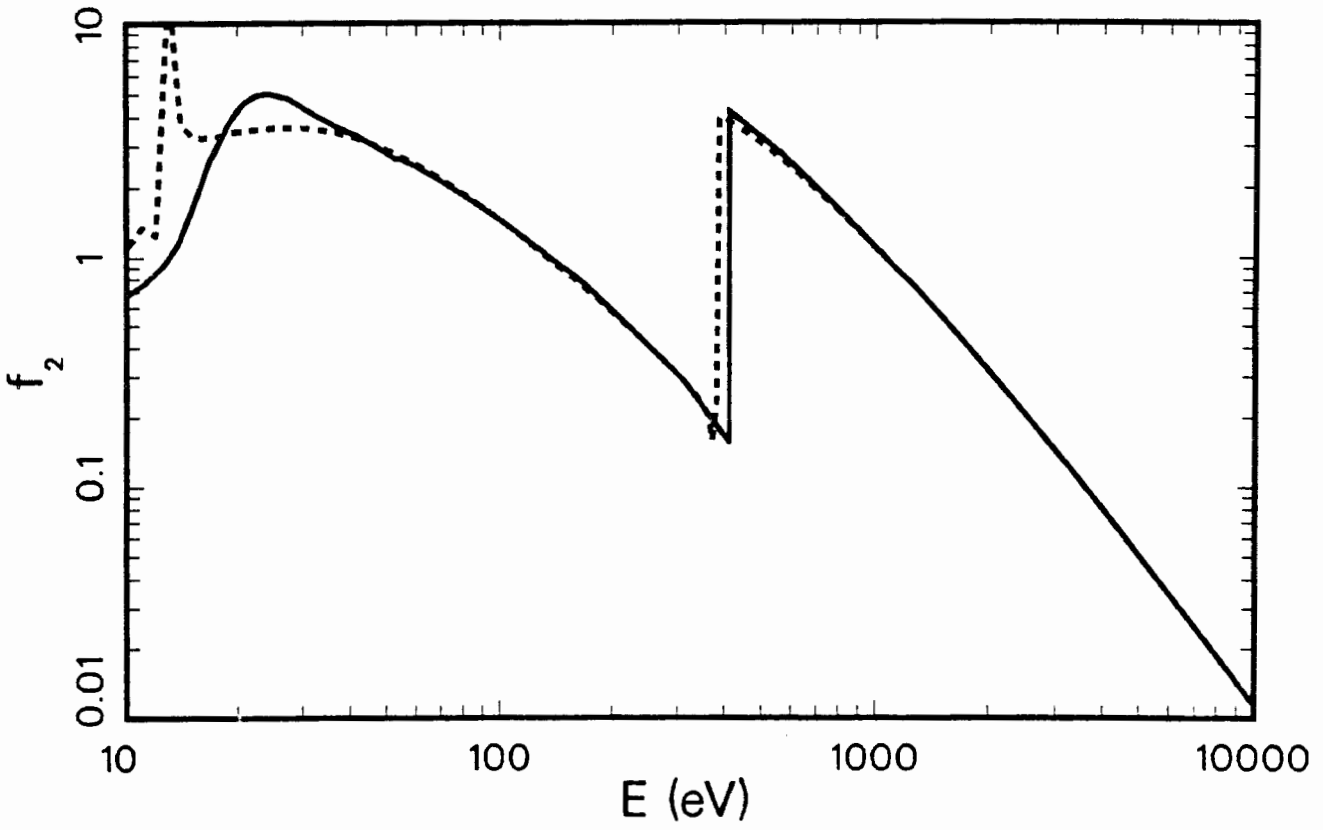
E(eV)	μ(cm^2/g)	% Error	Ref.
257.0	3.89e+3	54.1	230
261.0	3.74e+3	56.3	230
264.0	3.97e+3	72.2	230
267.0	4.69e+3	111.5	230
270.0	4.26e+3	99.4	230
274.0	3.97e+3	55.3	230
277.0	5.77e+3	89.1	230
282.0	1.99e+4	388.3	230
283.0	2.22e+4	416.0	230
284.0	2.47e+4	440.5	230
285.0	3.40e+4	604.6	230
286.0	3.74e+4	633.1	230
287.0	4.04e+4	648.3	230
288.0	4.41e+4	671.2	230
289.0	4.74e+4	685.0	230
290.0	5.06e+4	691.5	230
291.0	5.39e+4	698.2	230
292.0	5.82e+4	714.8	230
293.0	6.24e+4	726.9	230
294.0	6.37e+4	699.1	230
295.0	6.49e+4	670.7	230
296.0	6.58e+4	640.2	230
297.0	6.63e+4	606.6	230
300.0	6.50e+4	488.6	230
303.0	6.12e+4	372.5	230
306.0	5.55e+4	265.2	230
309.0	5.05e+4	183.9	230
312.0	4.67e+4	124.7	230
315.0	4.36e+4	79.6	230
318.0	4.22e+4	49.3	230
321.0	4.12e+4	25.2	230
324.0	4.02e+4	5.2	230
327.0	3.94e+4	4.1	230
330.0	3.90e+4	5.2	230
333.0	3.80e+4	4.7	230
336.0	3.68e+4	3.3	230
339.0	3.64e+4	4.3	230
402.0	2.18e+4	-7.5	230
408.0	2.24e+4	-1.4	230
414.0	2.11e+4	-3.7	230
420.0	2.15e+4	1.7	230
426.0	1.98e+4	-2.8	230
432.0	1.85e+4	-6.3	230
438.0	1.82e+4	-4.6	230
444.0	1.79e+4	-2.7	230
450.0	1.75e+4	-1.5	230
456.0	1.69e+4	-2.2	230
462.0	1.55e+4	-7.0	230
468.0	1.57e+4	-3.1	230
474.0	1.62e+4	3.6	230
480.0	1.54e+4	1.3	230
486.0	1.40e+4	-5.0	230
492.0	1.46e+4	2.1	230
498.0	1.38e+4	-0.5	230
504.0	1.35e+4	0.4	230

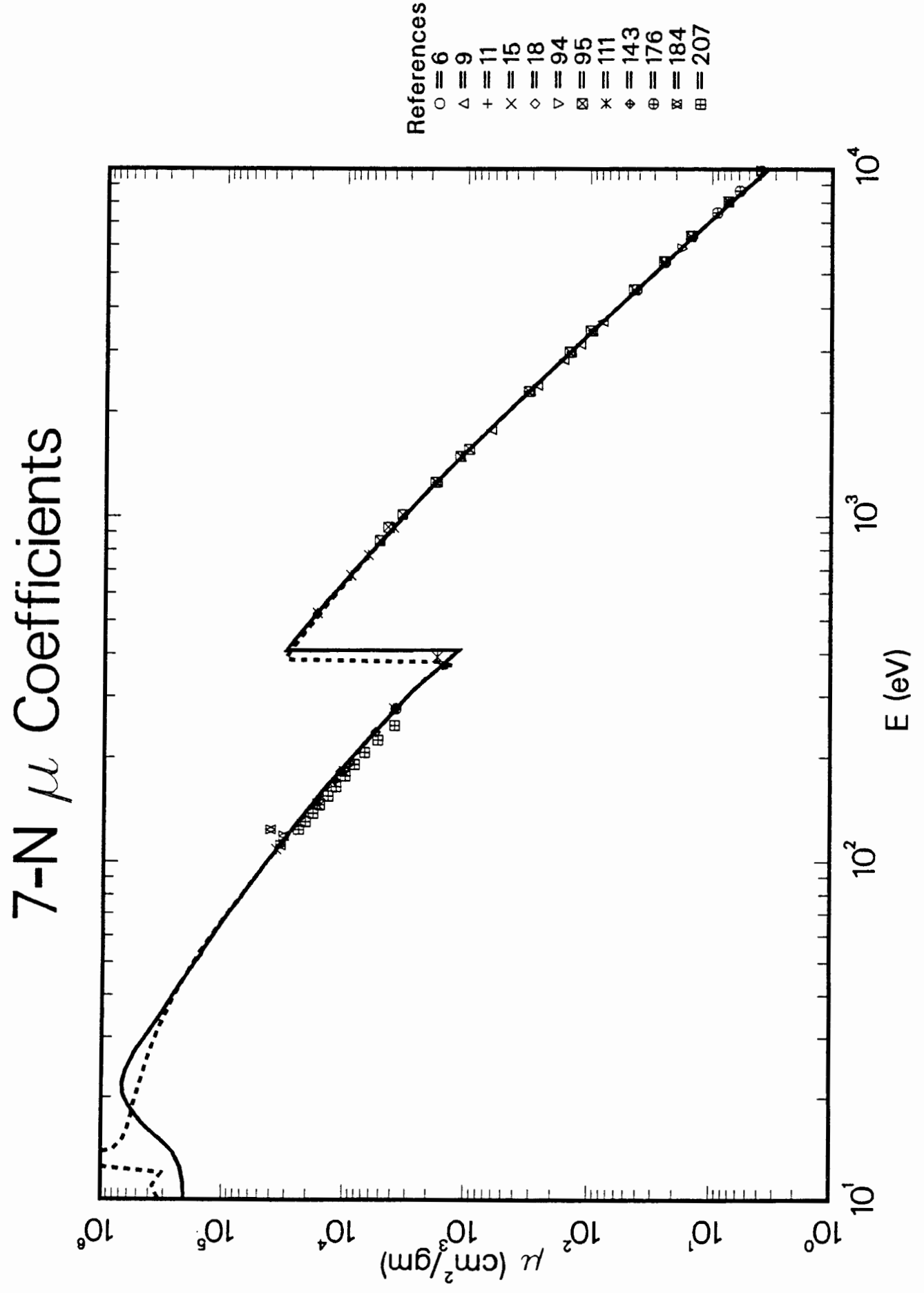
E(eV)	μ(cm^2/g)	% Error	Ref.
510.0	1.29e+4	-0.9	230
516.0	1.33e+4	4.8	230
522.0	1.29e+4	5.0	230
528.0	1.23e+4	3.3	230
534.0	1.27e+4	9.9	230
540.0	1.16e+4	3.0	230
546.0	1.15e+4	4.7	230
552.0	1.17e+4	9.5	230
558.0	1.13e+4	9.0	230
564.0	1.10e+4	9.0	230
570.0	1.08e+4	9.9	230
576.0	1.06e+4	11.0	230
582.0	1.03e+4	10.7	230
588.0	1.04e+4	14.6	230
594.0	9.45e+3	6.6	230
600.0	9.00e+3	4.2	230
606.0	9.20e+3	9.2	230
612.0	9.66e+3	17.6	230
618.0	9.51e+3	18.6	230
624.0	9.71e+3	24.1	230
630.0	9.05e+3	18.5	230
636.0	9.47e+3	27.1	230
642.0	8.64e+3	18.6	230
648.0	8.16e+3	14.8	230
654.0	7.92e+3	14.0	230
660.0	8.19e+3	20.7	230
666.0	7.16e+3	7.9	230
672.0	7.21e+3	11.1	230
678.0	7.09e+3	11.8	230
684.0	7.11e+3	14.5	230
690.0	6.83e+3	12.3	230
696.0	6.27e+3	5.2	230
702.0	6.80e+3	16.5	230
708.0	6.86e+3	19.9	230
714.0	6.56e+3	17.3	230
720.0	6.52e+3	19.4	230
726.0	6.50e+3	21.7	230
732.0	7.07e+3	35.4	230
738.0	6.47e+3	26.7	230
744.0	6.69e+3	33.9	230
750.0	6.60e+3	35.1	230
756.0	6.69e+3	40.0	230
762.0	6.77e+3	44.7	230
768.0	6.18e+3	34.9	230
774.0	5.86e+3	30.7	230
780.0	5.68e+3	29.4	230
786.0	5.13e+3	19.4	230
792.0	5.34e+3	26.9	230
798.0	5.09e+3	23.5	230
10.2	3.12e+5	5.2	232
10.3	3.29e+5	8.5	232
10.9	3.56e+5	2.6	232
11.4	4.52e+5	15.4	232
11.6	5.02e+5	22.3	232
11.8	5.33e+5	24.1	232

E(eV)	μ(cm^2/g)	% Error	Ref.
12.1	5.57e+5	21.8	232
12.5	6.35e+5	28.6	232
13.3	7.11e+5	24.2	232
13.5	7.51e+5	27.8	232
14.1	8.07e+5	29.0	232
14.9	8.08e+5	21.2	232
16.7	8.91e+5	27.5	232
16.8	8.54e+5	22.2	232
17.3	8.67e+5	24.5	232
18.5	8.23e+5	21.6	232
20.1	7.38e+5	14.7	232
21.2	7.34e+5	21.6	232
23.0	5.91e+5	9.7	232
25.3	5.12e+5	14.6	232
26.9	4.65e+5	18.0	232
27.7	4.41e+5	19.3	232
30.5	3.45e+5	15.0	232
32.7	2.95e+5	15.2	232
34.8	2.87e+5	28.7	232
37.9	2.55e+5	37.8	232
40.8	1.82e+5	16.6	232
48.4	1.20e+5	13.2	232
51.0	1.17e+5	23.1	232
72.3	5.17e+4	6.4	232
91.5	2.23e+4	-24.3	232

Atomic Scattering Factors, f_1+if_2
7 - Nitrogen (N)






7-N μ Coefficients
References
○ = 6
△ = 9
+ = 11
× = 15
◇ = 18
▽ = 94
⊠ = 95
✳ = 111
◆ = 143
⊕ = 176
⊠ = 184
⊞ = 207
μ (cm²/gm)
E (eV)
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Nitrogen (N) — 7

Atomic Weight = 14.01

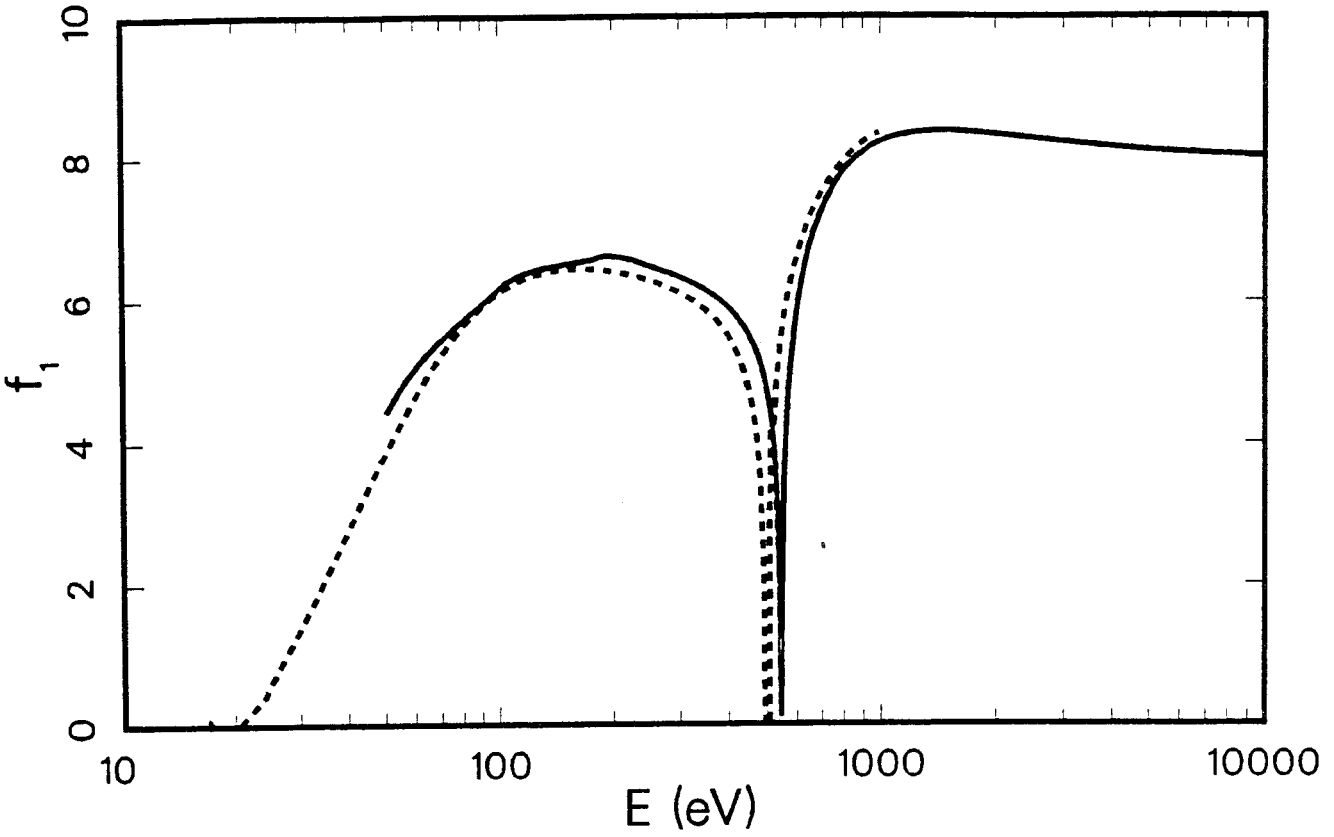
μ (barns/atom) = $\mu(cm^2/g) \times 23.26$

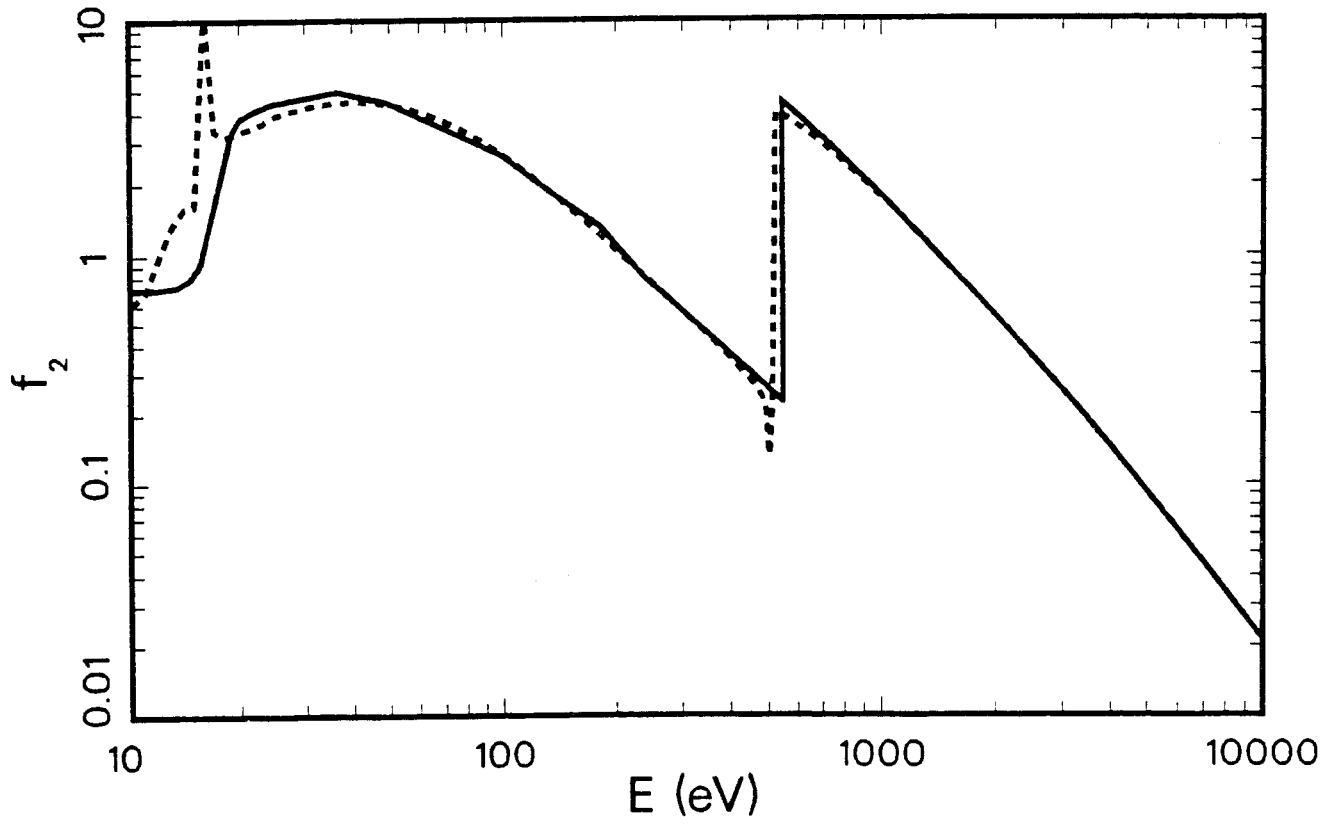
$E\mu(E) = 3004.1\, f_2$ keV cm^2/g

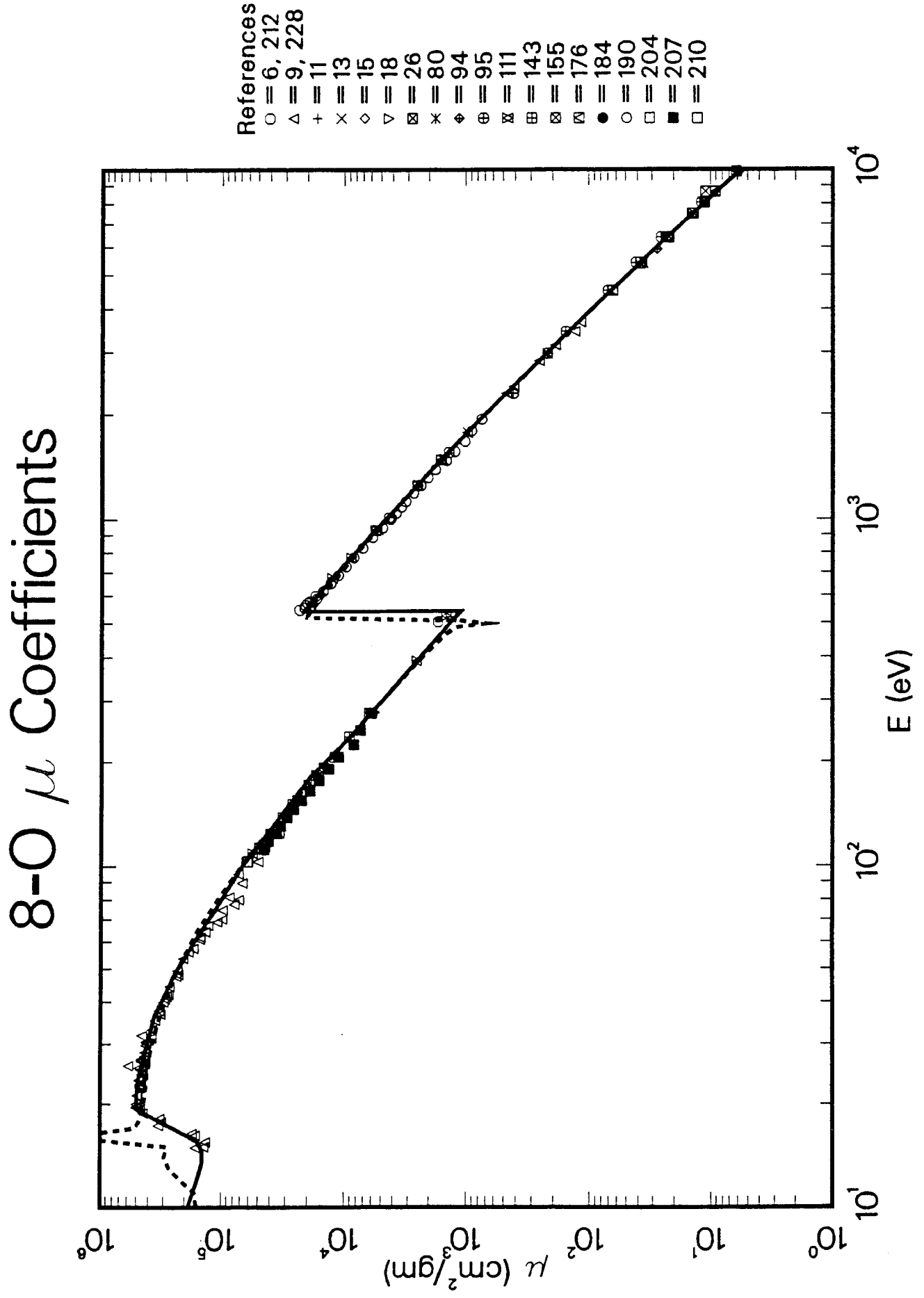
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	3.78e+3	0.4	6
1254.0	1.77e+3	-0.7	9
1778.0	6.45e+2	-3.0	9
2293.0	3.12e+2	-1.9	9
2395.0	2.73e+2	-2.5	9
2838.0	1.66e+2	-2.0	9
2984.0	1.44e+2	-1.1	9
3151.0	1.21e+2	-2.7	9
3444.0	9.63e+1	1.5	9
3662.0	7.95e+1	0.8	9
277.0	3.85e+3	2.2	11
8040.0	7.50e+0	9.1	15
182.3	1.09e+4	-1.4	18
278.6	3.79e+3	2.1	18
5898.0	1.77e+1	-2.7	94
9885.0	3.99e+0	12.4	94
852.0	5.29e+3	4.5	95
930.0	4.51e+3	12.4	95
1012.0	3.42e+3	6.9	95
1254.0	1.82e+3	2.1	95
1487.0	1.15e+3	3.8	95
1557.0	9.67e+2	-0.3	95
2293.0	3.20e+2	0.6	95
2984.0	1.49e+2	1.9	95
3444.0	9.97e+1	5.1	95
4511.0	4.43e+1	6.2	95
5415.0	2.52e+1	5.9	95
6404.0	1.50e+1	6.9	95
8048.0	7.31e+0	6.7	95
108.9	3.65e+4	1.0	111
147.2	1.70e+4	-8.3	111
182.6	1.03e+4	-6.7	111
278.0	3.94e+3	5.5	111
391.4	1.73e+3	25.7	111
526.0	1.72e+4	-0.3	111
676.8	9.11e+3	-1.1	111
774.9	6.55e+3	0.4	111
928.7	4.04e+3	0.2	111
1254.0	1.80e+3	0.9	111
1487.0	1.12e+3	1.5	111
151.0	1.60e+4	-8.8	143
171.7	1.21e+4	-5.8	143
183.4	1.01e+4	-7.6	143
192.6	9.16e+3	-4.8	143
236.9	5.55e+3	-2.1	143
277.0	3.83e+3	1.5	143
523.0	1.72e+4	-1.9	143
4508.0	4.21e+1	0.7	176
5411.0	2.45e+1	3.0	176
6400.0	1.46e+1	3.5	176

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
7472.0	9.10e+0	4.9	176
8041.0	7.36e+0	7.1	176
8631.0	5.90e+0	7.5	176
9876.0	3.92e+0	9.9	176
111.6	3.35e+4	-2.1	184
118.8	3.16e+4	5.8	184
124.0	4.08e+4	50.3	184
124.0	2.39e+4	-12.2	207
130.5	2.11e+4	-13.3	207
138.0	1.83e+4	-14.7	207
146.0	1.61e+4	-14.5	207
155.0	1.38e+4	-16.5	207
165.0	1.18e+4	-16.9	207
177.0	9.89e+3	-17.0	207
191.0	8.30e+3	-15.6	207
207.0	6.88e+3	-14.2	207
225.0	5.33e+3	-17.8	207
248.0	3.87e+3	-23.1	207

Atomic Scattering Factors, f_1+if_2
8 - Oxygen (O)






8-O μ Coefficients
References
○ = 6, 212
△ = 9, 228
+ = 11
× = 13
◇ = 15
▽ = 18
⊠ = 26
✳ = 80
◆ = 94
⊕ = 95
⊠ = 111
⊞ = 143
⊠ = 155
⊠ = 176
● = 184
○ = 190
□ = 204
■ = 207
□ = 210
μ (cm²/gm)
E (eV)
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶

Oxygen (O) — 8

Atomic Weight = 16.00

μ (barns/atom) = $\mu(cm^2/g) \times 26.57$

$E\mu(E) = 2630.0\, f_2$ keV cm^2/g

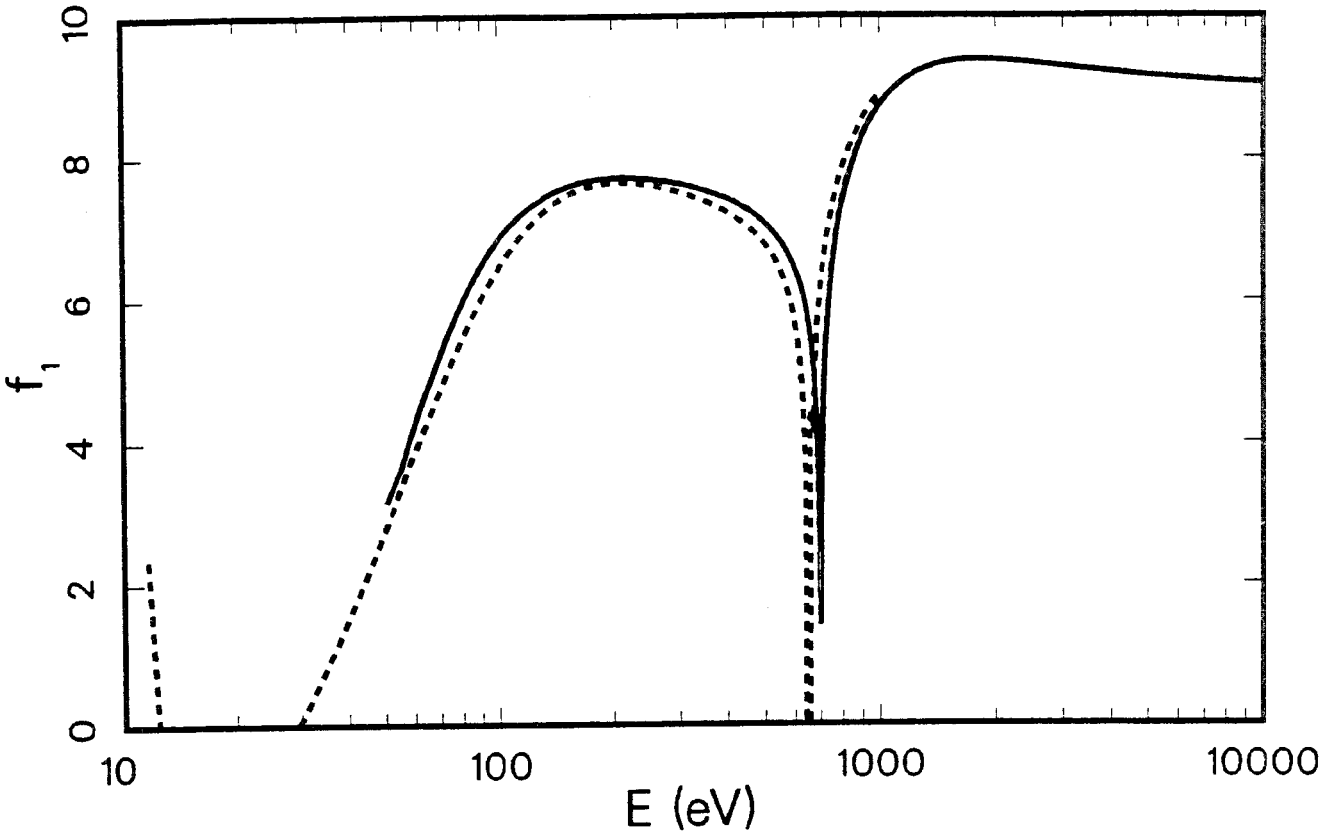
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	5.95e+3	-1.6	6
1254.0	2.54e+3	0.4	9
1487.0	1.59e+3	-0.6	9
1778.0	9.76e+2	0.3	9
2293.0	4.76e+2	-0.1	9
2395.0	4.13e+2	-1.9	9
2838.0	2.58e+2	-0.4	9
2984.0	2.22e+2	-0.9	9
3151.0	1.89e+2	-1.3	9
3444.0	1.31e+2	-11.2	9
3662.0	1.17e+2	-5.0	9
5414.0	3.66e+1	-2.8	9
277.0	5.77e+3	-4.5	11
1775.0	9.71e+2	-0.7	13
2980.0	2.21e+2	-1.7	13
5410.0	3.55e+1	-5.9	13
8040.0	1.16e+1	5.0	13
6407.0	2.22e+1	-1.0	15
8056.0	1.11e+1	1.1	15
182.3	1.62e+4	-13.4	18
278.6	5.65e+3	-5.1	18
6403.0	2.18e+1	-2.9	26
7477.0	1.37e+1	-1.2	26
8047.0	1.11e+1	0.7	26
8638.0	1.09e+1	24.0	26
277.0	6.15e+3	1.8	80
932.0	5.34e+3	-3.9	80
1256.0	2.48e+3	-1.6	80
1487.0	1.54e+3	-3.5	80
5898.0	2.72e+1	-6.1	94
9885.0	5.68e+0	-1.3	94
930.0	5.46e+3	-2.4	95
1012.0	4.33e+3	-3.2	95
1254.0	2.51e+3	-0.8	95
1487.0	1.61e+3	1.0	95
1557.0	1.38e+3	-2.0	95
2293.0	4.18e+2	-12.3	95
2984.0	2.20e+2	-1.9	95
3444.0	1.56e+2	5.7	95
4511.0	6.93e+1	5.5	95
5415.0	4.10e+1	9.0	95
6404.0	2.53e+1	12.7	95
8048.0	1.18e+1	7.3	95
108.9	5.60e+4	-0.7	111
147.2	2.65e+4	-10.1	111
182.6	1.65e+4	-11.7	111
278.0	6.25e+3	4.4	111
391.4	2.55e+3	0.3	111
526.0	1.44e+3	20.8	111
676.8	1.26e+4	1.7	111

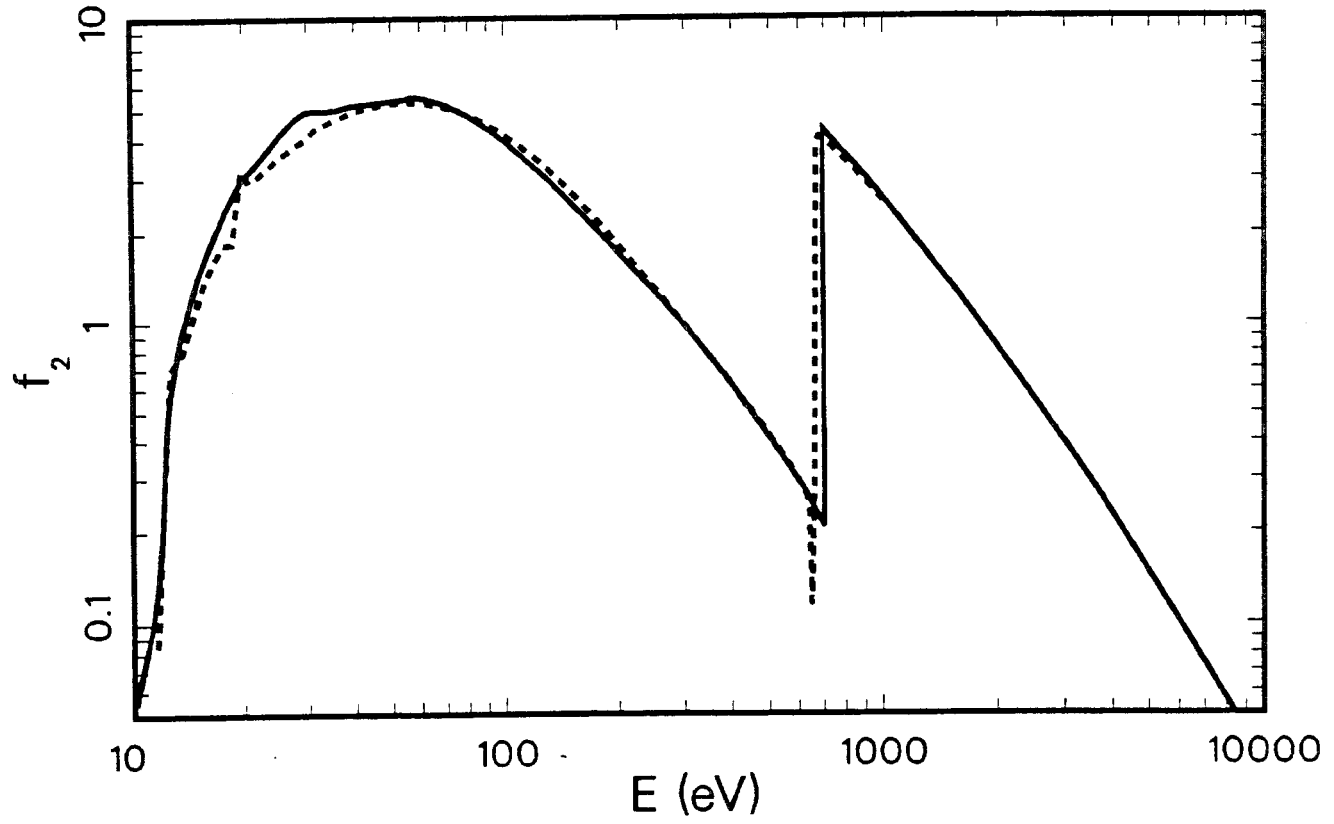
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
774.9	8.85e+3	-0.7	111
928.7	5.56e+3	-0.9	111
1254.0	2.54e+3	0.4	111
1487.0	1.60e+3	0.5	111
151.0	2.63e+4	-5.8	143
171.7	1.96e+4	-8.3	143
183.4	1.70e+4	-7.7	143
192.6	1.48e+4	-7.5	143
236.9	9.11e+3	2.4	143
277.0	6.02e+3	-0.3	143
523.0	1.32e+3	8.8	143
111.6	4.52e+4	-15.5	155
117.8	4.14e+4	-12.9	155
124.0	3.39e+4	-20.3	155
4508.0	6.42e+1	-2.4	176
5411.0	3.77e+1	-0.1	176
6400.0	2.24e+1	-0.5	176
7472.0	1.40e+1	0.9	176
8631.0	9.11e+0	3.1	176
9876.0	6.11e+0	5.8	176
111.6	4.42e+4	-17.3	184
118.8	4.14e+4	-11.3	184
124.0	3.58e+4	-15.9	184
563.4	1.87e+4	-4.1	190
590.3	1.69e+4	-3.0	190
619.8	1.50e+4	-3.4	190
652.4	1.30e+4	-4.8	190
688.6	1.12e+4	-5.9	190
729.2	9.71e+3	-6.4	190
774.7	8.39e+3	-5.8	190
826.4	7.11e+3	-5.5	190
885.4	5.91e+3	-6.5	190
946.2	4.89e+3	-8.4	190
999.6	4.22e+3	-8.8	190
1008.0	4.14e+3	-8.4	190
1042.0	3.80e+3	-8.2	190
1087.0	3.42e+3	-7.6	190
1127.0	3.15e+3	-6.3	190
1192.0	2.70e+3	-6.8	190
1252.0	2.35e+3	-7.5	190
1319.0	2.05e+3	-7.0	190
1393.0	1.78e+3	-6.5	190
1476.0	1.45e+3	-11.0	190
1569.0	1.23e+3	-10.5	190
1675.0	1.02e+3	-11.2	190
1796.0	9.00e+2	-4.9	190
1937.0	7.49e+2	-2.2	190
103.3	6.10e+4	-3.6	204
112.7	4.91e+4	-6.2	204
124.0	3.67e+4	-13.7	207

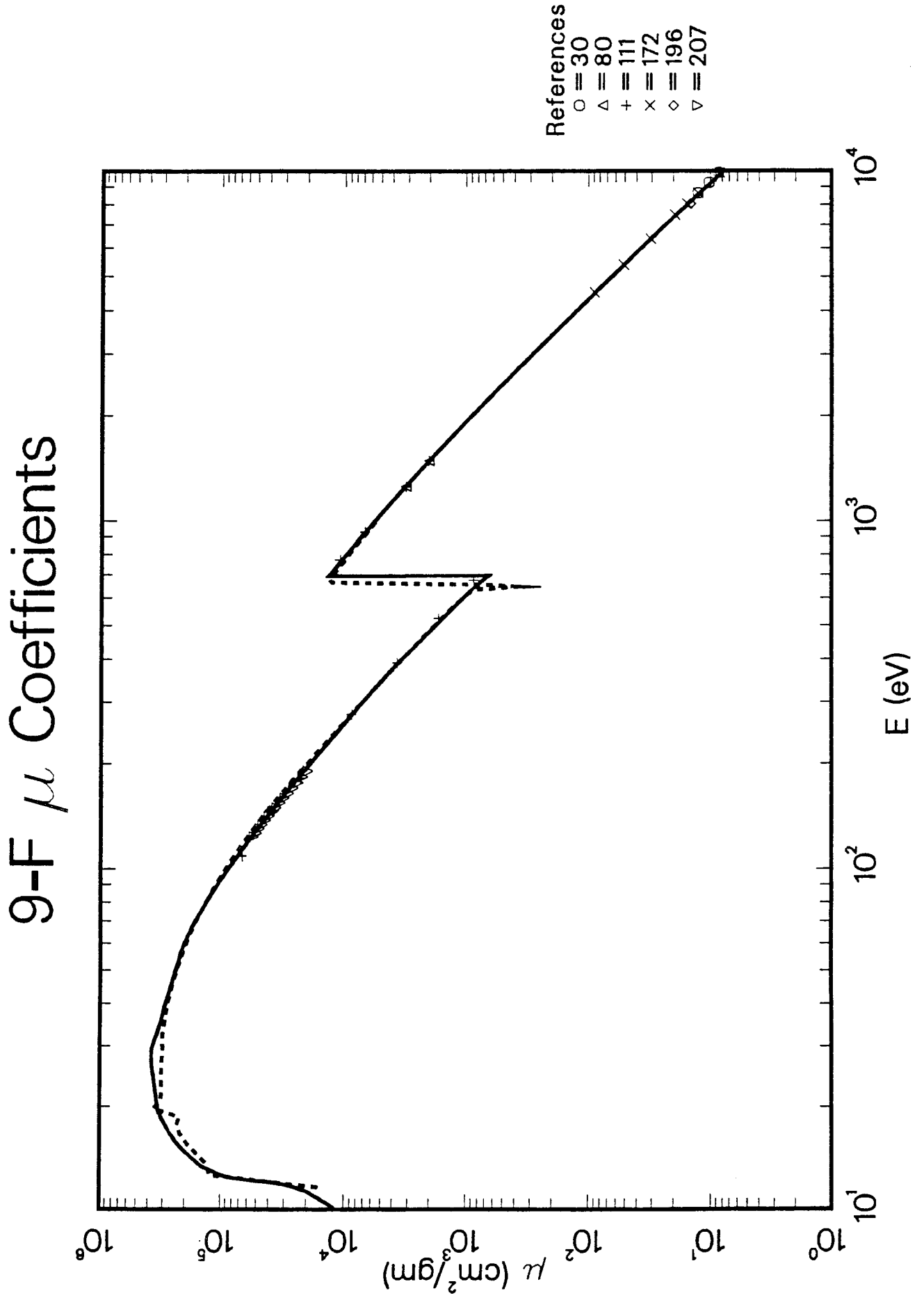
E(eV)	μ(cm^2/g)	% Error	Ref.
130.5	3.29e+4	-13.4	207
138.0	2.94e+4	-13.0	207
146.0	2.60e+4	-13.4	207
155.0	2.26e+4	-14.6	207
165.0	1.92e+4	-17.2	207
177.0	1.60e+4	-19.9	207
191.0	1.34e+4	-18.4	207
207.0	1.11e+4	-15.0	207
225.0	8.39e+3	-18.5	207
248.0	7.41e+3	-6.4	207
103.0	6.21e+4	-2.5	210
113.0	4.93e+4	-5.3	210
124.0	4.01e+4	-5.7	210
138.0	3.16e+4	-6.3	210
155.0	2.43e+4	-8.2	210
177.0	1.71e+4	-14.4	210
207.0	1.20e+4	-7.8	210
506.0	1.69e+3	28.3	212
547.0	2.32e+4	171.1	212
555.0	2.13e+4	5.2	212
563.0	2.09e+4	6.9	212
571.0	2.01e+4	6.4	212
579.0	1.92e+4	5.2	212
600.0	1.73e+4	3.2	212
14.9	1.61e+5	10.2	228
15.0	1.39e+5	-6.1	228
15.5	1.33e+5	-13.8	228
16.2	1.62e+5	-16.9	228
16.4	1.72e+5	-17.0	228
17.3	3.30e+5	19.9	228
17.7	3.12e+5	0.2	228
18.1	3.20e+5	-9.7	228
18.8	4.41e+5	-0.5	228
19.2	4.78e+5	2.1	228
19.3	4.65e+5	-1.8	228
19.5	4.91e+5	1.5	228
19.5	5.05e+5	4.4	228
19.7	4.96e+5	0.5	228
20.0	5.06e+5	1.6	228
21.2	4.97e+5	0.1	228
21.2	4.87e+5	-2.0	228
22.3	4.66e+5	-4.9	228
22.5	4.73e+5	-3.2	228
22.6	4.64e+5	-4.8	228
22.8	4.72e+5	-3.0	228
23.1	4.56e+5	-5.9	228
23.5	4.79e+5	-0.6	228
24.4	4.54e+5	-3.9	228
24.7	4.43e+5	-5.5	228
25.2	4.62e+5	0.0	228
25.5	4.76e+5	3.9	228
25.9	5.87e+5	29.6	228
26.3	4.23e+5	-5.5	228
26.7	4.20e+5	-5.2	228
26.8	4.60e+5	4.0	228

E(eV)	μ(cm^2/g)	% Error	Ref.
27.1	4.61e+5	5.1	228
27.6	4.30e+5	-0.8	228
28.4	4.28e+5	0.9	228
29.8	4.20e+5	2.4	228
30.3	4.15e+5	2.2	228
30.6	4.16e+5	3.2	228
31.3	3.77e+5	-5.0	228
31.8	4.54e+5	15.8	228
33.1	3.75e+5	-1.8	228
35.3	3.53e+5	-3.2	228
36.8	3.18e+5	-9.1	228
37.7	3.27e+5	-3.5	228
40.0	3.00e+5	-4.3	228
40.8	2.90e+5	-5.0	228
41.6	2.82e+5	-5.2	228
42.1	2.71e+5	-7.4	228
44.4	2.67e+5	-1.9	228
47.6	2.35e+5	-5.2	228
48.1	2.27e+5	-7.3	228
49.4	2.29e+5	-2.3	228
53.7	2.06e+5	1.6	228
56.1	1.85e+5	-1.5	228
57.5	1.68e+5	-6.3	228
61.1	1.49e+5	-7.4	228
62.1	1.48e+5	-5.5	228
64.3	1.35e+5	-8.7	228
67.3	1.28e+5	-5.7	228
68.8	1.08e+5	-17.2	228
70.2	9.90e+4	-21.7	228
74.9	9.82e+4	-13.0	228
78.0	7.87e+4	-25.2	228
80.3	7.26e+4	-27.4	228
81.6	8.66e+4	-11.0	228
89.6	6.81e+4	-17.6	228
94.9	7.34e+4	-1.9	228
103.2	5.04e+4	-20.5	228

Atomic Scattering Factors, f_1+if_2
9 - Flourine (F)



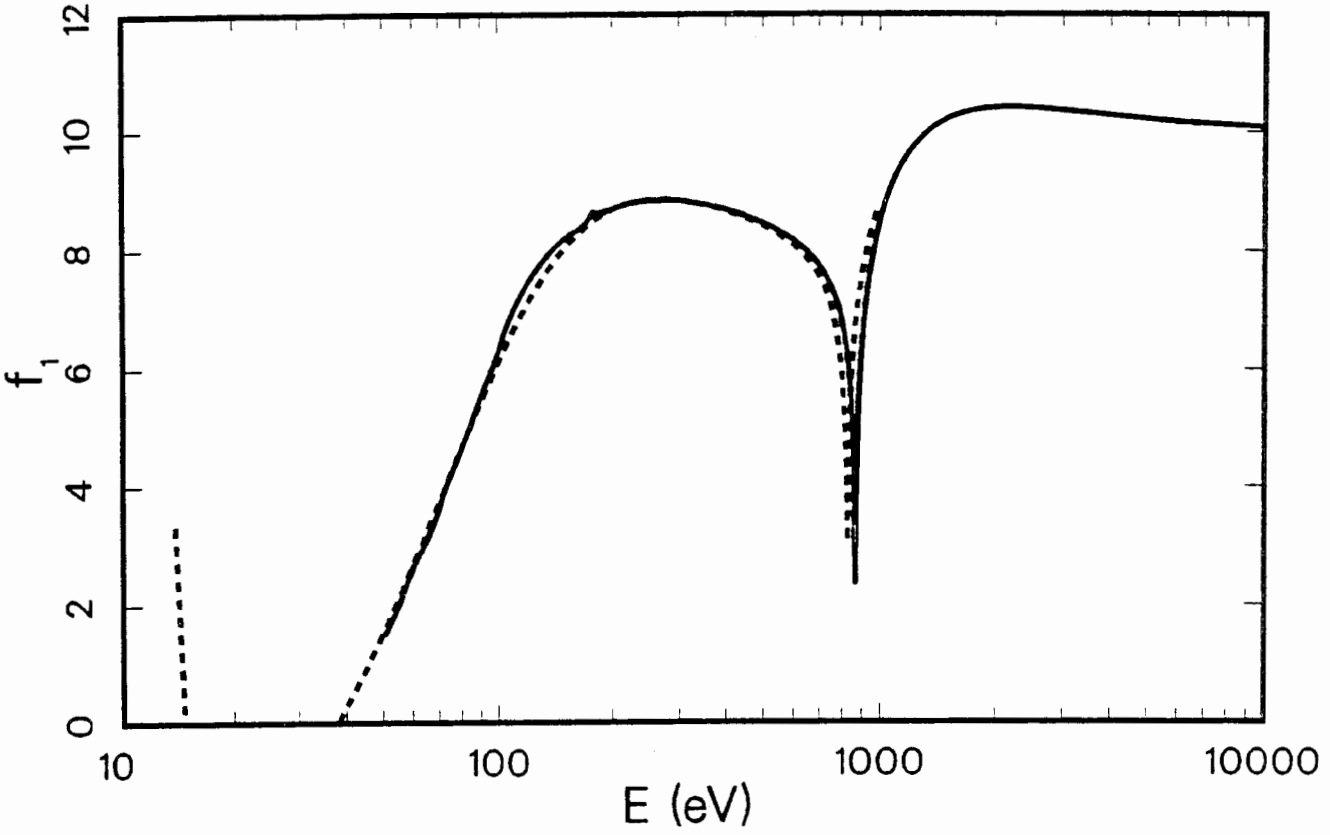


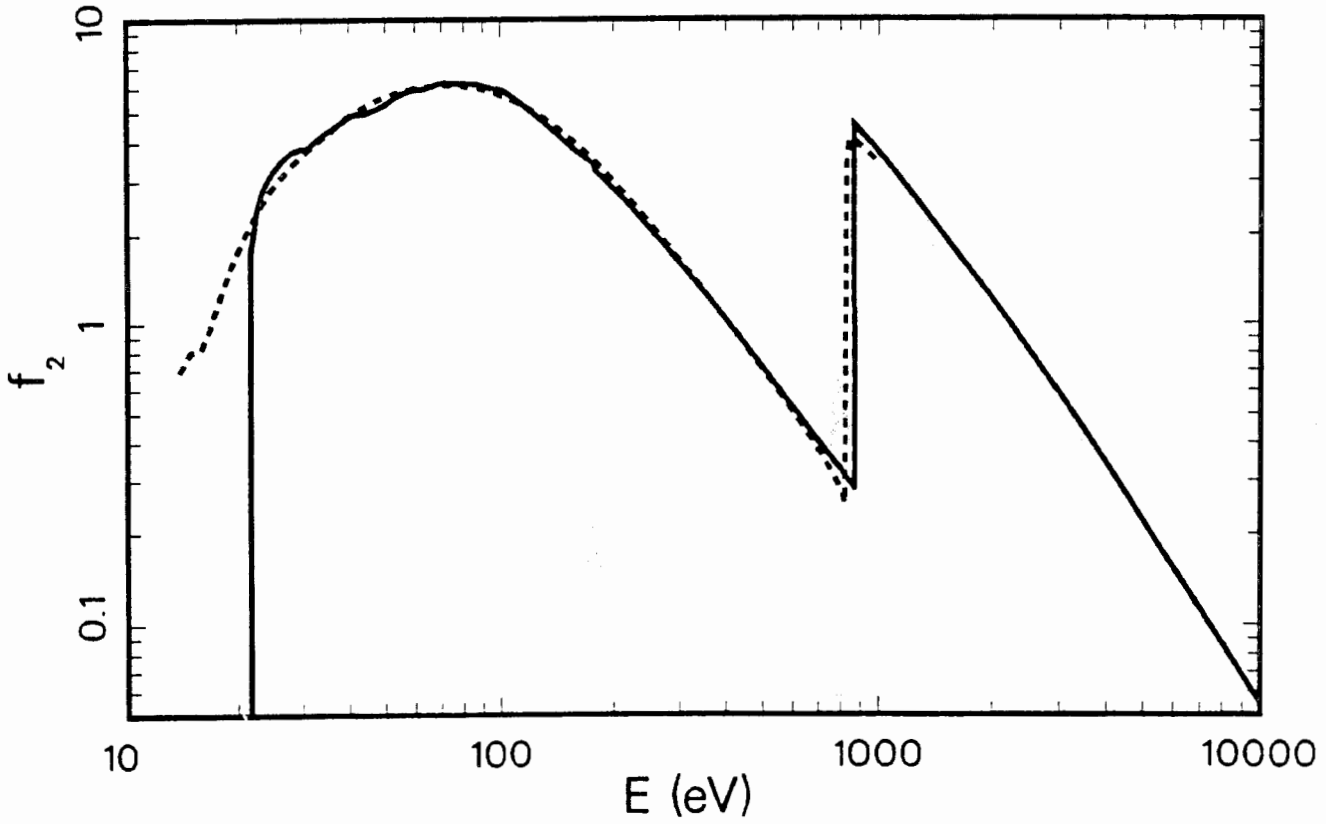

9-F μ Coefficients
References
○ = 30
△ = 80
+ = 111
× = 172
◇ = 196
▽ = 207
μ (cm²/gm)
E (eV)
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

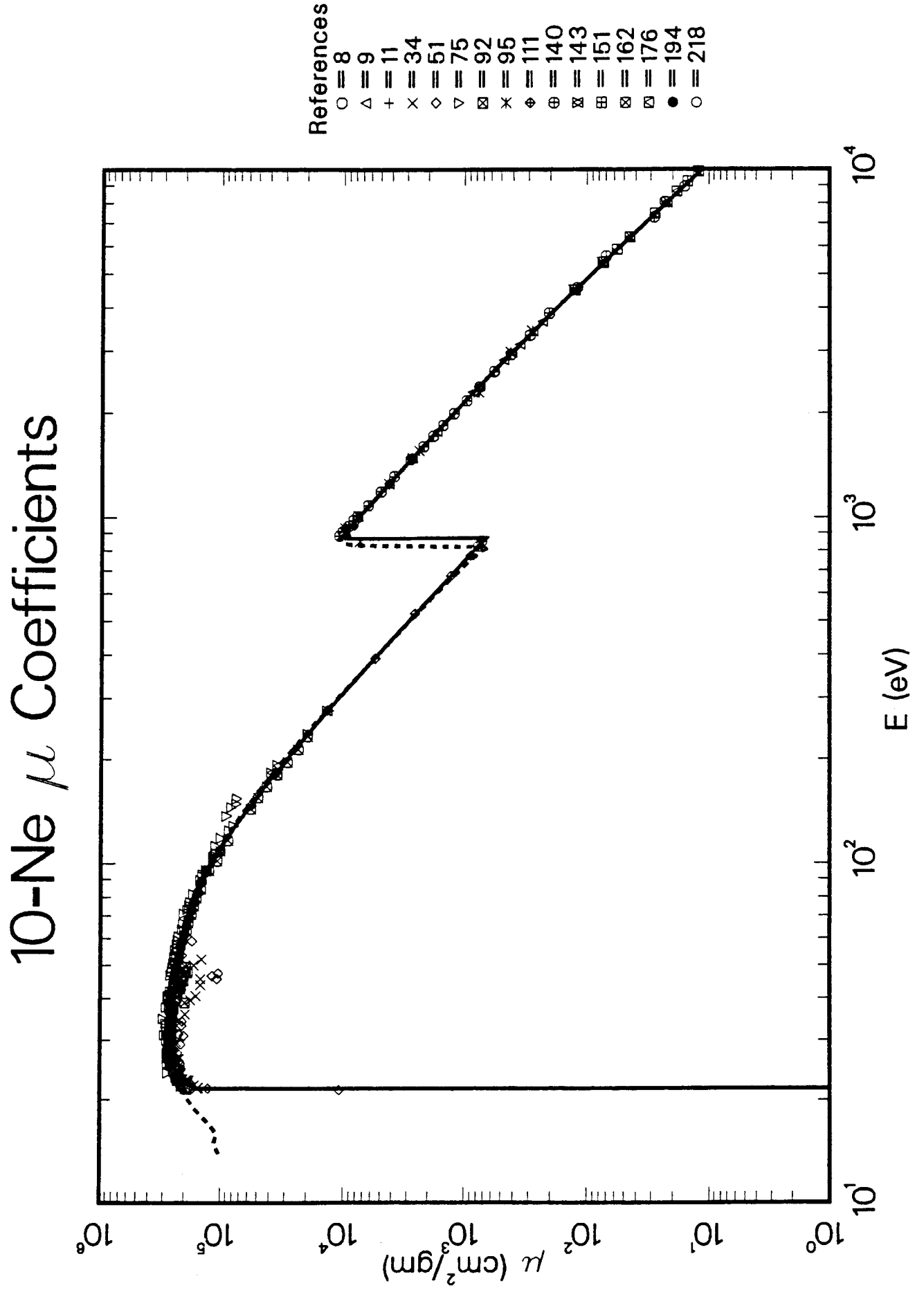
Flourine (F) — 9
Atomic Weight = 19.00
μ (barns/atom) = $\mu(cm^2/g) \times 31.55$
$E\mu(E) = 2214.8\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8638.0	1.26e+1	3.6	30
9251.0	1.02e+1	4.2	30
9885.0	8.56e+0	7.2	30
1256.0	3.14e+3	-0.8	80
1487.0	2.03e+3	0.5	80
108.9	6.69e+4	-8.5	111
147.2	3.66e+4	-4.5	111
182.6	2.25e+4	-4.4	111
278.0	8.78e+3	1.3	111
391.4	3.70e+3	1.9	111
526.0	1.70e+3	8.8	111
676.8	8.69e+2	19.3	111
774.9	1.10e+4	4.5	111
928.7	6.85e+3	0.4	111
1254.0	3.14e+3	-1.1	111
1487.0	2.03e+3	0.2	111
4508.0	8.89e+1	1.3	172
5411.0	5.12e+1	0.8	172
6400.0	3.10e+1	1.3	172
7472.0	1.94e+1	2.1	172
8041.0	1.56e+1	2.7	172
8631.0	1.26e+1	3.8	172
9876.0	8.38e+0	4.7	172
8048.0	1.45e+1	-4.2	196
124.0	5.36e+4	-3.9	207
127.0	5.07e+4	-4.3	207
130.5	4.82e+4	-3.7	207
134.0	4.53e+4	-4.0	207
138.0	4.28e+4	-3.2	207
142.0	4.03e+4	-3.0	207
146.0	3.77e+4	-3.3	207
150.0	3.52e+4	-4.3	207
155.0	3.26e+4	-4.5	207
160.0	3.03e+4	-4.9	207
165.0	2.80e+4	-5.8	207
171.0	2.57e+4	-6.0	207
177.0	2.36e+4	-6.8	207
184.0	2.17e+4	-6.3	207
191.0	1.98e+4	-6.6	207

Atomic Scattering Factors, f_1+if_2
10 - Neon (Ne)






10-Ne μ Coefficients
References
8
9
11
34
51
75
92
95
111
140
143
151
162
176
194
218
μ (cm²/gm)
E (eV)
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Neon (Ne) — 10
Atomic Weight = 20.18
μ (barns/atom) = μ(cm^2/g) × 33.51
Eμ(E) = 2085.2 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
5420.0	7.52e+1	3.8	8
8060.0	2.32e+1	5.6	8
8930.0	1.59e+1	-0.8	8
1254.0	4.31e+3	0.5	9
1487.0	2.75e+3	0.0	9
1778.0	1.73e+3	1.3	9
2293.0	8.65e+2	1.5	9
2395.0	7.63e+2	1.0	9
2838.0	4.78e+2	1.6	9
2984.0	4.16e+2	1.9	9
3151.0	3.56e+2	1.7	9
3444.0	2.79e+2	2.6	9
3662.0	2.31e+2	1.3	9
5414.0	7.49e+1	3.1	9
277.0	1.31e+4	-3.4	11
21.6	1.55e+5	9613.5	34
21.7	1.51e+5	1421.7	34
22.1	1.63e+5	-16.1	34
22.3	1.91e+5	-7.5	34
22.3	1.85e+5	-10.2	34
22.5	1.85e+5	-15.4	34
22.8	1.81e+5	-22.5	34
22.8	1.89e+5	-19.2	34
22.9	1.89e+5	-20.1	34
22.9	1.90e+5	-19.6	34
23.0	2.09e+5	-12.6	34
23.0	2.02e+5	-15.4	34
23.9	2.09e+5	-18.5	34
24.4	2.13e+5	-18.7	34
25.3	2.17e+5	-19.6	34
25.7	2.20e+5	-19.1	34
26.4	2.17e+5	-21.4	34
26.9	2.20e+5	-20.2	34
29.7	2.33e+5	-12.7	34
34.5	2.20e+5	-14.7	34
35.9	1.97e+5	-23.2	34
39.5	1.78e+5	-29.8	34
40.7	1.60e+5	-35.9	34
43.8	1.47e+5	-37.6	34
45.7	1.47e+5	-36.1	34
50.2	1.67e+5	-24.7	34
52.1	1.44e+5	-34.5	34
21.4	1.07e+4	26344.0	51
21.6	1.26e+5	7791.7	51
22.4	1.78e+5	-16.6	51
23.2	2.14e+5	-12.3	51
23.5	2.41e+5	-3.6	51
24.3	2.17e+5	-17.1	51
24.7	2.12e+5	-20.2	51
25.6	2.14e+5	-21.1	51

E(eV)	μ(cm^2/g)	% Error	Ref.
26.2	2.38e+5	-13.3	51
27.3	2.24e+5	-18.9	51
27.6	2.77e+5	0.3	51
27.7	2.47e+5	-10.3	51
28.1	2.44e+5	-11.5	51
29.2	2.13e+5	-21.0	51
30.0	2.38e+5	-9.9	51
30.9	2.02e+5	-21.9	51
31.3	2.22e+5	-13.9	51
32.0	2.44e+5	-5.6	51
33.2	2.10e+5	-18.9	51
34.2	2.09e+5	-19.1	51
34.7	2.47e+5	-4.2	51
36.0	2.58e+5	0.7	51
37.9	2.64e+5	3.8	51
39.7	2.63e+5	4.1	51
43.9	2.08e+5	-11.2	51
45.7	1.07e+5	-53.2	51
46.6	1.17e+5	-48.3	51
47.5	1.05e+5	-53.5	51
50.5	2.09e+5	-5.3	51
51.8	2.27e+5	3.2	51
53.6	2.09e+5	-4.1	51
55.6	2.32e+5	7.6	51
59.0	1.72e+5	-17.1	51
21.9	2.11e+5	15.3	75
24.0	2.74e+5	6.1	75
25.3	2.54e+5	-5.6	75
25.6	2.76e+5	1.8	75
26.5	2.65e+5	-3.8	75
26.7	2.73e+5	-1.1	75
27.4	2.78e+5	1.0	75
28.1	2.73e+5	-0.9	75
30.0	2.81e+5	6.3	75
31.1	2.92e+5	13.1	75
32.0	2.82e+5	9.0	75
32.6	2.79e+5	7.7	75
33.7	2.85e+5	10.2	75
34.8	3.01e+5	16.8	75
37.6	2.83e+5	11.1	75
38.3	2.68e+5	5.5	75
39.8	2.70e+5	7.0	75
40.4	2.76e+5	10.3	75
40.6	2.59e+5	3.7	75
40.7	2.69e+5	7.9	75
41.0	2.59e+5	4.1	75
41.9	2.63e+5	7.2	75
46.7	2.62e+5	15.3	75
48.0	2.54e+5	13.2	75
49.2	2.52e+5	13.4	75

E(eV)	μ(cm^2/g)	% Error	Ref.
50.6	2.49e+5	12.7	75
51.1	2.40e+5	8.5	75
51.3	2.35e+5	6.5	75
52.7	2.43e+5	10.7	75
53.8	2.34e+5	7.5	75
55.5	2.39e+5	10.9	75
56.5	2.29e+5	6.9	75
57.6	2.32e+5	9.5	75
59.4	2.28e+5	10.2	75
61.0	2.25e+5	11.3	75
63.2	2.02e+5	2.8	75
63.9	2.10e+5	7.9	75
66.6	2.04e+5	7.3	75
71.3	2.02e+5	11.4	75
73.3	1.90e+5	8.0	75
74.3	1.83e+5	5.3	75
75.7	1.83e+5	7.4	75
77.4	1.79e+5	7.4	75
81.7	1.69e+5	7.1	75
89.4	1.48e+5	4.2	75
91.7	1.42e+5	3.5	75
93.0	1.41e+5	4.9	75
95.4	1.32e+5	1.3	75
104.2	1.16e+5	0.8	75
105.2	1.13e+5	0.3	75
107.0	1.10e+5	1.2	75
112.2	1.11e+5	11.5	75
118.3	1.01e+5	12.4	75
124.5	8.59e+4	6.1	75
128.4	7.88e+4	3.4	75
137.1	8.98e+4	35.1	75
145.3	8.21e+4	39.6	75
148.6	7.52e+4	34.2	75
153.9	7.43e+4	42.8	75
21.5	1.88e+5	73247.0	92
21.6	1.96e+5	12141.0	92
21.9	2.01e+5	10.0	92
22.1	2.05e+5	5.5	92
22.3	2.07e+5	0.2	92
22.4	2.12e+5	-0.3	92
22.7	2.18e+5	-5.8	92
22.8	2.27e+5	-2.6	92
23.0	2.22e+5	-7.3	92
23.1	2.21e+5	-8.6	92
23.1	2.29e+5	-5.4	92
23.3	2.34e+5	-5.1	92
23.4	2.27e+5	-8.3	92
23.5	2.32e+5	-7.3	92
23.7	2.34e+5	-7.6	92
23.8	2.36e+5	-7.5	92
24.2	2.37e+5	-8.8	92
24.4	2.42e+5	-7.8	92
24.7	2.45e+5	-7.5	92
25.0	2.46e+5	-8.0	92
25.2	2.51e+5	-6.6	92

E(eV)	μ(cm^2/g)	% Error	Ref.
25.3	2.55e+5	-5.2	92
25.6	2.61e+5	-3.9	92
25.6	2.58e+5	-4.7	92
25.7	2.53e+5	-6.9	92
25.9	2.55e+5	-6.6	92
26.2	2.59e+5	-5.5	92
26.3	2.56e+5	-6.9	92
26.5	2.58e+5	-6.5	92
26.7	2.57e+5	-6.6	92
27.0	2.63e+5	-4.7	92
27.3	2.54e+5	-7.7	92
27.4	2.63e+5	-4.7	92
27.6	2.63e+5	-4.5	92
27.8	2.64e+5	-4.1	92
27.9	2.61e+5	-5.5	92
28.0	2.66e+5	-3.5	92
28.3	2.65e+5	-3.2	92
28.6	2.66e+5	-2.3	92
29.0	2.69e+5	-0.8	92
29.2	2.64e+5	-2.0	92
29.7	2.66e+5	-0.3	92
30.1	2.66e+5	1.0	92
30.3	2.67e+5	1.8	92
30.5	2.66e+5	2.0	92
30.8	2.57e+5	-0.6	92
31.0	2.61e+5	1.0	92
31.1	2.72e+5	5.3	92
31.1	2.66e+5	2.9	92
31.5	2.63e+5	1.9	92
31.8	2.61e+5	0.9	92
31.9	2.64e+5	2.0	92
32.4	2.61e+5	0.9	92
33.0	2.63e+5	1.7	92
33.1	2.58e+5	-0.4	92
33.6	2.57e+5	-0.7	92
34.1	2.58e+5	-0.2	92
34.7	2.54e+5	-1.5	92
35.1	2.53e+5	-1.7	92
35.6	2.52e+5	-1.8	92
36.1	2.52e+5	-1.3	92
36.3	2.54e+5	-0.5	92
37.3	2.47e+5	-3.1	92
37.6	2.46e+5	-3.4	92
38.0	2.53e+5	-0.5	92
38.8	1.98e+5	-21.8	92
38.8	1.98e+5	-21.8	92
39.5	2.40e+5	-5.0	92
40.2	2.34e+5	-6.7	92
41.5	2.29e+5	-7.3	92
42.8	2.16e+5	-9.8	92
43.4	2.19e+5	-7.2	92
43.6	2.14e+5	-9.2	92
44.0	2.13e+5	-9.2	92
45.1	2.02e+5	-12.6	92
45.8	2.09e+5	-8.7	92

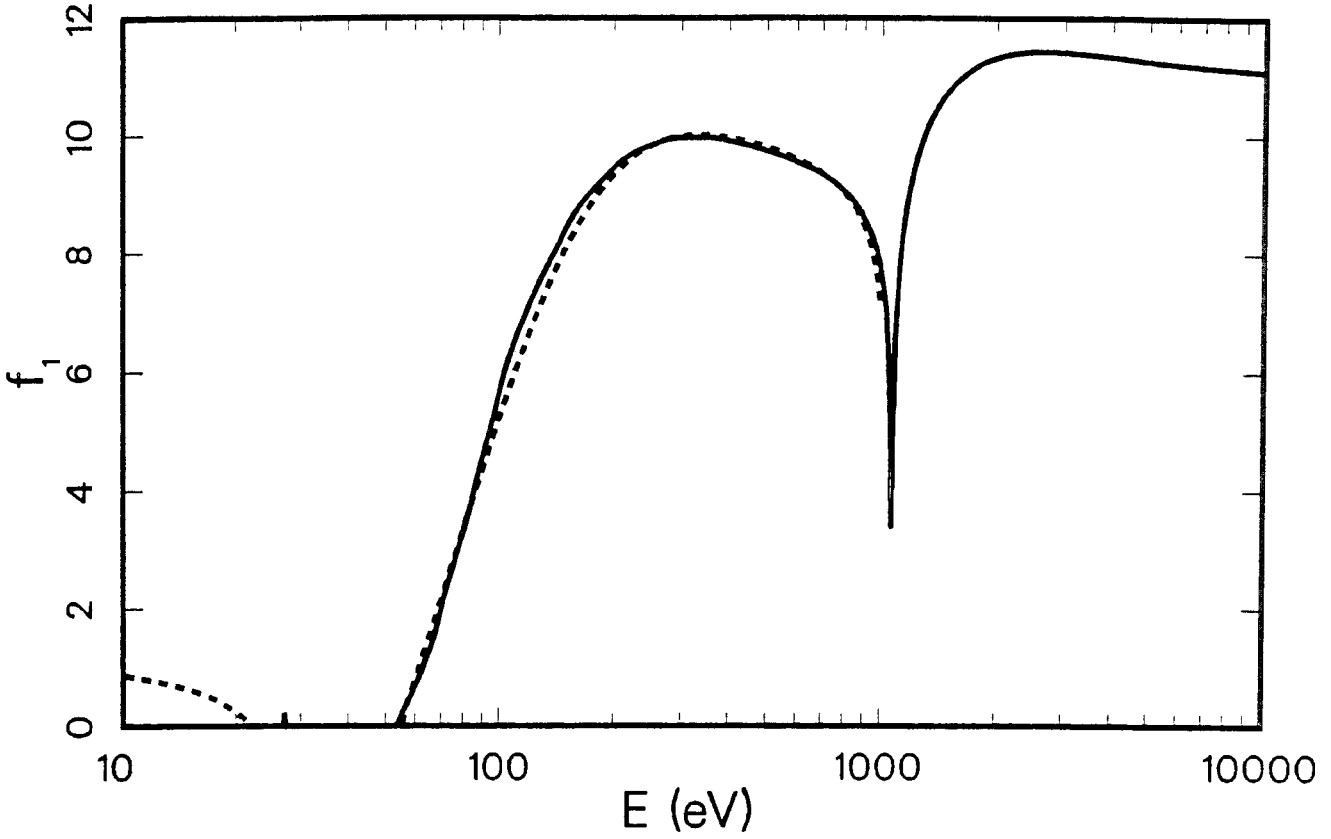
E(eV)	μ(cm^2/g)	% Error	Ref.
46.8	2.04e+5	-10.3	92
47.7	1.88e+5	-16.3	92
48.0	1.95e+5	-13.3	92
49.4	1.95e+5	-12.1	92
852.0	7.46e+3	944.8	95
930.0	9.82e+3	7.0	95
1012.0	7.70e+3	3.3	95
1254.0	4.33e+3	0.9	95
1487.0	2.75e+3	0.2	95
1557.0	2.42e+3	-0.6	95
2293.0	7.70e+2	-9.6	95
2984.0	4.21e+2	3.0	95
3444.0	2.82e+2	3.7	95
4511.0	1.30e+2	4.5	95
5415.0	7.61e+1	4.8	95
6404.0	4.48e+1	1.7	95
8048.0	2.20e+1	-0.2	95
108.9	1.02e+5	-3.2	111
147.2	5.68e+4	-0.6	111
182.6	3.59e+4	0.5	111
278.0	1.36e+4	1.5	111
391.4	5.54e+3	-1.8	111
526.0	2.60e+3	1.3	111
676.8	1.31e+3	0.6	111
774.9	8.98e+2	-2.5	111
928.7	9.76e+3	5.9	111
1254.0	4.31e+3	0.5	111
1487.0	2.78e+3	1.0	111
825.0	7.73e+2	-0.7	140
853.0	7.28e+2	2.3	140
884.0	1.10e+4	5.6	140
910.0	1.02e+4	5.4	140
944.0	9.25e+3	4.6	140
982.0	8.36e+3	4.1	140
1006.0	7.82e+3	3.4	140
1085.0	6.39e+3	2.6	140
1190.0	5.01e+3	2.2	140
1316.0	3.88e+3	2.6	140
1473.0	2.84e+3	0.8	140
1607.0	2.21e+3	-1.2	140
1718.0	1.84e+3	-1.4	140
1846.0	1.53e+3	-0.8	140
1995.0	1.24e+3	-1.0	140
2170.0	9.67e+2	-2.5	140
2379.0	7.55e+2	-1.9	140
2632.0	5.73e+2	-1.4	140
2945.0	4.19e+2	-1.1	140
3343.0	2.94e+2	-0.7	140
3866.0	2.04e+2	4.6	140
4582.0	1.20e+2	0.9	140
5623.0	6.98e+1	7.5	140
7277.0	2.83e+1	-5.5	140
183.4	3.91e+4	10.5	143
192.6	3.46e+4	9.0	143
236.9	1.99e+4	0.8	143

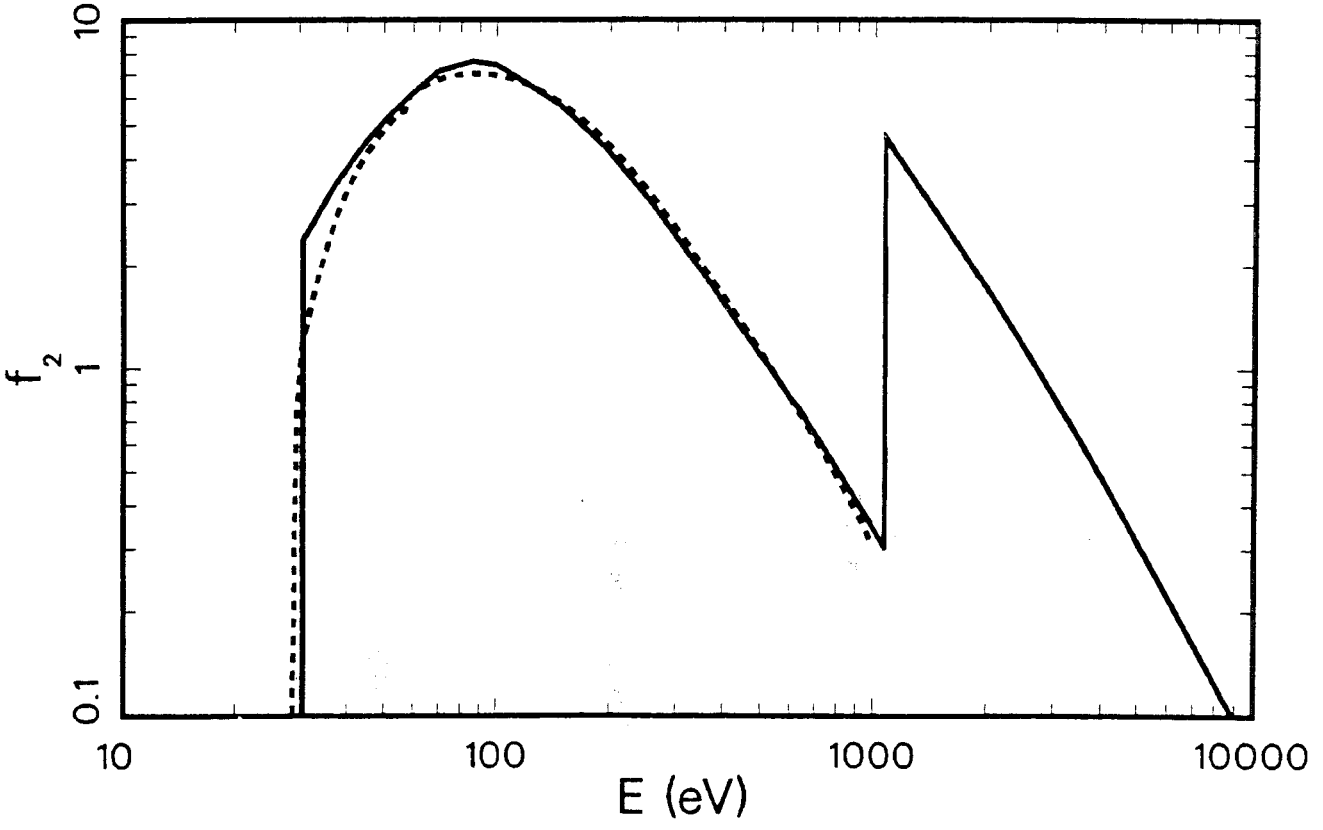
E(eV)	μ(cm^2/g)	% Error	Ref.
277.0	1.37e+4	1.0	143
4508.0	1.25e+2	0.2	151
5895.0	5.70e+1	1.1	151
9243.0	1.50e+1	4.1	151
63.1	1.91e+5	-2.8	162
66.8	1.86e+5	-2.2	162
70.7	1.75e+5	-4.7	162
74.9	1.67e+5	-3.0	162
79.3	1.59e+5	-2.2	162
84.3	1.46e+5	-4.3	162
95.5	1.26e+5	-3.2	162
101.7	1.07e+5	-10.3	162
108.6	1.01e+5	-4.5	162
116.3	8.79e+4	-5.4	162
143.5	5.75e+4	-4.7	162
154.9	5.00e+4	-2.6	162
166.9	4.24e+4	-4.4	162
180.8	3.50e+4	-4.1	162
196.2	2.89e+4	-5.3	162
213.6	2.38e+4	-6.1	162
233.2	1.98e+4	-3.7	162
4508.0	1.27e+2	1.5	176
5411.0	7.38e+1	1.4	176
6400.0	4.50e+1	2.0	176
7472.0	2.80e+1	1.4	176
8041.0	2.24e+1	1.3	176
8631.0	1.85e+1	4.2	176
9876.0	1.22e+1	4.2	176
21.6	1.85e+5	11478.0	194
21.8	1.89e+5	209.5	194
22.1	1.96e+5	1.0	194
23.0	2.10e+5	-11.9	194
23.8	2.23e+5	-12.4	194
24.8	2.34e+5	-12.3	194
25.8	2.43e+5	-10.7	194
27.0	2.51e+5	-8.8	194
28.2	2.58e+5	-6.1	194
29.5	2.63e+5	-2.1	194
31.0	2.66e+5	3.0	194
32.6	2.67e+5	3.3	194
34.4	2.67e+5	3.6	194
36.5	2.65e+5	3.9	194
38.7	2.62e+5	3.2	194
41.3	2.56e+5	3.4	194
42.8	2.53e+5	5.4	194
44.3	2.49e+5	6.7	194
45.9	2.44e+5	6.7	194
47.7	2.40e+5	6.5	194
49.6	2.34e+5	5.8	194
51.7	2.29e+5	3.7	194
53.9	2.22e+5	2.0	194
56.4	2.16e+5	0.7	194
59.0	2.08e+5	0.1	194
62.0	2.01e+5	0.9	194
65.3	1.92e+5	-0.1	194

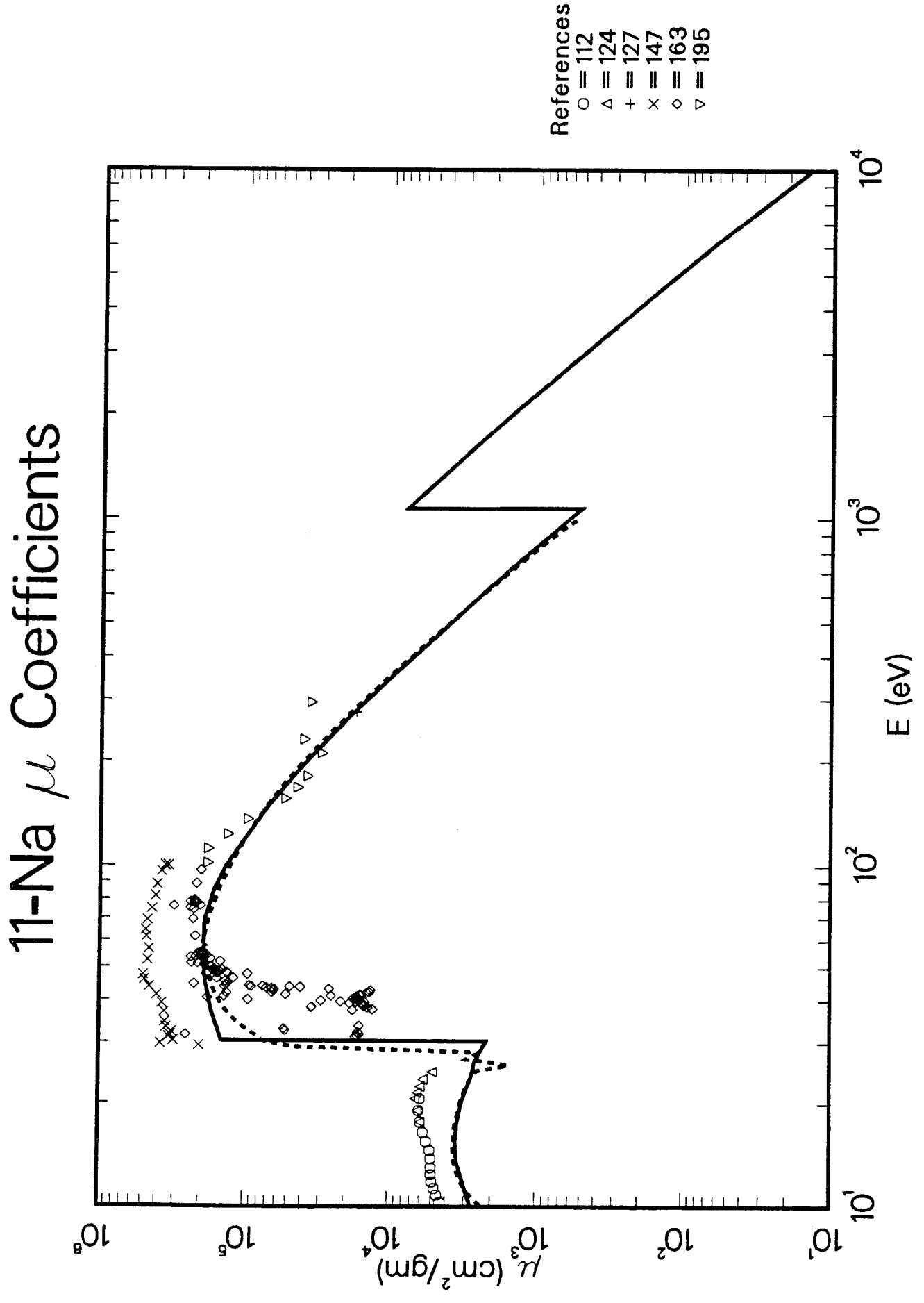
Neon (Ne) — 10

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
68.9	1.84e+5	-1.8	194
72.9	1.74e+5	-1.6	194
77.5	1.65e+5	-0.8	194
82.7	1.54e+5	-0.7	194
88.6	1.44e+5	0.0	194
95.4	1.32e+5	1.6	194
22.2	2.03e+5	1.4	218
22.3	2.04e+5	-1.0	218
22.4	2.06e+5	-3.4	218
22.5	2.07e+5	-5.8	218
22.6	2.09e+5	-7.5	218
22.8	2.12e+5	-9.2	218
23.0	2.15e+5	-9.8	218
23.5	2.24e+5	-10.1	218
23.7	2.27e+5	-10.5	218
23.7	2.25e+5	-10.9	218
24.0	2.31e+5	-10.4	218
24.1	2.32e+5	-10.4	218
24.4	2.35e+5	-10.2	218
24.9	2.41e+5	-9.7	218
25.2	2.43e+5	-9.5	218
25.4	2.45e+5	-9.1	218
26.2	2.51e+5	-8.6	218
26.3	2.53e+5	-7.9	218
26.5	2.54e+5	-7.7	218
26.7	2.55e+5	-7.3	218
27.0	2.58e+5	-6.6	218
27.5	2.61e+5	-5.3	218
28.4	2.64e+5	-3.4	218
29.8	2.68e+5	0.5	218
30.3	2.70e+5	3.0	218

Atomic Scattering Factors, f_1+if_2
11 - Sodium (Na)






11-Na μ Coefficients
References
○ = 112
△ = 124
+ = 127
× = 147
◇ = 163
▽ = 195
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴

Sodium (Na) — 11

Atomic Weight = 22.99

μ (barns/atom) = $\mu(cm^2/g) \times 38.18$

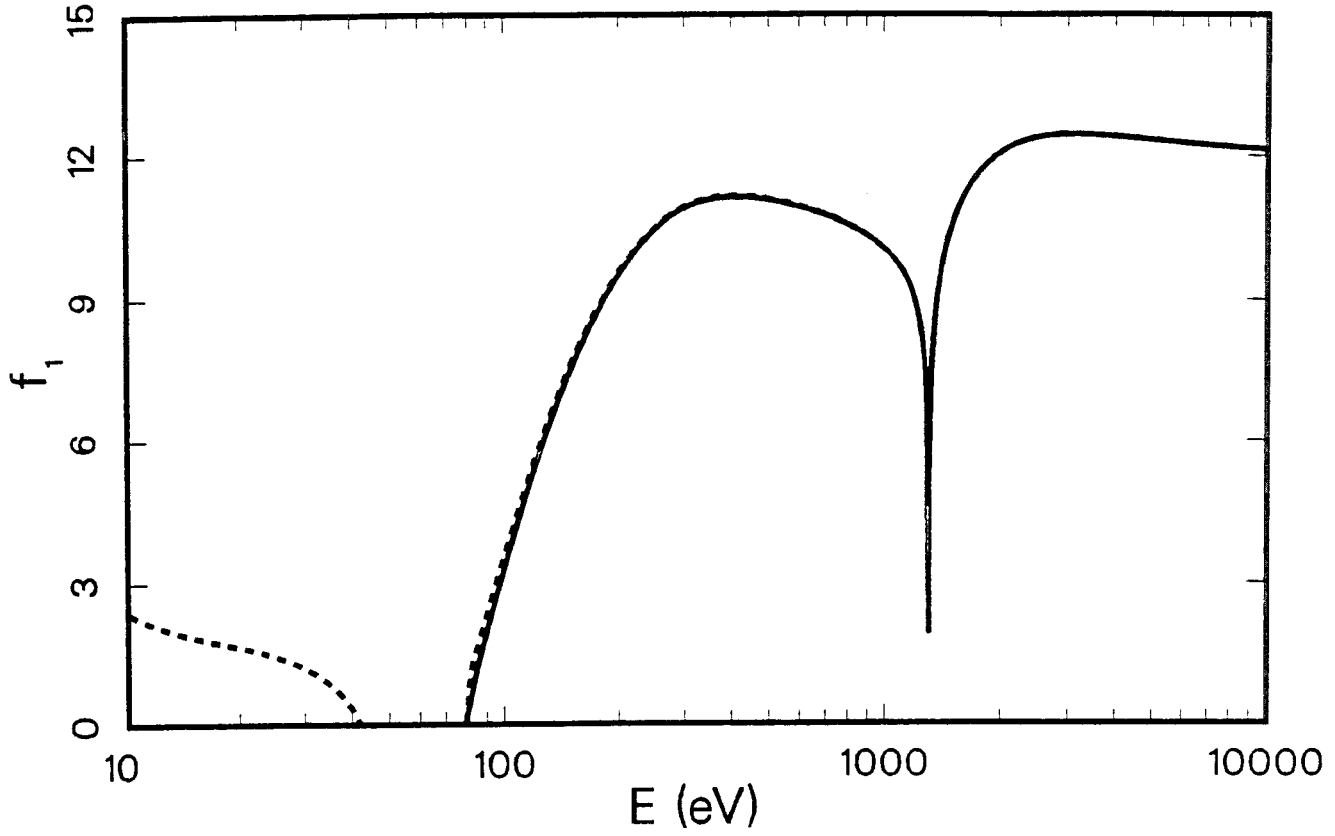
$E\mu(E) = 1830.3\, f_2$ keV cm^2/g

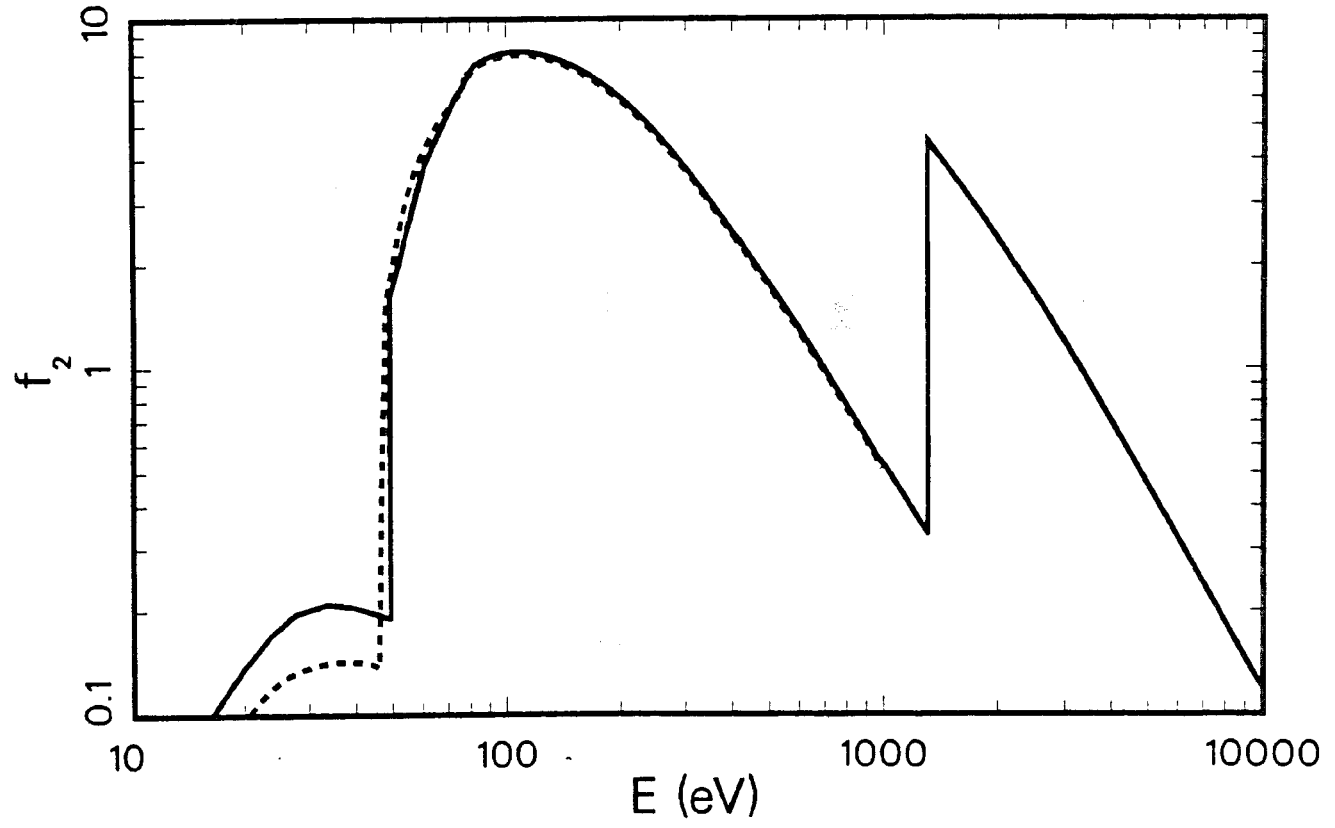
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
10.3	4.35e+3	57.6	112
10.8	4.58e+3	60.5	112
11.3	4.77e+3	61.5	112
11.8	4.95e+3	62.5	112
12.4	5.00e+3	58.4	112
13.0	5.03e+3	53.8	112
13.8	5.06e+3	49.2	112
14.6	5.11e+3	49.5	112
15.5	5.42e+3	57.5	112
16.5	5.74e+3	68.6	112
17.7	6.02e+3	79.5	112
19.1	6.13e+3	90.0	112
20.7	6.02e+3	95.5	112
17.7	6.02e+3	79.5	124
19.1	6.29e+3	94.9	124
20.7	6.55e+3	112.5	124
21.6	6.29e+3	111.7	124
22.5	6.02e+3	110.1	124
23.6	5.76e+3	109.5	124
24.8	4.98e+3	87.1	124
277.0	1.73e+4	-3.3	127
29.5	2.01e+5	2971.2	147
29.8	3.71e+5	4065.3	147
30.5	3.02e+5	1574.8	147
31.2	3.25e+5	804.5	147
31.7	3.18e+5	446.4	147
32.3	3.13e+5	203.9	147
33.3	3.40e+5	121.8	147
34.5	3.46e+5	119.5	147
36.9	3.50e+5	110.2	147
39.2	3.64e+5	111.6	147
41.4	3.97e+5	125.1	147
43.8	4.47e+5	146.8	147
45.9	4.82e+5	160.8	147
47.5	4.93e+5	164.6	147
52.4	4.58e+5	142.0	147
56.7	4.51e+5	137.8	147
61.6	4.68e+5	147.2	147
64.3	4.76e+5	151.9	147
69.0	4.62e+5	145.5	147
74.9	4.32e+5	142.3	147
81.6	4.07e+5	142.3	147
88.2	3.98e+5	153.5	147
96.3	3.71e+5	161.7	147
100.0	3.32e+5	145.2	147
100.0	3.49e+5	157.5	147
31.4	1.69e+4	-61.2	163
31.6	1.65e+4	-68.8	163
31.7	2.49e+5	327.0	163
31.7	2.49e+5	327.1	163

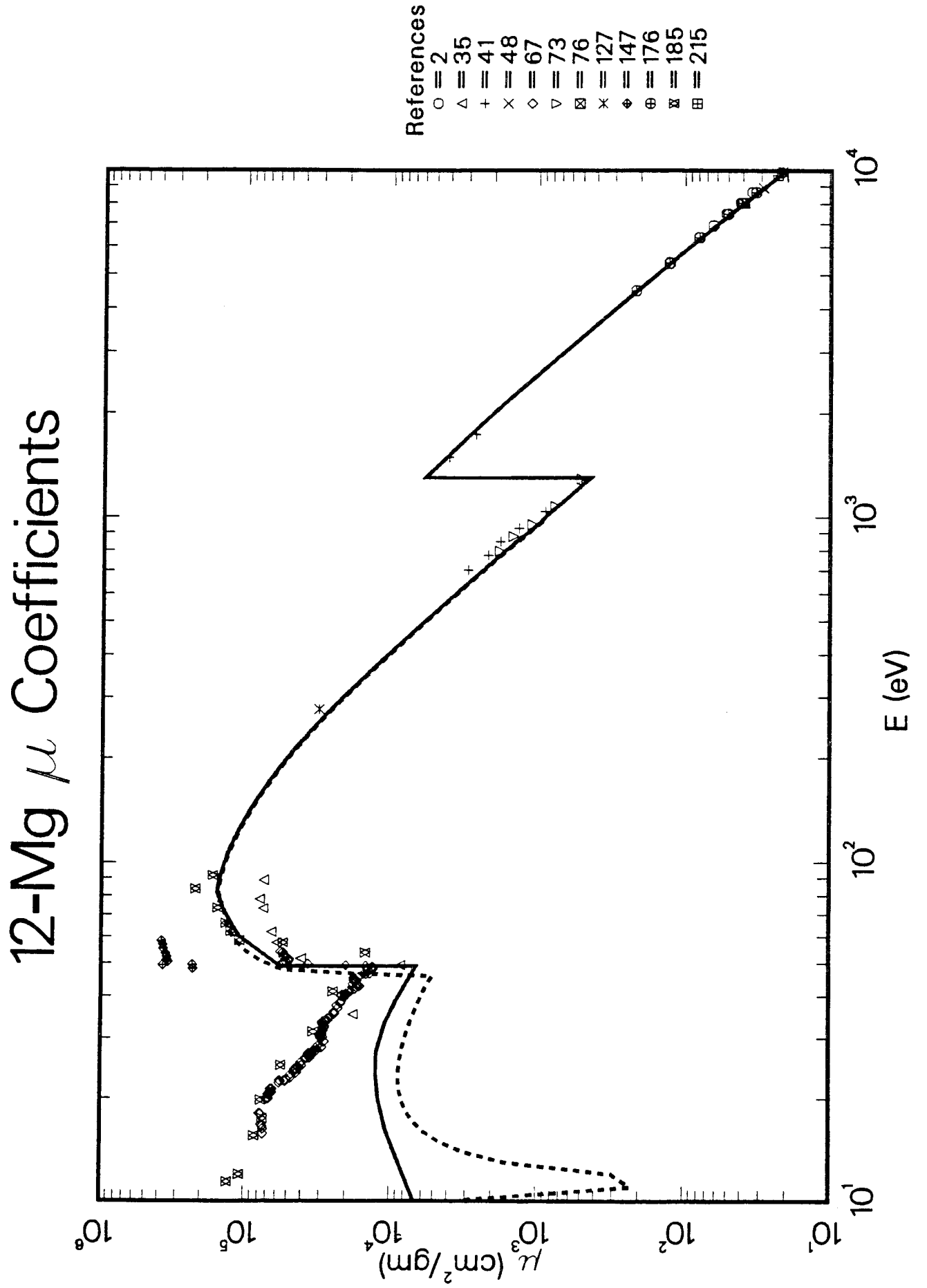
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
31.9	1.59e+4	-77.4	163
31.9	1.59e+4	-77.4	163
32.3	1.62e+4	-84.2	163
32.6	5.17e+4	-62.1	163
33.0	5.28e+4	-65.3	163
33.7	1.60e+4	-89.7	163
37.5	1.77e+4	-89.5	163
37.7	1.30e+4	-92.3	163
38.1	1.40e+4	-91.8	163
38.3	3.43e+4	-79.8	163
38.4	3.41e+4	-80.0	163
38.4	3.40e+4	-80.0	163
38.4	3.41e+4	-80.0	163
38.5	1.49e+4	-91.3	163
39.1	1.49e+4	-91.3	163
39.3	1.86e+4	-89.2	163
39.5	1.46e+4	-91.6	163
39.6	1.68e+4	-90.3	163
39.8	2.15e+4	-87.6	163
40.0	1.61e+4	-90.7	163
40.0	2.94e+4	-83.1	163
40.2	9.40e+4	-46.0	163
40.3	1.67e+4	-90.4	163
40.6	1.76e+4	-89.9	163
40.7	1.78e+5	1.6	163
40.7	1.66e+4	-90.5	163
41.1	1.37e+5	-21.9	163
41.2	1.67e+4	-90.5	163
41.3	2.50e+4	-85.8	163
41.4	1.56e+4	-91.1	163
41.7	5.16e+4	-70.9	163
41.7	1.58e+4	-91.1	163
42.0	1.32e+5	-26.0	163
42.2	1.42e+4	-92.0	163
42.3	6.45e+4	-63.8	163
42.3	1.36e+4	-92.4	163
42.8	6.28e+4	-65.0	163
42.9	1.34e+4	-92.6	163
43.2	6.21e+4	-65.5	163
43.3	2.61e+4	-85.6	163
43.5	6.49e+4	-64.1	163
43.6	6.98e+4	-61.4	163
43.8	4.08e+4	-77.5	163
43.9	4.82e+4	-73.4	163
43.9	8.93e+4	-50.8	163
44.0	1.37e+5	-24.8	163
44.1	7.46e+4	-59.0	163
44.2	9.25e+4	-49.2	163
44.4	1.33e+5	-27.0	163
44.7	2.19e+5	19.9	163

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
45.0	1.31e+5	-28.9	163
45.5	1.34e+5	-27.2	163
46.3	1.54e+5	-16.8	163
46.5	1.19e+5	-36.1	163
47.7	1.81e+5	-2.9	163
47.8	9.53e+4	-48.9	163
48.0	1.54e+5	-17.6	163
48.3	1.32e+5	-29.3	163
48.4	1.55e+5	-17.1	163
48.6	1.54e+5	-17.6	163
48.6	1.48e+5	-21.1	163
48.8	1.48e+5	-20.8	163
49.1	1.64e+5	-12.4	163
49.1	1.42e+5	-24.1	163
49.2	1.58e+5	-15.8	163
50.3	1.68e+5	-11.0	163
51.0	1.88e+5	-0.5	163
51.4	2.07e+5	9.2	163
51.6	2.29e+5	21.1	163
52.0	1.46e+5	-22.7	163
52.9	1.70e+5	-10.1	163
53.5	2.30e+5	21.6	163
53.7	2.13e+5	12.4	163
54.0	1.96e+5	3.4	163
54.2	1.80e+5	-5.0	163
54.4	1.92e+5	1.5	163
54.8	1.97e+5	3.8	163
54.9	2.07e+5	9.2	163
55.0	1.87e+5	-1.3	163
55.3	1.98e+5	4.5	163
61.7	2.16e+5	14.0	163
69.4	2.24e+5	19.2	163
74.6	2.22e+5	24.5	163
75.5	2.34e+5	32.3	163
76.3	3.05e+5	73.4	163
76.6	2.00e+5	14.2	163
77.6	2.18e+5	25.1	163
78.2	2.11e+5	21.8	163
78.7	2.18e+5	26.5	163
78.7	2.33e+5	35.3	163
79.2	2.16e+5	25.8	163
79.6	2.20e+5	28.6	163
88.7	2.13e+5	36.6	163
96.9	1.99e+5	41.3	163
102.0	1.78e+5	36.0	195
112.0	1.77e+5	57.5	195
123.0	1.30e+5	35.0	195
136.0	9.51e+4	17.4	195
156.0	5.24e+4	-16.9	195
168.0	4.32e+4	-20.3	195
181.0	3.72e+4	-20.2	195
211.0	2.96e+4	-11.9	195
231.0	3.93e+4	43.7	195
296.0	3.54e+4	133.0	195

Atomic Scattering Factors, f_1+if_2
12 - Magnesium (Mg)






12-Mg μ Coefficients
References
○ = 2
△ = 35
+ = 41
× = 48
◇ = 67
▽ = 73
⊠ = 76
✕ = 127
◆ = 147
⊕ = 176
⊠ = 185
⊞ = 215
μ (cm²/gm)
E (eV)
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶

Magnesium (Mg) — 12

Atomic Weight = 24.31

μ (barns/atom) = $\mu(cm^2/g) \times 40.36$

$E\mu(E) = 1731.3\, f_2$ keV cm^2/g

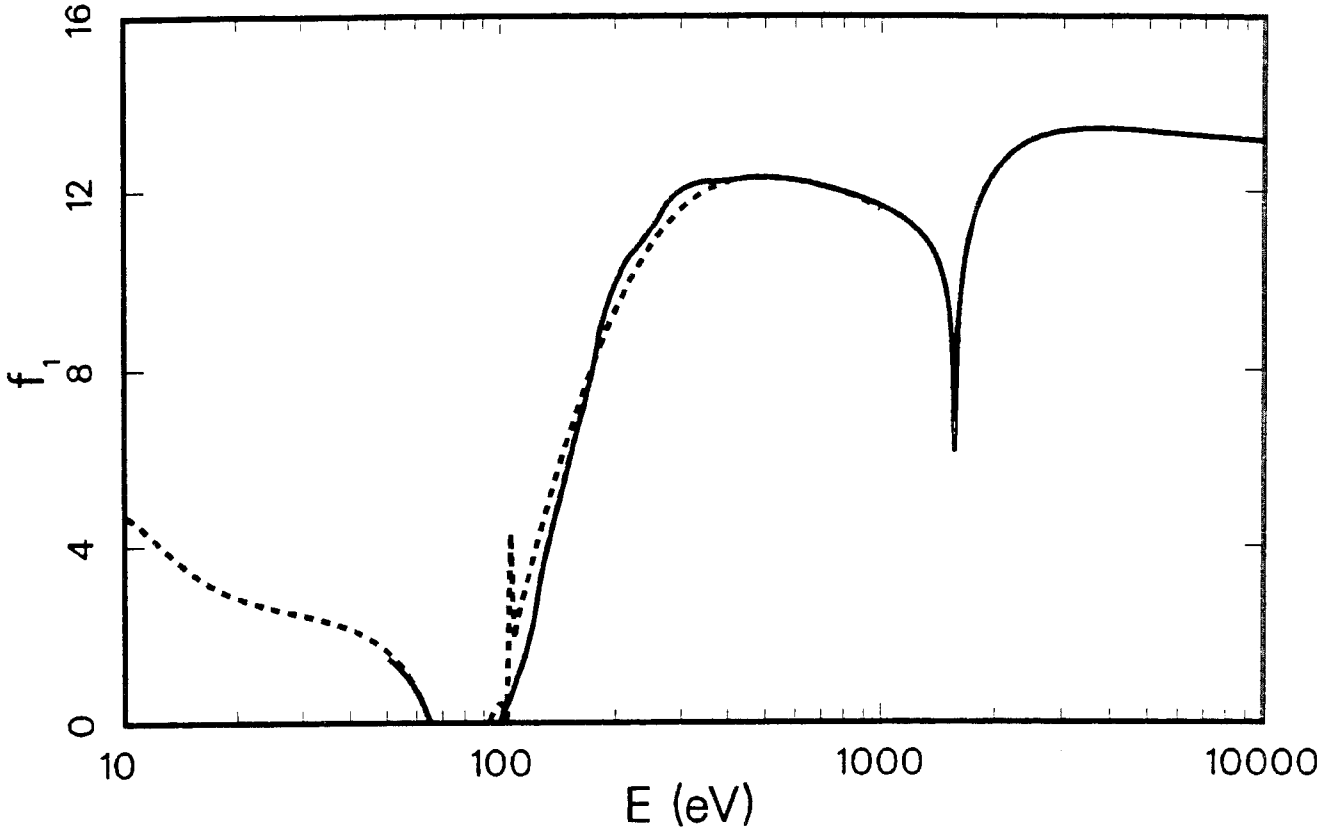
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5410.0	1.27e+2	0.9	2
6400.0	8.00e+1	4.3	2
6930.0	6.35e+1	4.7	2
7480.0	5.18e+1	7.0	2
8050.0	4.14e+1	6.3	2
8640.0	3.47e+1	10.0	2
35.4	1.79e+4	77.1	35
49.6	8.50e+3	-71.1	35
50.2	5.61e+4	61.2	35
51.9	4.08e+4	-26.0	35
57.8	6.00e+4	-36.7	35
62.3	6.51e+4	-43.0	35
73.5	7.43e+4	-47.8	35
78.4	7.88e+4	-47.5	35
89.1	7.38e+4	-51.1	35
705.0	3.00e+3	26.5	41
776.0	2.18e+3	20.0	41
852.0	1.80e+3	28.5	41
930.0	1.34e+3	22.5	41
1040.0	8.99e+2	10.1	41
1250.0	5.10e+2	3.6	41
1490.0	4.11e+3	-3.4	41
1740.0	2.68e+3	-7.8	41
8047.0	3.93e+1	0.9	48
8904.0	2.93e+1	1.7	48
9885.0	2.15e+1	2.1	48
15.8	7.35e+4	611.2	67
16.3	7.35e+4	592.9	67
16.6	7.39e+4	589.5	67
16.8	7.53e+4	597.5	67
18.0	7.62e+4	577.9	67
18.1	7.76e+4	588.7	67
19.9	6.93e+4	482.3	67
20.0	6.72e+4	463.9	67
20.5	6.58e+4	448.8	67
20.6	6.75e+4	462.2	67
20.8	6.40e+4	432.0	67
20.8	6.63e+4	450.8	67
21.3	6.34e+4	423.8	67
21.3	6.51e+4	438.0	67
22.2	5.67e+4	363.8	67
22.5	5.54e+4	351.5	67
22.5	5.14e+4	319.1	67
22.6	5.64e+4	359.2	67
22.6	5.23e+4	325.7	67
23.0	4.74e+4	284.1	67
23.3	4.84e+4	291.2	67
23.6	4.71e+4	279.2	67
23.8	4.32e+4	248.2	67
23.9	4.48e+4	261.1	67

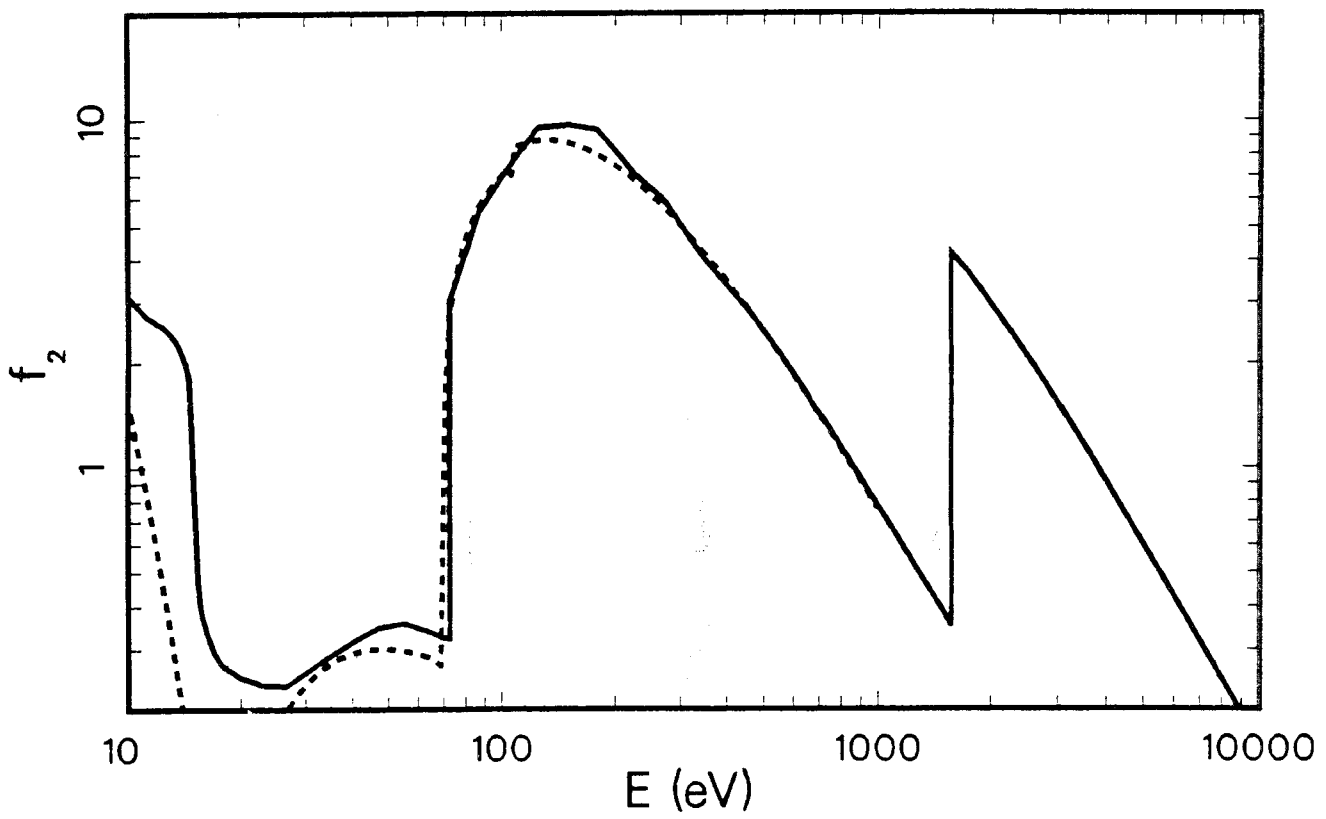
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
24.4	4.43e+4	257.0	67
24.5	4.31e+4	248.1	67
24.6	4.15e+4	235.2	67
24.8	4.20e+4	238.7	67
25.0	3.99e+4	222.2	67
25.5	4.01e+4	224.6	67
26.2	3.79e+4	206.8	67
26.3	3.67e+4	197.2	67
26.3	3.51e+4	184.4	67
26.7	3.57e+4	189.9	67
26.8	3.42e+4	177.5	67
26.9	3.61e+4	192.7	67
27.2	3.59e+4	191.3	67
27.3	3.39e+4	175.8	67
27.3	3.24e+4	163.1	67
27.7	3.14e+4	156.7	67
27.7	3.30e+4	170.0	67
28.1	3.19e+4	162.8	67
28.3	2.90e+4	140.2	67
28.5	3.11e+4	159.1	67
29.4	2.81e+4	139.0	67
30.1	2.97e+4	156.3	67
30.3	2.86e+4	148.4	67
30.4	2.99e+4	159.7	67
30.7	2.99e+4	161.7	67
30.9	2.90e+4	155.2	67
31.4	2.91e+4	158.3	67
31.8	2.84e+4	154.6	67
32.3	2.80e+4	153.6	67
32.6	2.78e+4	153.5	67
32.9	2.84e+4	160.2	67
33.3	2.89e+4	166.8	67
33.7	2.87e+4	168.8	67
33.7	2.76e+4	158.1	67
33.9	2.67e+4	151.1	67
34.1	2.72e+4	158.0	67
34.4	2.65e+4	153.8	67
34.8	2.54e+4	146.2	67
35.5	2.39e+4	137.3	67
36.0	2.40e+4	142.1	67
36.9	2.27e+4	134.6	67
37.6	2.31e+4	144.6	67
38.2	2.18e+4	134.1	67
38.7	2.15e+4	135.1	67
39.9	2.04e+4	131.6	67
40.1	2.16e+4	146.3	67
40.3	2.02e+4	131.8	67
40.4	2.12e+4	144.6	67
40.6	1.96e+4	127.8	67
40.7	2.02e+4	135.0	67

E(eV)	μ(cm^2/g)	% Error	Ref.
41.0	1.90e+4	123.2	67
41.3	1.95e+4	131.5	67
41.7	1.92e+4	130.6	67
42.0	1.75e+4	112.5	67
42.5	1.70e+4	109.3	67
42.9	1.62e+4	102.2	67
43.0	1.68e+4	110.2	67
43.6	1.68e+4	114.0	67
43.7	1.79e+4	128.9	67
44.2	1.75e+4	127.5	67
44.6	1.77e+4	132.5	67
44.6	1.68e+4	120.9	67
45.2	1.77e+4	116.3	67
45.5	1.77e+4	97.9	67
45.7	1.64e+4	72.3	67
46.6	1.45e+4	16.8	67
46.7	1.38e+4	7.4	67
46.8	1.52e+4	15.4	67
47.9	1.42e+4	-22.0	67
48.2	1.31e+4	-34.0	67
48.6	1.43e+4	-35.6	67
48.7	1.29e+4	-43.4	67
49.0	1.32e+4	-46.9	67
49.3	1.46e+4	-46.0	67
49.5	2.01e+4	-29.8	67
49.9	3.65e+4	13.9	67
50.1	5.42e+4	60.0	67
50.6	5.37e+4	38.2	67
50.8	5.18e+4	26.4	67
51.0	4.91e+4	13.4	67
51.3	5.01e+4	6.8	67
51.6	4.90e+4	-3.7	67
52.3	5.15e+4	-16.0	67
52.4	5.38e+4	-14.5	67
53.2	5.31e+4	-27.0	67
54.1	5.40e+4	-29.7	67
54.2	5.62e+4	-27.3	67
800.0	1.83e+3	9.6	73
882.0	1.47e+3	15.7	73
954.0	1.10e+3	8.3	73
1078.0	7.67e+2	3.7	73
1294.0	5.10e+2	13.8	73
8040.0	3.96e+1	1.4	76
277.0	3.14e+4	20.3	127
48.3	2.29e+5	1023.1	147
49.4	3.73e+5	1236.9	147
49.6	2.30e+5	680.5	147
50.6	3.43e+5	782.7	147
51.3	3.49e+5	643.5	147
52.3	3.51e+5	472.0	147
53.6	3.56e+5	377.3	147
55.3	3.69e+5	347.9	147
56.9	3.71e+5	311.5	147
58.4	3.80e+5	288.1	147
4508.0	2.16e+2	1.7	176

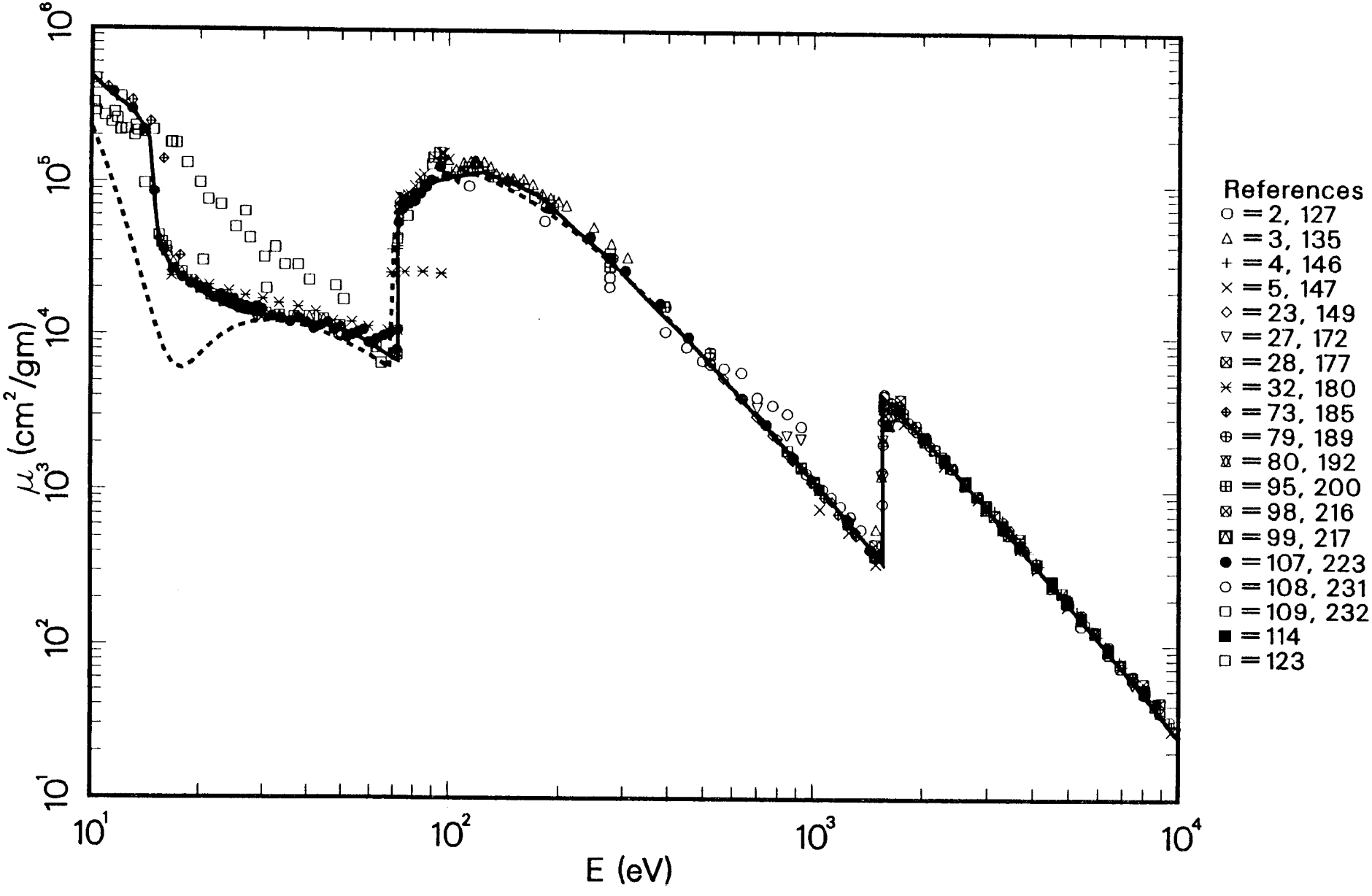
E(eV)	μ(cm^2/g)	% Error	Ref.
5411.0	1.29e+2	2.6	176
6400.0	7.92e+1	3.3	176
7472.0	5.05e+1	4.0	176
8041.0	4.03e+1	3.2	176
8631.0	3.27e+1	3.3	176
9876.0	2.20e+1	4.2	176
11.4	1.30e+5	1600.1	185
12.0	1.07e+5	1235.5	185
15.6	8.46e+4	727.9	185
17.5	7.37e+4	566.7	185
19.8	7.60e+4	539.7	185
25.1	5.54e+4	347.5	185
31.5	3.33e+4	195.9	185
41.4	2.45e+4	192.1	185
54.1	1.49e+4	-80.7	185
57.9	5.42e+4	-43.2	185
58.7	1.08e+5	8.6	185
62.5	1.25e+5	8.7	185
66.0	1.36e+5	9.6	185
73.6	1.55e+5	8.5	185
83.9	2.21e+5	42.1	185
91.8	1.68e+5	13.0	185
9680.0	2.32e+1	3.3	215
9970.0	2.12e+1	3.1	215

Atomic Scattering Factors, f_1+if_2
13 - Aluminum (Al)





13-Al μ Coefficients



Aluminum (Al) — 13

Atomic Weight = 26.98

μ (barns/atom) = μ(cm^2/g) × 44.80

Eμ(E) = 1559.6 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
5410.0	1.36e+2	-8.5	2
6400.0	8.85e+1	-3.2	2
6930.0	7.16e+1	-1.3	2
7480.0	5.91e+1	1.9	2
8050.0	4.77e+1	2.0	2
1490.0	5.80e+2	44.8	3
3150.0	7.59e+2	11.1	4
3310.0	6.61e+2	10.9	4
3390.0	6.20e+2	11.3	4
3600.0	5.16e+2	9.3	4
3680.0	4.84e+2	9.2	4
3850.0	4.26e+2	9.0	4
3900.0	4.10e+2	8.7	4
4080.0	3.59e+2	8.2	4
4170.0	3.37e+2	7.9	4
4770.0	2.25e+2	5.8	4
4980.0	2.00e+2	6.1	4
5280.0	1.70e+2	6.7	4
5530.0	1.48e+2	6.1	4
5690.0	1.36e+2	5.8	4
6020.0	1.16e+2	6.3	4
6290.0	1.01e+2	5.0	4
6410.0	9.40e+1	3.3	4
6420.0	9.40e+1	3.7	4
6890.0	7.99e+1	8.4	4
7040.0	7.32e+1	5.7	4
7490.0	6.16e+1	6.6	4
8050.0	4.80e+1	2.6	4
8070.0	4.84e+1	4.3	4
8550.0	4.20e+1	7.1	4
8660.0	4.04e+1	7.1	4
8930.0	3.59e+1	4.3	4
9590.0	2.99e+1	7.1	4
10000.0	2.66e+1	7.7	4
1043.0	7.68e+2	-27.7	5
1256.0	5.54e+2	-13.0	5
1490.0	3.44e+2	-14.2	5
1780.0	2.79e+3	-8.2	5
2300.0	1.48e+3	-6.9	5
2840.0	8.95e+2	-1.2	5
2990.0	7.70e+2	-2.2	5
3700.0	4.33e+2	-0.9	5
4100.0	3.19e+2	-2.5	5
4520.0	2.48e+2	-0.3	5
4960.0	1.82e+2	-4.6	5
6410.0	9.40e+1	3.3	5
6940.0	7.21e+1	-0.2	5
7480.0	6.12e+1	5.4	5
8050.0	5.12e+1	9.5	5
8650.0	4.18e+1	10.4	5

E(eV)	μ(cm^2/g)	% Error	Ref.
9590.0	2.77e+1	-0.8	5
523.6	6.92e+3	2.4	23
570.5	5.42e+3	0.0	23
634.2	4.04e+3	-1.2	23
700.4	3.08e+3	-1.6	23
776.8	2.32e+3	-2.2	23
851.5	1.74e+3	-5.8	23
523.0	7.32e+3	8.0	27
704.0	3.53e+3	14.1	27
849.0	2.29e+3	23.0	27
928.0	2.18e+3	49.4	27
1487.0	4.60e+2	14.2	28
1740.0	3.17e+3	-1.4	28
2042.0	2.13e+3	-1.5	28
2293.0	1.63e+3	1.6	28
2395.0	1.43e+3	0.1	28
2622.0	1.11e+3	-1.5	28
2821.0	9.42e+2	2.1	28
2984.0	8.21e+2	3.7	28
3151.0	7.10e+2	4.0	28
3691.0	4.60e+2	4.5	28
4090.0	3.48e+2	5.6	28
4510.0	2.68e+2	7.1	28
4952.0	1.94e+2	1.3	28
5414.0	1.53e+2	3.1	28
6403.0	9.35e+1	2.5	28
7477.0	6.14e+1	5.7	28
8047.0	4.98e+1	6.3	28
16.8	2.41e+4	-13.7	32
19.1	2.21e+4	5.3	32
21.3	2.10e+4	18.0	32
24.2	1.92e+4	26.8	32
26.9	1.80e+4	30.7	32
30.1	1.71e+4	28.6	32
33.5	1.61e+4	24.4	32
37.9	1.53e+4	23.0	32
42.5	1.42e+4	19.2	32
47.6	1.24e+4	9.6	32
53.7	1.22e+4	19.2	32
59.7	1.14e+4	27.1	32
67.9	1.08e+4	43.7	32
69.4	2.58e+4	255.5	32
75.9	2.62e+4	-52.6	32
85.4	2.63e+4	-72.5	32
85.4	2.63e+4	-72.5	32
95.7	2.56e+4	-75.6	32
729.0	2.84e+3	0.8	73
800.0	2.20e+3	0.4	73
880.0	1.57e+3	-6.8	73
882.0	1.70e+3	1.3	73

E(eV)	μ(cm^2/g)	% Error	Ref.
989.0	1.15e+3	-6.6	73
992.0	1.20e+3	-1.3	73
1075.0	9.14e+2	-6.5	73
1127.0	8.62e+2	0.5	73
1176.0	7.16e+2	-6.1	73
1312.0	5.56e+2	-1.6	73
1319.0	5.25e+2	-5.8	73
1442.0	4.30e+2	-1.8	73
1480.0	3.84e+2	-5.9	73
1653.0	3.89e+3	7.1	73
1739.0	3.37e+3	4.7	73
109.7	1.20e+5	6.6	79
185.0	7.01e+4	-7.4	79
282.0	3.28e+4	7.6	79
395.0	1.57e+4	17.6	79
525.0	7.97e+3	18.7	79
932.0	1.41e+3	-2.3	80
1044.0	1.03e+3	-2.9	80
1256.0	6.32e+2	-0.7	80
1256.0	6.30e+2	-1.0	80
1487.0	3.96e+2	-1.7	80
1490.0	3.95e+2	-1.3	80
1744.0	3.43e+3	7.2	80
2019.0	2.25e+3	1.0	80
2312.0	1.57e+3	-0.1	80
2627.0	1.17e+3	4.4	80
3320.0	6.14e+2	3.9	80
3698.0	4.51e+2	3.0	80
4097.0	3.33e+2	1.3	80
4517.0	2.54e+2	2.2	80
4960.0	1.96e+2	2.9	80
5423.0	1.52e+2	3.2	80
852.0	1.84e+3	-0.2	95
930.0	1.44e+3	-0.7	95
1012.0	1.15e+3	0.0	95
1254.0	6.29e+2	-1.5	95
1487.0	3.91e+2	-3.0	95
2293.0	1.62e+3	1.2	95
2984.0	7.72e+2	-2.5	95
3444.0	5.40e+2	1.2	95
4511.0	2.43e+2	-2.6	95
5415.0	1.50e+2	0.9	95
6404.0	9.24e+1	1.3	95
8048.0	5.16e+1	10.1	95
10000.0	2.99e+1	21.3	95
1743.0	4.00e+3	24.8	98
2312.0	1.60e+3	1.9	98
2627.0	1.14e+3	2.2	98
3314.0	5.95e+2	0.2	98
3318.0	5.80e+2	-1.9	98
3444.0	5.35e+2	0.3	98
3692.0	4.47e+2	1.7	98
3697.0	5.07e+2	15.7	98
4511.0	2.52e+2	0.7	98
4516.0	2.52e+2	1.3	98

E(eV)	μ(cm^2/g)	% Error	Ref.
5415.0	1.49e+2	0.9	98
5420.0	1.49e+2	0.9	98
5904.0	1.23e+2	6.5	98
6404.0	9.21e+1	0.9	98
7484.0	6.23e+1	7.5	98
8048.0	4.91e+1	4.9	98
8053.0	5.07e+1	8.4	98
8644.0	4.15e+1	9.4	98
8905.0	3.64e+1	4.8	98
15.5	4.41e+4	7.6	99
15.8	3.99e+4	10.0	99
16.3	3.49e+4	11.0	99
17.0	2.99e+4	11.5	99
17.9	2.56e+4	9.4	99
19.0	2.23e+4	5.6	99
20.2	1.98e+4	4.1	99
21.6	1.80e+4	3.2	99
23.5	1.63e+4	4.3	99
26.3	1.48e+4	6.1	99
30.7	1.37e+4	3.6	99
33.6	1.34e+4	3.7	99
36.9	1.32e+4	4.8	99
40.8	1.32e+4	8.5	99
44.7	1.28e+4	9.4	99
49.8	1.16e+4	5.9	99
63.0	8.42e+3	0.9	99
72.4	7.57e+3	-28.8	99
145.0	1.04e+5	0.6	107
190.0	7.01e+4	-1.7	107
244.0	4.46e+4	7.2	107
306.0	2.70e+4	8.8	107
382.0	1.64e+4	13.9	107
457.0	9.95e+3	4.8	107
642.0	4.04e+3	2.1	107
746.0	2.72e+3	2.9	107
885.0	1.65e+3	-0.8	107
1040.0	1.05e+3	-2.0	107
1240.0	6.70e+2	1.6	107
1440.0	4.26e+2	-3.0	107
114.0	9.62e+4	-16.0	108
183.3	5.67e+4	-26.6	108
277.0	2.11e+4	-33.8	108
395.3	1.07e+4	-19.4	108
452.2	8.59e+3	-11.9	108
500.3	7.03e+3	-7.3	108
524.9	6.67e+3	-0.6	108
572.8	6.29e+3	17.3	108
637.4	5.91e+3	46.6	108
705.0	4.08e+3	32.7	108
776.2	3.64e+3	53.0	108
851.5	3.21e+3	74.0	108
929.7	2.66e+3	82.8	108
10.3	4.65e+5	2.1	109
12.1	3.57e+5	7.5	109
13.2	2.00e+5	-27.8	109

E(eV)	μ(cm^2/g)	% Error	Ref.
14.1	9.78e+4	-56.3	109
16.2	3.70e+4	14.9	109
20.5	3.04e+4	62.8	109
30.9	2.01e+4	51.7	109
49.5	1.04e+4	-5.4	109
65.0	6.68e+3	-16.5	109
77.5	6.07e+4	-20.4	109
90.7	1.34e+5	31.8	109
94.8	1.59e+5	52.2	109
114.1	1.28e+5	11.7	109
132.7	1.11e+5	-1.1	109
151.0	9.73e+4	-2.3	109
171.7	8.08e+4	-5.7	109
192.6	6.90e+4	-0.3	109
277.3	3.53e+4	10.9	109
392.3	1.59e+4	17.2	109
524.9	7.79e+3	16.0	109
278.0	3.30e+4	4.4	114
1487.0	3.86e+2	-4.1	123
1740.0	3.41e+3	6.1	123
2014.0	2.27e+3	1.4	123
2166.0	1.88e+3	1.1	123
2257.0	1.69e+3	1.2	123
2308.0	1.59e+3	1.2	123
2622.0	1.13e+3	0.4	123
3314.0	6.01e+2	1.3	123
3692.0	4.76e+2	8.3	123
4512.0	2.60e+2	4.3	123
4953.0	2.00e+2	4.7	123
5414.0	1.53e+2	3.5	123
5898.0	1.21e+2	4.4	123
6404.0	9.53e+1	4.5	123
6930.0	7.63e+1	5.2	123
7478.0	6.17e+1	6.3	123
8040.0	4.98e+1	6.1	123
8640.0	4.05e+1	6.5	123
277.0	2.44e+4	-23.5	127
100.0	1.43e+5	32.8	135
105.0	1.24e+5	12.1	135
110.0	1.37e+5	21.5	135
115.0	1.40e+5	21.8	135
117.0	1.40e+5	20.9	135
118.0	1.41e+5	21.5	135
119.0	1.40e+5	20.1	135
120.0	1.39e+5	18.9	135
125.0	1.39e+5	17.4	135
130.0	1.29e+5	12.9	135
135.0	1.17e+5	6.0	135
140.0	1.11e+5	3.9	135
145.0	1.09e+5	5.3	135
150.0	1.09e+5	8.6	135
160.0	1.08e+5	16.1	135
170.0	9.95e+4	14.8	135
180.0	8.64e+4	7.3	135
190.0	8.08e+4	13.3	135

E(eV)	μ(cm^2/g)	% Error	Ref.
200.0	7.63e+4	20.1	135
210.0	7.21e+4	26.7	135
250.0	5.20e+4	30.9	135
280.0	4.06e+4	30.9	135
310.0	3.33e+4	38.5	135
69.7	3.69e+4	412.0	146
72.1	3.70e+4	302.5	146
72.2	3.70e+4	283.5	146
72.3	3.70e+4	265.4	146
72.3	3.69e+4	264.1	146
72.4	3.70e+4	248.2	146
72.6	6.39e+4	445.6	146
72.6	3.70e+4	216.2	146
72.6	3.87e+4	230.1	146
72.7	4.56e+4	270.7	146
72.8	6.34e+4	392.1	146
72.8	5.47e+4	324.2	146
72.9	6.44e+4	375.9	146
72.9	6.21e+4	359.5	146
73.0	6.15e+4	333.4	146
73.1	6.55e+4	340.0	146
73.2	7.06e+4	352.5	146
73.3	7.44e+4	354.7	146
73.3	7.42e+4	353.6	146
73.3	7.30e+4	345.7	146
73.5	7.21e+4	300.6	146
73.6	7.12e+4	277.0	146
73.8	7.15e+4	244.8	146
73.9	7.19e+4	230.4	146
75.8	7.26e+4	37.6	146
76.9	7.68e+4	2.6	146
77.0	7.66e+4	2.0	146
78.9	7.92e+4	-0.3	146
82.0	9.07e+4	4.4	146
83.9	1.01e+5	10.7	146
86.1	1.05e+5	7.9	146
95.1	1.48e+5	41.8	146
95.9	1.48e+5	41.1	146
97.1	1.48e+5	40.0	146
98.1	1.44e+5	35.3	146
102.0	1.19e+5	8.7	146
104.0	1.11e+5	0.8	146
106.0	1.14e+5	2.6	146
110.0	1.23e+5	8.6	146
116.0	1.25e+5	8.6	146
118.0	1.28e+5	9.9	146
120.0	1.26e+5	7.7	146
124.0	1.28e+5	8.1	146
128.0	1.23e+5	6.1	146
132.0	1.10e+5	-2.1	146
140.0	1.02e+5	-4.7	146
150.0	1.04e+5	3.3	146
156.0	1.01e+5	5.5	146
160.0	9.93e+4	6.7	146
170.0	8.93e+4	3.0	146

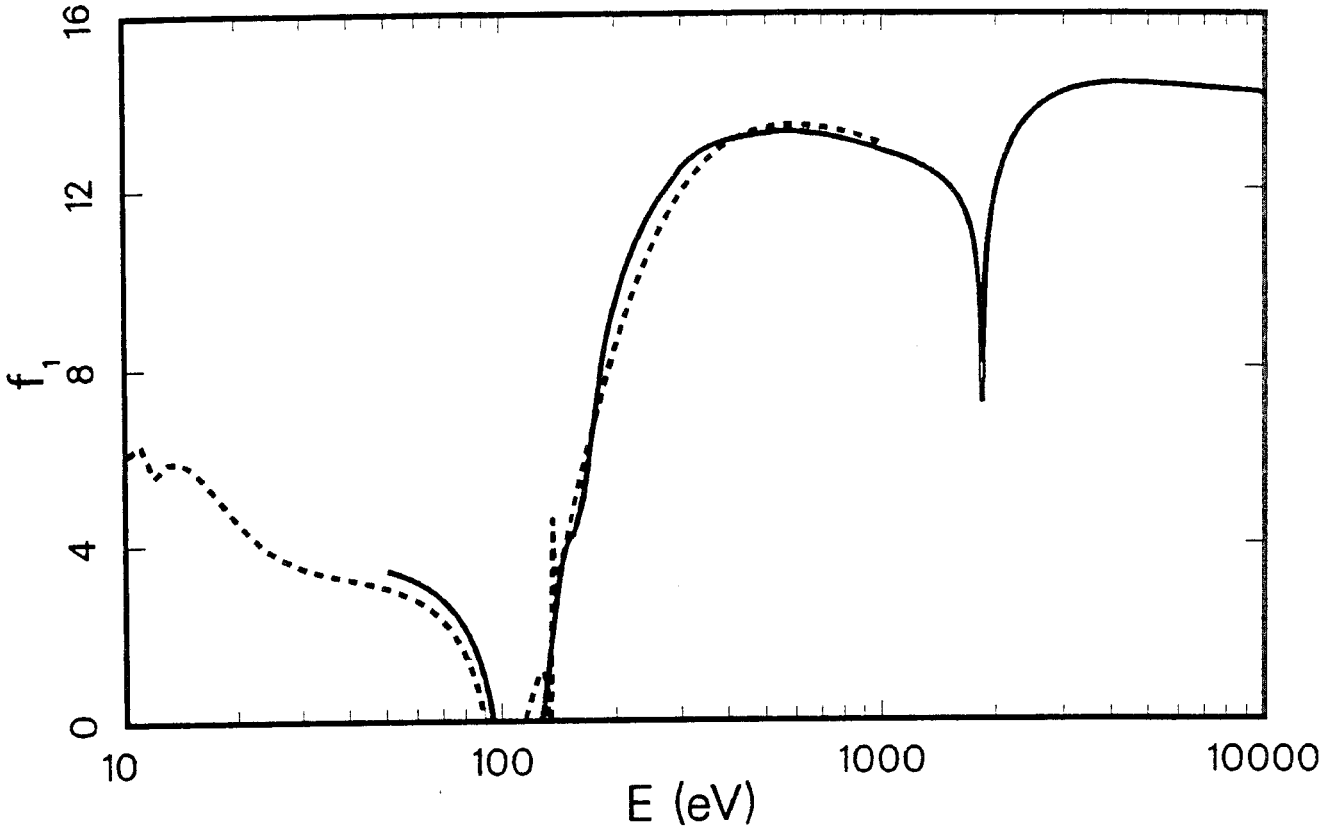
E(eV)	μ(cm^2/g)	% Error	Ref.
180.0	8.15e+4	1.2	146
188.0	7.81e+4	7.0	146
194.0	7.86e+4	15.5	146
72.5	1.08e+4	-3.4	147
72.6	6.57e+4	461.3	147
73.2	6.28e+4	302.6	147
73.3	8.23e+4	402.8	147
73.9	7.94e+4	265.2	147
75.0	8.06e+4	121.4	147
76.0	8.07e+4	39.6	147
77.3	8.39e+4	10.7	147
78.8	8.37e+4	5.7	147
81.3	9.58e+4	12.4	147
83.7	1.09e+5	20.0	147
86.0	1.15e+5	17.9	147
92.3	1.45e+5	41.1	147
95.9	1.58e+5	50.3	147
97.2	1.58e+5	49.0	147
100.0	1.45e+5	34.3	147
1490.0	3.99e+2	-0.3	149
1740.0	3.39e+3	5.4	149
2310.0	1.60e+3	1.8	149
2840.0	9.28e+2	2.5	149
2990.0	8.17e+2	3.7	149
3440.0	5.67e+2	5.9	149
4510.0	2.70e+2	8.0	149
5410.0	1.60e+2	7.7	149
6390.0	9.95e+1	8.4	149
7470.0	6.36e+1	9.2	149
8050.0	5.16e+1	10.2	149
4508.0	2.55e+2	2.0	172
5411.0	1.54e+2	3.5	172
6400.0	9.39e+1	2.8	172
7472.0	5.53e+1	-5.0	172
8041.0	5.00e+1	6.6	172
8631.0	4.05e+1	6.3	172
9876.0	2.72e+1	6.4	172
4800.0	2.23e+2	6.6	177
5900.0	1.23e+2	6.7	177
8000.0	5.65e+1	18.5	177
8900.0	4.20e+1	20.5	177
1487.0	4.06e+2	0.8	180
2043.0	2.15e+3	-0.4	180
2984.0	7.97e+2	0.6	180
11.1	4.11e+5	6.8	185
13.0	3.39e+5	18.0	185
14.6	2.48e+5	43.9	185
15.9	1.40e+5	298.5	185
17.7	3.27e+4	35.8	185
19.8	2.15e+4	9.4	185
25.0	1.54e+4	4.9	185
29.1	1.31e+4	-3.0	185
1254.0	6.44e+2	0.8	189
1487.0	3.97e+2	-1.4	189
1710.0	3.64e+3	8.6	189

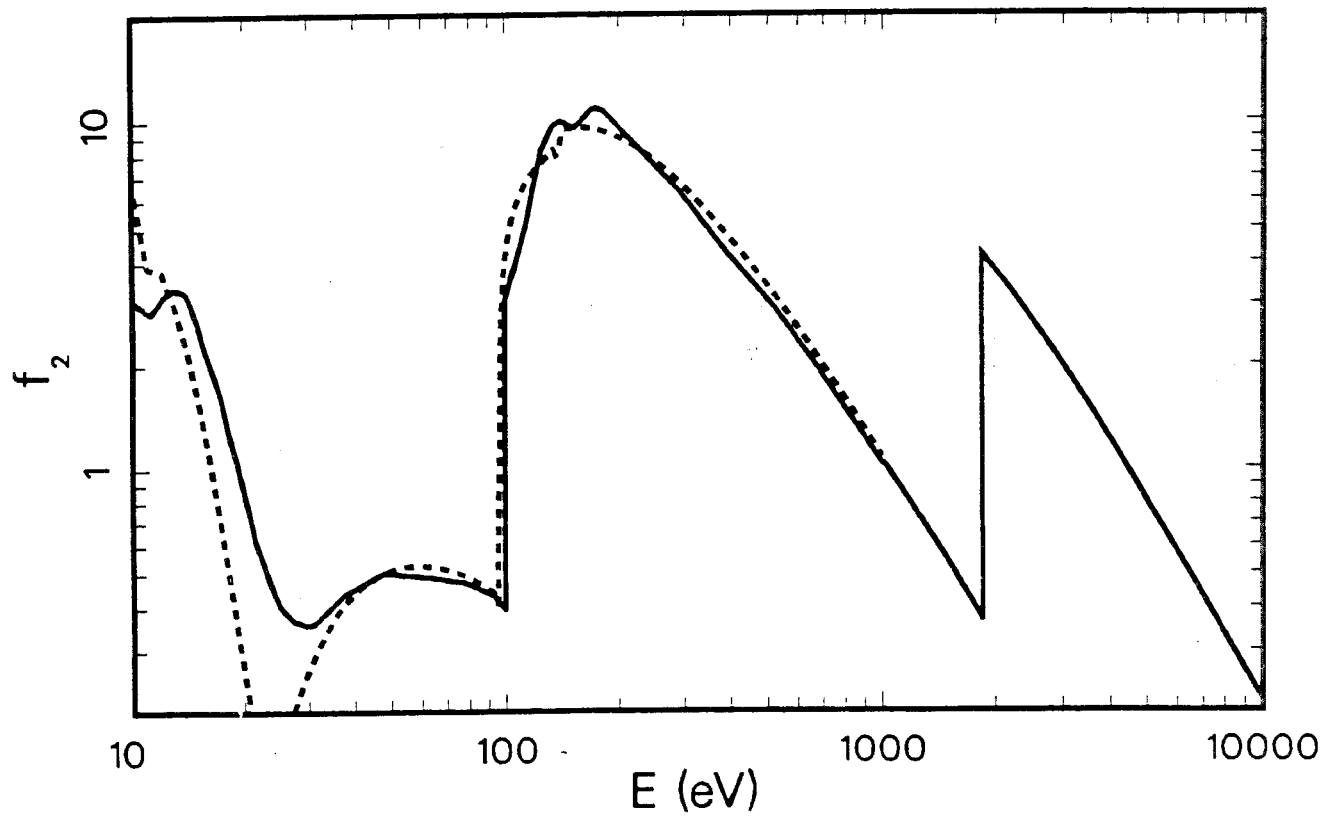
E(eV)	μ(cm^2/g)	% Error	Ref.
1740.0	3.45e+3	7.3	189
1775.0	3.30e+3	7.7	189
1923.0	2.70e+3	7.6	189
2043.0	2.28e+3	5.6	189
2050.0	2.21e+3	3.0	189
2166.0	1.90e+3	2.3	189
2293.0	1.64e+3	2.6	189
2423.0	1.41e+3	1.7	189
2839.0	9.36e+2	3.2	189
2985.0	8.13e+2	2.7	189
3304.0	6.39e+2	6.7	189
3444.0	5.67e+2	6.2	189
3769.0	4.30e+2	3.6	189
4089.0	3.50e+2	6.1	189
4511.0	2.67e+2	6.8	189
4949.0	2.05e+2	6.9	189
5415.0	1.60e+2	8.2	189
6404.0	9.97e+1	9.3	189
7478.0	6.31e+1	8.7	189
8048.0	5.06e+1	8.1	189
9442.0	3.18e+1	8.8	189
1545.0	1.27e+3	57.0	192
1559.0	2.17e+3	7.8	192
1564.0	3.66e+3	31.4	192
1570.0	3.48e+3	-15.1	192
1583.0	2.75e+3	-31.7	192
1591.0	2.99e+3	-24.8	192
1604.0	2.72e+3	-30.2	192
1616.0	3.21e+3	-16.1	192
1628.0	2.72e+3	-27.7	192
277.0	2.88e+4	-9.7	200
5000.0	1.90e+2	1.8	216
5900.0	1.24e+2	7.5	216
6400.0	9.42e+1	3.1	216
8100.0	5.00e+1	8.8	216
1740.0	3.50e+3	8.9	217
4510.0	2.62e+2	4.8	217
8040.0	4.96e+1	5.6	217
10.0	4.42e+5	-9.1	223
11.5	3.81e+5	5.3	223
13.0	2.97e+5	3.4	223
14.0	2.19e+5	-4.6	223
15.0	8.62e+4	2.7	223
16.0	3.60e+4	5.5	223
17.0	2.68e+4	0.0	223
18.0	2.37e+4	1.9	223
19.0	2.14e+4	1.2	223
20.0	2.03e+4	4.9	223
21.0	1.89e+4	4.5	223
22.0	1.73e+4	2.1	223
23.0	1.81e+4	13.4	223
24.0	1.71e+4	11.9	223
25.0	1.69e+4	15.2	223
26.0	1.56e+4	10.9	223
27.0	1.52e+4	10.8	223

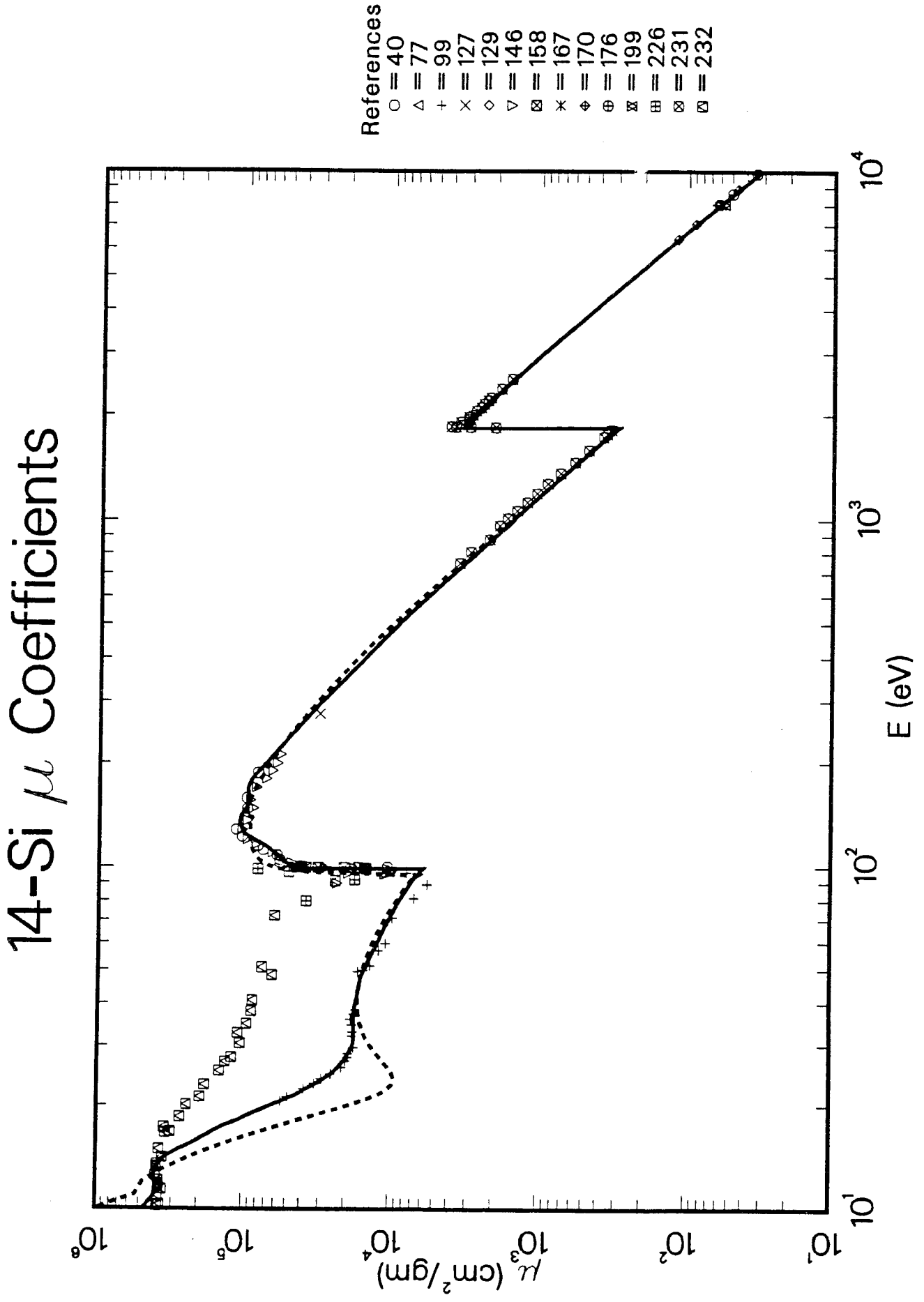
E(eV)	μ(cm^2/g)	% Error	Ref.
28.0	1.47e+4	8.3	223
29.0	1.52e+4	13.2	223
30.0	1.46e+4	9.7	223
32.0	1.32e+4	0.8	223
34.0	1.28e+4	-0.9	223
36.0	1.22e+4	-3.8	223
38.0	1.28e+4	3.3	223
40.0	1.20e+4	-1.8	223
42.0	1.10e+4	-8.0	223
44.0	1.16e+4	-1.8	223
46.0	1.21e+4	4.6	223
48.0	1.08e+4	-4.0	223
50.0	1.13e+4	3.4	223
52.0	9.76e+3	-7.4	223
54.0	1.01e+4	-0.8	223
56.0	1.05e+4	6.9	223
58.0	1.09e+4	16.3	223
60.0	9.01e+3	0.9	223
63.0	9.46e+3	13.3	223
66.0	9.91e+3	26.7	223
69.0	1.04e+4	41.7	223
72.0	8.11e+3	-7.5	223
72.6	1.09e+4	-6.9	223
72.8	5.47e+4	324.0	223
75.0	6.76e+4	85.5	223
78.0	7.32e+4	-5.3	223
81.0	7.60e+4	-10.0	223
84.0	8.51e+4	-7.4	223
87.0	9.47e+4	-4.3	223
90.0	1.05e+5	3.7	223
95.0	1.28e+5	23.0	223
99.0	1.11e+5	4.1	223
960.7	1.30e+3	-1.9	231
1009.3	1.16e+3	0.1	231
1063.4	1.04e+3	2.9	231
1123.9	9.16e+2	6.0	231
1192.1	8.04e+2	9.5	231
1269.6	6.89e+2	11.6	231
1358.3	5.73e+2	11.3	231
1460.7	4.63e+2	9.4	231
1518.2	3.99e+2	5.1	231
1554.9	8.30e+2	-46.3	231
1558.1	1.33e+3	-30.1	231
1561.2	2.04e+3	-12.4	231
1564.4	2.90e+3	1.4	231
1567.6	3.68e+3	4.6	231
1570.8	4.18e+3	2.1	231
1574.0	4.32e+3	6.0	231
1577.2	4.18e+3	3.0	231
1620.4	3.61e+3	-5.2	231
1677.0	3.50e+3	-0.4	231
1722.1	3.31e+3	0.4	231
1778.0	3.09e+3	1.3	231
1837.8	2.84e+3	1.1	231
1892.3	2.60e+3	-0.4	231

E(eV)	μ(cm^2/g)	% Error	Ref.
1930.5	2.48e+3	-0.1	231
2100.5	2.00e+3	-0.6	231
10.2	3.27e+5	-29.7	232
10.3	2.90e+5	-36.4	232
10.9	2.70e+5	-32.6	232
11.4	2.44e+5	-33.5	232
11.6	2.83e+5	-20.6	232
11.8	2.60e+5	-25.0	232
12.1	2.18e+5	-34.3	232
12.5	2.20e+5	-29.9	232
13.3	2.31e+5	-15.1	232
13.5	2.14e+5	-17.9	232
14.1	2.10e+5	-6.0	232
14.9	2.18e+5	117.5	232
16.7	1.80e+5	530.6	232
16.8	1.81e+5	547.7	232
17.3	1.79e+5	601.5	232
18.5	1.32e+5	498.2	232
20.1	9.89e+4	416.1	232
21.2	7.64e+4	327.5	232
23.0	7.10e+4	343.8	232
25.3	5.04e+4	247.8	232
26.9	6.41e+4	366.2	232
27.7	4.28e+4	214.2	232
30.5	3.22e+4	142.6	232
32.7	3.77e+4	189.0	232
34.8	2.88e+4	125.4	232
37.9	2.89e+4	132.2	232
40.8	2.30e+4	89.3	232
48.4	2.11e+4	88.3	232
51.0	1.71e+4	60.0	232
72.3	4.32e+4	325.9	232
91.5	1.48e+5	45.4	232

Atomic Scattering Factors, f_1+if_2
14 - Silicon (Si)






14-Si μ Coefficients
References
○ = 40
△ = 77
+ = 99
× = 127
◇ = 129
▽ = 146
⊠ = 158
✳ = 167
⊕ = 170
⊕ = 176
⊠ = 199
⊞ = 226
⊠ = 231
⊠ = 232
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10⁻¹
10²
10³
10⁴

Silicon (Si) — 14

Atomic Weight = 28.09

μ (barns/atom) = $\mu(cm^2/g) \times 46.64$

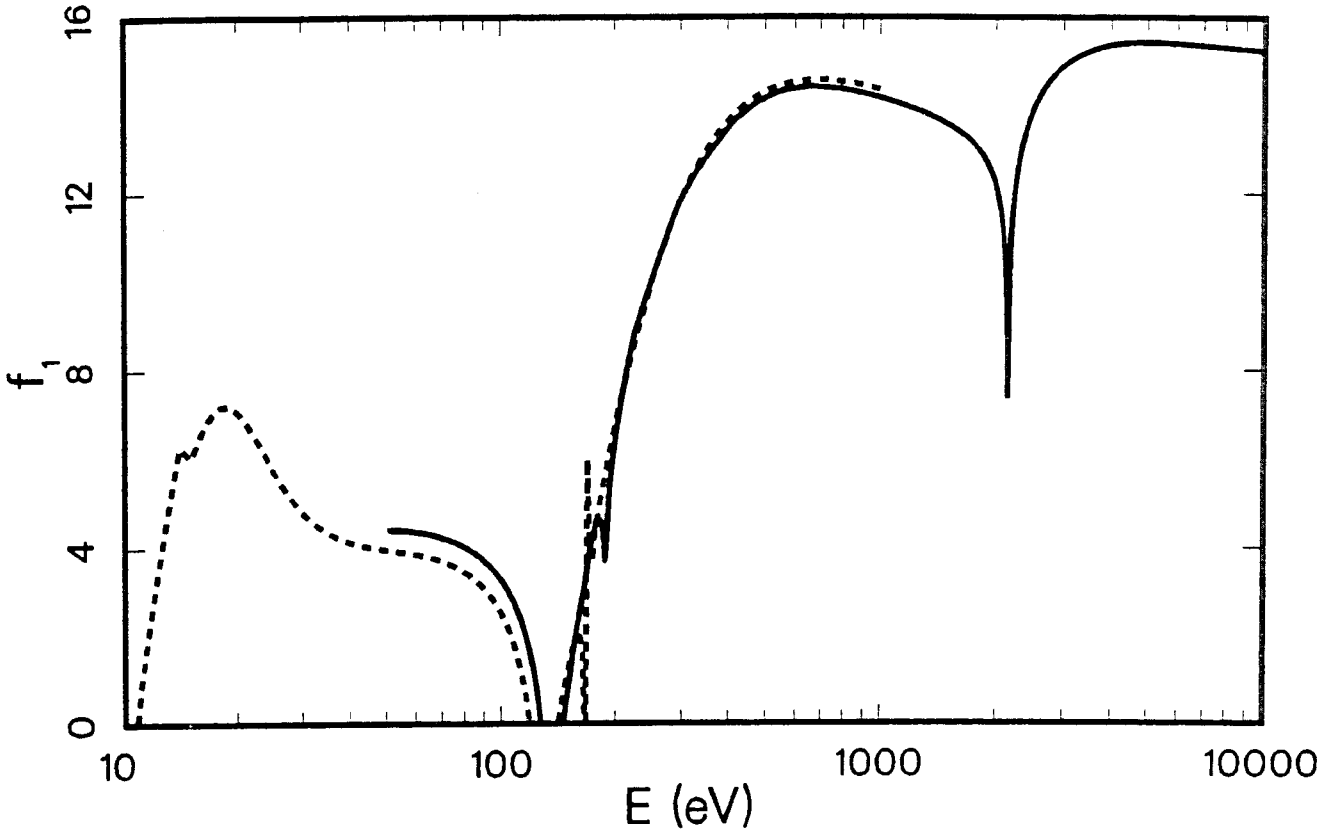
$E\mu(E) = 1498.2\, f_2$ keV cm^2/g

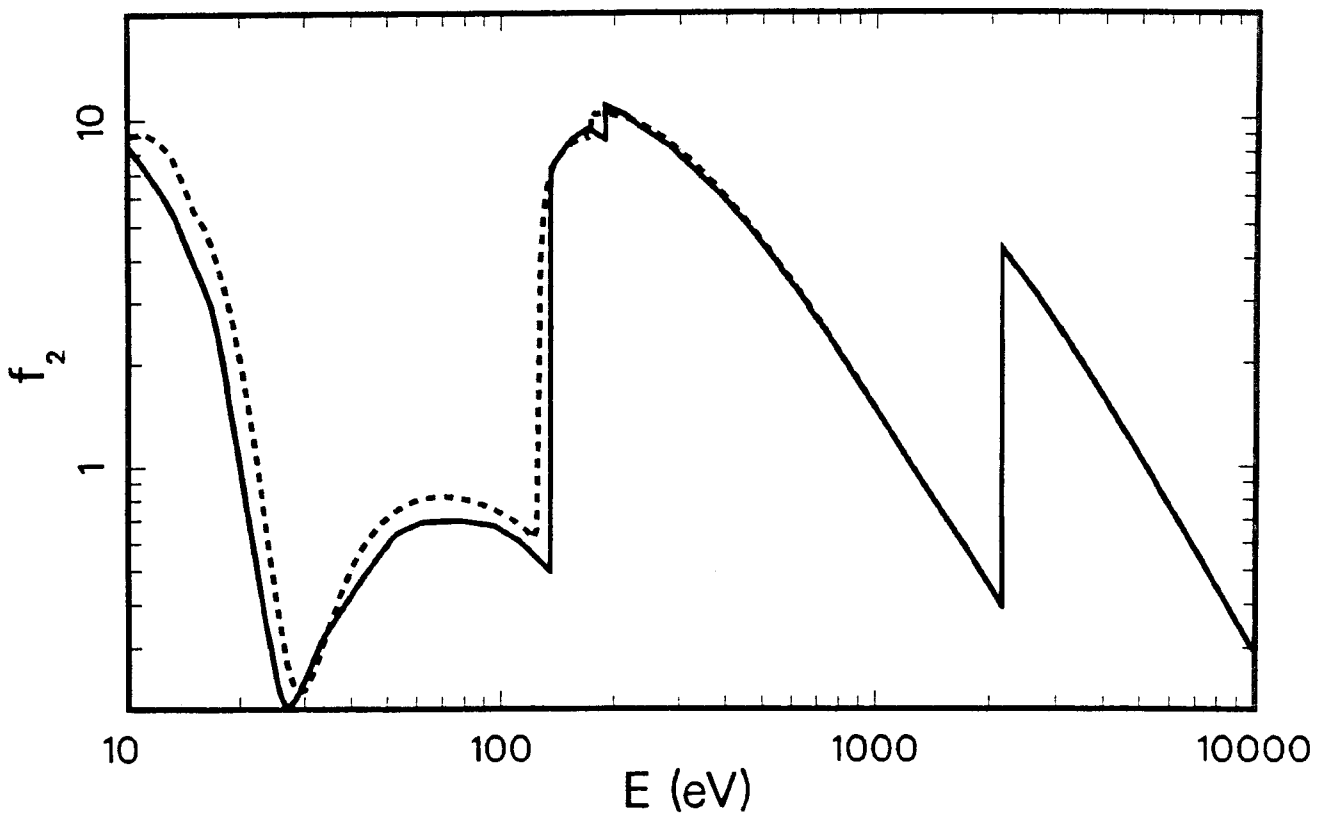
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
100.0	1.05e+4	-4.5	40
100.5	4.16e+4	239.7	40
103.0	5.73e+4	176.3	40
105.0	5.73e+4	83.1	40
108.0	5.96e+4	4.3	40
112.0	7.46e+4	13.4	40
115.0	8.13e+4	12.3	40
122.0	1.04e+5	12.5	40
128.0	1.15e+5	11.1	40
147.0	9.61e+4	-2.7	40
158.0	9.71e+4	3.1	40
187.0	8.13e+4	-1.5	40
8040.0	6.47e+1	6.6	77
20.6	5.44e+4	-0.3	99
21.2	4.88e+4	5.1	99
22.4	3.78e+4	2.9	99
23.2	3.21e+4	1.2	99
24.0	2.89e+4	4.0	99
24.8	2.50e+4	0.3	99
25.9	2.11e+4	-5.7	99
27.1	1.98e+4	-2.9	99
27.7	1.91e+4	-3.2	99
28.5	1.90e+4	0.2	99
29.7	1.75e+4	-2.8	99
32.0	1.79e+4	2.3	99
33.0	1.77e+4	1.1	99
34.6	1.79e+4	2.3	99
35.9	1.84e+4	4.9	99
37.2	1.74e+4	-0.6	99
38.4	1.70e+4	-1.8	99
49.6	1.65e+4	9.1	99
50.0	1.51e+4	0.6	99
51.6	1.36e+4	-6.1	99
57.2	1.19e+4	-7.6	99
59.9	1.06e+4	-13.3	99
71.2	9.62e+3	-4.4	99
81.5	6.85e+3	-19.2	99
89.2	5.60e+3	-24.3	99
96.3	7.73e+3	20.9	99
98.5	1.54e+4	93.8	99
277.0	3.12e+4	-13.2	127
8040.0	6.25e+1	3.0	129
90.0	2.33e+4	218.8	146
95.7	1.10e+4	68.9	146
96.0	1.95e+4	202.9	146
96.1	1.05e+4	63.3	146
97.0	9.93e+3	57.8	146
98.0	9.69e+3	35.7	146
99.0	1.04e+4	17.7	146
99.2	1.75e+4	88.7	146

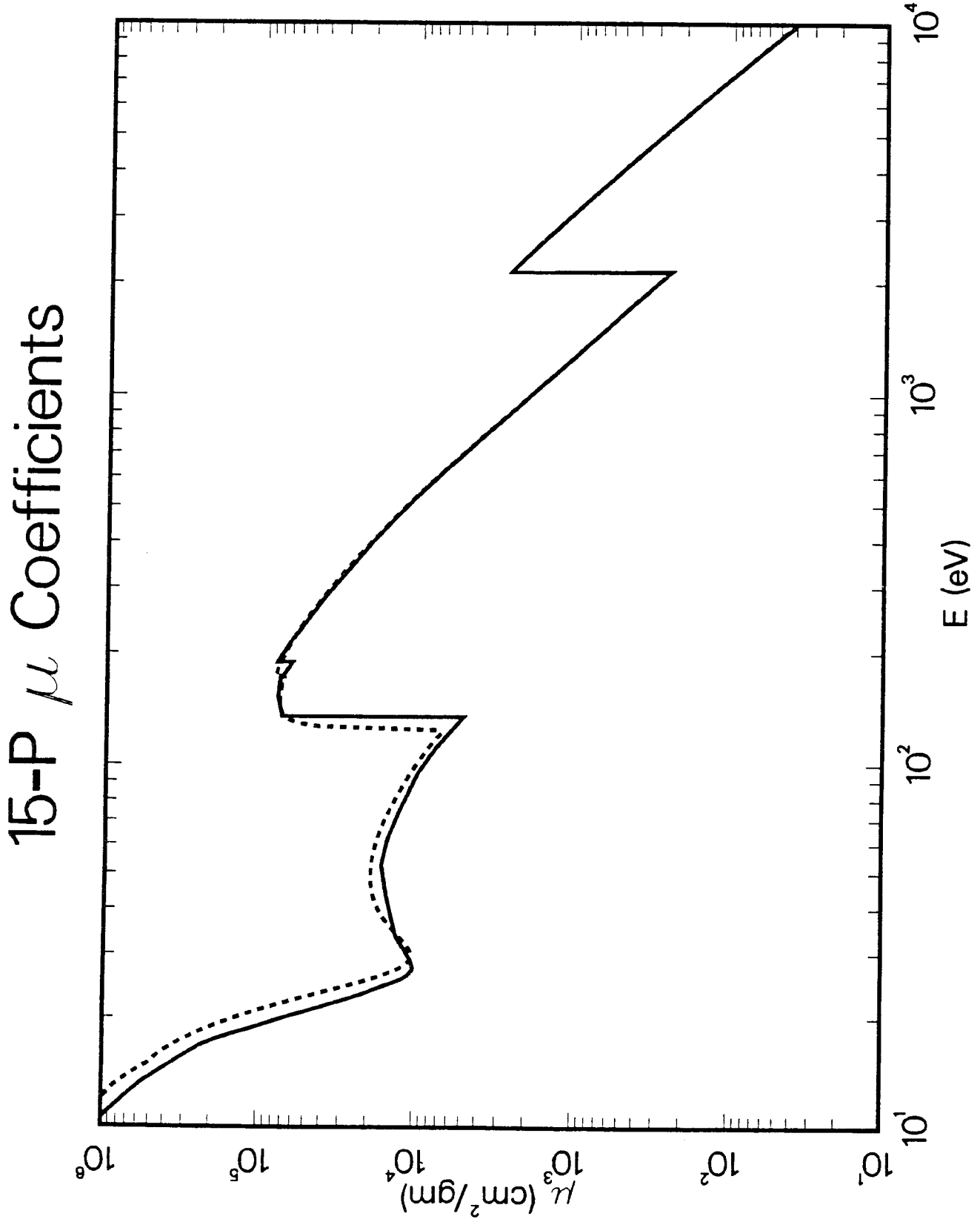
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
99.3	1.49e+4	57.0	146
99.4	2.83e+4	192.1	146
99.6	2.74e+4	171.4	146
99.8	4.00e+4	279.9	146
99.9	4.36e+4	304.6	146
100.0	4.72e+4	329.3	146
100.0	4.55e+4	313.1	146
101.0	5.38e+4	295.3	146
103.0	4.72e+4	127.7	146
110.0	6.41e+4	2.7	146
116.0	8.28e+4	10.2	146
120.0	9.50e+4	9.6	146
128.0	1.03e+5	0.3	146
136.0	9.50e+4	-11.9	146
148.0	8.68e+4	-11.2	146
156.0	9.09e+4	-3.3	146
170.0	8.28e+4	-12.7	146
180.0	7.08e+4	-20.5	146
190.0	6.41e+4	-19.5	146
200.0	5.96e+4	-16.6	146
212.0	5.66e+4	-10.4	146
99.0	1.46e+4	64.6	158
99.3	1.47e+4	54.9	158
99.5	1.52e+4	53.9	158
99.7	1.66e+4	61.0	158
99.8	2.09e+4	98.0	158
99.8	3.13e+4	196.5	158
99.9	3.79e+4	252.0	158
100.0	4.05e+4	268.4	158
8040.0	6.09e+1	0.4	167
6400.0	1.19e+2	0.8	170
7060.0	8.96e+1	1.3	170
8040.0	6.21e+1	2.3	170
8910.0	4.61e+1	2.7	170
8041.0	6.23e+1	2.7	176
8631.0	5.01e+1	1.7	176
9876.0	3.43e+1	3.4	176
8040.0	5.69e+1	-6.2	199
80.0	3.76e+4	331.9	226
92.2	1.76e+4	149.7	226
97.1	4.93e+4	686.3	226
98.7	8.06e+4	868.9	226
751.2	3.53e+3	9.0	231
809.8	2.98e+3	12.5	231
879.4	2.22e+3	3.8	231
963.5	1.90e+3	13.2	231
1012.4	1.68e+3	11.8	231
1066.8	1.45e+3	10.3	231
1127.8	1.25e+3	9.6	231
1196.5	1.07e+3	9.6	231

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1274.6	9.02e+2	9.7	231
1364.0	7.40e+2	8.0	231
1467.4	5.95e+2	5.7	231
1588.3	4.80e+2	6.0	231
1731.4	3.82e+2	7.3	231
1763.3	3.60e+2	6.7	231
1813.4	3.36e+2	8.1	231
1843.9	2.05e+3	44.1	231
1848.4	3.07e+3	70.0	231
1852.9	3.84e+3	68.4	231
1857.4	4.12e+3	43.1	231
1880.2	3.50e+3	8.9	231
1908.4	3.57e+3	15.2	231
1942.3	3.15e+3	6.1	231
1972.4	3.14e+3	9.6	231
1998.2	2.96e+3	6.6	231
2057.4	2.78e+3	7.5	231
2102.8	2.59e+3	5.7	231
2150.3	2.47e+3	6.5	231
2200.0	2.31e+3	5.3	231
2238.9	2.22e+3	5.8	231
2378.8	1.88e+3	4.2	231
2537.6	1.58e+3	4.0	231
10.2	3.75e+5	-16.5	232
10.3	3.62e+5	-18.0	232
10.9	3.73e+5	-6.2	232
11.4	3.51e+5	-8.4	232
11.6	3.70e+5	-3.9	232
11.8	3.68e+5	-5.3	232
12.1	3.71e+5	-6.1	232
12.5	3.86e+5	-2.3	232
13.3	3.80e+5	1.0	232
13.5	3.79e+5	3.1	232
14.1	3.48e+5	2.9	232
14.9	3.66e+5	35.2	232
16.7	3.34e+5	104.5	232
16.8	3.09e+5	94.5	232
17.3	3.40e+5	141.9	232
18.5	2.66e+5	176.4	232
20.1	2.41e+5	286.0	232
21.2	1.93e+5	315.9	232
23.0	1.80e+5	447.0	232
25.3	1.43e+5	508.7	232
26.9	1.31e+5	534.6	232
27.7	1.19e+5	500.6	232
30.5	1.04e+5	494.0	232
32.7	1.08e+5	516.2	232
34.8	9.37e+4	435.2	232
37.9	8.76e+4	403.0	232
40.8	8.65e+4	412.4	232
48.4	6.33e+4	307.5	232
51.0	7.46e+4	408.5	232
72.3	6.14e+4	521.0	232
91.5	2.39e+4	235.5	232

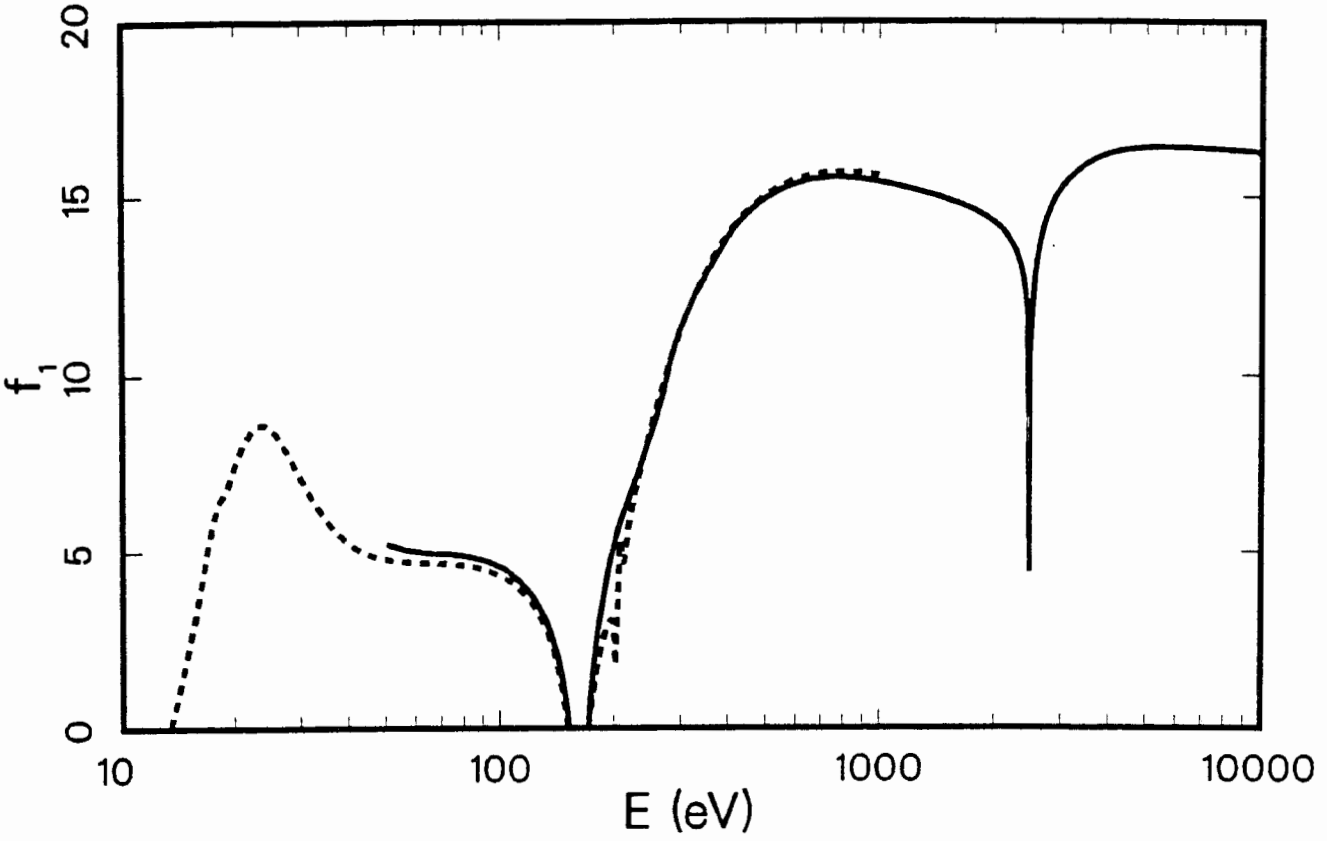
Atomic Scattering Factors, f_1+if_2
15 - Phosphorus (P)

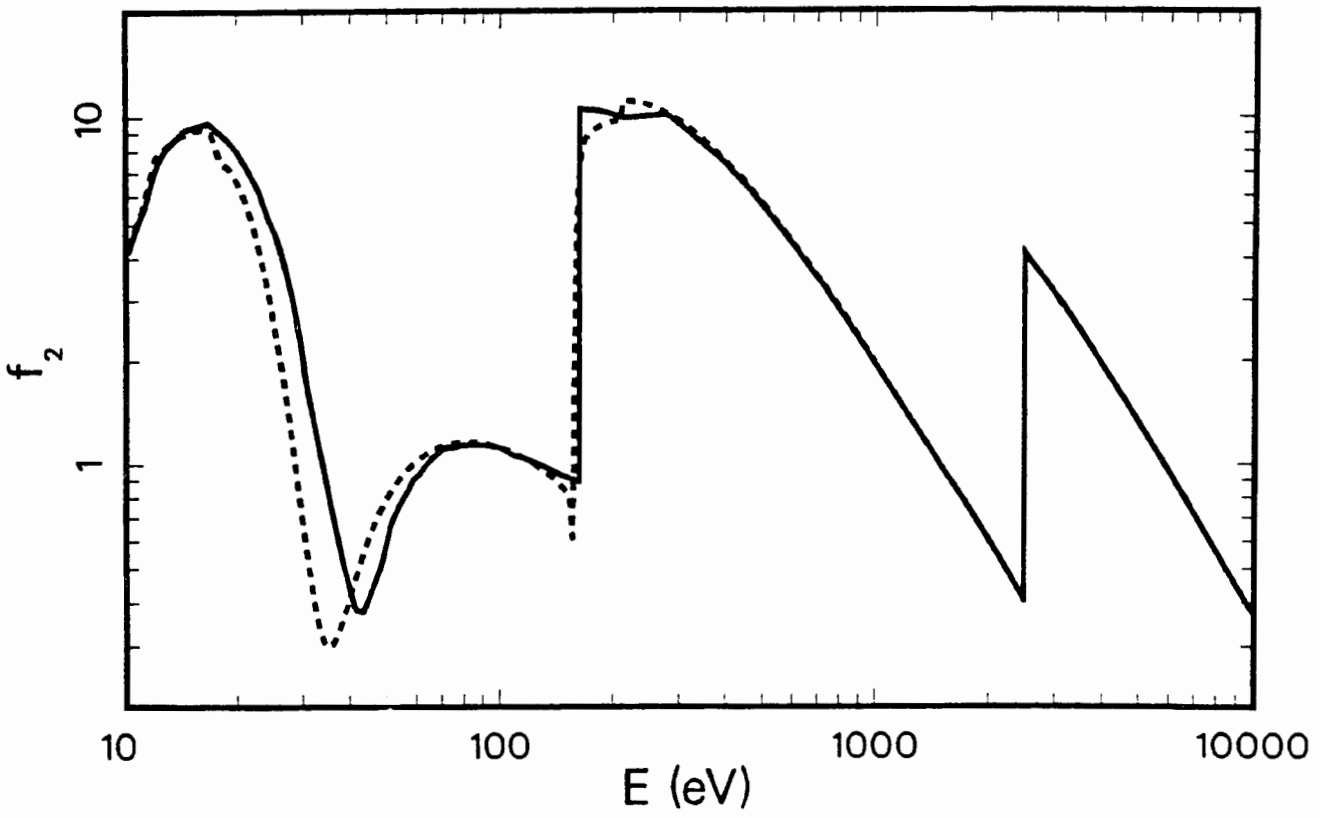


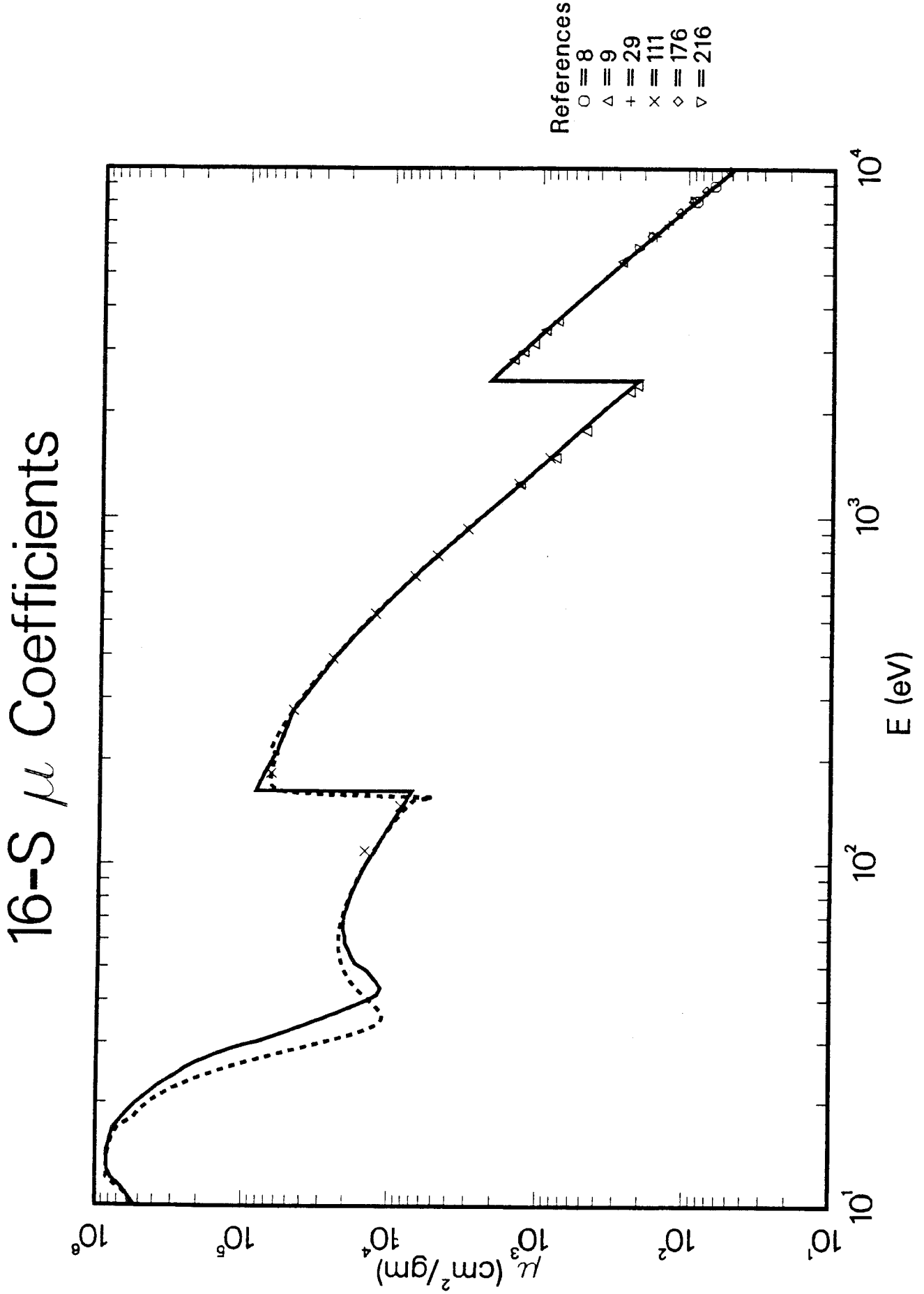



15-P μ Coefficients
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
16 - Sulfur (S)






16-S μ Coefficients
References
○ = 8
△ = 9
+ = 29
× = 111
◇ = 176
▽ = 216
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10⁷
10⁸

Sulfur (S) — 16

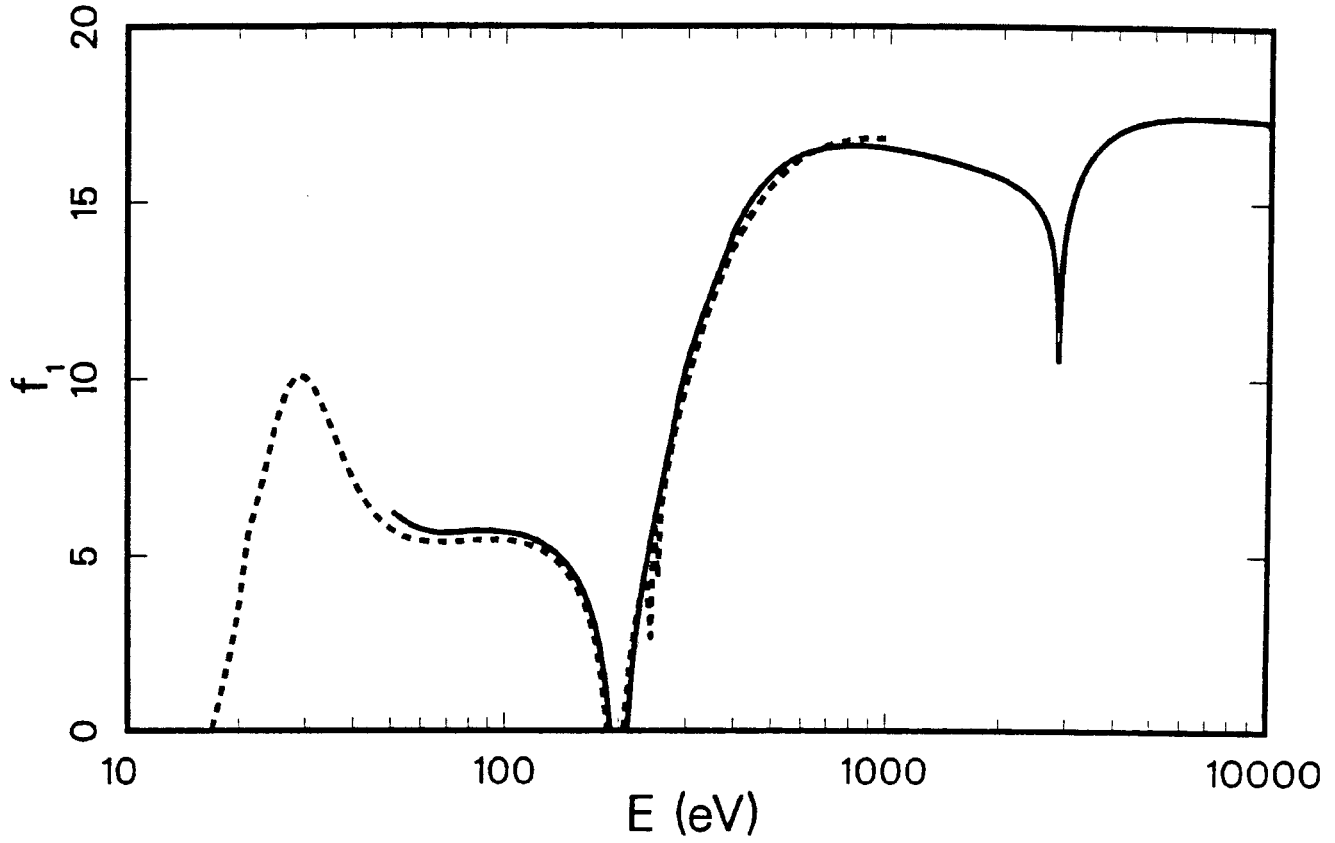
Atomic Weight = 32.06

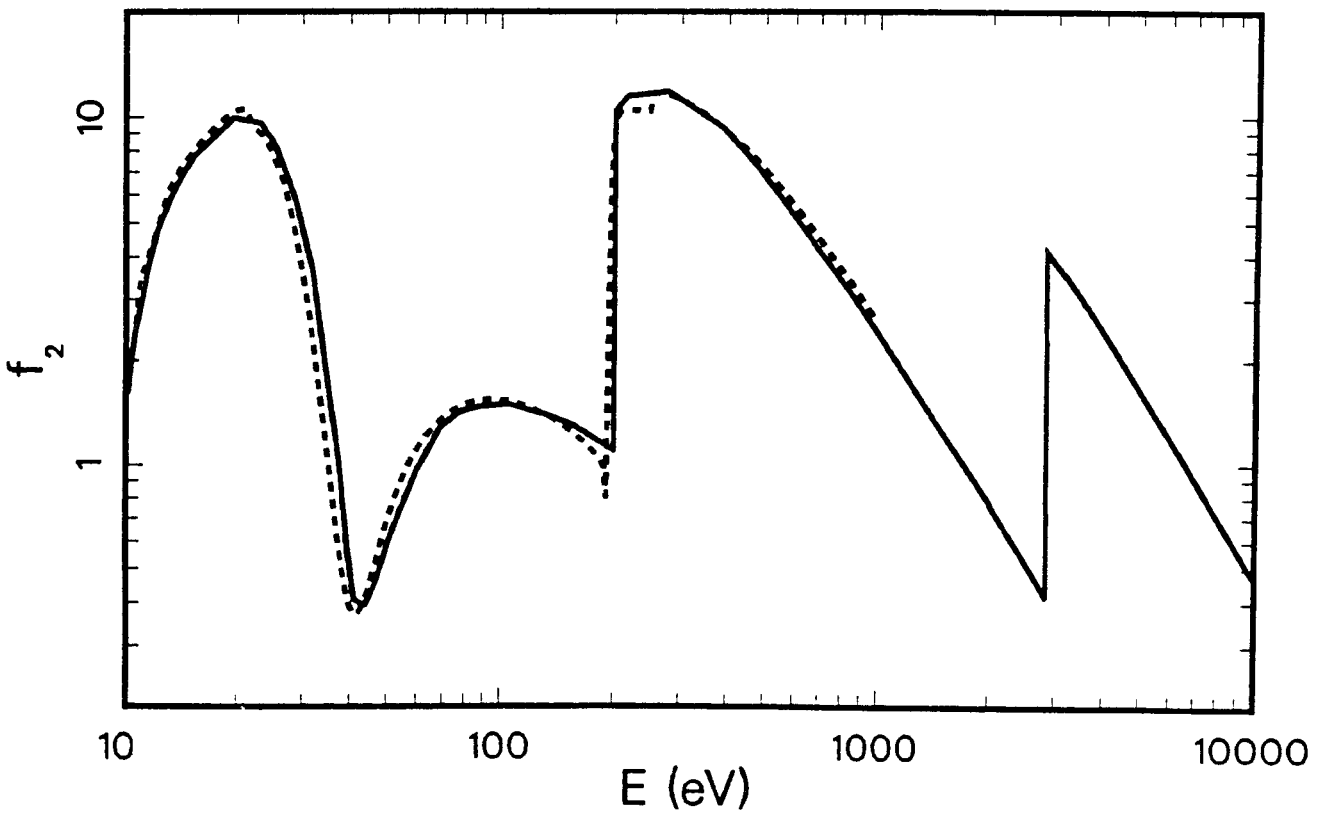
μ (barns/atom) = $\mu(cm^2/g) \times 53.24$

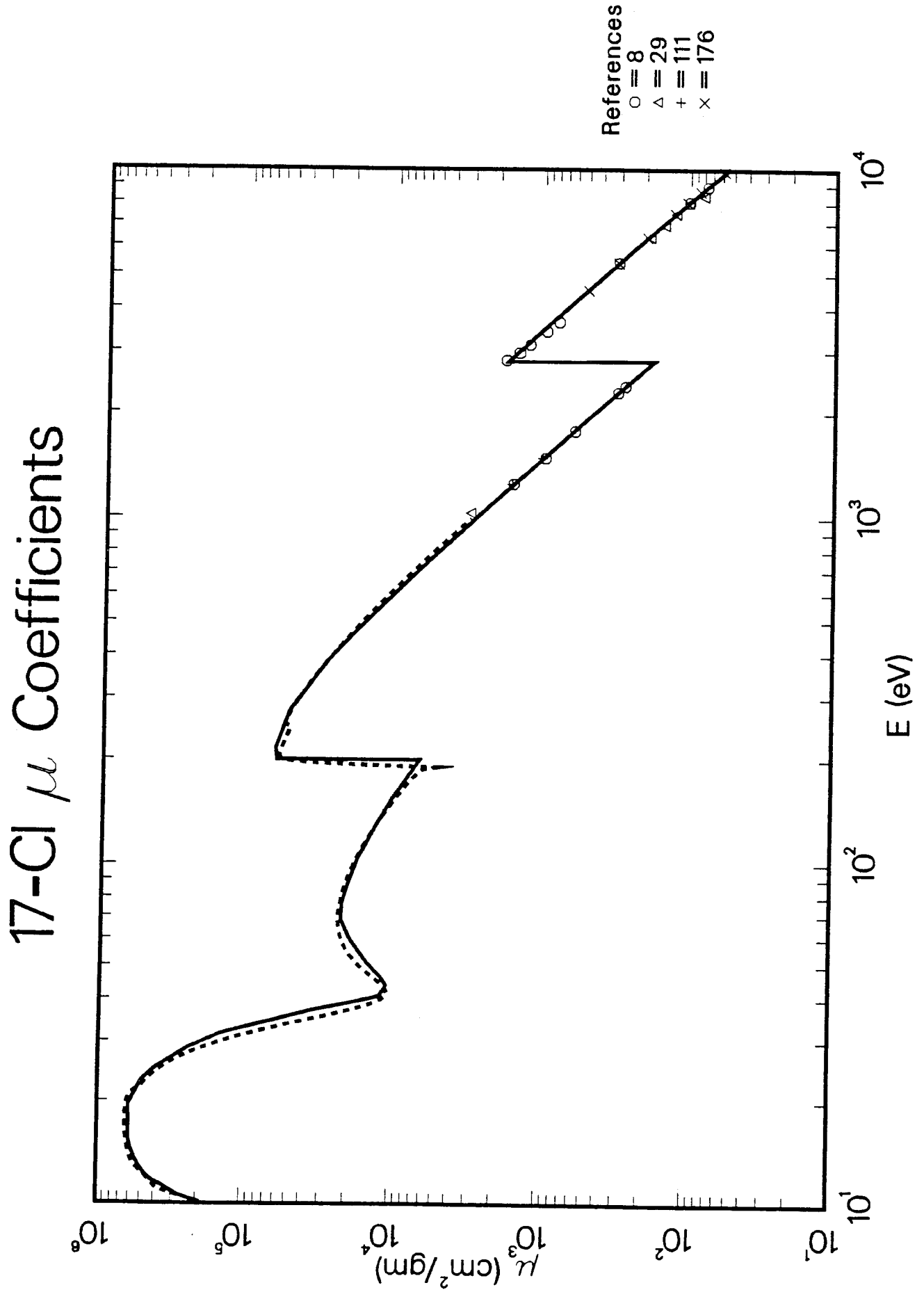
$E\mu(E) = 1312.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8060.0	8.75e+1	-2.1	8
8930.0	6.57e+1	-1.3	8
1254.0	1.39e+3	0.8	9
1487.0	7.94e+2	-8.7	9
1778.0	4.93e+2	-9.1	9
2293.0	2.49e+2	-6.8	9
2395.0	2.21e+2	-6.1	9
2838.0	1.56e+3	0.5	9
2984.0	1.35e+3	-1.2	9
3151.0	1.14e+3	-4.2	9
3444.0	9.48e+2	0.7	9
3662.0	7.87e+2	-1.7	9
5414.0	2.85e+2	3.5	9
6403.0	1.66e+2	-3.8	29
6930.0	1.38e+2	0.3	29
7477.0	1.11e+2	0.4	29
8047.0	9.13e+1	1.7	29
8638.0	7.49e+1	2.3	29
108.9	1.49e+4	16.9	111
147.2	8.51e+3	3.5	111
182.6	6.71e+4	-9.9	111
278.0	4.77e+4	0.6	111
391.4	2.55e+4	2.0	111
526.0	1.30e+4	0.4	111
676.8	7.03e+3	0.2	111
774.9	4.96e+3	-0.2	111
928.7	3.10e+3	0.4	111
1254.0	1.40e+3	1.7	111
1487.0	8.72e+2	0.3	111
6400.0	1.78e+2	3.4	176
7472.0	1.15e+2	3.4	176
8041.0	9.30e+1	3.4	176
8631.0	7.60e+1	3.4	176
9876.0	5.18e+1	4.1	176
5900.0	2.16e+2	-0.1	216
6400.0	1.74e+2	1.0	216
8100.0	9.08e+1	3.0	216

Atomic Scattering Factors, f_1+if_2
17 - Chlorine (Cl)






17-Cl μ Coefficients
References
○ = 8
△ = 29
+ = 111
× = 176
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10⁻¹

Chlorine (Cl) — 17

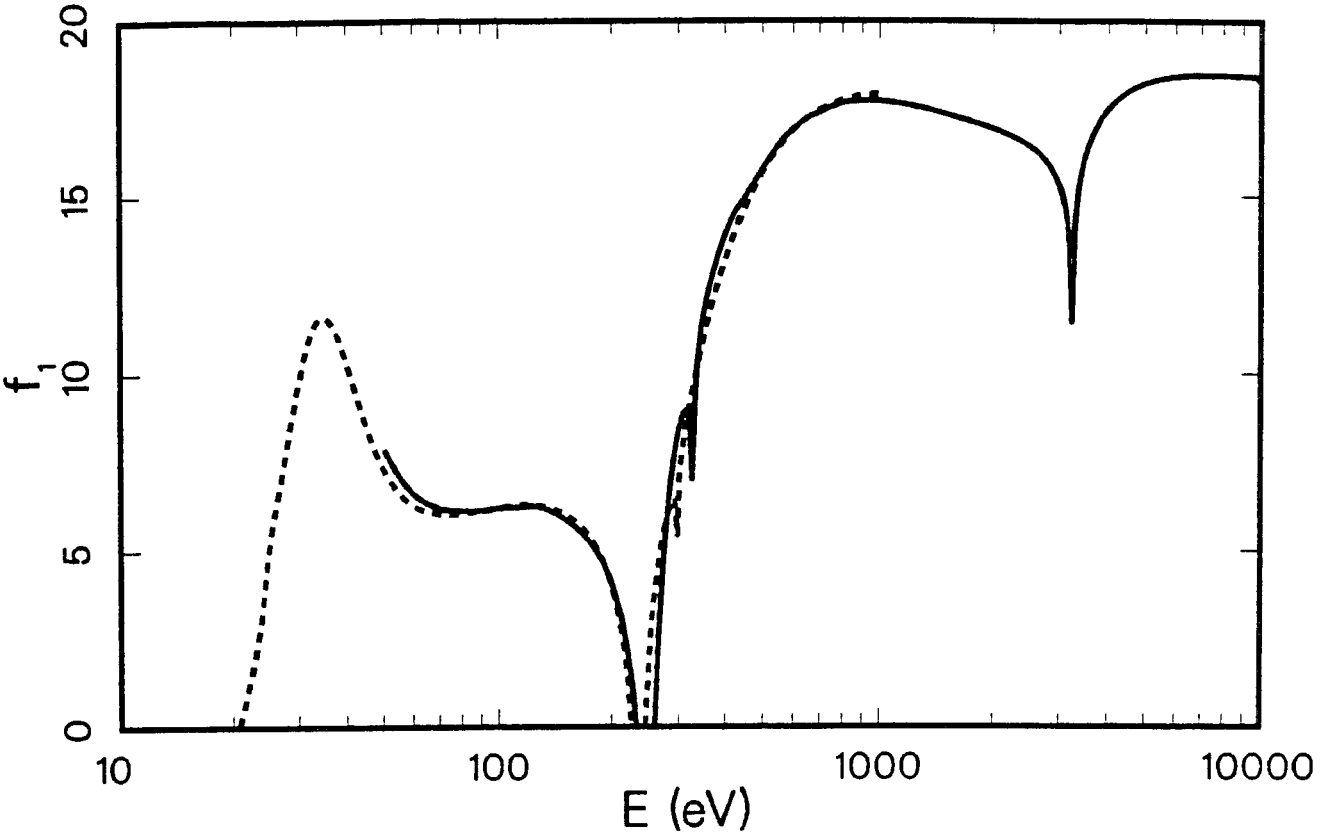
Atomic Weight = 35.45

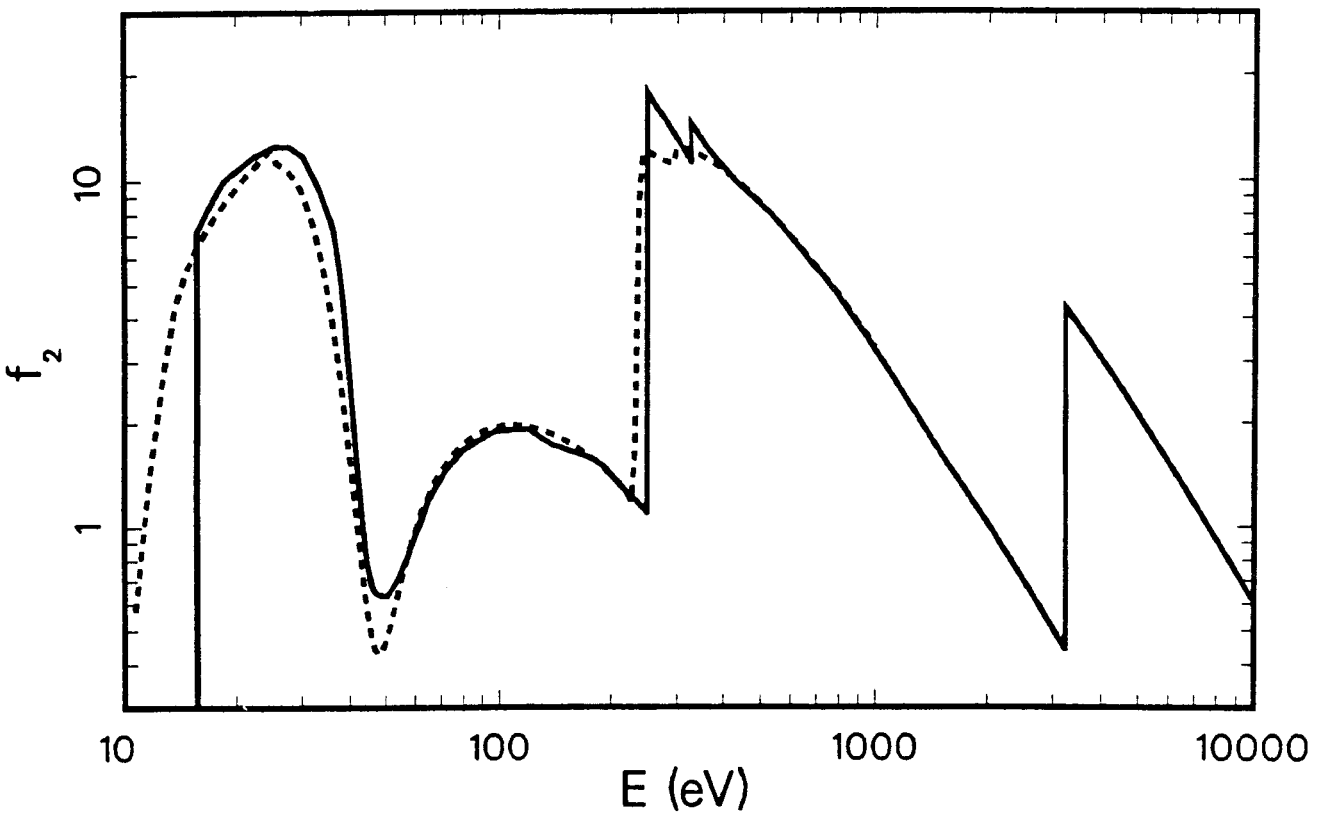
μ (barns/atom) = $\mu(cm^2/g) \times 58.87$

$E\mu(E) = 1186.9\, f_2$ keV cm^2/g

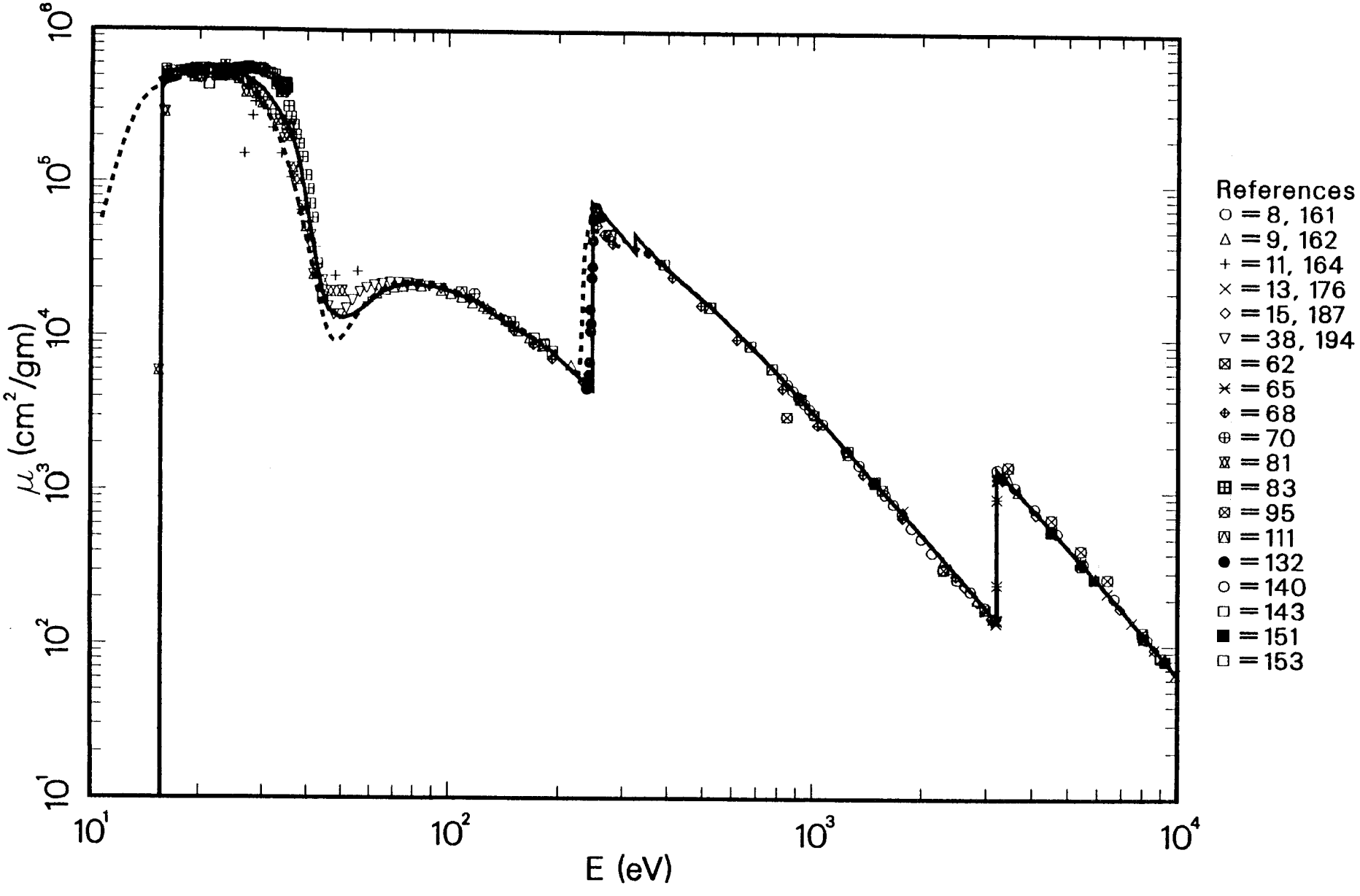
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1254.0	1.57e+3	0.7	8
1487.0	9.62e+2	-3.0	8
1778.0	6.10e+2	-1.9	8
2293.0	3.10e+2	-0.5	8
2395.0	2.77e+2	0.2	8
2838.0	1.80e+3	11.9	8
2984.0	1.48e+3	-2.2	8
3151.0	1.26e+3	-4.6	8
3444.0	9.66e+2	-8.0	8
3662.0	7.99e+2	-10.8	8
5420.0	3.13e+2	0.4	8
8060.0	1.02e+2	-0.4	8
8930.0	7.64e+1	-0.2	8
1033.0	3.07e+3	18.5	29
6403.0	1.90e+2	-3.0	29
6930.0	1.52e+2	-3.4	29
7477.0	1.27e+2	0.1	29
8047.0	1.04e+2	0.5	29
8368.0	8.08e+1	-12.3	29
1254.0	1.61e+3	3.3	111
1487.0	1.01e+3	1.9	111
4508.0	5.07e+2	-1.7	176
5411.0	3.16e+2	0.9	176
6400.0	2.00e+2	1.6	176
7472.0	1.29e+2	1.4	176
8041.0	1.06e+2	2.5	176
8631.0	8.61e+1	2.0	176
9876.0	5.92e+1	3.1	176

Atomic Scattering Factors, f_1+if_2
18 - Argon (Ar)





18-Ar μ Coefficients



Argon (Ar) — 18

Atomic Weight = 39.95

μ (barns/atom) = $\mu(cm^2/g) \times 66.34$

$E\mu(E) = 1053.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5420.0	3.37e+2	-4.8	8
8060.0	1.13e+2	-3.8	8
1254.0	1.86e+3	1.5	9
1487.0	1.16e+3	-0.1	9
1778.0	7.48e+2	3.1	9
2293.0	3.60e+2	-2.5	9
2395.0	3.24e+2	-1.2	9
2838.0	2.02e+2	-1.7	9
2984.0	1.74e+2	-2.4	9
3151.0	1.53e+2	-0.1	9
3444.0	1.25e+3	6.7	9
3660.0	1.02e+3	2.5	9
5414.0	3.54e+2	-0.2	9
5946.0	2.82e+2	2.8	9
277.0	4.57e+4	-18.9	11
1778.0	7.62e+2	5.0	13
2991.0	1.71e+2	-3.6	13
3142.0	1.51e+2	-2.0	13
3206.0	1.47e+2	-56.0	13
3209.0	1.46e+2	-62.7	13
3336.0	1.32e+3	4.5	13
5428.0	3.44e+2	-2.3	13
8067.0	1.12e+2	-4.4	13
8040.0	1.12e+2	-4.9	15
15.9	2.89e+5	1945400.0	38
15.9	2.92e+5	1964300.0	38
16.1	4.99e+5	13389.0	38
16.1	5.44e+5	14602.0	38
16.1	5.16e+5	13844.0	38
16.6	5.27e+5	3.1	38
16.6	5.27e+5	3.1	38
17.1	4.94e+5	-6.5	38
17.7	5.33e+5	-2.2	38
18.1	5.27e+5	-5.3	38
18.5	5.27e+5	-7.2	38
18.8	5.05e+5	-11.0	38
19.2	5.05e+5	-10.8	38
19.5	5.05e+5	-10.6	38
19.8	4.82e+5	-14.5	38
20.1	4.77e+5	-15.3	38
20.6	4.77e+5	-15.0	38
8000.0	1.23e+2	2.5	62
9000.0	8.40e+1	-2.3	62
10000.0	6.30e+1	-1.1	62
3195.0	1.40e+2	-23.6	65
3197.0	1.40e+2	-31.5	65
3198.0	1.50e+2	-30.6	65
3201.0	2.50e+2	-1.6	65
3204.0	9.11e+2	204.0	65
3211.0	1.25e+3	184.1	65

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
3217.0	1.22e+3	100.1	65
3223.0	1.21e+3	44.1	65
3226.0	1.23e+3	24.9	65
3241.0	1.23e+3	-9.1	65
114.3	1.76e+4	0.0	68
151.2	1.11e+4	-4.5	68
171.0	9.01e+3	-8.2	68
192.2	7.33e+3	-9.7	68
234.0	5.19e+3	-2.0	68
256.0	5.31e+4	-22.9	68
267.0	4.68e+4	-24.0	68
282.0	4.07e+4	-24.1	68
354.0	3.63e+4	-3.2	68
413.0	2.48e+4	-6.0	68
496.0	1.62e+4	-10.3	68
620.0	9.88e+3	-10.6	68
826.5	4.73e+3	-13.6	68
1033.0	2.72e+3	-11.4	68
1378.0	1.32e+3	-7.4	68
1771.0	6.84e+2	-6.7	68
2480.0	2.85e+2	-4.4	68
3100.0	1.51e+2	-5.5	68
117.7	1.90e+4	11.1	70
15.5	5.91e+3	**********	81
16.0	2.89e+5	122240.0	81
16.1	4.75e+5	12720.0	81
16.3	4.92e+5	-2.0	81
16.4	4.84e+5	-4.2	81
16.6	5.01e+5	-2.1	81
17.7	5.29e+5	-2.9	81
18.1	5.32e+5	-4.4	81
19.3	4.87e+5	-13.9	81
19.7	5.30e+5	-6.1	81
19.9	5.38e+5	-4.6	81
20.2	5.37e+5	-4.6	81
20.3	5.30e+5	-5.7	81
20.7	5.39e+5	-3.9	81
22.4	5.37e+5	-2.7	81
23.1	5.52e+5	1.5	81
23.5	5.79e+5	7.3	81
23.7	5.38e+5	0.1	81
24.5	5.13e+5	-3.1	81
24.7	4.99e+5	-5.4	81
25.7	4.79e+5	-6.5	81
26.3	5.39e+5	7.7	81
26.9	3.91e+5	-19.9	81
27.6	4.51e+5	-5.2	81
28.8	3.83e+5	-13.8	81
29.9	3.32e+5	-20.1	81
33.6	2.56e+5	-10.2	81

E(eV)	μ(cm^2/g)	% Error	Ref.
34.8	2.41e+5	-3.1	81
35.0	2.01e+5	-17.2	81
35.9	2.27e+5	3.3	81
36.5	1.24e+5	-36.4	81
37.4	1.04e+5	-35.1	81
38.7	6.62e+4	-39.9	81
39.8	5.11e+4	-32.1	81
41.1	4.48e+4	-7.9	81
41.8	2.51e+4	-34.9	81
44.3	2.30e+4	19.7	81
46.7	1.96e+4	33.8	81
50.3	1.96e+4	48.4	81
22.3	4.97e+5	-10.2	83
22.6	4.97e+5	-9.5	83
22.6	5.11e+5	-7.0	83
22.8	5.02e+5	-8.2	83
22.9	4.94e+5	-9.5	83
23.0	4.97e+5	-8.8	83
23.1	5.17e+5	-4.9	83
23.3	5.16e+5	-4.8	83
23.6	5.25e+5	-2.6	83
23.8	5.33e+5	-0.7	83
24.0	5.27e+5	-1.4	83
24.1	5.35e+5	0.4	83
24.2	5.27e+5	-1.0	83
24.4	5.42e+5	2.3	83
24.5	5.42e+5	2.4	83
24.7	5.40e+5	2.4	83
24.9	5.34e+5	1.7	83
25.1	5.45e+5	4.1	83
25.4	5.54e+5	6.8	83
25.7	5.58e+5	9.0	83
26.1	5.53e+5	9.6	83
26.5	5.57e+5	12.1	83
26.8	5.64e+5	14.9	83
26.9	5.50e+5	12.6	83
27.3	5.69e+5	18.2	83
27.4	5.55e+5	15.8	83
27.7	5.55e+5	17.0	83
28.0	5.54e+5	18.7	83
28.5	5.56e+5	23.0	83
29.1	5.46e+5	25.4	83
29.5	5.57e+5	30.9	83
29.9	5.51e+5	32.6	83
30.3	5.34e+5	32.7	83
30.7	5.22e+5	35.3	83
31.3	5.21e+5	43.6	83
31.8	5.11e+5	48.4	83
32.3	5.07e+5	54.7	83
32.5	2.78e+5	-13.4	83
32.7	4.37e+5	38.8	83
33.1	4.56e+5	50.7	83
33.5	4.47e+5	54.8	83
33.7	3.88e+5	37.7	83
33.8	4.32e+5	55.1	83

E(eV)	μ(cm^2/g)	% Error	Ref.
34.0	4.45e+5	63.4	83
34.1	3.92e+5	45.7	83
34.2	4.53e+5	70.3	83
34.4	4.29e+5	65.0	83
34.5	4.07e+5	58.2	83
34.6	4.45e+5	75.2	83
34.6	4.24e+5	66.9	83
34.8	4.18e+5	68.5	83
34.9	4.51e+5	83.6	83
35.0	4.20e+5	73.0	83
35.4	3.16e+5	36.3	83
36.0	2.71e+5	24.7	83
36.6	2.40e+5	25.4	83
37.2	2.05e+5	22.8	83
37.9	1.79e+5	25.3	83
38.8	1.46e+5	37.6	83
39.7	1.11e+5	42.2	83
40.3	9.01e+4	42.0	83
40.8	7.24e+4	35.0	83
41.5	5.84e+4	37.1	83
42.8	2.95e+4	3.1	83
44.3	1.77e+4	-7.9	83
852.0	3.09e+3	-39.0	95
930.0	4.04e+3	-0.1	95
1012.0	3.20e+3	-1.5	95
1254.0	1.76e+3	-4.0	95
1487.0	1.15e+3	-0.8	95
1557.0	1.04e+3	1.4	95
2293.0	3.15e+2	-14.6	95
2984.0	1.73e+2	-2.9	95
3444.0	1.47e+3	25.8	95
4511.0	6.66e+2	15.0	95
5415.0	4.22e+2	19.1	95
6404.0	2.74e+2	22.8	95
8048.0	1.18e+2	0.0	95
108.9	1.95e+4	6.0	111
147.2	1.27e+4	5.3	111
182.6	9.17e+3	3.4	111
278.0	4.56e+4	-18.2	111
391.4	3.02e+4	1.4	111
526.0	1.59e+4	-1.0	111
676.8	8.94e+3	0.1	111
774.9	6.39e+3	-1.3	111
928.7	4.07e+3	0.3	111
1254.0	1.85e+3	0.7	111
1487.0	1.18e+3	2.0	111
239.6	4.67e+3	-7.0	132
240.4	4.67e+3	-6.3	132
241.0	5.28e+3	6.4	132
241.8	5.43e+3	10.3	132
242.5	5.58e+3	14.1	132
243.3	5.73e+3	18.0	132
244.1	6.93e+3	44.0	132
244.9	1.52e+4	202.2	132
245.7	1.10e+4	78.5	132

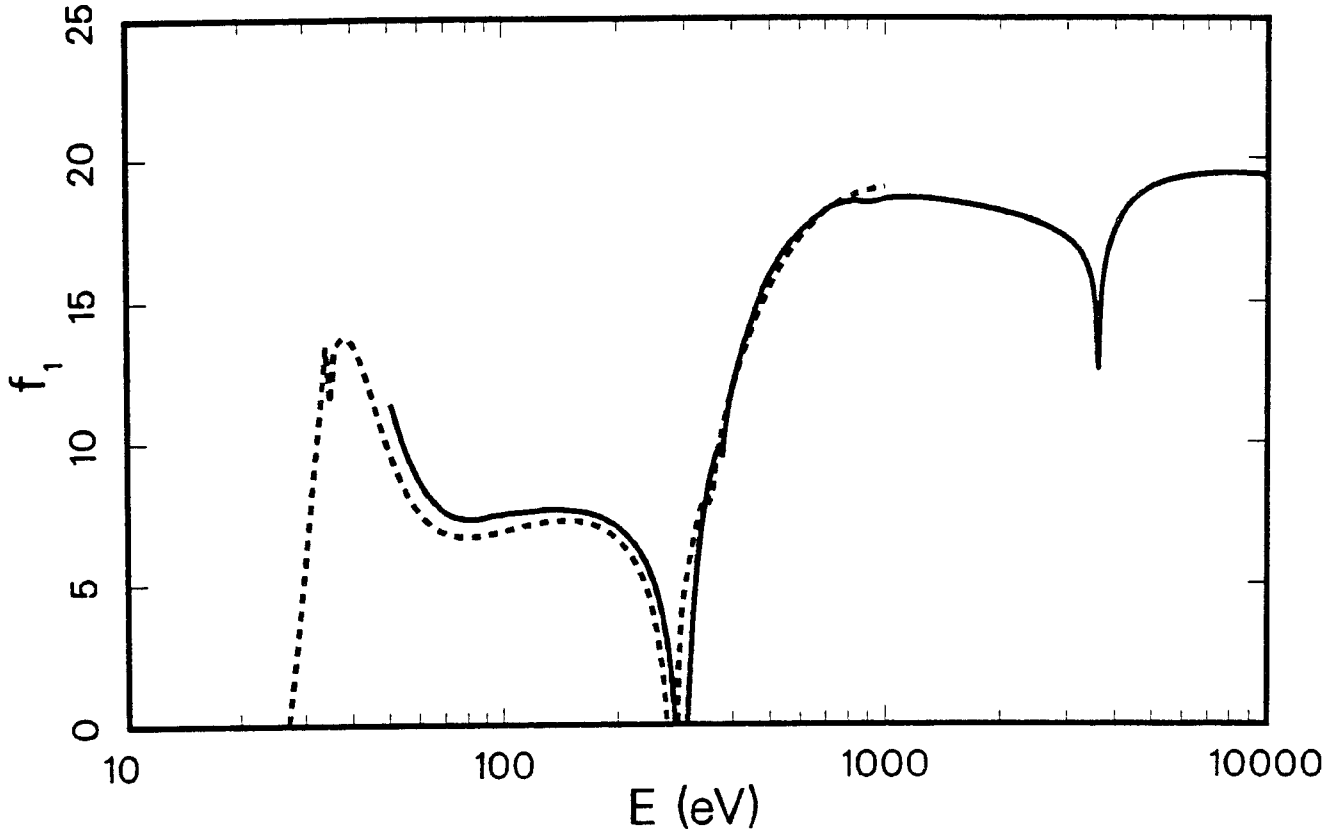
E(eV)	μ(cm^2/g)	% Error	Ref.
246.5	1.24e+4	64.0	132
247.3	2.44e+4	165.2	132
248.2	2.88e+4	149.8	132
249.1	4.27e+4	195.9	132
249.9	5.73e+4	225.8	132
250.6	6.11e+4	192.1	132
252.3	7.01e+4	120.8	132
254.2	7.04e+4	39.4	132
256.0	6.75e+4	-1.9	132
257.8	6.48e+4	-4.0	132
261.7	6.09e+4	-6.0	132
263.4	6.09e+4	-4.3	132
825.0	5.58e+3	1.3	140
853.0	5.07e+3	0.4	140
884.0	4.60e+3	-0.2	140
916.0	4.19e+3	-0.3	140
952.0	3.80e+3	-0.2	140
982.0	3.48e+3	-0.8	140
1006.0	3.26e+3	-1.2	140
1066.0	2.79e+3	-1.4	140
1237.0	1.87e+3	-1.9	140
1345.0	1.50e+3	-1.1	140
1473.0	1.16e+3	-2.1	140
1586.0	9.71e+2	-0.7	140
1672.0	8.40e+2	-1.5	140
1767.0	7.27e+2	-1.5	140
1874.0	5.89e+2	-6.7	140
1995.0	5.04e+2	-5.9	140
2133.0	4.07e+2	-9.2	140
2291.0	3.20e+2	-13.6	140
2499.0	2.71e+2	-7.1	140
2719.0	2.28e+2	-1.7	140
2981.0	1.79e+2	0.2	140
3213.0	1.41e+3	189.1	140
3586.0	1.09e+3	3.3	140
4056.0	7.90e+2	3.0	140
4668.0	5.46e+2	3.1	140
5498.0	3.47e+2	2.0	140
6687.0	2.07e+2	4.2	140
8247.0	1.11e+2	0.8	140
151.0	1.18e+4	1.1	143
171.7	9.95e+3	1.8	143
183.4	8.92e+3	1.5	143
192.6	8.19e+3	1.3	143
236.9	5.43e+3	5.3	143
277.0	4.67e+4	-17.0	143
523.0	1.58e+4	-2.6	143
4508.0	5.58e+2	-3.9	151
5895.0	2.74e+2	-2.3	151
9243.0	7.97e+1	0.0	151
21.2	4.40e+5	-21.2	153
21.2	5.20e+5	-6.9	161
63.1	1.90e+4	3.9	162
66.8	2.00e+4	0.8	162
70.7	2.09e+4	-0.4	162

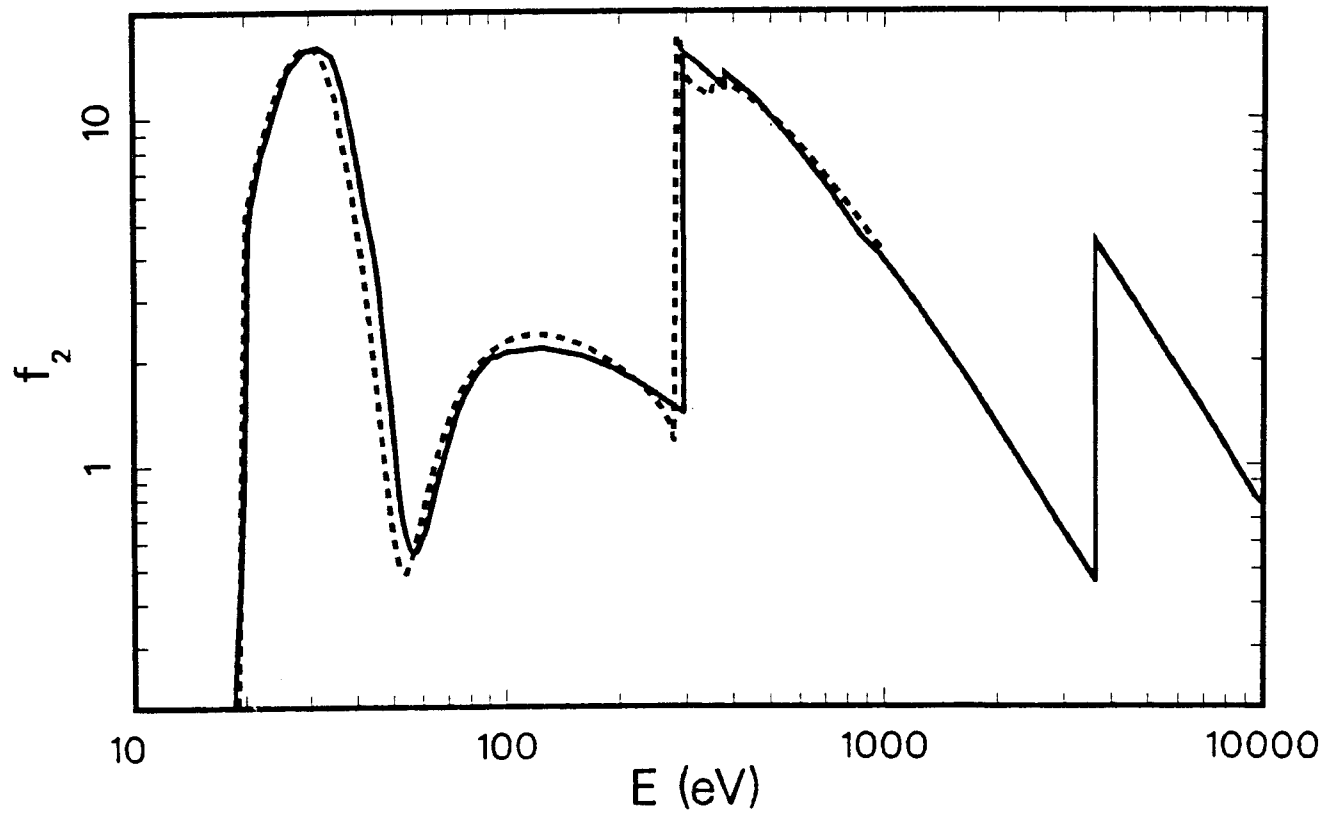
E(eV)	μ(cm^2/g)	% Error	Ref.
74.9	2.10e+4	-2.4	162
79.3	2.17e+4	-1.2	162
84.3	2.13e+4	-1.2	162
95.5	2.00e+4	-3.0	162
101.7	1.90e+4	-2.9	162
108.6	1.81e+4	-1.7	162
116.3	1.67e+4	-3.7	162
124.5	1.58e+4	0.9	162
128.0	1.53e+4	2.0	162
133.5	1.41e+4	1.5	162
143.5	1.30e+4	4.2	162
154.9	1.11e+4	-1.2	162
166.9	1.00e+4	-1.1	162
172.5	9.42e+3	-3.0	162
180.8	8.80e+3	-2.3	162
196.2	7.85e+3	1.4	162
217.2	6.68e+3	8.4	162
17.7	5.12e+5	-6.1	164
18.1	5.38e+5	-3.4	164
19.0	5.58e+5	-1.6	164
21.0	5.62e+5	0.5	164
22.8	5.52e+5	0.9	164
24.2	5.29e+5	-0.7	164
25.5	4.91e+5	-4.9	164
26.4	5.00e+5	0.2	164
26.7	1.54e+5	-68.7	164
27.0	4.32e+5	-11.2	164
27.9	4.50e+5	-4.2	164
28.1	2.75e+5	-40.8	164
28.5	4.31e+5	-4.8	164
28.6	3.37e+5	-24.9	164
28.8	3.81e+5	-14.1	164
29.6	3.35e+5	-20.7	164
30.9	3.00e+5	-20.6	164
32.0	2.28e+5	-32.6	164
33.9	1.53e+5	-44.3	164
36.1	1.07e+5	-49.9	164
38.6	6.55e+4	-42.5	164
42.3	3.77e+4	14.8	164
48.2	2.46e+4	78.0	164
55.6	2.63e+4	82.0	164
59.6	1.67e+4	2.1	164
4508.0	5.61e+2	-3.4	176
5411.0	3.52e+2	-0.9	176
6400.0	2.22e+2	-1.0	176
7472.0	1.43e+2	-1.3	176
8041.0	1.18e+2	-0.4	176
8631.0	9.58e+1	-1.1	176
9876.0	6.54e+1	-0.8	176
2622.0	2.44e+2	-4.6	187
2839.0	1.94e+2	-5.6	187
3134.0	1.47e+2	-5.1	187
3313.0	1.28e+3	-0.4	187
4089.0	7.24e+2	-3.5	187
5412.0	3.45e+2	-2.8	187

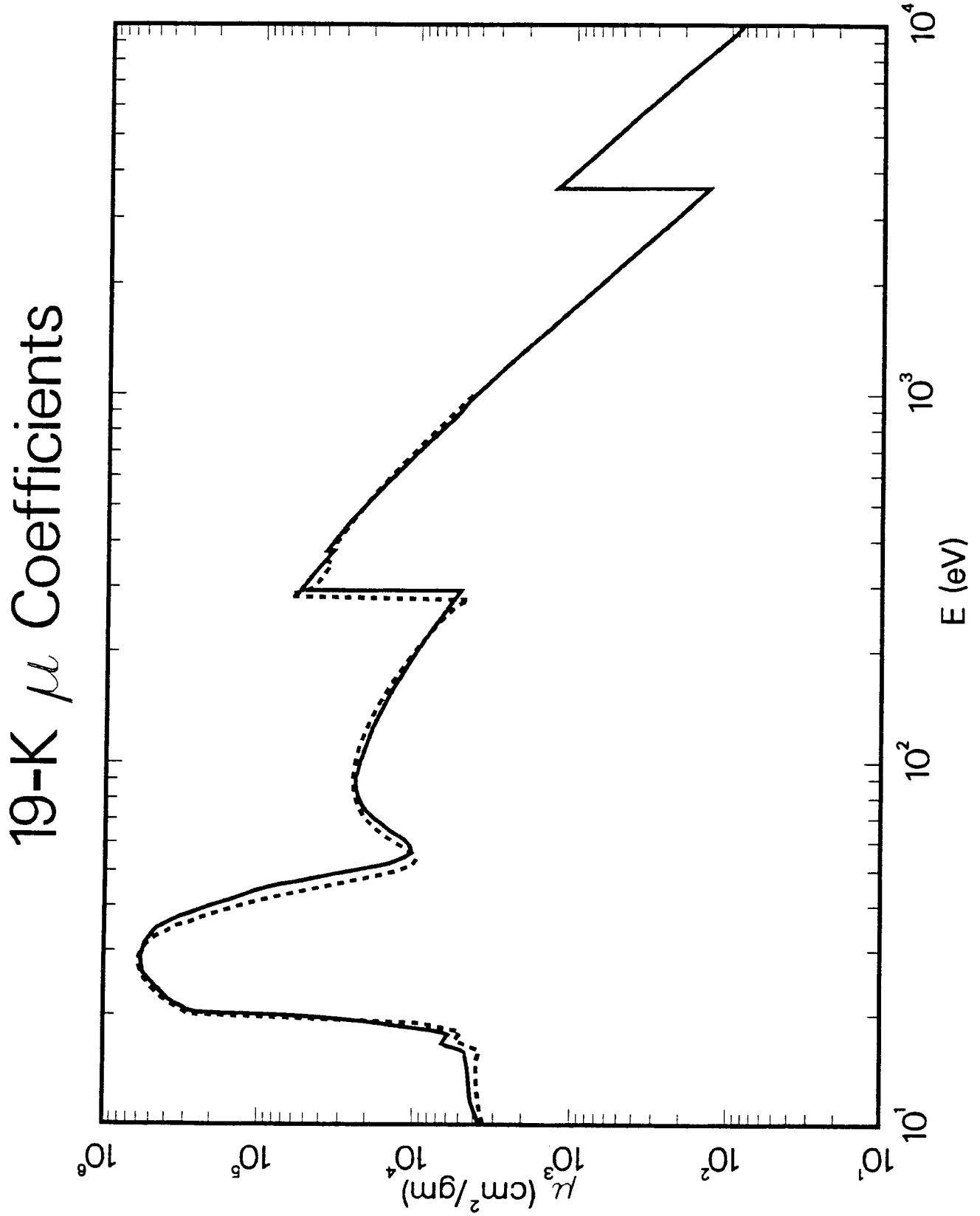
Argon (Ar) — 18

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6925.0	1.76e+2	-2.0	187
8631.0	9.53e+1	-1.5	187
15.8	4.40e+5	48032000.0	194
15.9	4.45e+5	2994600.0	194
16.3	4.69e+5	-6.6	194
16.8	4.90e+5	-5.5	194
17.2	5.08e+5	-4.3	194
17.7	5.23e+5	-4.0	194
18.2	5.35e+5	-4.4	194
18.8	5.44e+5	-4.1	194
19.4	5.50e+5	-2.7	194
20.0	5.53e+5	-1.8	194
20.7	5.53e+5	-1.3	194
21.4	5.50e+5	-1.4	194
22.1	5.44e+5	-2.0	194
23.0	5.34e+5	-2.1	194
23.8	5.19e+5	-3.3	194
24.8	4.99e+5	-5.2	194
25.8	4.73e+5	-7.2	194
27.0	4.45e+5	-8.7	194
28.2	4.09e+5	-11.3	194
29.5	3.66e+5	-13.9	194
31.0	3.17e+5	-15.3	194
32.6	2.58e+5	-18.9	194
34.4	1.93e+5	-25.8	194
36.5	1.17e+5	-40.1	194
38.7	6.96e+4	-36.7	194
41.3	3.72e+4	-18.1	194
42.8	2.67e+4	-6.7	194
44.3	1.96e+4	2.1	194
45.9	1.55e+4	1.2	194
47.7	1.38e+4	-2.2	194
49.6	1.38e+4	3.1	194
51.7	1.51e+4	12.8	194
53.9	1.70e+4	23.5	194
56.4	1.93e+4	30.4	194
59.0	2.05e+4	28.2	194
62.0	2.14e+4	21.2	194
65.3	2.19e+4	12.4	194
68.9	2.23e+4	9.1	194
72.9	2.23e+4	4.3	194
77.5	2.22e+4	1.8	194
82.7	2.19e+4	0.8	194
88.6	2.13e+4	0.5	194
95.4	2.05e+4	-0.5	194

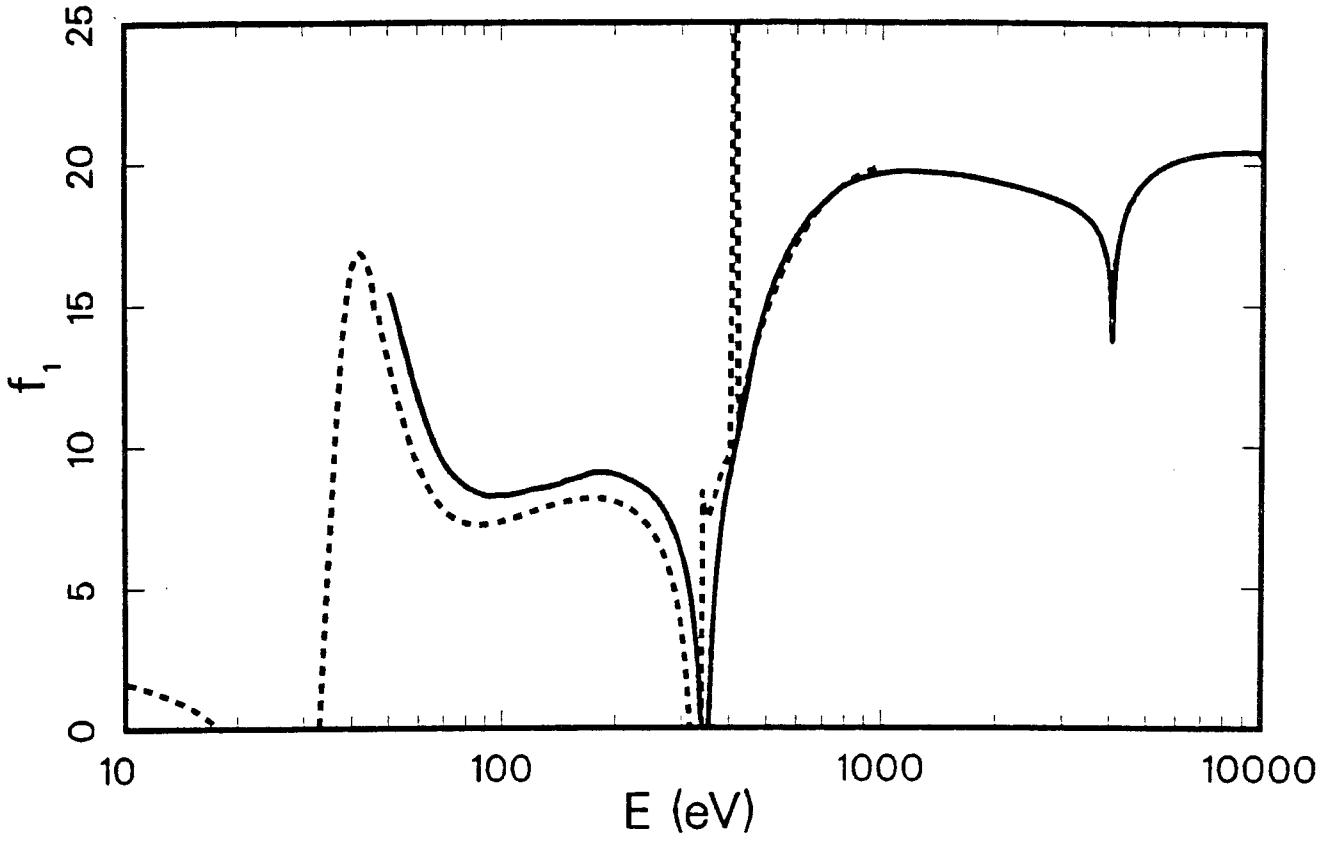
Atomic Scattering Factors, f_1+if_2
19 - Potassium (K)

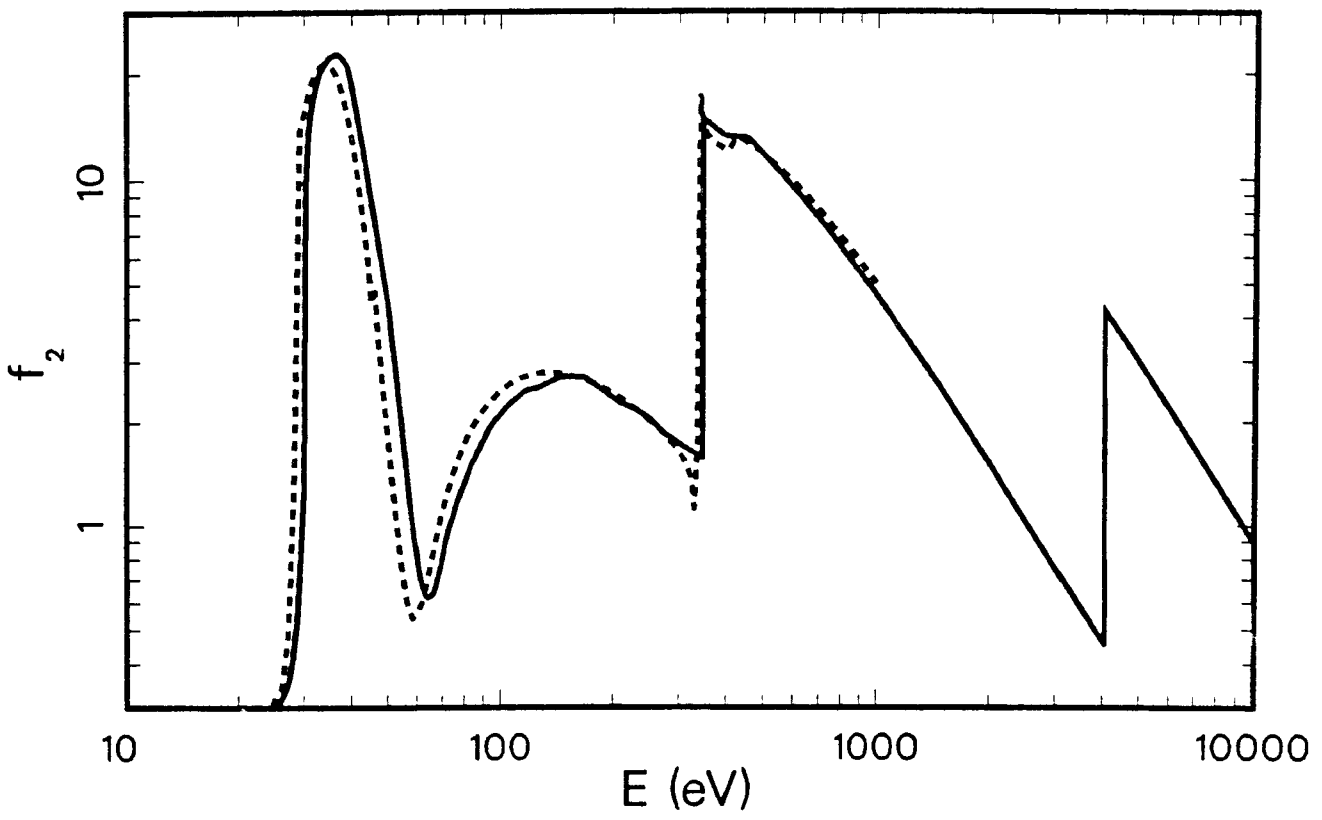


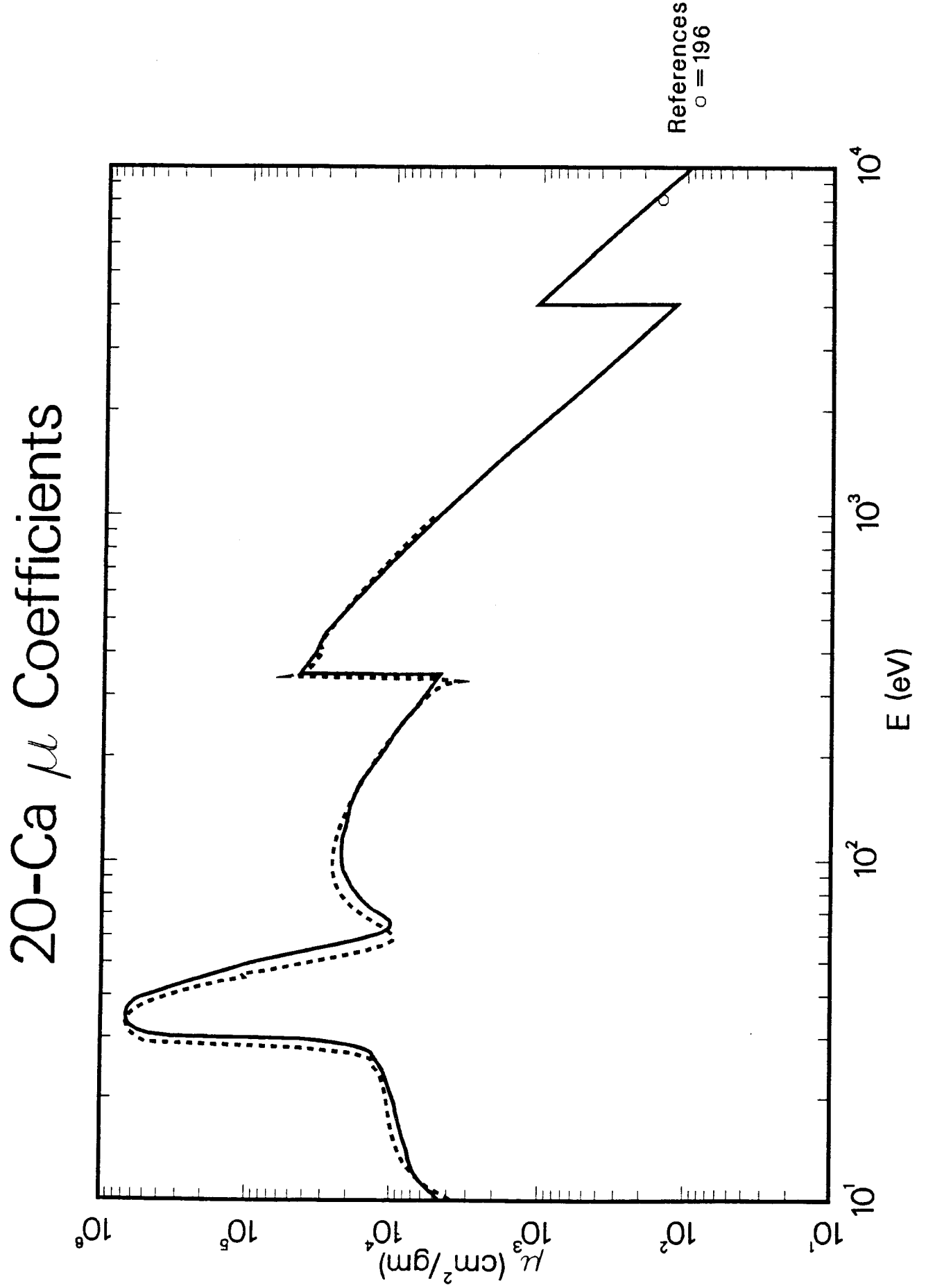



19-K μ Coefficients
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

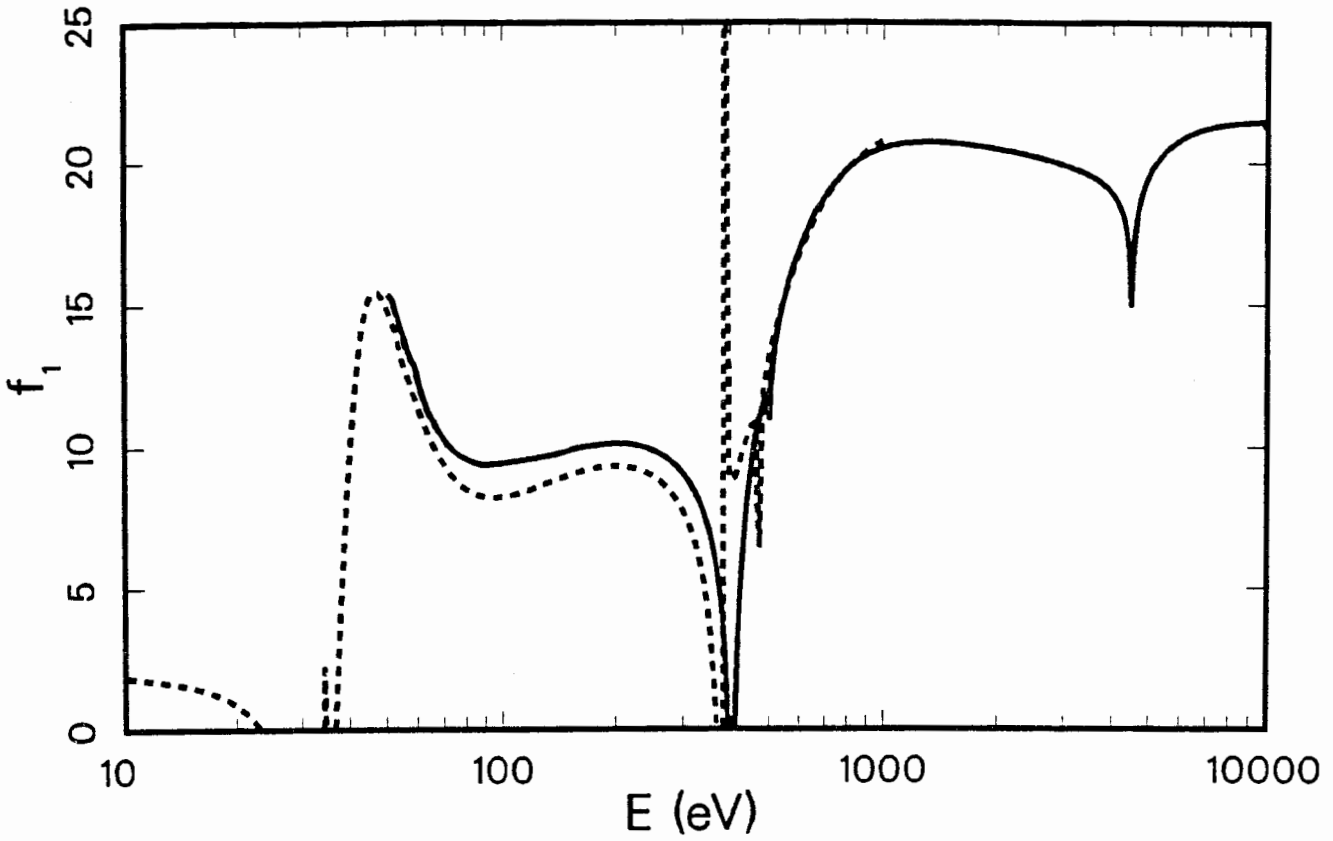
Atomic Scattering Factors, f_1+if_2
20 - Calcium (Ca)

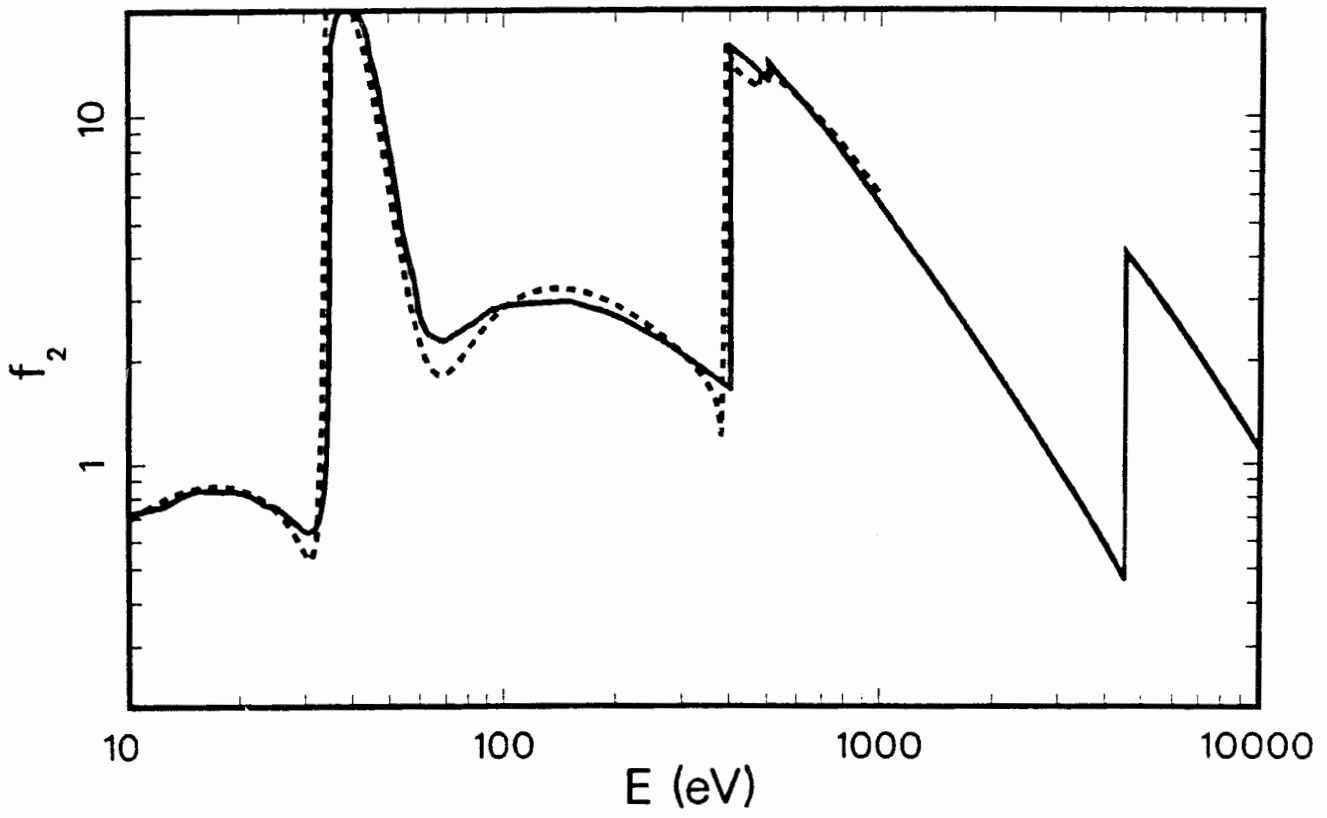


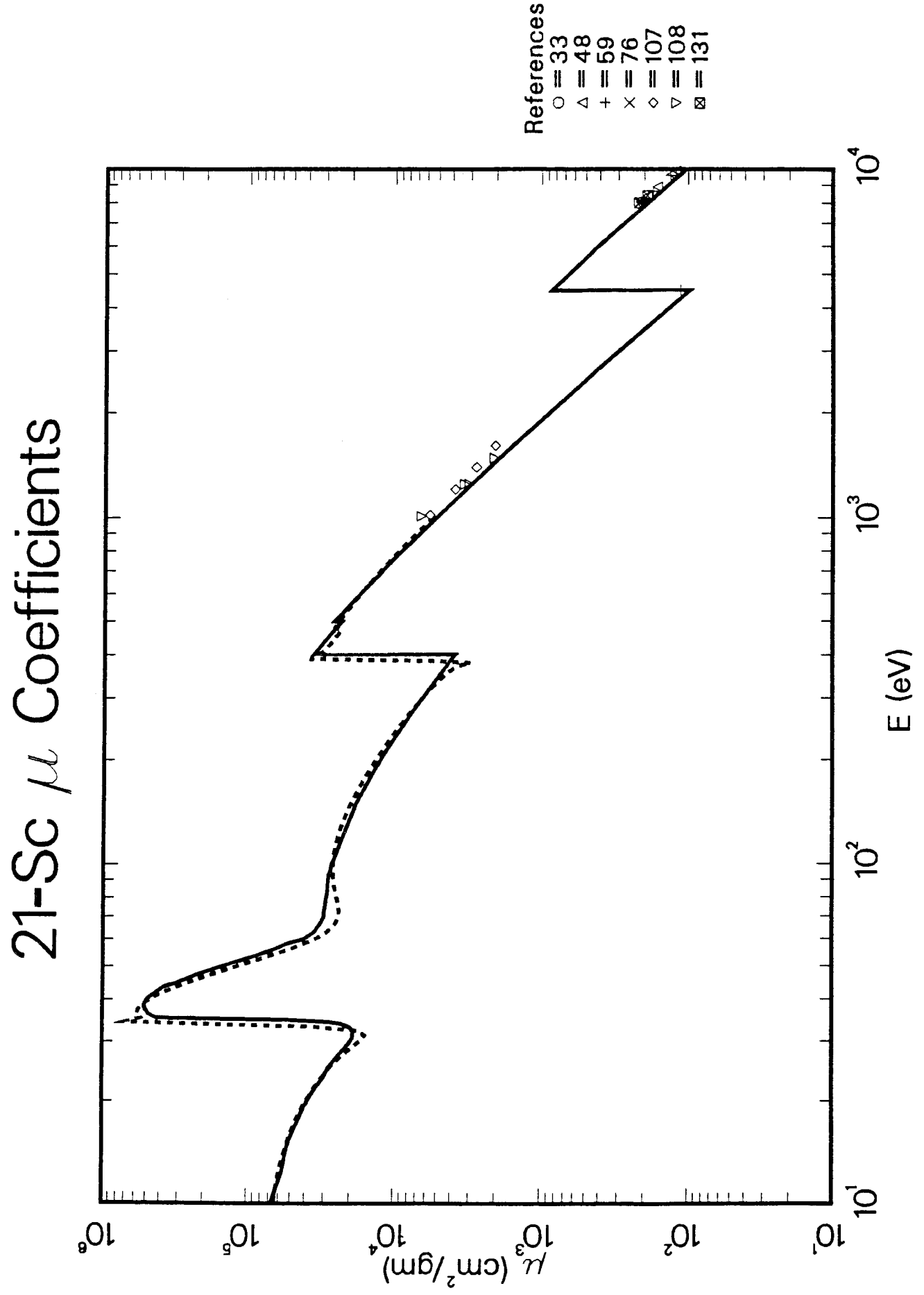



20-Ca μ Coefficients
References
○ = 196
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
21 - Scandium (Sc)






21-Sc μ Coefficients
References
○ = 33
△ = 48
+ = 59
× = 76
◇ = 107
▷ = 108
⊠ = 131
μ (cm²/gm)
10⁶
10⁵
10⁴
10³
10²
10¹
E (eV)
10¹
10²
10³
10⁴

Scandium (Sc) — 21

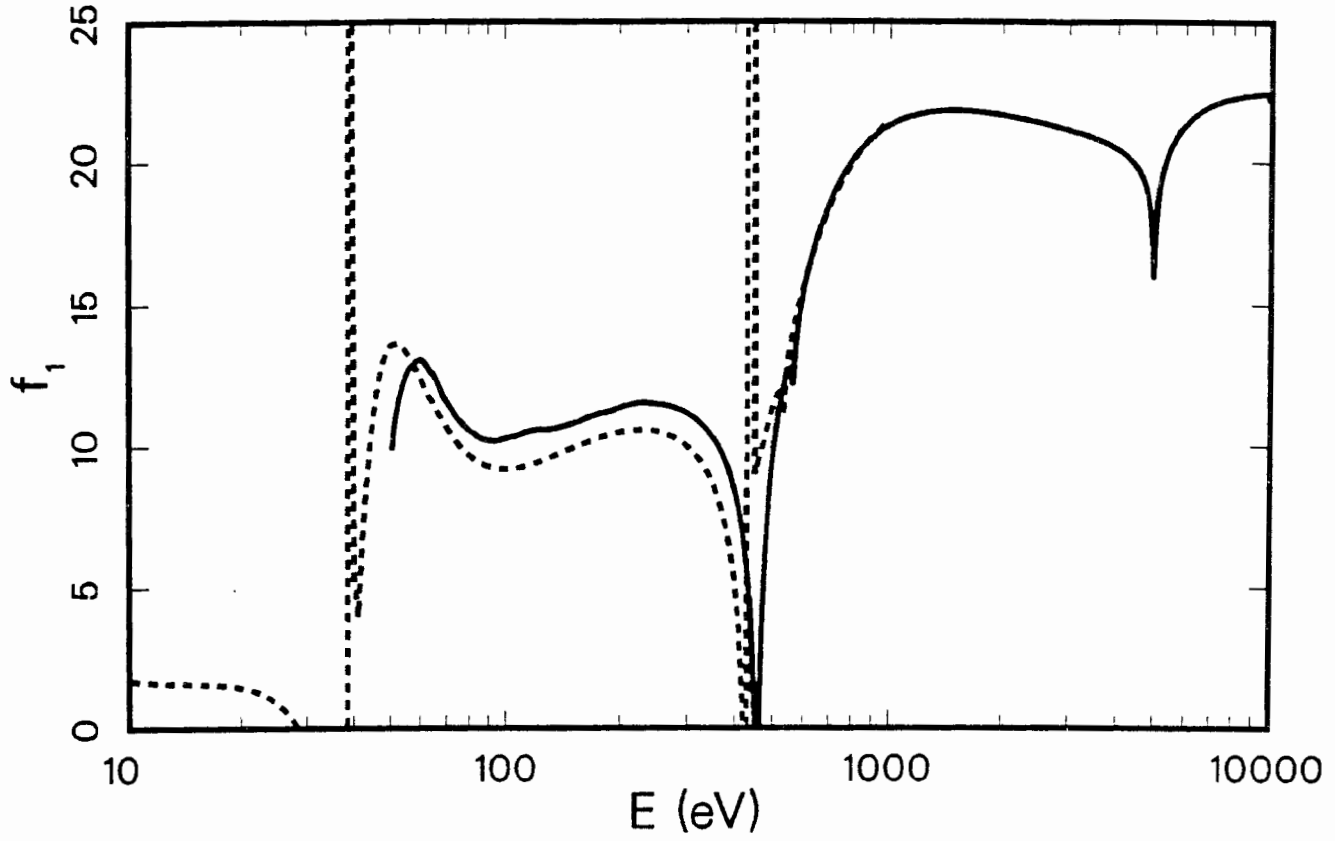
Atomic Weight = 44.96

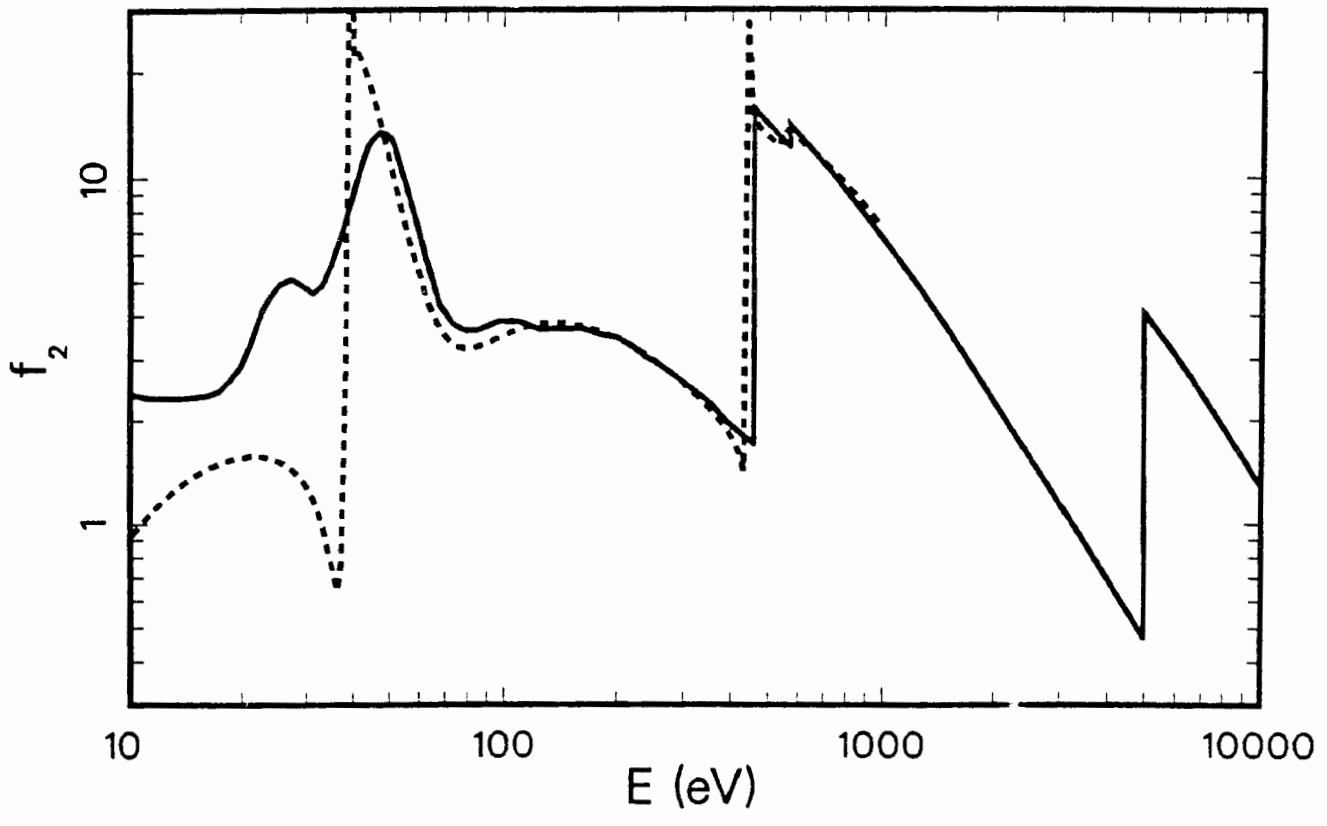
μ (barns/atom) = $\mu(cm^2/g) \times 74.65$

$E\mu(E) = 936.0\, f_2$ keV cm^2/g

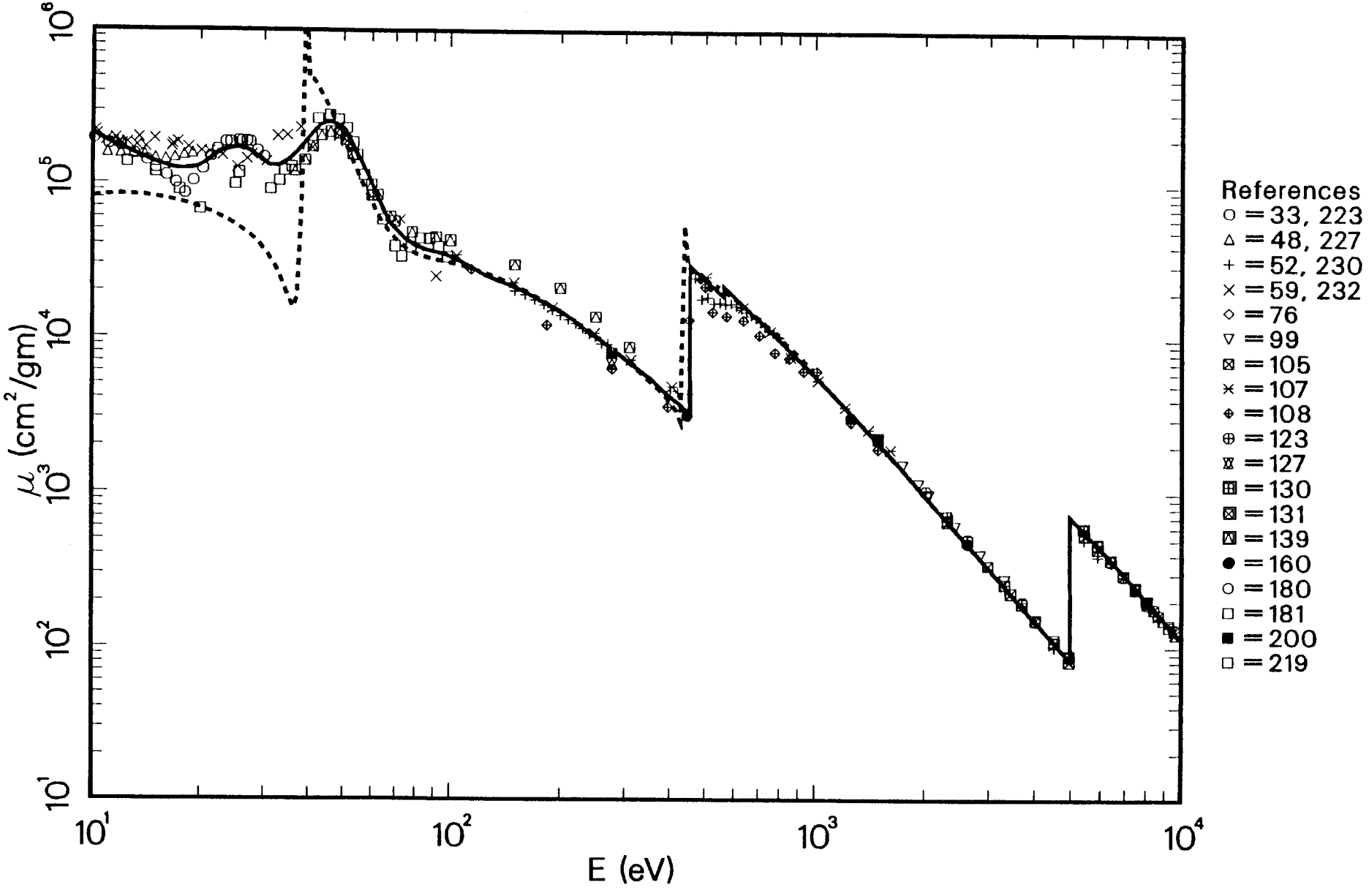
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	2.07e+2	10.6	33
8047.0	2.14e+2	14.0	48
8396.0	1.92e+2	15.0	48
8904.0	1.64e+2	15.7	48
9670.0	1.31e+2	16.3	48
9885.0	1.22e+2	15.3	48
4511.0	1.13e+2	-72.9	59
8048.0	2.09e+2	11.6	59
8639.0	1.75e+2	14.0	59
9572.0	1.33e+2	14.9	59
8040.0	2.14e+2	14.1	76
1020.0	5.76e+3	16.0	107
1210.0	3.86e+3	19.4	107
1400.0	2.75e+3	23.1	107
1610.0	2.04e+3	30.8	107
1012.0	6.63e+3	31.0	108
1254.0	3.29e+3	11.5	108
1254.0	3.08e+3	4.3	108
1487.0	2.06e+3	7.8	108
8000.0	2.19e+2	15.0	131
8398.0	1.92e+2	15.4	131
9962.0	1.20e+2	16.4	131

Atomic Scattering Factors, f_1+if_2
22 - Titanium (Ti)





22-Ti μ Coefficients



Titanium (Ti) — 22
Atomic Weight = 47.90
μ (barns/atom) = $\mu(cm^2/g) \times 79.54$
$E\mu(E) = 878.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	1.94e+2	-4.8	33
8047.0	2.00e+2	-1.8	48
8396.0	1.80e+2	-1.0	48
8904.0	1.54e+2	-0.6	48
9670.0	1.23e+2	-0.3	48
2312.0	6.87e+2	3.7	52
2627.0	4.73e+2	0.7	52
3318.0	2.41e+2	-3.8	52
3697.0	1.88e+2	0.7	52
4516.0	1.00e+2	-7.1	52
5420.0	5.03e+2	-12.7	52
5904.0	3.96e+2	-14.7	52
6409.0	3.61e+2	-3.7	52
7484.0	2.39e+2	-3.8	52
8053.0	2.00e+2	-1.9	52
8644.0	1.57e+2	-6.6	52
4511.0	1.06e+2	-2.1	59
8048.0	1.96e+2	-3.9	59
8639.0	1.65e+2	-2.0	59
9572.0	1.25e+2	-1.5	59
8040.0	2.01e+2	-1.7	76
1487.0	2.28e+3	6.8	99
1739.0	1.51e+3	7.0	99
1922.0	1.16e+3	6.5	99
2050.0	9.81e+2	7.3	99
2293.0	7.22e+2	6.5	99
2423.0	6.13e+2	4.9	99
2839.0	4.02e+2	5.4	99
3304.0	2.77e+2	9.5	99
4511.0	1.14e+2	5.3	99
4952.0	8.93e+1	6.5	99
5415.0	5.93e+2	2.7	99
5899.0	4.70e+2	1.2	99
6404.0	3.77e+2	0.4	99
7478.0	2.51e+2	0.8	99
8048.0	2.06e+2	0.9	99
9252.0	1.42e+2	1.9	99
9442.0	1.34e+2	1.6	99
1490.0	2.24e+3	5.3	105
2310.0	6.58e+2	-1.0	105
2980.0	3.44e+2	2.8	105
3440.0	2.28e+2	0.6	105
4010.0	1.53e+2	2.6	105
4950.0	8.08e+1	-3.8	105
5430.0	5.40e+2	-5.8	105
5900.0	4.43e+2	-4.6	105
6930.0	2.99e+2	-2.0	105
7480.0	2.43e+2	-2.3	105
8050.0	2.04e+2	0.2	105
9570.0	1.31e+2	3.5	105

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
104.0	3.44e+4	6.5	107
149.0	2.30e+4	6.5	107
190.0	1.60e+4	-0.8	107
248.0	1.09e+4	4.3	107
313.0	7.30e+3	5.7	107
406.0	4.89e+3	19.7	107
505.0	2.55e+4	6.1	107
636.0	1.62e+4	-3.5	107
754.0	1.12e+4	-1.7	107
859.0	7.68e+3	-8.3	107
1020.0	5.41e+3	-2.0	107
1210.0	3.62e+3	0.5	107
1400.0	2.58e+3	3.5	107
1610.0	1.91e+3	10.3	107
114.0	2.80e+4	-3.5	108
183.3	1.22e+4	-27.2	108
277.0	6.36e+3	-26.3	108
395.3	3.60e+3	-16.4	108
452.2	1.33e+4	39.9	108
500.3	2.20e+4	-10.4	108
524.9	1.51e+4	-31.8	108
572.8	1.42e+4	-29.3	108
637.4	1.33e+4	-20.3	108
705.0	1.07e+4	-20.1	108
776.2	8.22e+3	-22.9	108
851.5	7.56e+3	-11.7	108
929.7	6.22e+3	-10.1	108
1012.0	6.22e+3	10.7	108
1254.0	2.89e+3	-12.3	108
1487.0	1.94e+3	-9.3	108
2014.0	1.04e+3	8.3	123
2308.0	7.21e+2	8.3	123
2622.0	5.10e+2	7.8	123
3314.0	2.59e+2	3.4	123
3314.0	2.59e+2	3.4	123
3692.0	2.00e+2	7.1	123
4012.0	1.50e+2	0.7	123
4512.0	1.09e+2	0.2	123
4953.0	8.73e+1	4.1	123
5414.0	5.89e+2	2.0	123
5898.0	4.67e+2	0.5	123
6404.0	3.70e+2	-1.6	123
6930.0	2.95e+2	-3.4	123
7478.0	2.45e+2	-1.6	123
8040.0	2.02e+2	-1.1	123
8640.0	1.66e+2	-1.4	123
277.0	6.90e+3	-20.0	127
2307.0	6.79e+2	1.8	130
2622.0	4.98e+2	5.4	130
3313.0	2.60e+2	3.4	130

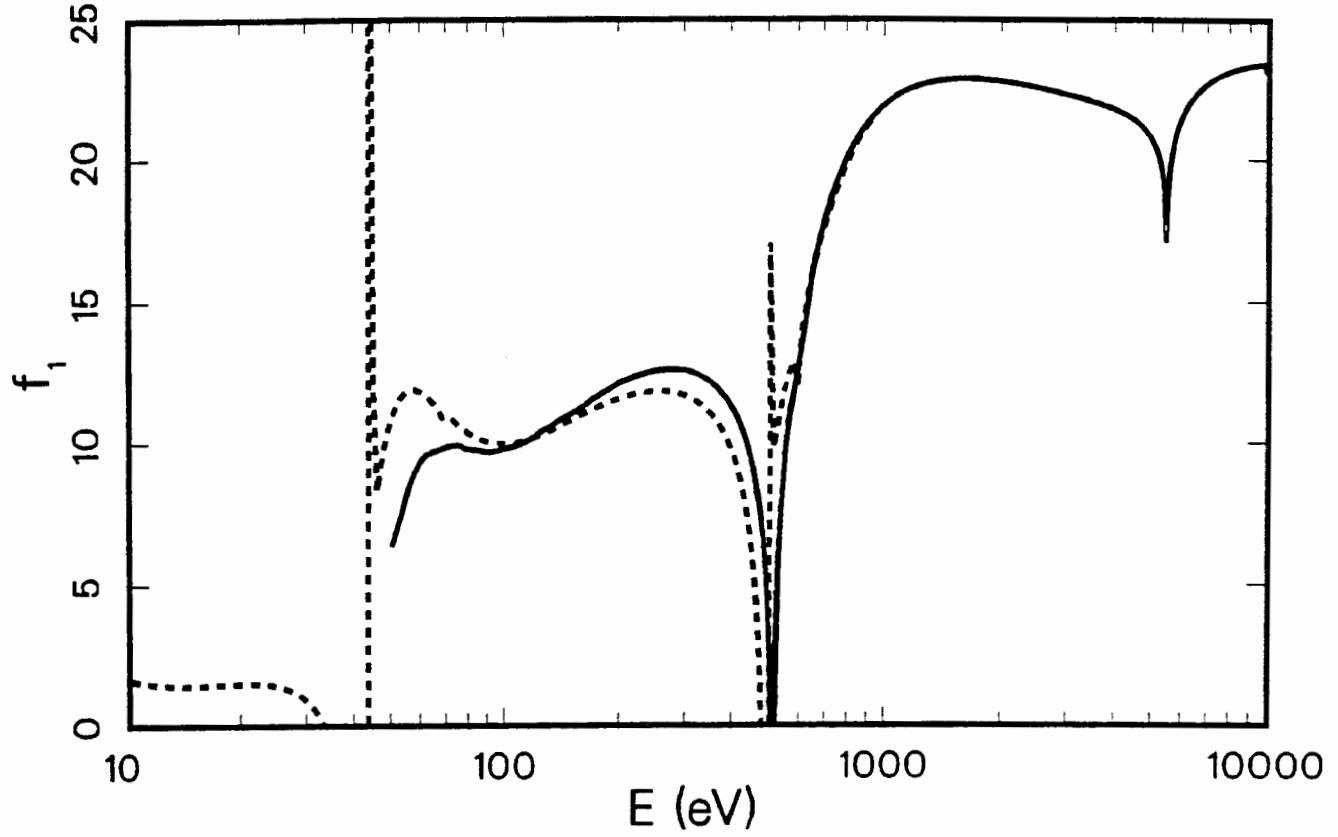
E(eV)	μ(cm^2/g)	% Error	Ref.
3691.0	1.94e+2	3.8	130
4512.0	1.10e+2	1.8	130
4951.0	8.88e+1	5.9	130
5412.0	6.01e+2	4.1	130
5895.0	4.77e+2	2.5	130
6401.0	3.76e+2	0.0	130
7473.0	2.48e+2	-0.6	130
9245.0	1.39e+2	-0.4	130
8000.0	2.05e+2	-0.9	131
8398.0	1.80e+2	-0.7	131
9962.0	1.13e+2	-0.3	131
36.6	1.20e+5	-23.2	139
39.0	1.41e+5	-23.8	139
41.1	1.75e+5	-18.5	139
43.4	2.05e+5	-15.7	139
46.0	2.17e+5	-13.8	139
48.6	2.10e+5	-12.6	139
50.7	1.92e+5	-13.4	139
53.1	1.54e+5	-14.5	139
59.9	9.80e+4	-3.4	139
62.4	8.47e+4	4.3	139
67.8	6.08e+4	10.6	139
69.8	5.67e+4	11.2	139
78.3	4.82e+4	18.6	139
91.3	4.48e+4	24.3	139
100.0	4.27e+4	26.9	139
150.0	3.02e+4	40.6	139
200.0	2.14e+4	41.4	139
250.0	1.38e+4	34.1	139
310.0	8.80e+3	25.2	139
446.5	3.16e+3	-7.1	160
1254.0	3.09e+3	-6.2	160
1486.0	2.24e+3	4.8	160
2621.0	4.80e+2	1.5	160
1487.0	2.25e+3	5.2	180
25.6	1.17e+5	-31.2	181
31.3	9.14e+4	-30.2	181
33.1	1.04e+5	-20.5	181
34.2	1.21e+5	-11.7	181
35.8	1.28e+5	-13.9	181
42.4	2.67e+5	14.9	181
45.8	2.82e+5	12.1	181
48.4	2.62e+5	8.7	181
51.0	2.30e+5	6.4	181
53.2	1.85e+5	3.2	181
54.6	1.53e+5	-4.0	181
57.1	1.14e+5	-11.8	181
60.0	8.40e+4	-16.5	181
60.0	8.33e+4	-17.1	181
64.4	5.84e+4	-16.4	181
69.9	3.92e+4	-22.9	181
73.1	3.39e+4	-25.5	181
77.6	3.87e+4	-6.0	181
82.6	4.40e+4	14.2	181
87.6	4.37e+4	18.4	181

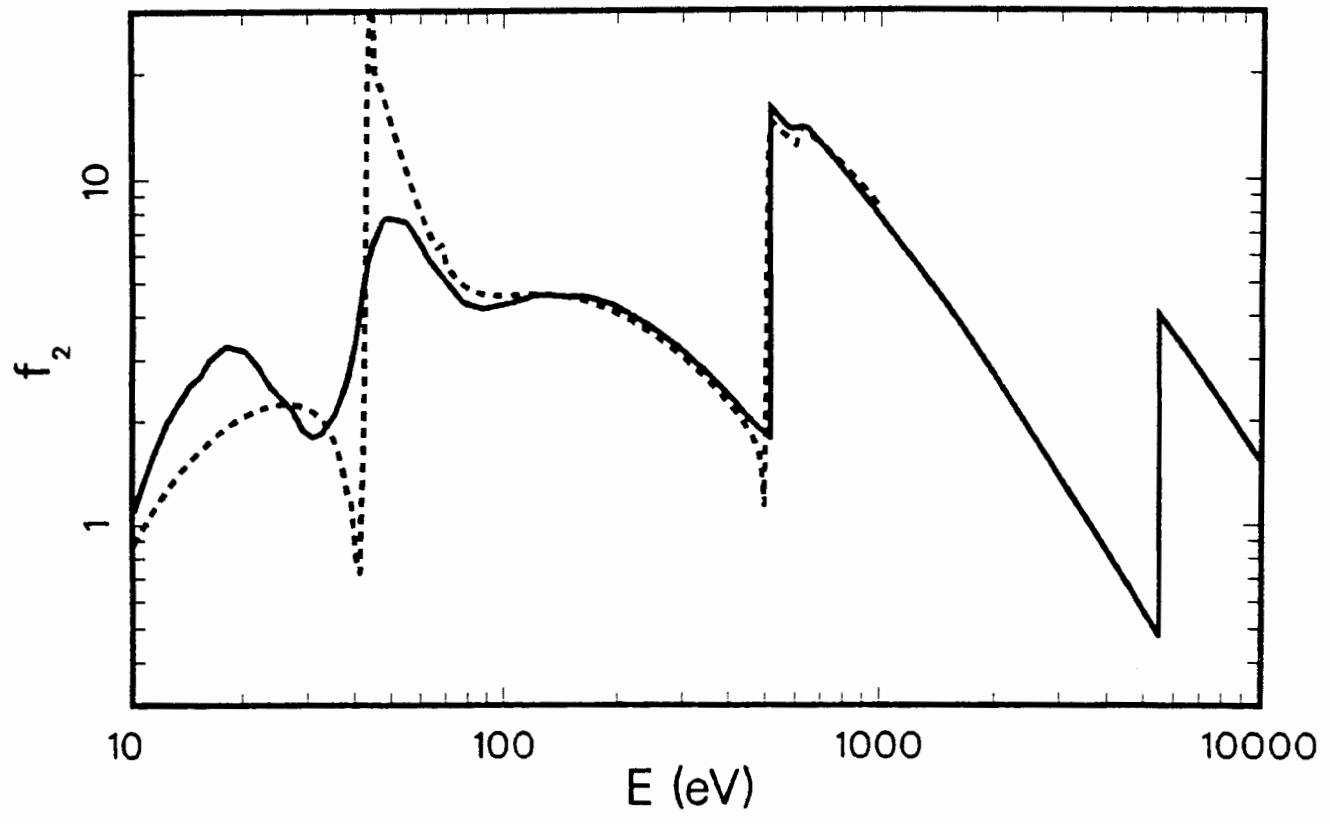
E(eV)	μ(cm^2/g)	% Error	Ref.
87.7	4.36e+4	18.3	181
92.8	3.86e+4	8.1	181
98.0	3.36e+4	-2.2	181
277.0	8.06e+3	-6.6	200
10.0	1.31e+5	-37.7	219
12.5	1.37e+5	-16.3	219
15.0	1.18e+5	-13.6	219
17.5	9.07e+4	-26.8	219
20.0	6.76e+4	-48.0	219
25.0	9.85e+4	-42.2	219
10.1	1.95e+5	-5.7	223
11.1	1.80e+5	-2.5	223
12.0	1.73e+5	2.0	223
13.1	1.54e+5	-1.1	223
14.2	1.40e+5	-2.5	223
15.0	1.25e+5	-8.6	223
16.1	1.12e+5	-12.8	223
17.1	1.00e+5	-19.4	223
18.1	8.56e+4	-31.0	223
19.1	1.03e+5	-17.9	223
20.3	1.24e+5	-6.9	223
21.4	1.49e+5	3.0	223
22.3	1.66e+5	6.3	223
23.6	1.86e+5	12.7	223
24.3	1.86e+5	10.9	223
25.6	1.90e+5	12.1	223
26.1	1.88e+5	12.1	223
26.9	1.88e+5	13.9	223
27.5	1.86e+5	15.3	223
28.8	1.62e+5	8.7	223
30.0	1.49e+5	6.8	223
10.0	1.51e+5	-28.0	227
11.0	1.58e+5	-15.4	227
12.0	1.57e+5	-7.6	227
13.0	1.57e+5	0.2	227
14.0	1.53e+5	5.0	227
15.0	1.46e+5	6.8	227
16.0	1.44e+5	11.2	227
17.0	1.48e+5	18.6	227
18.0	1.54e+5	24.0	227
19.0	1.57e+5	25.4	227
150.0	2.03e+4	-5.4	230
160.0	1.92e+4	-4.4	230
170.0	1.78e+4	-4.0	230
180.0	1.65e+4	-4.1	230
190.0	1.52e+4	-5.8	230
200.0	1.42e+4	-6.1	230
210.0	1.33e+4	-5.0	230
220.0	1.25e+4	-3.1	230
230.0	1.17e+4	-1.8	230
240.0	1.08e+4	-1.6	230
250.0	1.03e+4	-0.5	230
260.0	9.26e+3	-4.2	230
270.0	9.21e+3	2.0	230
402.0	4.59e+3	10.3	230

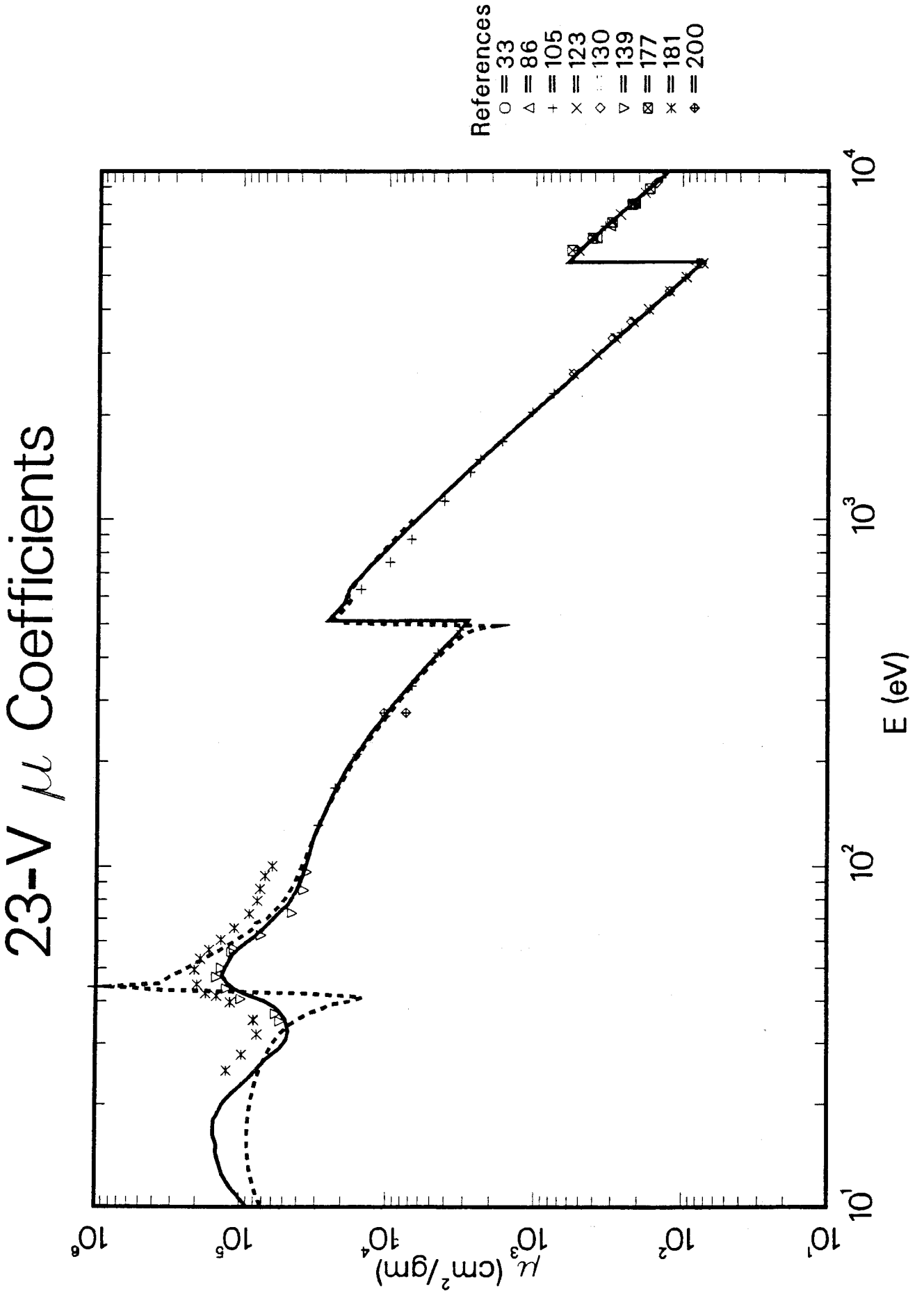
Titanium (Ti) — 22

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
422.0	4.46e+3	17.6	230
450.0	4.36e+3	-29.2	230
470.0	2.49e+4	-11.3	230
490.0	1.83e+4	-28.9	230
510.0	1.87e+4	-20.5	230
530.0	1.71e+4	-21.3	230
550.0	1.74e+4	-13.2	230
570.0	1.68e+4	-16.0	230
590.0	1.72e+4	-13.6	230
610.0	1.65e+4	-10.3	230
630.0	1.57e+4	-8.4	230
650.0	1.51e+4	-5.7	230
670.0	1.42e+4	-4.4	230
690.0	1.36e+4	-2.4	230
710.0	1.30e+4	-1.4	230
730.0	1.22e+4	-1.4	230
750.0	1.16e+4	0.0	230
770.0	1.10e+4	1.4	230
790.0	1.05e+4	3.0	230
800.0	1.03e+4	3.6	230
10.2	2.21e+5	8.1	232
10.3	2.08e+5	2.9	232
10.9	1.89e+5	0.2	232
11.4	1.83e+5	2.0	232
11.6	1.95e+5	10.8	232
11.8	1.82e+5	5.2	232
12.1	1.79e+5	5.9	232
12.5	1.83e+5	12.0	232
13.3	1.76e+5	14.7	232
13.5	1.98e+5	31.2	232
14.1	1.71e+5	18.1	232
14.9	1.95e+5	41.6	232
16.7	1.73e+5	37.8	232
16.8	1.79e+5	42.4	232
17.3	1.86e+5	50.2	232
18.5	1.70e+5	37.1	232
20.1	1.61e+5	23.3	232
21.2	1.59e+5	11.8	232
23.0	1.52e+5	-6.7	232
25.3	1.26e+5	-26.1	232
26.9	1.43e+5	-13.4	232
27.7	1.53e+5	-3.8	232
30.5	1.38e+5	2.3	232
32.7	2.03e+5	55.4	232
34.8	2.06e+5	46.4	232
37.9	2.31e+5	35.5	232
40.8	1.71e+5	-18.6	232
48.4	2.03e+5	-15.9	232
51.0	1.88e+5	-13.0	232
72.3	5.82e+4	24.9	232
91.5	2.51e+4	-30.2	232

Atomic Scattering Factors, f_1+if_2
23 - Vandium (V)





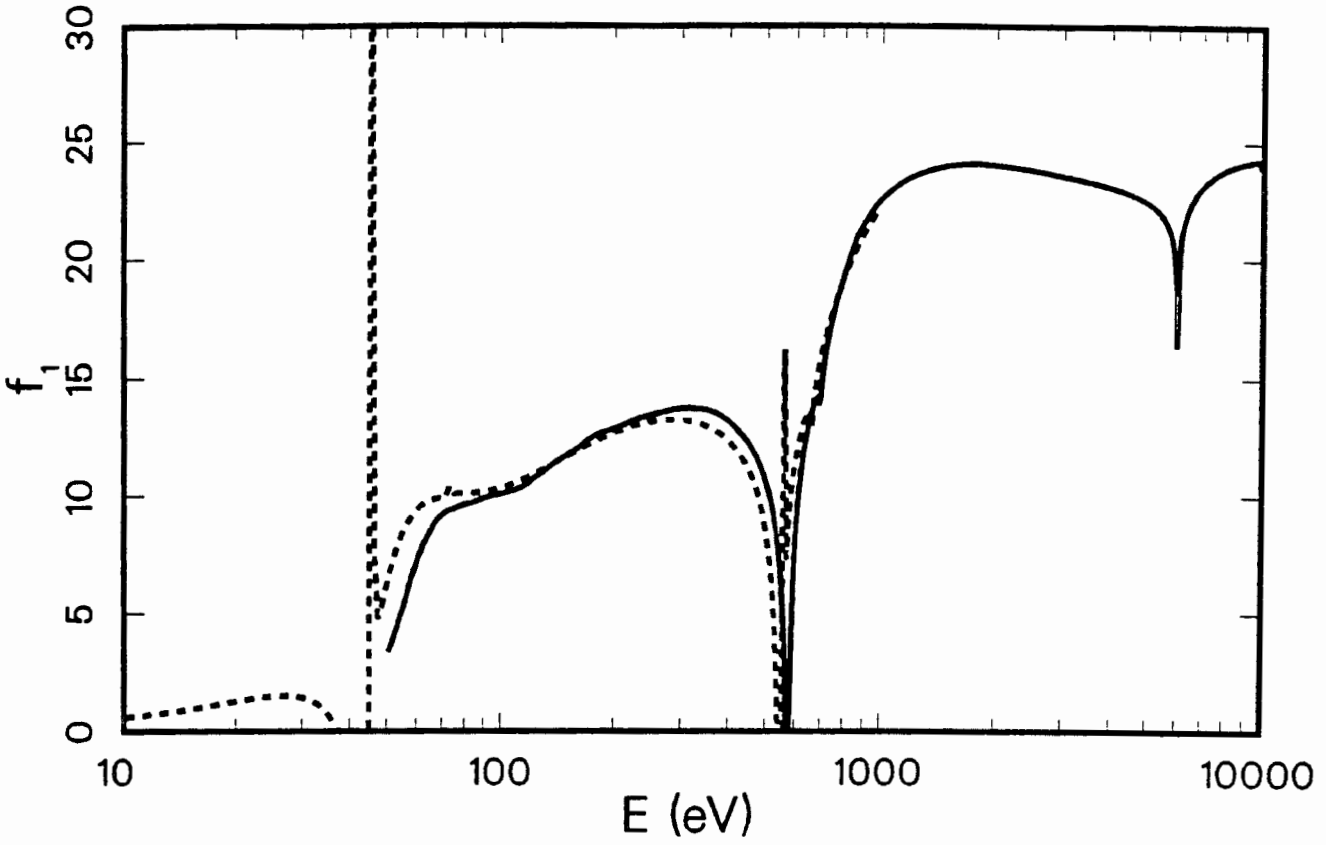

23-V μ Coefficients
References
○ = 33
△ = 86
+ = 105
× = 123
◇ = 130
▽ = 139
⊠ = 177
✕ = 181
◆ = 200
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

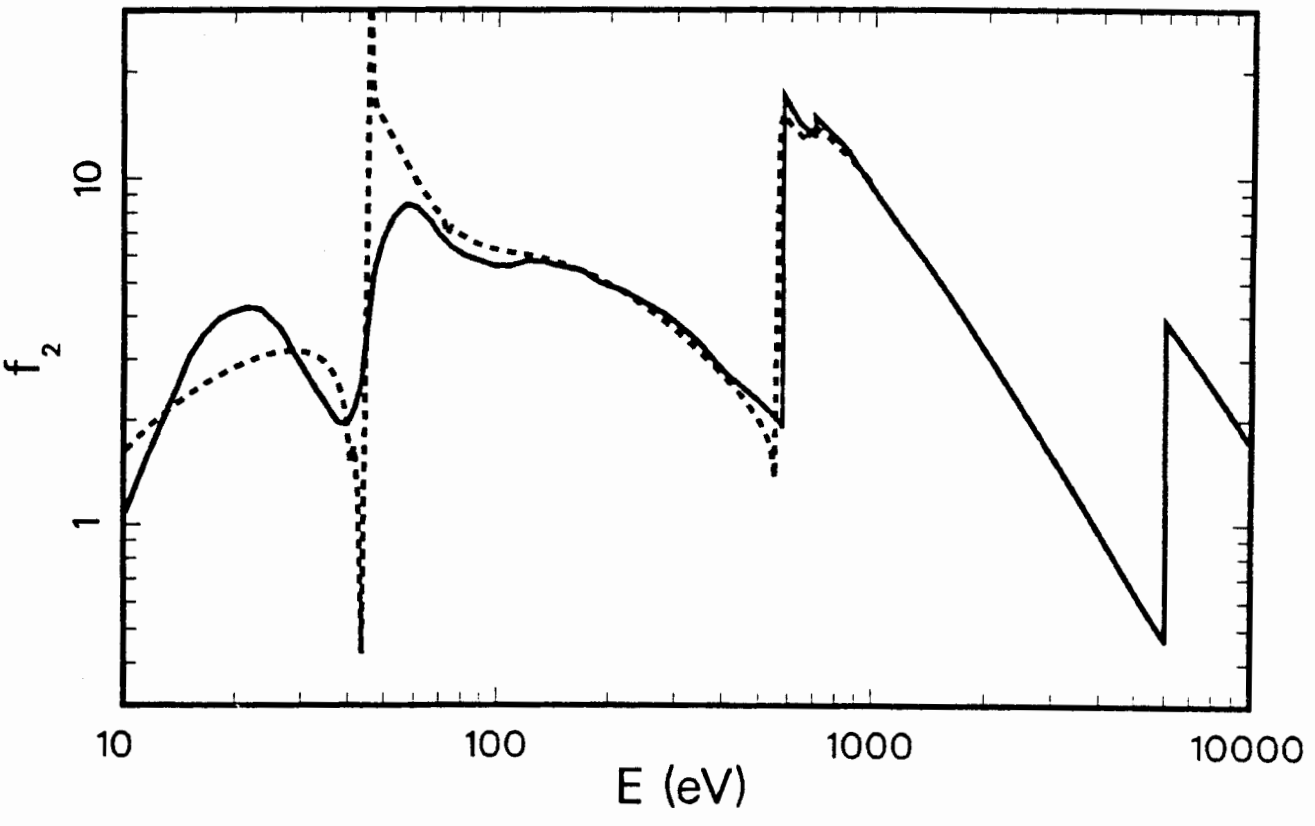
Vandium (V) — 23
Atomic Weight = 50.94
μ (barns/atom) = $\mu(cm^2/g) \times 84.59$
$E\mu(E) = 826.0\, f_2$ keV cm^2/g

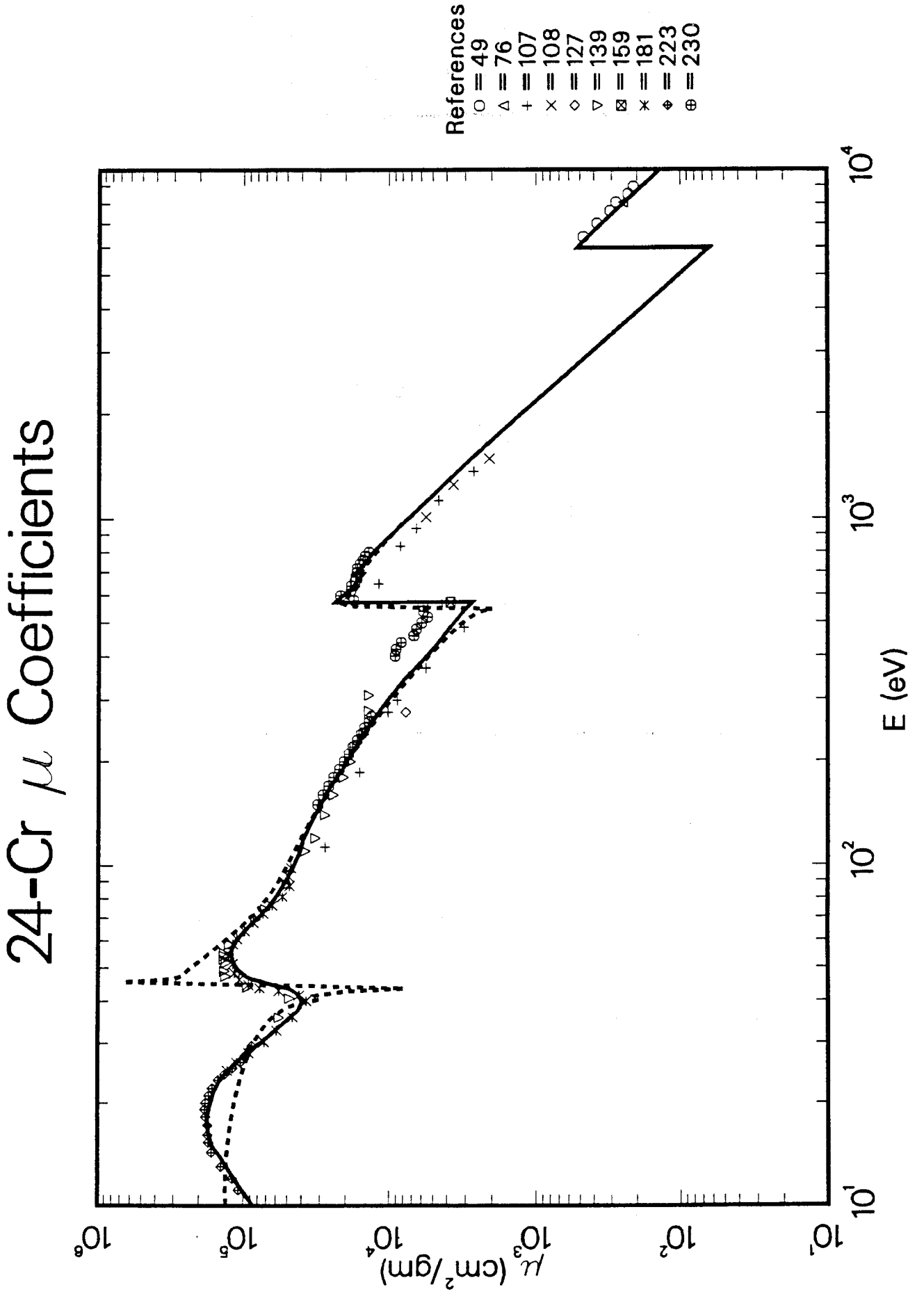
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	2.18e+2	-3.2	33
5415.0	8.27e+1	11.5	86
6404.0	3.88e+2	-5.2	86
6930.0	3.16e+2	-5.5	86
8048.0	2.14e+2	-5.0	86
131.0	2.92e+4	0.7	105
168.0	2.27e+4	1.8	105
210.0	1.60e+4	-1.5	105
272.0	1.02e+4	-2.5	105
332.0	6.83e+3	-4.4	105
414.0	4.59e+3	1.4	105
481.0	3.23e+3	-0.4	105
630.0	1.53e+4	-16.7	105
754.0	9.71e+3	-21.8	105
876.0	6.97e+3	-20.4	105
1130.0	4.15e+3	-12.2	105
1370.0	2.78e+3	-5.0	105
1490.0	2.39e+3	1.0	105
1680.0	1.69e+3	-2.4	105
2040.0	1.06e+3	1.9	105
2310.0	7.63e+2	1.9	105
3440.0	2.65e+2	3.0	105
4010.0	1.69e+2	-0.3	105
4950.0	9.57e+1	0.6	105
5430.0	8.00e+1	8.7	105
5900.0	5.24e+2	4.3	105
6930.0	3.41e+2	2.1	105
8050.0	2.20e+2	-2.2	105
9570.0	1.40e+2	-0.6	105
2622.0	5.58e+2	4.4	123
2985.0	3.89e+2	3.0	123
3314.0	2.89e+2	1.6	123
3692.0	2.19e+2	3.1	123
4012.0	1.73e+2	2.2	123
4512.0	1.24e+2	1.0	123
4953.0	9.47e+1	-0.3	123
5414.0	7.20e+1	-3.0	123
5898.0	5.11e+2	1.7	123
6404.0	4.06e+2	-0.8	123
7478.0	2.69e+2	-1.8	123
8040.0	2.20e+2	-2.4	123
8640.0	1.82e+2	-2.2	123
2622.0	5.58e+2	4.5	130
3313.0	3.03e+2	6.2	130
3691.0	2.27e+2	7.0	130
4512.0	1.24e+2	0.8	130
5428.0	7.41e+1	0.6	130
5895.0	5.30e+2	5.2	130
6401.0	4.20e+2	2.5	130
6401.0	4.20e+2	2.5	130

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8040.0	2.22e+2	-1.7	130
9245.0	1.53e+2	-1.1	130
34.9	5.29e+4	9.1	139
36.7	5.69e+4	9.0	139
40.6	9.86e+4	31.8	139
43.5	1.25e+5	12.7	139
47.1	1.46e+5	11.0	139
50.1	1.35e+5	6.3	139
55.9	1.15e+5	6.3	139
57.2	1.10e+5	8.1	139
62.6	7.18e+4	-8.1	139
72.9	4.37e+4	-19.3	139
85.5	3.66e+4	-10.7	139
96.3	3.51e+4	-4.7	139
5900.0	5.73e+2	14.1	177
6400.0	4.13e+2	0.9	177
7100.0	3.07e+2	-2.0	177
8000.0	2.24e+2	-1.9	177
8900.0	1.70e+2	-1.0	177
25.0	1.24e+5	58.3	181
27.8	9.72e+4	59.5	181
31.9	7.63e+4	62.1	181
35.1	8.04e+4	65.2	181
35.2	8.10e+4	66.1	181
39.7	1.17e+5	77.1	181
41.4	1.46e+5	71.6	181
42.1	1.74e+5	84.8	181
44.7	1.98e+5	65.0	181
49.4	2.07e+5	60.0	181
53.3	1.90e+5	60.9	181
56.7	1.64e+5	57.6	181
60.7	1.37e+5	59.3	181
65.6	1.10e+5	59.1	181
72.4	8.68e+4	57.8	181
79.4	7.65e+4	69.0	181
86.1	7.33e+4	80.5	181
93.8	6.81e+4	80.9	181
100.0	6.03e+4	68.5	181
277.0	1.06e+4	4.7	200
277.0	7.49e+3	-26.0	200

Atomic Scattering Factors, f_1+if_2
24 - Chromium (Cr)






24-Cr μ Coefficients
References
○ = 49
△ = 76
+ = 107
× = 108
◇ = 127
▽ = 139
⊠ = 159
✳ = 181
◆ = 223
⊕ = 230
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴

Chromium (Cr) — 24

Atomic Weight = 52.00

μ (barns/atom) = $\mu(cm^2/g) \times 86.34$

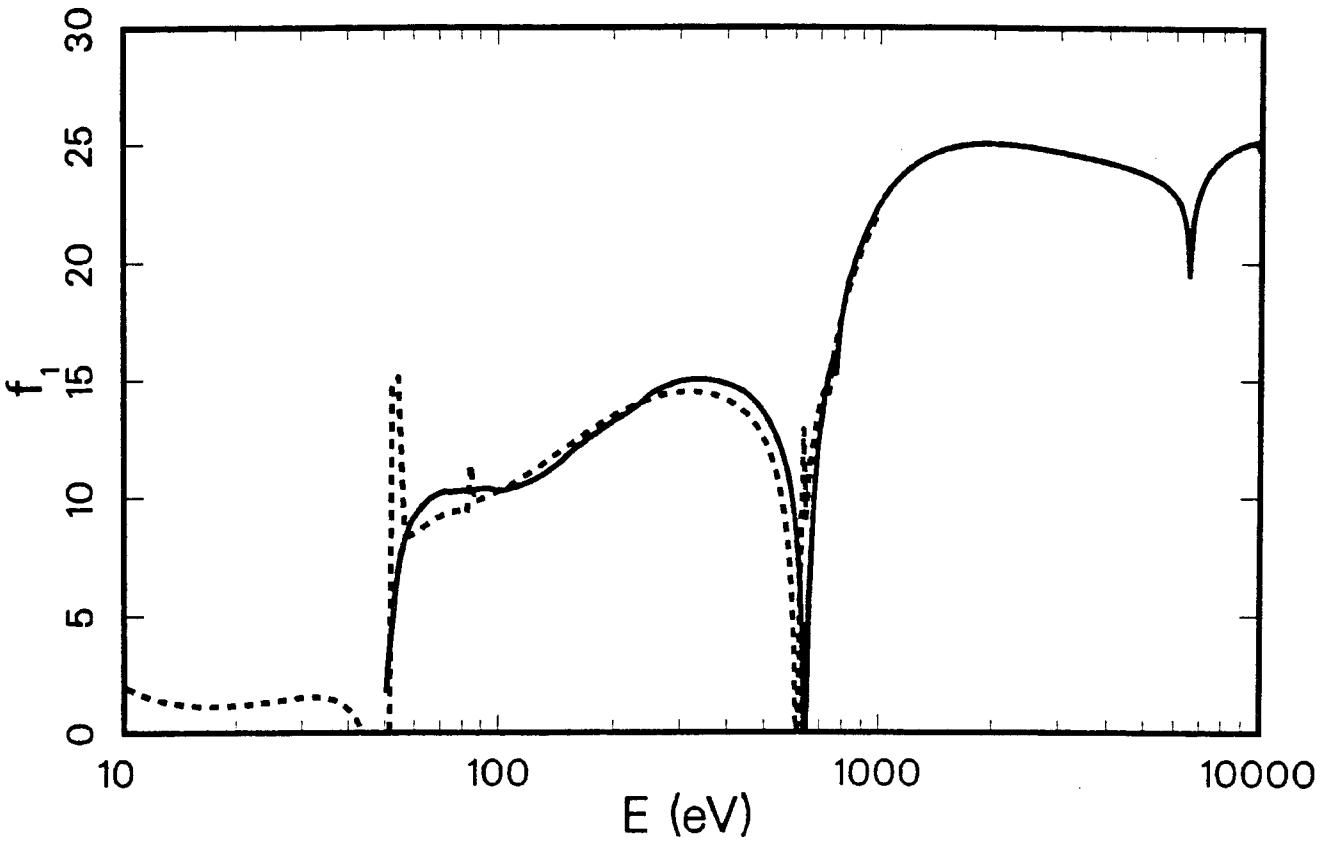
$E\mu(E) = 809.3\, f_2$ keV cm^2/g

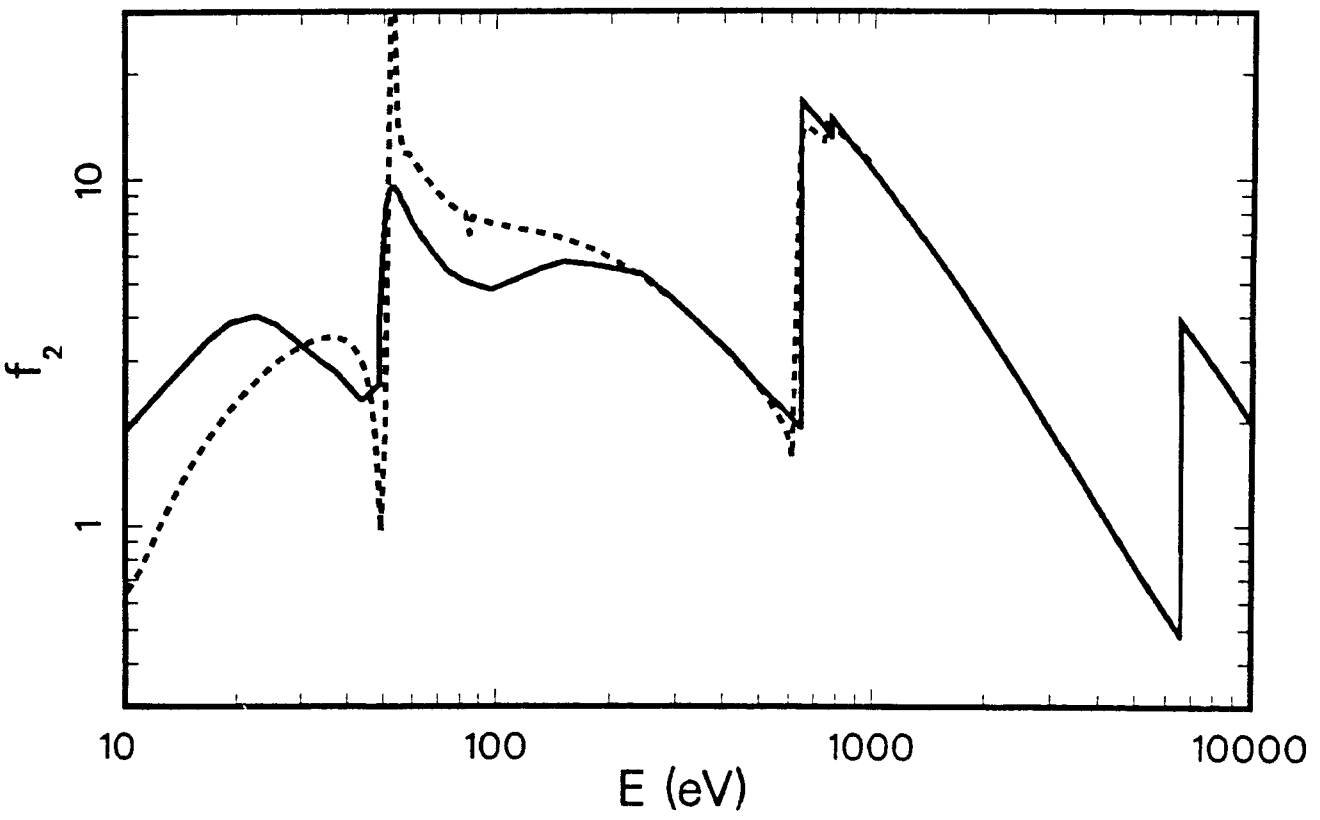
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6410.0	4.74e+2	7.8	49
7000.0	3.80e+2	7.9	49
7600.0	3.09e+2	8.4	49
8050.0	2.80e+2	14.2	49
8500.0	2.31e+2	8.8	49
8920.0	2.12e+2	13.6	49
8040.0	2.50e+2	1.6	76
113.0	2.78e+4	-31.5	107
186.0	1.61e+4	-26.4	107
277.0	1.02e+4	-13.8	107
300.0	8.81e+3	-14.2	107
371.0	5.62e+3	-15.3	107
486.0	3.08e+3	-19.6	107
570.0	4.38e+3	0.9	107
649.0	1.19e+4	-31.3	107
833.0	8.39e+3	-29.1	107
939.0	6.53e+3	-25.1	107
1130.0	4.60e+3	-16.3	107
1370.0	2.65e+3	-21.9	107
1012.0	5.61e+3	-22.2	108
1254.0	3.64e+3	-14.3	108
1487.0	2.08e+3	-24.5	108
277.0	7.70e+3	-35.2	127
35.7	5.67e+4	18.0	139
40.7	4.82e+4	18.0	139
43.9	9.38e+4	73.5	139
47.3	1.32e+5	37.6	139
49.0	1.34e+5	26.3	139
51.8	1.31e+5	12.3	139
53.0	1.35e+5	13.2	139
54.3	1.35e+5	13.3	139
55.4	1.34e+5	12.2	139
58.7	1.25e+5	8.6	139
69.4	8.25e+4	1.5	139
74.3	7.08e+4	1.4	139
88.2	5.04e+4	-5.3	139
110.0	3.82e+4	-7.5	139
120.0	3.24e+4	-16.7	139
140.0	2.78e+4	-14.7	139
160.0	2.43e+4	-12.1	139
180.0	2.08e+4	-9.9	139
200.0	1.85e+4	-6.0	139
220.0	1.74e+4	0.8	139
240.0	1.51e+4	0.4	139
260.0	1.39e+4	5.5	139
280.0	1.39e+4	19.0	139
310.0	1.39e+4	43.9	139
572.8	3.81e+3	-22.5	159
24.9	1.28e+5	1.2	181
26.3	1.11e+5	-2.2	181

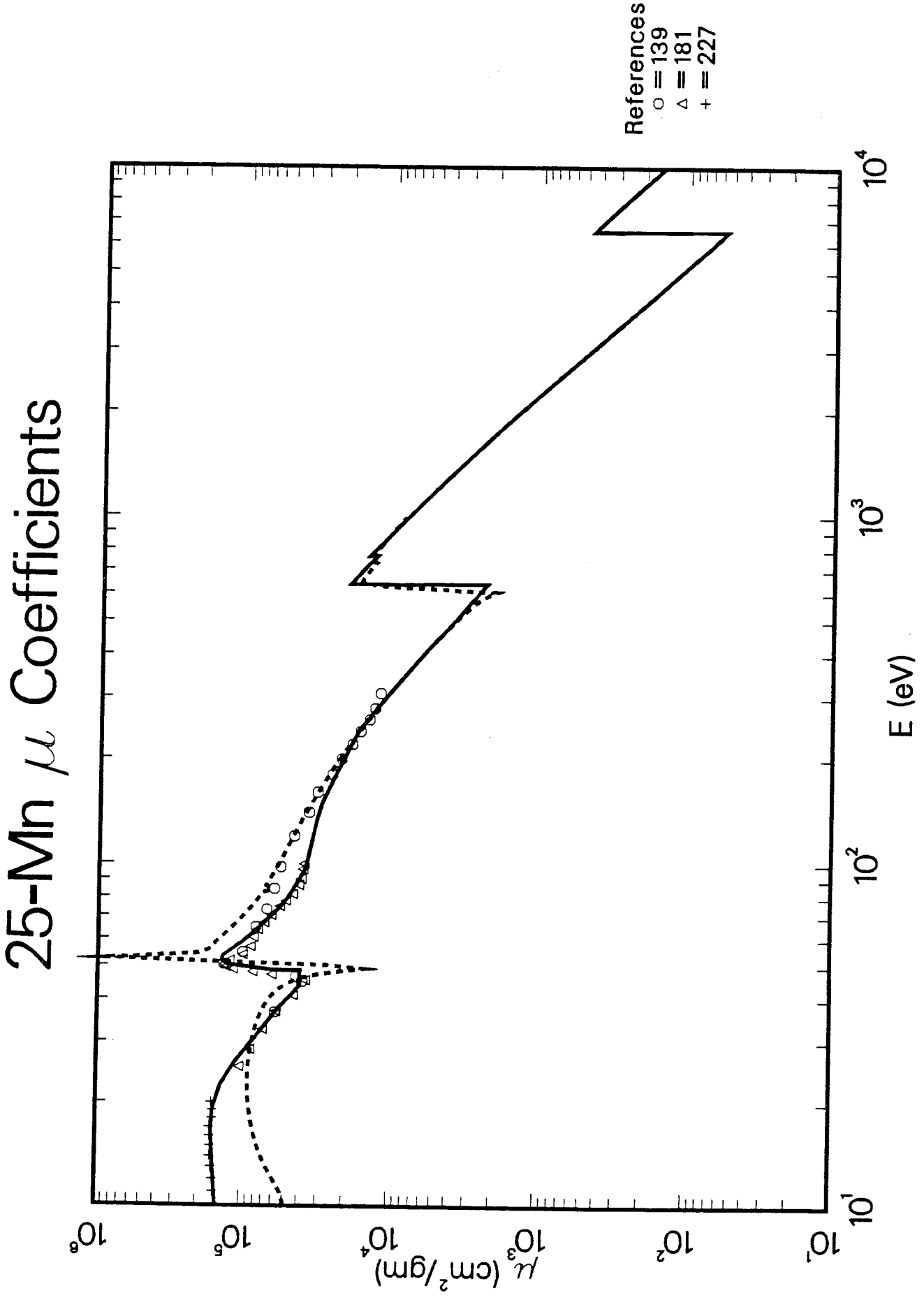
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
28.1	9.18e+4	-1.7	181
30.3	7.21e+4	-4.1	181
32.7	5.90e+4	-3.2	181
35.8	4.59e+4	-3.9	181
40.0	3.73e+4	-7.1	181
41.5	4.15e+4	-0.4	181
42.8	5.72e+4	25.0	181
43.7	7.73e+4	48.8	181
44.6	9.26e+4	48.8	181
46.2	1.07e+5	25.4	181
48.3	1.15e+5	12.7	181
51.4	1.18e+5	2.1	181
54.3	1.25e+5	4.9	181
58.7	1.18e+5	2.1	181
60.8	1.11e+5	1.0	181
64.1	9.84e+4	0.1	181
67.9	8.57e+4	-0.2	181
72.1	7.35e+4	-1.4	181
76.2	6.32e+4	-5.2	181
81.1	5.40e+4	-9.7	181
87.3	4.83e+4	-10.4	181
92.7	4.91e+4	-1.2	181
98.3	4.73e+4	3.0	181
10.0	1.03e+5	20.3	223
11.1	1.08e+5	5.5	223
12.0	1.19e+5	3.4	223
13.0	1.42e+5	9.3	223
14.3	1.65e+5	9.6	223
15.3	1.73e+5	4.4	223
16.1	1.75e+5	2.1	223
17.2	1.75e+5	0.0	223
18.2	1.80e+5	2.9	223
19.1	1.83e+5	6.7	223
20.0	1.80e+5	8.1	223
21.0	1.72e+5	6.3	223
22.1	1.62e+5	5.4	223
23.4	1.48e+5	3.1	223
24.3	1.34e+5	0.2	223
25.3	1.18e+5	-4.1	223
26.4	1.04e+5	-7.4	223
27.6	9.71e+4	-1.4	223
28.8	8.94e+4	3.0	223
29.5	8.74e+4	7.9	223
150.0	3.12e+4	4.5	230
160.0	2.89e+4	4.4	230
170.0	2.64e+4	3.4	230
180.0	2.44e+4	5.5	230
190.0	2.23e+4	5.2	230
200.0	2.07e+4	4.8	230
210.0	1.92e+4	3.9	230

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
220.0	1.80e+4	4.5	230
230.0	1.68e+4	4.4	230
240.0	1.57e+4	4.8	230
250.0	1.49e+4	5.8	230
260.0	1.38e+4	5.0	230
270.0	1.34e+4	7.8	230
402.0	9.13e+3	64.5	230
420.0	9.01e+3	78.2	230
440.0	8.31e+3	79.3	230
460.0	6.79e+3	59.3	230
480.0	6.53e+3	66.3	230
500.0	6.02e+3	65.9	230
520.0	5.48e+3	63.6	230
540.0	5.85e+3	88.8	230
560.0	5.88e+3	106.3	230
580.0	1.77e+4	162.0	230
600.0	2.19e+4	37.3	230
620.0	1.86e+4	-3.7	230
640.0	1.85e+4	4.1	230
660.0	1.73e+4	3.1	230
680.0	1.72e+4	5.8	230
700.0	1.68e+4	5.6	230
720.0	1.68e+4	7.2	230
740.0	1.61e+4	6.4	230
760.0	1.53e+4	7.0	230
780.0	1.48e+4	9.4	230
800.0	1.39e+4	8.3	230

Atomic Scattering Factors, f_1+if_2
25 - Manganese (Mn)





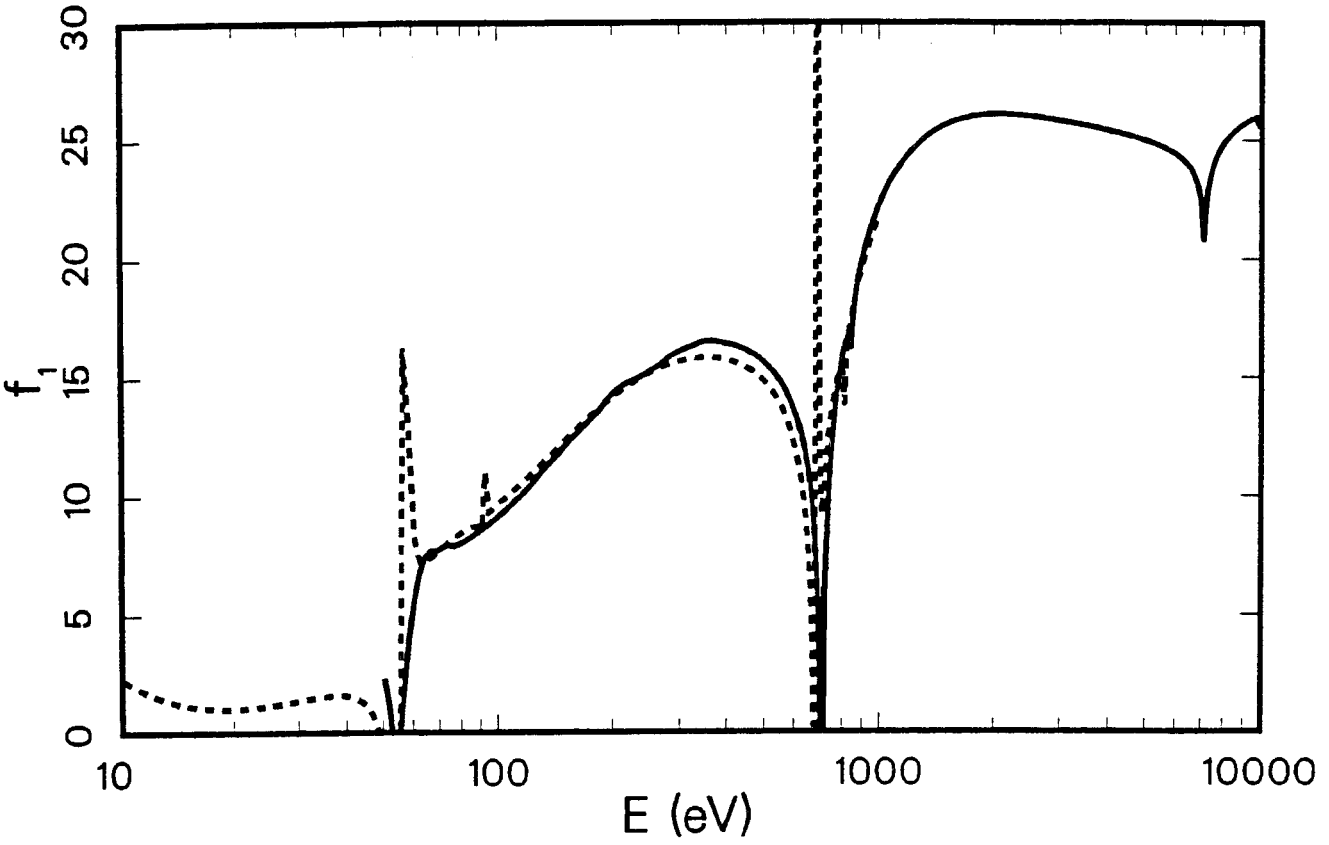

25-Mn μ Coefficients
References
○ = 139
△ = 181
+ = 227
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

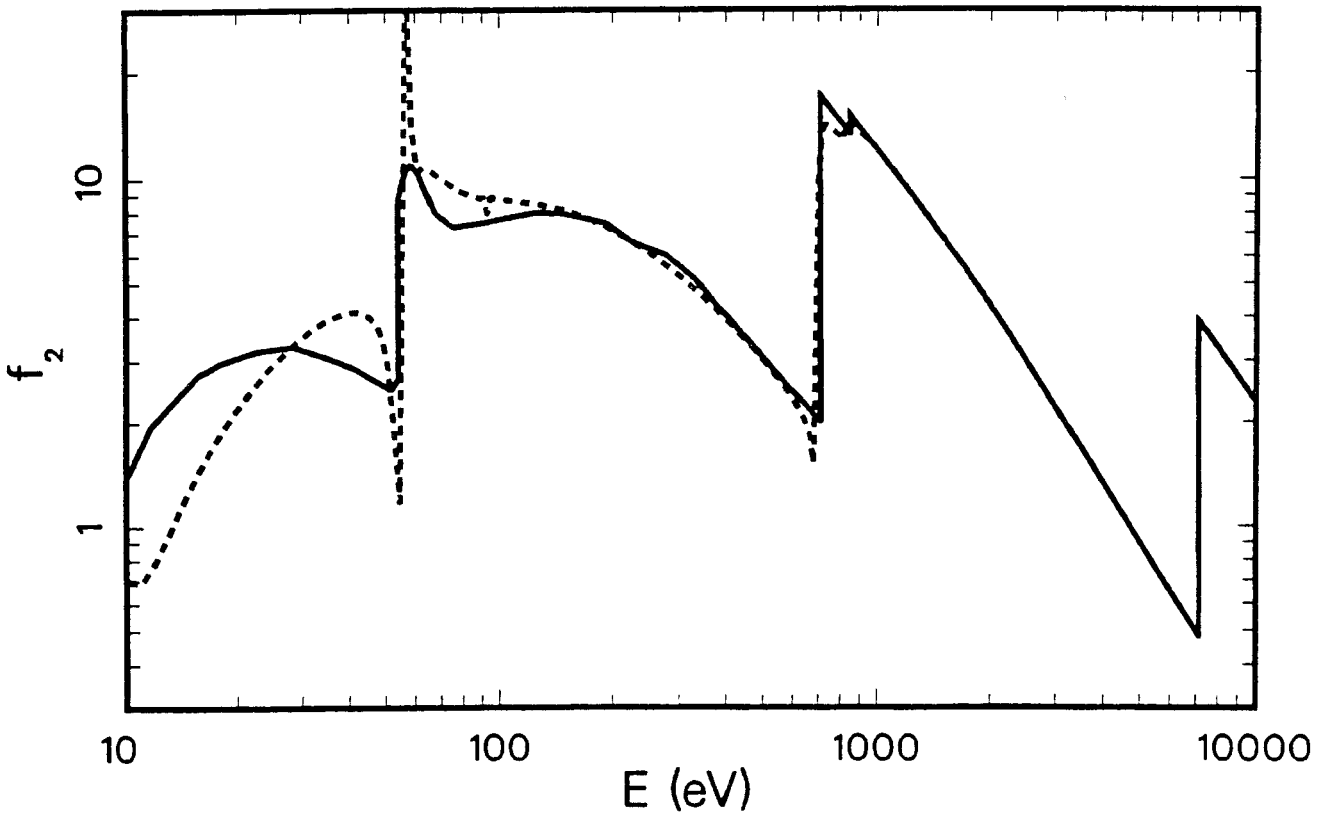
Manganese (Mn) — 25
Atomic Weight = 54.94
μ (barns/atom) = μ(cm^2/g) × 91.23
Eμ(E) = 765.9 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
36.6	5.87e+4	-0.1	139
45.0	3.87e+4	-4.0	139
46.5	4.24e+4	-2.6	139
50.6	1.34e+5	5.0	139
54.8	9.88e+4	-21.9	139
65.0	8.08e+4	5.2	139
73.4	6.80e+4	19.1	139
84.7	6.06e+4	33.9	139
97.8	5.51e+4	46.2	139
120.0	4.49e+4	33.0	139
140.0	3.62e+4	17.2	139
160.0	3.18e+4	16.0	139
180.0	2.52e+4	5.2	139
200.0	2.19e+4	3.6	139
220.0	1.86e+4	-1.2	139
240.0	1.64e+4	-3.1	139
260.0	1.43e+4	-2.8	139
280.0	1.32e+4	3.0	139
310.0	1.21e+4	15.2	139
25.4	1.03e+5	-10.6	181
28.5	8.67e+4	-6.7	181
32.6	7.11e+4	-1.5	181
36.8	5.81e+4	-0.1	181
41.0	4.45e+4	-3.5	181
45.4	3.70e+4	-8.1	181
47.2	6.20e+4	23.1	181
48.0	8.44e+4	42.6	181
48.0	8.45e+4	42.6	181
48.9	1.15e+5	62.3	181
49.6	1.29e+5	43.5	181
50.3	1.32e+5	12.4	181
51.9	1.22e+5	-11.1	181
53.9	9.89e+4	-25.8	181
56.9	8.78e+4	-21.6	181
60.6	8.37e+4	-9.2	181
63.9	7.84e+4	-2.3	181
67.0	7.07e+4	-0.5	181
70.5	6.34e+4	0.9	181
75.0	5.55e+4	1.2	181
77.9	5.06e+4	-1.6	181
81.7	4.56e+4	-4.1	181
87.0	4.17e+4	-4.5	181
90.3	4.04e+4	-2.5	181
96.5	3.93e+4	3.5	181
100.0	3.86e+4	3.7	181
10.0	1.54e+5	6.6	227
11.0	1.52e+5	3.0	227
12.0	1.52e+5	1.7	227
13.0	1.57e+5	3.1	227
14.0	1.61e+5	4.6	227

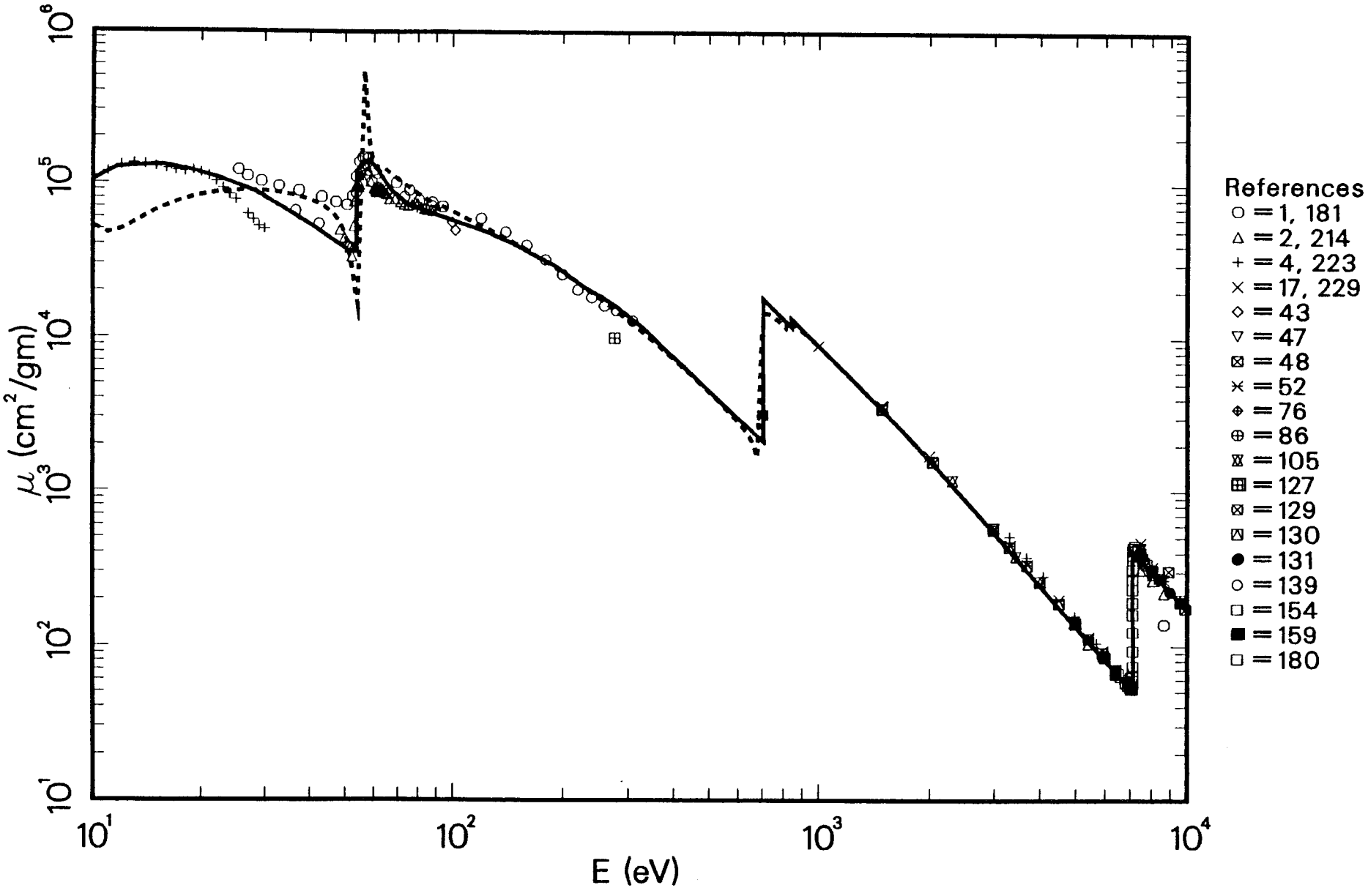
E(eV)	μ(cm^2/g)	% Error	Ref.
15.0	1.59e+5	2.7	227
16.0	1.60e+5	2.1	227
17.0	1.62e+5	2.7	227
18.0	1.55e+5	-0.8	227
19.0	1.54e+5	-0.2	227
20.0	1.58e+5	6.0	227

Atomic Scattering Factors, f_1+if_2
26 - Iron (Fe)





26-Fe μ Coefficients



Iron (Fe) — 26

Atomic Weight = 55.85

μ (barns/atom) = $\mu(cm^2/g) \times 92.74$

$E\mu(E) = 753.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6400.0	6.57e+1	-3.6	1
6930.0	6.19e+1	12.9	1
8630.0	1.39e+2	-44.8	1
5410.0	1.04e+2	-3.9	2
6400.0	6.61e+1	-3.0	2
6930.0	6.72e+1	22.6	2
7480.0	3.14e+2	-13.0	2
8050.0	2.68e+2	-10.7	2
8640.0	2.21e+2	-11.8	2
3310.0	5.10e+2	22.9	4
3680.0	3.74e+2	20.4	4
4080.0	2.84e+2	21.1	4
4980.0	1.56e+2	15.3	4
5690.0	1.05e+2	11.7	4
6410.0	7.10e+1	4.6	4
7490.0	4.30e+2	19.6	4
8660.0	2.90e+2	16.5	4
6404.0	7.10e+1	4.4	17
7478.0	4.27e+2	18.2	17
8048.0	3.27e+2	8.8	17
8398.0	2.86e+2	6.0	17
8639.0	2.70e+2	7.6	17
9713.0	1.94e+2	5.1	17
9962.0	1.84e+2	6.6	17
100.0	5.61e+4	-2.9	43
102.0	4.96e+4	-12.8	43
6400.0	7.05e+1	3.5	47
8047.0	3.06e+2	1.8	48
8904.0	3.06e+2	32.0	48
9885.0	1.75e+2	-0.5	48
3318.0	4.49e+2	9.0	52
3697.0	3.38e+2	10.0	52
4516.0	2.00e+2	13.0	52
5420.0	1.15e+2	6.5	52
5904.0	9.39e+1	10.5	52
6409.0	6.57e+1	-3.2	52
7484.0	4.66e+2	29.2	52
8053.0	3.27e+2	8.9	52
8644.0	2.69e+2	7.4	52
8040.0	3.10e+2	2.9	76
5415.0	1.12e+2	4.1	86
6404.0	7.00e+1	2.9	86
6930.0	5.65e+1	3.0	86
8048.0	3.14e+2	4.6	86
1490.0	3.43e+3	0.3	105
2040.0	1.57e+3	3.1	105
2310.0	1.18e+3	8.0	105
2980.0	5.62e+2	1.7	105
3440.0	3.80e+2	1.7	105
4010.0	2.62e+2	6.7	105

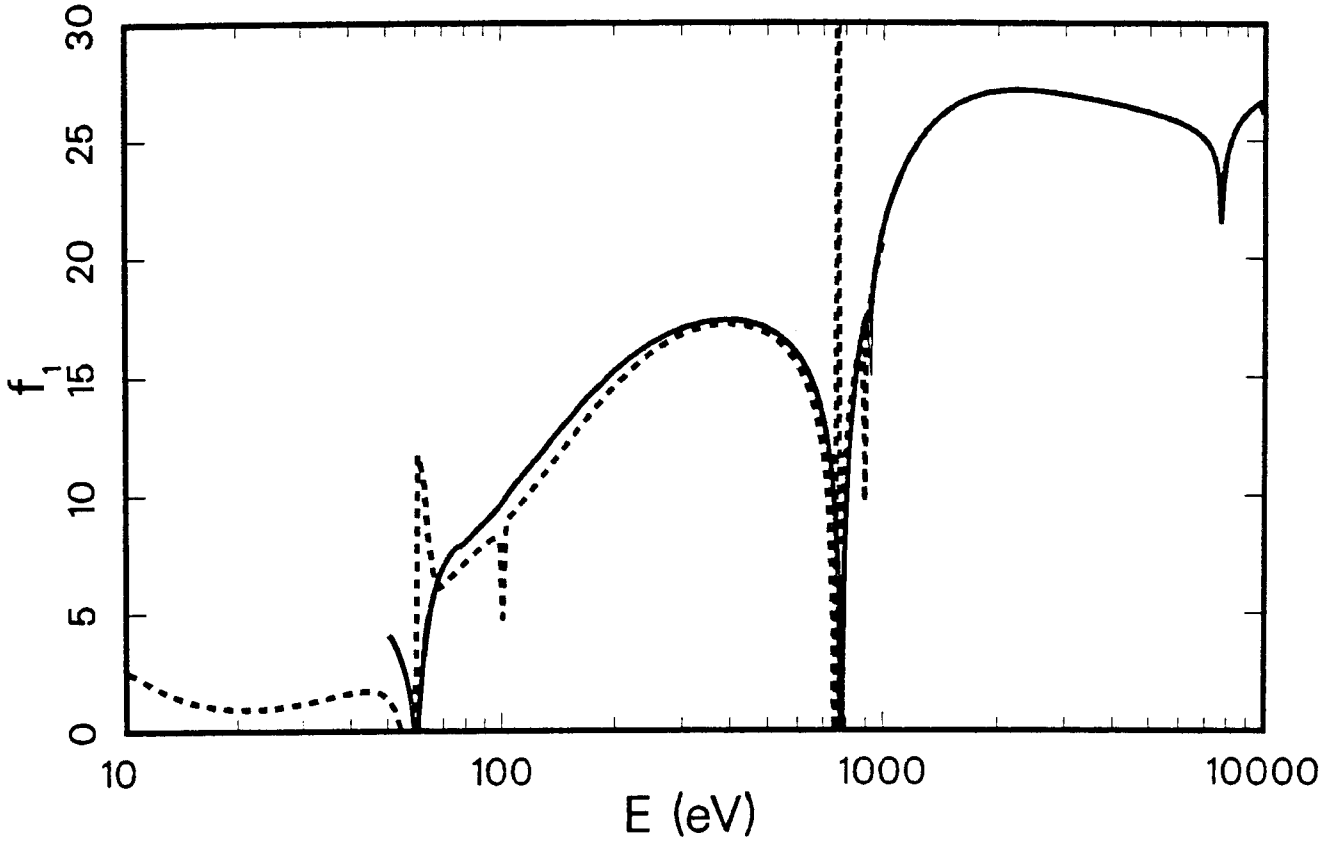
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
4950.0	1.42e+2	3.0	105
5900.0	9.11e+1	7.0	105
6930.0	5.84e+1	6.6	105
7480.0	3.94e+2	9.1	105
8050.0	3.10e+2	3.3	105
9570.0	2.00e+2	4.3	105
277.0	1.00e+4	-38.9	127
8040.0	2.93e+2	-2.6	129
3313.0	4.38e+2	5.8	130
3691.0	3.34e+2	8.4	130
4512.0	1.89e+2	6.3	130
5946.0	8.65e+1	3.8	130
7056.0	5.30e+1	-24.3	130
7473.0	3.88e+2	7.3	130
8040.0	3.10e+2	2.9	130
9574.0	1.93e+2	0.9	130
5000.0	1.40e+2	4.7	131
6000.0	8.42e+1	3.5	131
6404.0	6.92e+1	1.7	131
7058.0	5.22e+1	-28.8	131
8000.0	3.15e+2	3.3	131
8398.0	2.78e+2	3.1	131
9000.0	2.25e+2	0.0	131
9962.0	1.73e+2	0.2	131
10000.0	1.71e+2	-0.1	131
36.6	6.59e+4	7.1	139
42.5	5.44e+4	10.0	139
51.3	3.88e+4	7.1	139
53.8	8.58e+4	41.9	139
56.4	1.29e+5	-7.3	139
59.4	1.02e+5	-24.6	139
65.8	8.92e+4	-8.1	139
73.5	8.16e+4	7.3	139
88.4	7.52e+4	18.3	139
120.0	5.93e+4	18.8	139
140.0	4.85e+4	13.3	139
160.0	3.99e+4	8.9	139
180.0	3.23e+4	2.0	139
200.0	2.59e+4	-4.8	139
220.0	2.05e+4	-10.7	139
240.0	1.83e+4	-8.9	139
260.0	1.62e+4	-9.8	139
280.0	1.51e+4	-5.7	139
310.0	1.29e+4	-1.7	139
2984.0	5.79e+2	5.3	154
4000.0	2.61e+2	5.4	154
5000.0	1.41e+2	5.1	154
6000.0	8.47e+1	4.1	154
6404.0	7.00e+1	2.9	154
6500.0	6.65e+1	1.8	154

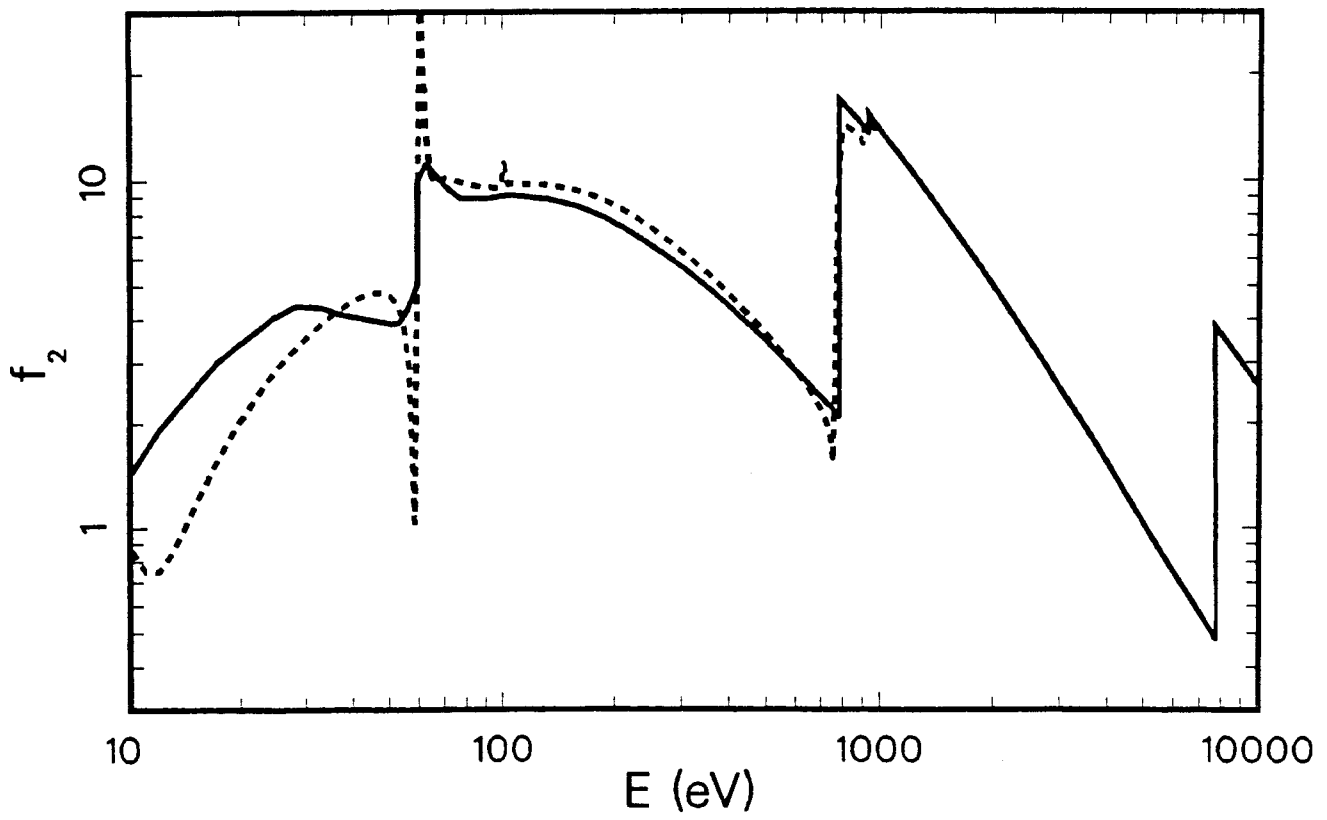
E(eV)	μ(cm^2/g)	% Error	Ref.
6600.0	6.32e+1	1.0	154
6800.0	5.79e+1	0.3	154
6900.0	5.55e+1	0.2	154
7000.0	5.39e+1	1.1	154
7020.0	5.27e+1	-0.3	154
7040.0	5.27e+1	0.4	154
7080.0	5.26e+1	-56.1	154
7090.0	5.34e+1	-64.3	154
7100.0	5.39e+1	-71.1	154
7102.0	5.69e+1	-70.8	154
7104.0	5.94e+1	-70.9	154
7106.0	6.45e+1	-69.8	154
7108.0	7.33e+1	-67.1	154
7110.0	9.33e+1	-60.0	154
7112.0	1.23e+2	-49.4	154
7114.0	1.60e+2	-37.0	154
7116.0	1.92e+2	-27.7	154
7118.0	2.34e+2	-15.9	154
7120.0	2.73e+2	-6.2	154
7122.0	3.12e+2	2.6	154
7124.0	3.64e+2	14.7	154
7126.0	3.90e+2	17.4	154
7128.0	4.16e+2	19.9	154
7146.0	4.31e+2	6.8	154
7180.0	4.17e+2	4.4	154
7214.0	4.44e+2	12.5	154
7260.0	4.15e+2	6.8	154
7360.0	4.22e+2	12.3	154
7460.0	3.95e+2	8.6	154
7560.0	3.74e+2	6.4	154
7660.0	3.50e+2	2.8	154
7760.0	3.40e+2	3.3	154
705.0	3.17e+3	47.8	159
1487.0	3.48e+3	1.3	180
2043.0	1.56e+3	2.7	180
2984.0	5.82e+2	5.8	180
25.4	1.22e+5	26.4	181
26.9	1.11e+5	21.3	181
29.4	1.02e+5	23.1	181
32.9	9.53e+4	33.5	181
37.4	8.87e+4	48.5	181
43.2	8.07e+4	67.7	181
47.3	7.50e+4	80.6	181
50.8	7.19e+4	94.9	181
52.7	8.16e+4	124.4	181
53.9	1.10e+5	64.9	181
55.0	1.38e+5	6.5	181
56.1	1.47e+5	5.9	181
57.0	1.48e+5	5.5	181
58.0	1.44e+5	1.8	181
60.4	1.21e+5	-6.6	181
61.4	1.15e+5	-6.8	181
69.6	1.00e+5	19.3	181
75.8	8.99e+4	24.0	181
81.0	7.70e+4	12.4	181

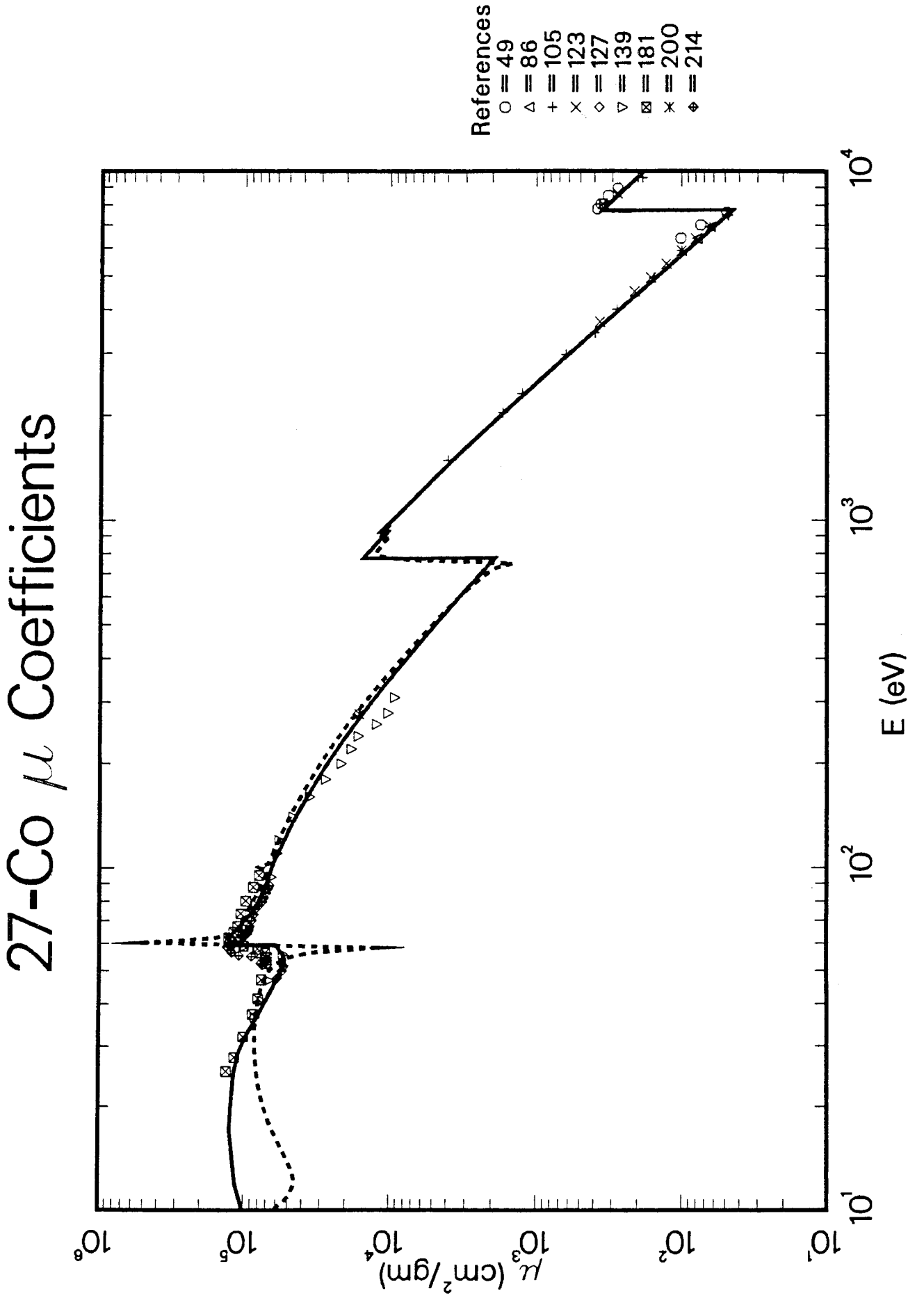
E(eV)	μ(cm^2/g)	% Error	Ref.
87.4	7.10e+4	10.6	181
94.2	7.04e+4	16.3	181
48.6	4.97e+4	24.9	214
50.0	4.41e+4	16.1	214
51.3	4.01e+4	10.5	214
51.7	3.82e+4	6.6	214
52.5	3.35e+4	-7.6	214
52.8	3.81e+4	4.7	214
53.0	5.25e+4	43.8	214
53.2	7.62e+4	107.9	214
53.6	9.39e+4	88.8	214
54.0	9.58e+4	30.6	214
54.6	9.38e+4	-25.7	214
55.0	9.72e+4	-25.0	214
55.5	1.12e+5	-16.0	214
55.7	1.21e+5	-10.6	214
56.2	1.29e+5	-7.3	214
56.7	1.34e+5	-3.8	214
57.1	1.33e+5	-4.6	214
58.0	1.21e+5	-14.4	214
59.1	1.01e+5	-26.0	214
60.2	9.14e+4	-30.3	214
60.5	9.34e+4	-27.9	214
60.9	9.09e+4	-28.5	214
61.0	8.87e+4	-29.8	214
61.3	8.73e+4	-29.7	214
61.6	9.14e+4	-25.2	214
62.0	9.41e+4	-21.2	214
62.5	8.99e+4	-22.6	214
62.7	8.85e+4	-22.9	214
63.1	9.27e+4	-17.5	214
63.4	9.14e+4	-17.2	214
63.8	9.05e+4	-16.3	214
64.5	8.68e+4	-16.6	214
65.2	8.50e+4	-15.2	214
66.6	7.85e+4	-15.6	214
69.0	7.86e+4	-8.0	214
71.6	7.53e+4	-5.7	214
73.3	7.28e+4	-4.8	214
75.3	7.13e+4	-2.1	214
77.3	7.23e+4	1.4	214
78.9	7.48e+4	6.7	214
80.3	7.32e+4	6.1	214
82.2	6.93e+4	2.5	214
83.8	6.81e+4	2.3	214
85.7	6.73e+4	3.1	214
87.3	6.69e+4	4.1	214
88.8	6.63e+4	4.7	214
10.0	1.25e+5	20.4	223
11.0	1.18e+5	0.5	223
12.0	1.30e+5	2.3	223
13.0	1.34e+5	4.4	223
14.0	1.32e+5	1.5	223
15.0	1.28e+5	-2.6	223
16.0	1.24e+5	-4.9	223

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
17.0	1.21e+5	-4.9	223
18.0	1.18e+5	-4.3	223
19.0	1.20e+5	0.5	223
20.0	1.16e+5	0.4	223
21.0	1.11e+5	-0.9	223
22.0	1.02e+5	-6.1	223
23.0	9.19e+4	-12.4	223
24.0	8.36e+4	-17.4	223
25.0	7.74e+4	-20.7	223
27.0	6.27e+4	-31.3	223
28.0	5.78e+4	-34.6	223
29.0	5.24e+4	-38.1	223
30.0	5.03e+4	-37.8	223
1000.0	8.97e+3	-0.4	229
1486.7	3.68e+3	7.0	229
1500.0	3.60e+3	7.2	229
2000.0	1.72e+3	6.9	229
3000.0	5.83e+2	7.6	229
4000.0	2.58e+2	4.4	229
5000.0	1.38e+2	3.0	229
5414.7	1.12e+2	3.6	229
5946.7	8.77e+1	5.3	229
6000.0	8.49e+1	4.4	229
6399.5	6.88e+1	0.9	229
7058.0	5.30e+1	-27.7	229
7472.4	3.85e+2	6.4	229
8000.0	3.14e+2	2.8	229
8397.6	2.78e+2	3.1	229
9961.5	1.73e+2	0.2	229
10000.0	1.72e+2	0.8	229

Atomic Scattering Factors, f_1+if_2
27 - Cobalt (Co)






27-Co μ Coefficients
References
○ = 49
△ = 86
+ = 105
× = 123
◇ = 127
▽ = 139
⊠ = 181
✳ = 200
◆ = 214
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴

Cobalt (Co) — 27

Atomic Weight = 58.93

μ (barns/atom) = $\mu(cm^2/g) \times 97.86$

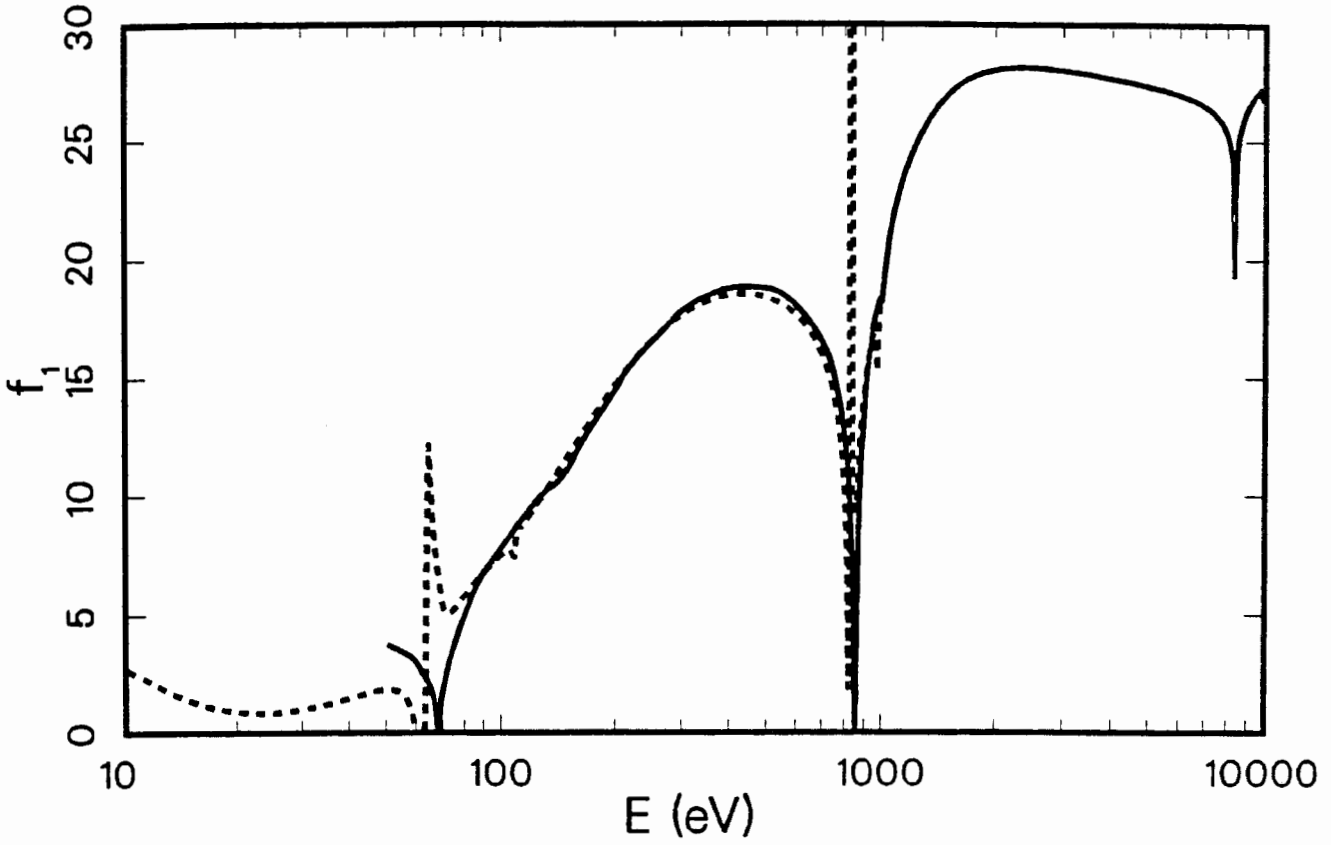
$E\mu(E) = 714.0\, f_2$ keV cm^2/g

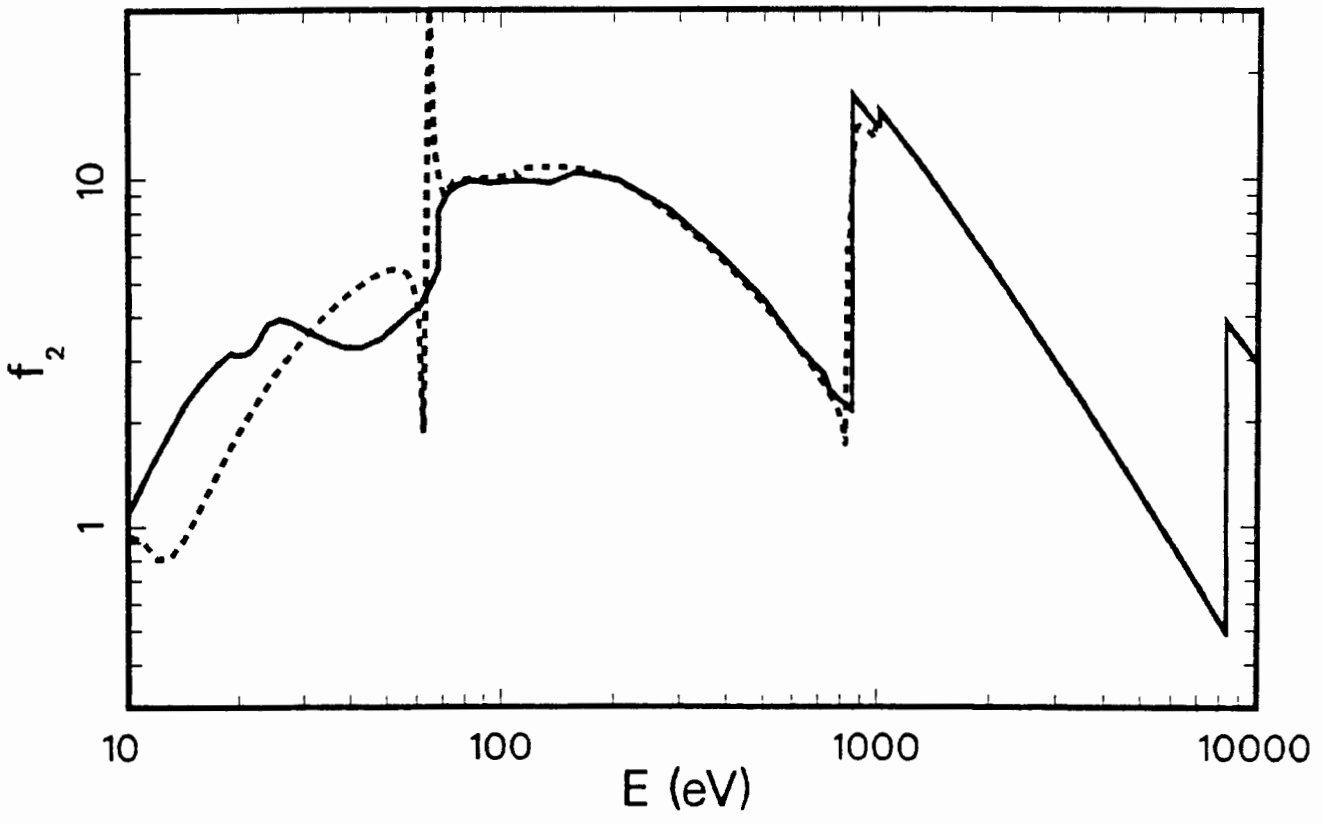
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6410.0	1.01e+2	36.9	49
7000.0	7.40e+1	27.5	49
7600.0	4.90e+1	5.5	49
7800.0	3.81e+2	11.6	49
8040.0	3.44e+2	8.6	49
8050.0	3.62e+2	14.6	49
8500.0	3.22e+2	16.8	49
8920.0	2.76e+2	13.1	49
6404.0	7.80e+1	5.5	86
6930.0	6.34e+1	6.3	86
1490.0	3.99e+3	7.4	105
2040.0	1.70e+3	1.6	105
2310.0	1.25e+3	4.2	105
2980.0	6.27e+2	3.7	105
3440.0	3.97e+2	-2.8	105
4010.0	2.80e+2	4.5	105
4950.0	1.55e+2	3.2	105
5900.0	9.97e+1	7.7	105
6930.0	6.41e+1	7.5	105
7480.0	4.76e+1	-1.8	105
8050.0	3.28e+2	3.8	105
9570.0	1.85e+2	-9.1	105
3692.0	3.68e+2	9.4	123
4512.0	2.11e+2	9.1	123
4953.0	1.63e+2	8.6	123
5414.0	1.27e+2	8.5	123
5898.0	9.97e+1	7.7	123
6404.0	7.97e+1	7.8	123
6930.0	6.36e+1	6.6	123
7478.0	5.10e+1	5.1	123
8040.0	3.53e+2	11.4	123
8640.0	2.77e+2	4.9	123
277.0	1.67e+4	7.6	127
36.5	8.32e+4	2.2	139
40.8	7.37e+4	4.0	139
46.9	6.71e+4	12.1	139
56.0	5.36e+4	-1.9	139
58.1	7.84e+4	9.4	139
59.0	9.79e+4	12.8	139
60.8	1.24e+5	0.6	139
66.6	9.78e+4	-11.0	139
77.8	8.13e+4	-0.4	139
94.2	6.46e+4	-4.7	139
94.2	6.46e+4	-4.7	139
110.0	5.93e+4	1.2	139
120.0	5.72e+4	7.7	139
140.0	4.60e+4	3.3	139
160.0	3.58e+4	-4.8	139
180.0	2.76e+4	-13.0	139
200.0	2.15e+4	-20.6	139

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
220.0	1.84e+4	-20.6	139
240.0	1.64e+4	-18.3	139
260.0	1.23e+4	-29.5	139
280.0	1.02e+4	-33.0	139
310.0	9.20e+3	-27.2	139
25.3	1.32e+5	13.9	181
27.8	1.16e+5	4.2	181
32.0	1.01e+5	4.3	181
37.3	8.69e+4	9.9	181
41.4	8.00e+4	14.9	181
47.1	7.55e+4	26.6	181
54.7	6.95e+4	30.7	181
56.4	7.11e+4	28.6	181
57.8	8.05e+4	19.9	181
59.0	9.98e+4	14.9	181
60.9	1.27e+5	3.3	181
62.5	1.27e+5	-0.3	181
64.9	1.17e+5	0.7	181
67.4	1.10e+5	2.9	181
73.4	1.05e+5	16.4	181
80.2	9.72e+4	22.8	181
88.0	8.62e+4	19.6	181
95.1	7.87e+4	17.0	181
277.0	1.63e+4	4.9	200
47.6	5.89e+4	0.1	214
49.9	5.48e+4	-1.5	214
51.6	5.33e+4	-0.7	214
51.9	7.38e+4	38.1	214
52.2	6.90e+4	29.9	214
52.5	7.67e+4	45.0	214
53.7	6.96e+4	32.0	214
54.1	6.94e+4	31.0	214
54.7	7.67e+4	44.2	214
55.0	8.86e+4	66.1	214
55.4	1.08e+5	101.2	214
56.5	1.21e+5	118.6	214
57.4	1.23e+5	99.2	214
58.6	1.30e+5	63.2	214
58.9	1.30e+5	53.1	214
59.7	1.24e+5	23.6	214
60.3	1.15e+5	0.4	214
61.1	1.06e+5	-14.0	214
63.1	9.92e+4	-20.2	214
63.3	1.04e+5	-15.9	214
63.5	9.89e+4	-19.3	214
63.8	9.79e+4	-19.2	214
64.2	9.52e+4	-20.2	214
64.5	9.62e+4	-18.4	214
65.0	9.36e+4	-19.2	214
65.3	9.42e+4	-17.8	214

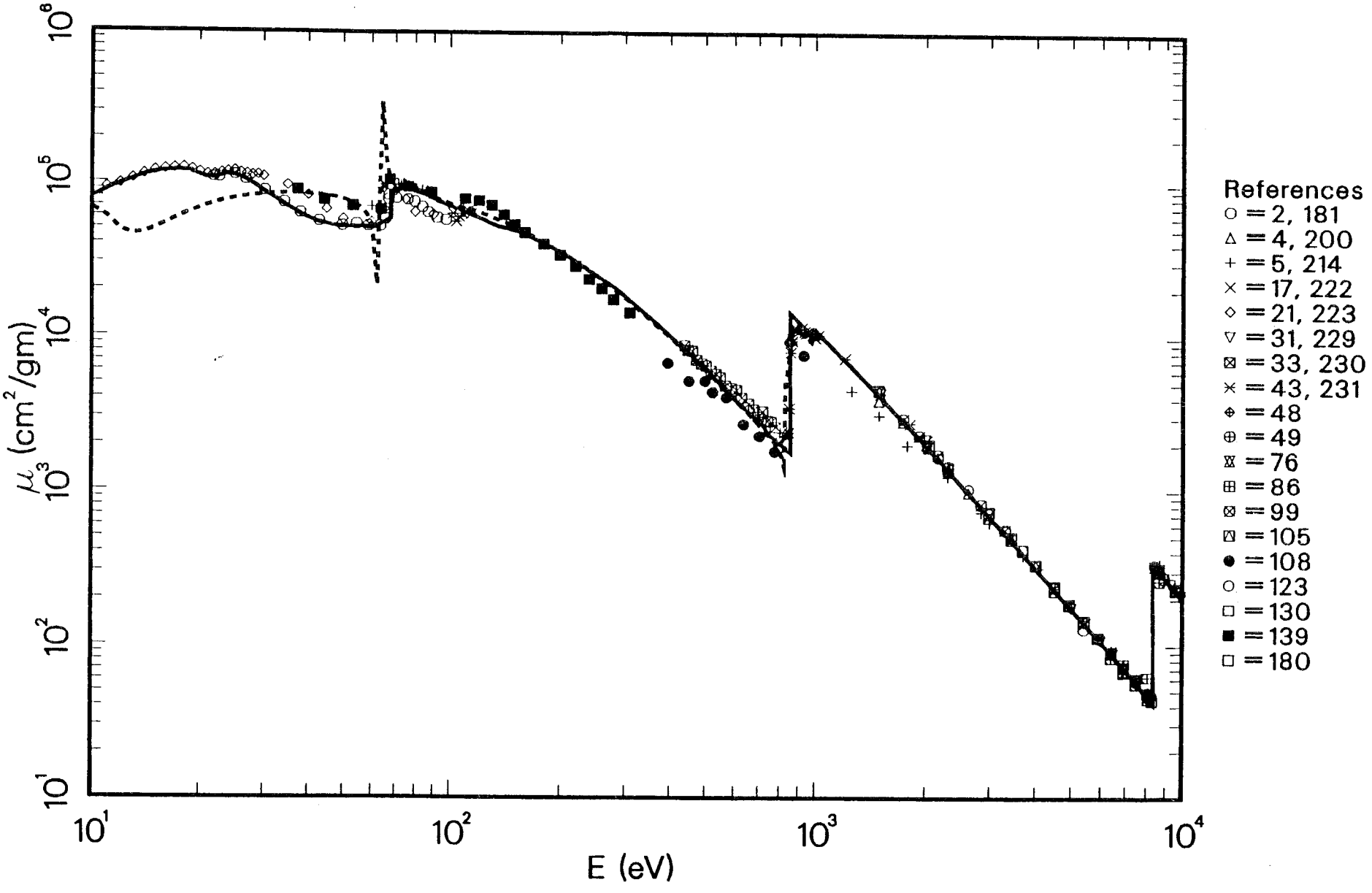
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
65.6	9.26e+4	-18.4	214
67.2	9.11e+4	-15.4	214
70.0	8.87e+4	-10.0	214
73.0	8.59e+4	-5.5	214
75.8	8.30e+4	-2.0	214
77.8	7.94e+4	-2.8	214
79.9	7.50e+4	-5.6	214
81.9	7.30e+4	-5.9	214
84.7	7.03e+4	-6.2	214
87.3	6.83e+4	-6.0	214
88.9	6.72e+4	-5.9	214

Atomic Scattering Factors, f_1+if_2
28 - Nickel (Ni)





28-Ni μ Coefficients



Nickel (Ni) — 28

Atomic Weight = 58.71

μ (barns/atom) = $\mu(cm^2/g) \times 97.49$

$E\mu(E) = 716.7\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5410.0	1.29e+2	-8.8	2
6400.0	8.38e+1	-6.0	2
6930.0	6.72e+1	-5.8	2
7480.0	5.63e+1	-2.2	2
8050.0	6.27e+1	34.4	2
8640.0	2.65e+2	-12.3	2
6410.0	9.00e+1	1.4	4
7040.0	6.90e+1	1.1	4
7490.0	6.00e+1	4.7	4
8070.0	4.75e+1	2.5	4
8660.0	3.23e+2	7.6	4
9590.0	2.37e+2	2.0	4
1256.0	4.54e+3	-29.9	5
1490.0	3.14e+3	-26.3	5
1780.0	2.00e+3	-26.2	5
2300.0	1.25e+3	-10.2	5
2840.0	7.35e+2	-8.0	5
2990.0	6.27e+2	-10.0	5
3700.0	3.84e+2	-2.8	5
4100.0	3.19e+2	6.4	5
4520.0	2.39e+2	3.7	5
4960.0	1.80e+2	0.4	5
6410.0	9.43e+1	6.3	5
6940.0	7.57e+1	6.5	5
7480.0	6.07e+1	5.5	5
8050.0	4.81e+1	3.1	5
8280.0	4.67e+1	-58.2	5
8650.0	3.42e+2	13.5	5
8920.0	3.02e+2	8.2	5
9200.0	2.75e+2	6.5	5
9590.0	2.46e+2	5.9	5
6404.0	9.30e+1	4.6	17
7478.0	6.20e+1	7.6	17
8048.0	4.73e+1	1.3	17
8398.0	3.32e+2	2.5	17
8639.0	3.22e+2	6.6	17
9713.0	2.30e+2	2.3	17
5911.0	1.12e+2	1.3	21
6944.0	7.26e+1	2.3	21
7493.0	6.07e+1	6.0	21
8064.0	5.00e+1	7.7	21
5907.0	1.12e+2	1.0	31
6412.0	9.01e+1	1.6	31
6939.0	7.27e+1	2.2	31
7487.0	6.04e+1	5.2	31
8057.0	4.93e+1	5.8	31
8650.0	3.05e+2	1.4	31
9273.0	2.53e+2	0.1	31
9894.0	2.14e+2	-0.2	31
8047.0	4.91e+1	5.1	33

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
102.0	6.26e+4	-9.2	43
104.0	5.54e+4	-18.2	43
106.0	5.95e+4	-10.6	43
108.0	6.26e+4	-4.3	43
110.0	6.46e+4	0.7	43
112.0	6.57e+4	4.2	43
114.0	6.26e+4	1.1	43
8047.0	4.81e+1	3.0	48
8396.0	3.35e+2	3.4	48
8904.0	2.91e+2	3.9	48
9670.0	2.32e+2	2.1	48
9885.0	2.19e+2	2.0	48
6410.0	9.00e+1	1.4	49
7500.0	6.10e+1	6.8	49
8220.0	4.80e+1	9.2	49
8400.0	3.35e+2	3.4	49
8500.0	3.27e+2	3.9	49
8920.0	2.77e+2	-0.8	49
8040.0	4.55e+1	-2.8	76
5415.0	1.47e+2	3.8	86
5415.0	1.47e+2	3.8	86
6400.0	8.38e+1	-6.0	86
6404.0	9.15e+1	2.9	86
6930.0	7.28e+1	2.0	86
6930.0	6.72e+1	-5.8	86
7480.0	5.63e+1	-2.2	86
8048.0	4.90e+1	4.9	86
8050.0	6.27e+1	34.4	86
8640.0	2.65e+2	-12.3	86
1740.0	2.99e+3	4.1	99
1923.0	2.31e+3	4.1	99
2042.0	1.98e+3	4.2	99
2166.0	1.73e+3	6.3	99
2293.0	1.45e+3	3.1	99
2839.0	8.31e+2	4.0	99
2984.0	7.20e+2	2.8	99
3304.0	5.65e+2	5.8	99
3444.0	5.10e+2	6.6	99
4511.0	2.40e+2	3.6	99
5415.0	1.45e+2	3.0	99
6404.0	9.20e+1	3.4	99
7478.0	6.13e+1	6.5	99
8048.0	4.96e+1	6.2	99
1490.0	4.56e+3	7.0	105
1490.0	4.56e+3	7.0	105
2040.0	1.94e+3	1.8	105
2040.0	1.94e+3	1.8	105
2310.0	1.44e+3	4.3	105
2310.0	1.44e+3	4.3	105
2980.0	6.80e+2	-3.3	105

E(eV)	μ(cm^2/g)	% Error	Ref.
2980.0	6.80e+2	-3.3	105
3440.0	5.01e+2	4.4	105
3440.0	4.87e+2	1.6	105
4010.0	3.36e+2	5.6	105
4510.0	2.29e+2	-1.4	105
4950.0	1.88e+2	4.3	105
5900.0	1.14e+2	2.4	105
6930.0	7.61e+1	6.6	105
8050.0	4.90e+1	5.0	105
8610.0	3.02e+2	-1.0	105
8640.0	3.15e+2	4.3	105
9570.0	2.32e+2	-0.7	105
395.3	6.82e+3	-35.2	108
452.2	5.22e+3	-33.9	108
500.3	5.22e+3	-17.8	108
524.9	4.43e+3	-21.4	108
572.8	4.09e+3	-9.8	108
637.4	2.73e+3	-22.6	108
705.0	2.28e+3	-19.6	108
776.2	1.82e+3	-16.1	108
851.5	9.43e+3	161.8	108
929.7	7.73e+3	-34.3	108
2166.0	1.66e+3	2.1	123
2308.0	1.47e+3	6.7	123
2622.0	1.05e+3	6.0	123
3314.0	5.59e+2	5.4	123
3692.0	4.20e+2	5.7	123
4512.0	2.39e+2	3.4	123
4953.0	1.85e+2	2.7	123
5898.0	1.13e+2	1.2	123
6404.0	9.20e+1	3.4	123
6930.0	7.31e+1	2.5	123
7478.0	5.86e+1	1.8	123
8040.0	4.80e+1	2.4	123
8640.0	3.09e+2	2.2	123
3691.0	4.20e+2	5.6	130
4512.0	2.43e+2	5.1	130
4951.0	1.86e+2	3.2	130
5412.0	1.44e+2	1.9	130
6401.0	8.99e+1	0.9	130
8265.0	4.40e+1	-47.9	130
8634.0	3.20e+2	5.7	130
9574.0	2.37e+2	1.5	130
37.4	8.90e+4	41.0	139
44.3	7.64e+4	42.8	139
53.3	6.99e+4	37.0	139
63.9	6.60e+4	23.8	139
67.6	1.05e+5	37.9	139
76.5	9.38e+4	4.8	139
88.7	8.62e+4	8.9	139
110.0	7.80e+4	21.5	139
120.0	7.59e+4	29.1	139
130.0	7.08e+4	31.4	139
140.0	6.16e+4	21.5	139
150.0	5.33e+4	9.6	139

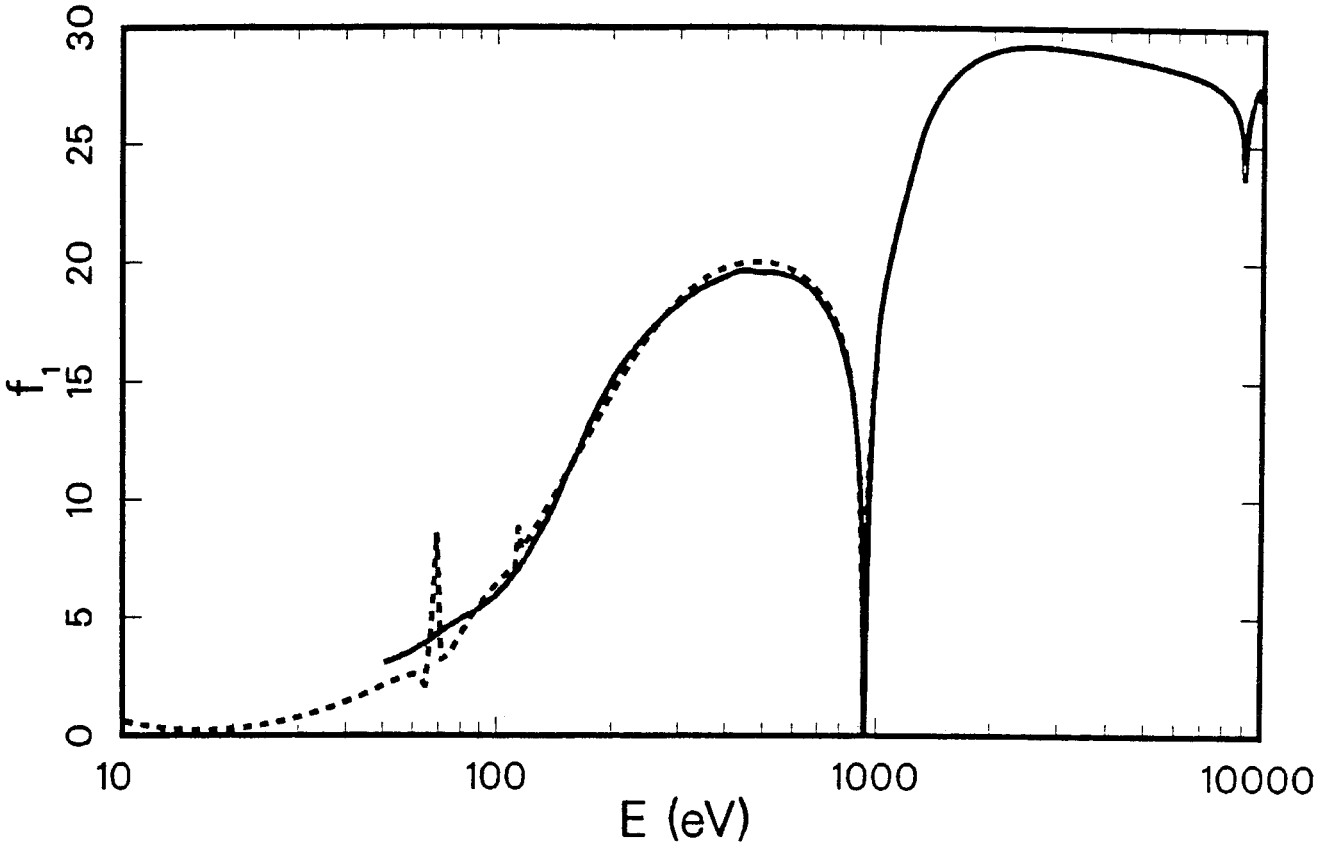
E(eV)	μ(cm^2/g)	% Error	Ref.
160.0	4.72e+4	1.5	139
180.0	4.00e+4	-1.0	139
200.0	3.39e+4	-5.1	139
220.0	2.87e+4	-7.0	139
240.0	2.36e+4	-12.2	139
260.0	2.05e+4	-13.1	139
280.0	1.74e+4	-16.8	139
310.0	1.44e+4	-16.7	139
2043.0	2.03e+3	7.1	180
2984.0	7.42e+2	5.9	180
21.8	1.08e+5	1.4	181
22.7	1.08e+5	-1.1	181
25.0	1.12e+5	1.4	181
26.8	1.04e+5	0.0	181
30.3	8.81e+4	2.4	181
34.3	7.34e+4	2.9	181
38.0	6.29e+4	2.1	181
42.9	5.55e+4	1.9	181
49.8	5.19e+4	1.3	181
54.6	5.33e+4	4.3	181
58.9	5.17e+4	2.0	181
63.8	5.19e+4	-2.5	181
65.8	5.75e+4	-7.3	181
67.1	7.76e+4	7.6	181
67.3	8.24e+4	11.6	181
70.5	7.87e+4	-11.2	181
76.3	7.70e+4	-14.0	181
79.8	7.48e+4	-14.5	181
84.0	6.88e+4	-18.4	181
87.2	6.38e+4	-20.9	181
92.2	5.89e+4	-22.2	181
97.6	5.68e+4	-20.9	181
1490.0	3.94e+3	-7.6	200
1740.0	2.88e+3	0.2	200
2010.0	2.02e+3	2.3	200
2310.0	1.39e+3	1.0	200
2620.0	9.98e+2	1.0	200
3440.0	4.87e+2	1.6	200
4510.0	2.29e+2	-1.4	200
8610.0	3.02e+2	-1.0	200
60.2	6.93e+4	37.6	214
63.1	6.67e+4	27.3	214
63.6	6.81e+4	28.6	214
64.4	9.15e+4	69.9	214
64.7	9.27e+4	70.5	214
65.4	9.67e+4	63.6	214
65.9	9.66e+4	54.0	214
66.7	9.63e+4	39.8	214
68.1	1.06e+5	30.5	214
68.7	1.07e+5	23.8	214
69.5	1.05e+5	20.0	214
71.6	9.76e+4	8.2	214
72.9	9.62e+4	6.6	214
74.0	9.67e+4	7.4	214
74.2	9.84e+4	9.3	214

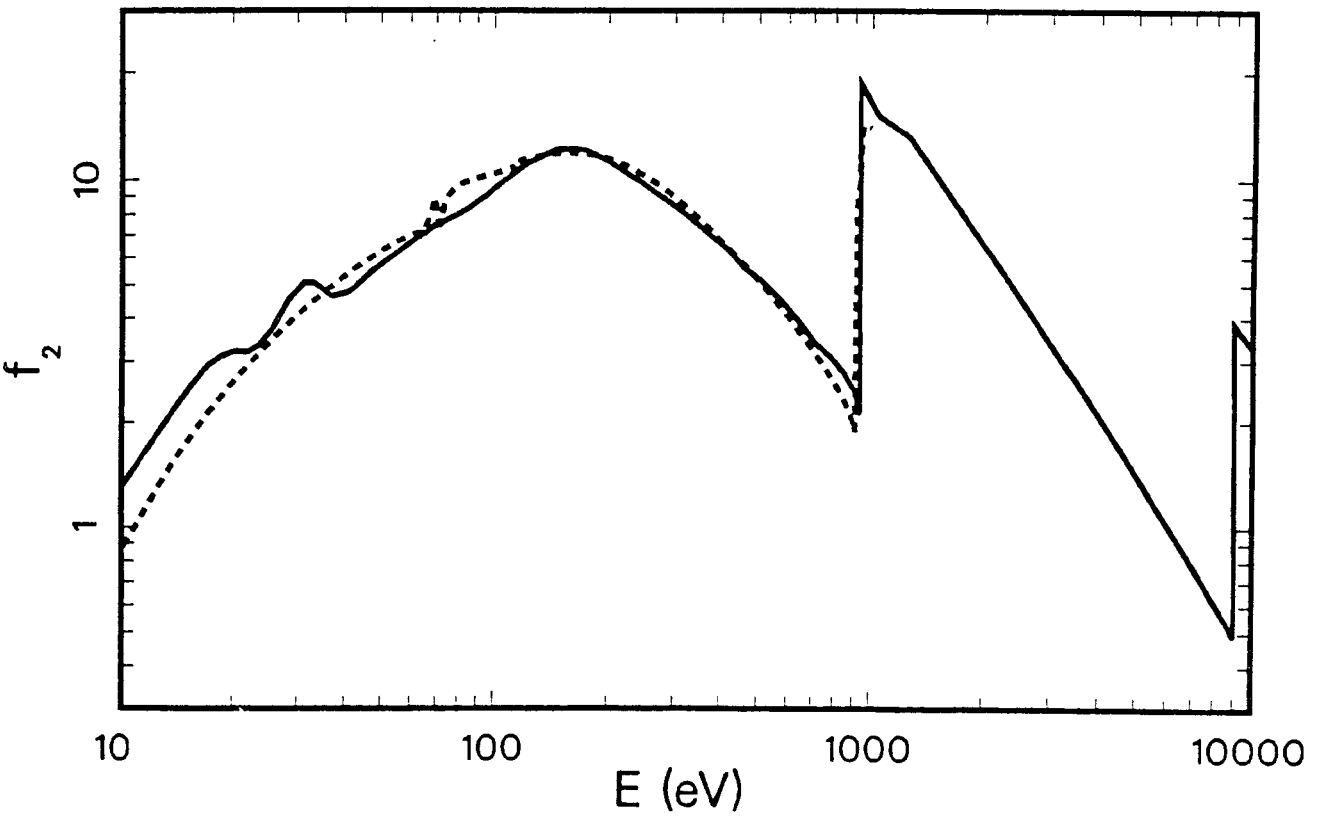
Nickel (Ni) — 28

E(eV)	μ(cm^2/g)	% Error	Ref.
74.5	9.67e+4	7.5	214
74.9	9.62e+4	7.0	214
75.2	9.55e+4	6.4	214
75.4	9.58e+4	6.7	214
76.5	9.51e+4	6.2	214
77.7	9.34e+4	5.1	214
78.8	9.33e+4	5.9	214
80.0	9.14e+4	4.7	214
80.8	9.03e+4	4.1	214
83.9	8.90e+4	5.5	214
86.5	8.82e+4	8.2	214
89.1	8.75e+4	11.1	214
5470.0	1.42e+2	3.2	222
6470.0	8.93e+1	3.3	222
10.0	9.91e+4	26.8	223
11.0	9.15e+4	4.3	223
12.0	9.70e+4	1.2	223
13.0	1.05e+5	1.8	223
14.0	1.13e+5	2.2	223
15.0	1.20e+5	3.7	223
16.0	1.22e+5	3.4	223
17.0	1.24e+5	3.7	223
18.0	1.25e+5	4.7	223
19.0	1.21e+5	2.2	223
20.0	1.16e+5	4.5	223
21.0	1.12e+5	5.0	223
22.0	1.13e+5	5.9	223
23.0	1.15e+5	4.6	223
24.0	1.18e+5	3.7	223
25.0	1.20e+5	7.9	223
26.0	1.15e+5	6.9	223
27.0	1.14e+5	10.9	223
28.0	1.12e+5	14.5	223
29.0	1.12e+5	21.7	223
30.0	1.09e+5	25.1	223
35.0	9.57e+4	38.2	223
40.0	8.20e+4	40.8	223
45.0	6.66e+4	25.5	223
50.0	5.69e+4	11.2	223
60.0	5.47e+4	8.5	223
65.0	6.66e+4	18.2	223
68.0	9.29e+4	16.2	223
70.0	8.77e+4	-0.2	223
75.0	7.69e+4	-14.4	223
80.0	6.38e+4	-26.9	223
90.0	6.15e+4	-21.0	223
1486.7	4.61e+3	7.6	229
1500.0	4.44e+3	5.9	229
2000.0	2.19e+3	9.1	229
3000.0	7.36e+2	6.6	229
4000.0	3.32e+2	3.5	229
5000.0	1.78e+2	1.2	229
5414.7	1.44e+2	1.7	229
5946.7	1.11e+2	1.8	229
6000.0	1.09e+2	2.2	229

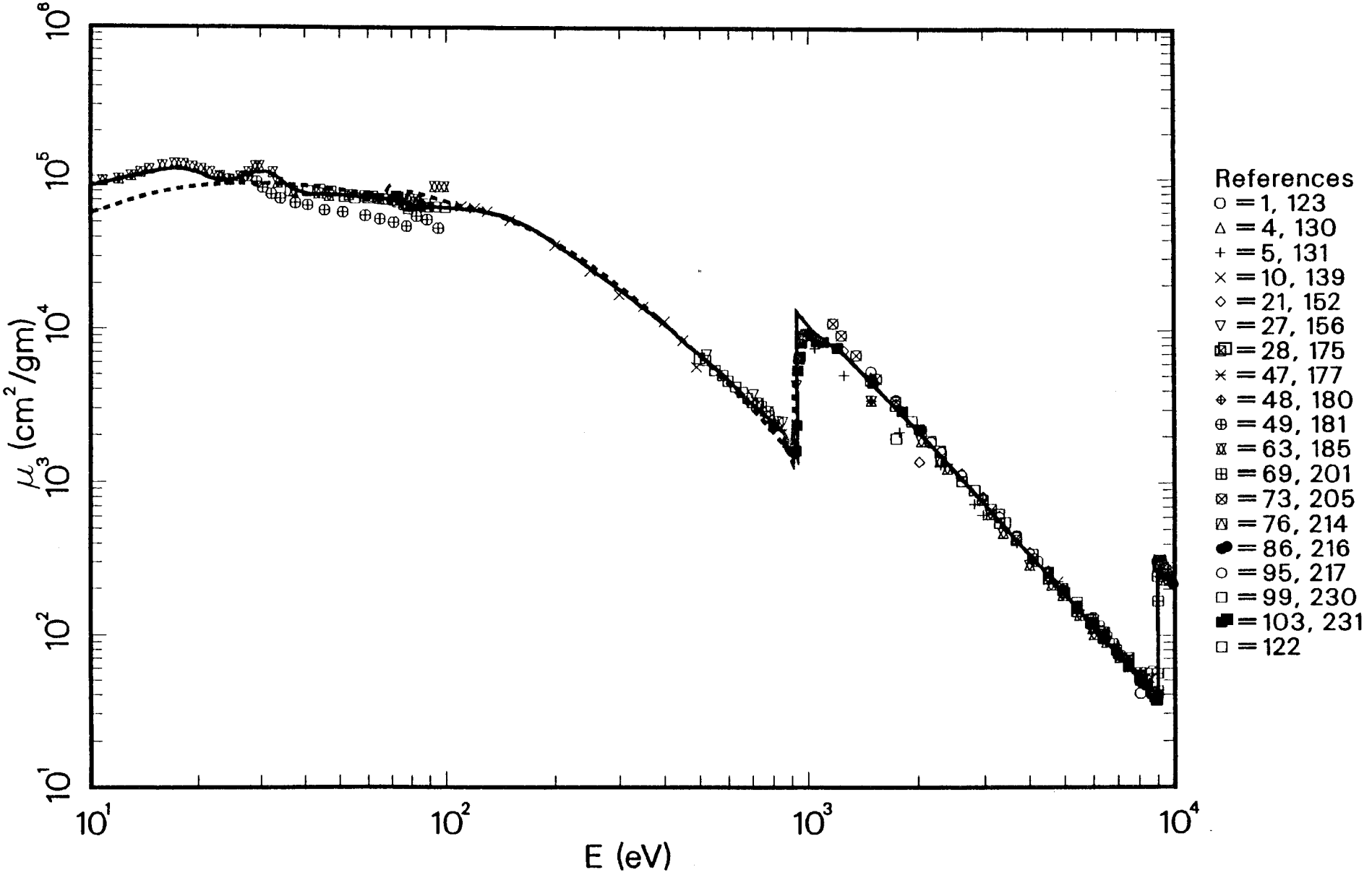
E(eV)	μ(cm^2/g)	% Error	Ref.
7472.4	5.91e+1	2.4	229
8000.0	4.84e+1	1.9	229
8264.7	4.47e+1	-46.8	229
10000.0	2.14e+2	2.3	229
440.0	8.88e+3	6.0	230
450.0	8.28e+3	3.7	230
462.0	8.16e+3	8.1	230
474.0	7.16e+3	0.3	230
490.0	6.75e+3	1.5	230
504.0	6.60e+3	5.8	230
520.0	6.11e+3	5.9	230
536.0	5.80e+3	8.3	230
550.0	5.54e+3	10.4	230
570.0	4.89e+3	6.4	230
590.0	4.70e+3	11.5	230
610.0	4.59e+3	18.2	230
630.0	4.10e+3	13.4	230
658.0	3.75e+3	13.8	230
680.0	3.43e+3	11.8	230
700.0	3.08e+3	7.1	230
720.0	3.33e+3	23.1	230
742.0	2.88e+3	20.1	230
758.0	2.85e+3	24.8	230
780.0	2.63e+3	22.5	230
809.8	2.42e+3	21.7	231
813.0	2.43e+3	23.2	231
819.5	2.38e+3	22.6	231
826.0	2.30e+3	20.4	231
832.9	2.26e+3	20.4	231
839.7	2.23e+3	10.5	231
846.5	2.41e+3	-14.5	231
850.1	3.49e+3	3.8	231
855.5	8.05e+3	84.2	231
860.8	9.93e+3	75.8	231
866.3	9.56e+3	30.1	231
871.9	1.14e+4	18.8	231
877.6	1.17e+4	-6.8	231
883.3	1.13e+4	-14.6	231
895.0	1.13e+4	-11.9	231
919.4	1.16e+4	-4.0	231
936.5	1.10e+4	-4.8	231
945.4	1.08e+4	-4.3	231
954.3	1.09e+4	-1.6	231
963.6	1.08e+4	0.4	231
973.0	1.09e+4	2.9	231
982.5	1.05e+4	0.5	231
992.3	1.02e+4	-1.2	231
1002.2	9.92e+3	-5.4	231
1020.3	1.05e+4	-2.2	231
1204.4	7.38e+3	3.0	231
1506.9	4.36e+3	5.2	231
1810.4	2.78e+3	7.3	231
2013.0	2.15e+3	9.2	231

Atomic Scattering Factors, f_1+if_2
29 - Copper (Cu)





29-Cu μ Coefficients



Copper (Cu) — 29
Atomic Weight = 63.55
μ (barns/atom) = $\mu(cm^2/g) \times 105.52$
$E\mu(E) = 662.2\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6400.0	1.01e+2	6.5	1
6404.0	9.80e+1	3.3	1
6930.0	8.15e+1	7.1	1
7470.0	6.83e+1	10.6	1
7478.0	6.50e+1	5.6	1
8040.0	4.10e+1	-18.2	1
8048.0	4.94e+1	-1.2	1
8335.0	4.64e+1	2.5	1
8630.0	5.75e+1	40.4	1
8639.0	4.21e+1	3.1	1
9628.0	2.61e+2	9.2	1
9713.0	2.54e+2	8.6	1
9962.0	2.31e+2	5.3	1
6410.0	9.86e+1	4.2	4
7040.0	7.60e+1	4.3	4
7490.0	6.40e+1	4.4	4
8070.0	5.00e+1	0.9	4
8660.0	4.20e+1	3.5	4
8930.0	3.80e+1	-43.1	4
9590.0	2.66e+2	10.3	4
1043.0	7.56e+3	-20.6	5
1256.0	5.03e+3	-27.2	5
1490.0	3.45e+3	-23.8	5
1780.0	2.12e+3	-26.7	5
2300.0	1.30e+3	-13.0	5
2840.0	7.30e+2	-14.8	5
2990.0	6.21e+2	-16.9	5
3700.0	4.04e+2	-4.4	5
4100.0	3.21e+2	0.2	5
4520.0	2.62e+2	6.4	5
4960.0	2.02e+2	5.6	5
6410.0	1.00e+2	5.7	5
6940.0	8.56e+1	12.8	5
7480.0	6.51e+1	5.9	5
8050.0	5.04e+1	0.9	5
8280.0	4.63e+1	0.4	5
8650.0	4.26e+1	4.7	5
8920.0	3.78e+1	-32.6	5
9200.0	2.87e+2	7.2	5
9590.0	2.62e+2	8.5	5
8994.0	2.96e+2	45.9	10
9004.0	2.89e+2	19.9	10
9018.0	3.06e+2	9.0	10
9063.0	3.14e+2	13.1	10
9122.0	3.15e+2	15.4	10
9179.0	2.91e+2	8.1	10
9229.0	2.72e+2	2.6	10
6417.0	9.63e+1	2.1	21
7493.0	6.28e+1	2.6	21
8064.0	5.12e+1	3.1	21

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8656.0	4.16e+1	2.5	21
523.0	6.87e+3	9.4	27
704.0	3.77e+3	17.6	27
849.0	2.47e+3	15.2	27
928.0	4.34e+3	67.6	27
2984.0	7.73e+2	2.9	28
3151.0	6.73e+2	3.5	28
3691.0	4.39e+2	3.1	28
4090.0	3.19e+2	-1.0	28
4510.0	2.56e+2	3.3	28
4952.0	1.98e+2	3.1	28
5414.0	1.55e+2	2.9	28
6403.0	9.67e+1	1.9	28
7477.0	6.30e+1	2.4	28
8047.0	5.00e+1	-0.1	28
6400.0	9.63e+1	1.4	47
8047.0	5.12e+1	2.4	48
6000.0	1.31e+2	15.4	49
6210.0	1.16e+2	12.2	49
6510.0	9.93e+1	9.6	49
6810.0	8.83e+1	10.4	49
7000.0	7.36e+1	-0.7	49
7130.0	7.33e+1	4.2	49
8000.0	5.03e+1	-1.1	49
8080.0	5.32e+1	7.6	49
8380.0	4.68e+1	4.9	49
8590.0	4.07e+1	-2.0	49
8750.0	4.03e+1	2.3	49
8830.0	3.95e+1	3.0	49
8950.0	3.06e+2	223.5	49
9000.0	2.90e+2	28.9	49
9300.0	2.62e+2	0.5	49
9410.0	2.75e+2	8.8	49
9690.0	2.61e+2	10.8	49
10000.0	2.06e+2	-5.3	49
1490.0	3.44e+3	-24.0	63
2040.0	1.86e+3	-9.1	63
2290.0	1.37e+3	-9.2	63
2400.0	1.24e+3	-7.3	63
3130.0	6.29e+2	-4.9	63
3400.0	4.71e+2	-11.2	63
4010.0	2.90e+2	-14.9	63
4510.0	2.37e+2	-4.5	63
4600.0	2.12e+2	-9.5	63
4950.0	1.83e+2	-4.6	63
5410.0	1.43e+2	-5.0	63
5500.0	1.36e+2	-5.7	63
5890.0	1.21e+2	1.2	63
5980.0	1.11e+2	-3.2	63
6020.0	1.01e+2	-10.2	63

E(eV)	μ(cm^2/g)	% Error	Ref.
6400.0	1.02e+2	7.3	63
6500.0	8.99e+1	-1.2	63
7070.0	7.11e+1	-1.3	63
7470.0	6.25e+1	1.3	63
7490.0	6.53e+1	6.6	63
8040.0	5.65e+1	12.7	63
8490.0	5.14e+1	19.7	63
8790.0	3.86e+1	-0.7	63
8890.0	4.01e+1	6.6	63
9110.0	2.56e+2	-6.5	63
9220.0	2.50e+2	-6.0	63
9450.0	2.31e+2	-7.9	63
8833.0	3.86e+1	0.7	69
8874.0	3.82e+1	1.0	69
8888.0	3.82e+1	1.5	69
8910.0	3.70e+1	-21.5	69
8917.0	3.81e+1	-28.4	69
8952.0	3.99e+1	-59.2	69
8970.0	4.22e+1	-68.5	69
8978.0	5.55e+1	-63.9	69
8987.0	2.43e+2	35.3	69
8995.0	1.67e+2	-19.1	69
9002.0	2.98e+2	27.8	69
9013.0	2.81e+2	-0.4	69
9025.0	3.07e+2	9.4	69
9029.0	3.03e+2	8.1	69
9042.0	2.88e+2	3.1	69
9074.0	3.13e+2	12.9	69
9098.0	2.78e+2	0.9	69
9133.0	3.11e+2	14.1	69
9158.0	2.72e+2	0.5	69
9211.0	2.95e+2	10.4	69
9241.0	2.69e+2	1.7	69
9290.0	2.82e+2	8.1	69
729.0	3.35e+3	12.1	73
775.0	2.94e+3	11.1	73
824.0	2.52e+3	9.5	73
886.0	2.09e+3	10.4	73
1170.0	1.10e+4	40.3	73
1234.0	9.19e+3	28.4	73
1359.0	6.83e+3	19.8	73
1540.0	4.76e+3	14.1	73
1739.0	3.39e+3	10.2	73
8040.0	5.02e+1	0.1	76
5415.0	1.54e+2	2.7	86
5907.0	1.20e+2	1.3	86
6404.0	9.60e+1	1.2	86
6412.0	9.61e+1	1.7	86
6930.0	7.72e+1	1.4	86
6939.0	7.77e+1	2.4	86
7487.0	6.26e+1	2.1	86
8048.0	5.18e+1	3.7	86
8057.0	5.15e+1	3.3	86
8650.0	4.14e+1	1.8	86
9273.0	2.53e+2	-3.7	86

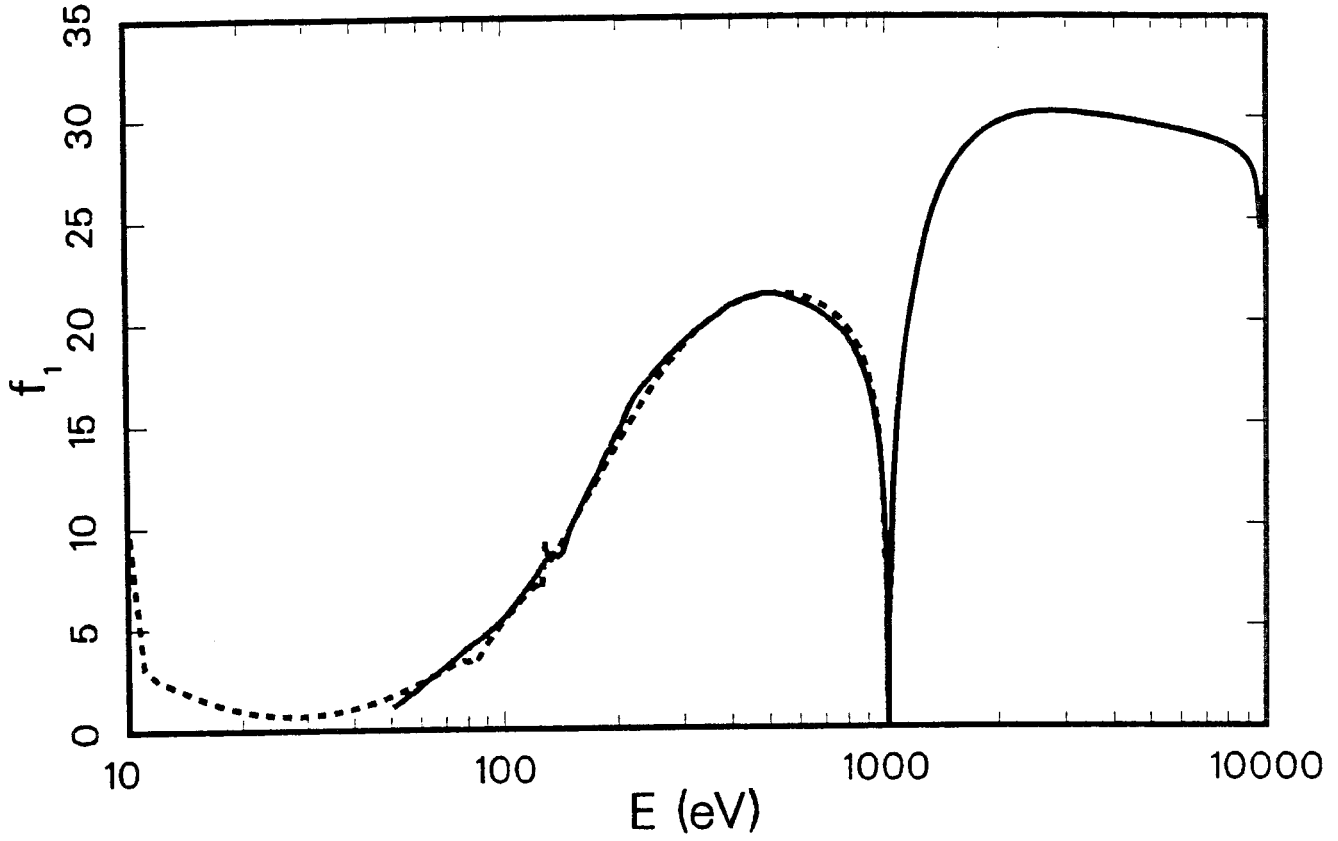
E(eV)	μ(cm^2/g)	% Error	Ref.
9894.0	2.17e+2	-2.7	86
8048.0	5.23e+1	4.6	95
10000.0	2.57e+2	18.2	95
1487.0	4.68e+3	2.8	99
1739.0	3.19e+3	3.7	99
1743.0	1.93e+3	-36.9	99
1923.0	2.52e+3	6.0	99
2042.0	2.17e+3	6.5	99
2166.0	1.87e+3	7.0	99
2293.0	1.61e+3	6.6	99
2312.0	1.37e+3	-7.3	99
2627.0	1.03e+3	-2.7	99
2839.0	8.96e+2	4.4	99
3304.0	6.31e+2	10.2	99
3318.0	5.51e+2	-2.6	99
3444.0	5.53e+2	7.9	99
3697.0	4.25e+2	0.3	99
4091.0	3.42e+2	6.1	99
4511.0	2.61e+2	5.5	99
4516.0	2.35e+2	-4.9	99
4952.0	2.03e+2	5.7	99
5415.0	1.56e+2	3.7	99
5420.0	1.65e+2	9.9	99
5899.0	1.25e+2	5.4	99
5904.0	1.29e+2	8.3	99
6404.0	9.97e+1	5.1	99
6409.0	1.05e+2	10.9	99
6930.0	8.01e+1	5.2	99
7478.0	6.46e+1	5.0	99
7484.0	6.72e+1	9.4	99
8048.0	5.22e+1	4.4	99
8053.0	5.44e+1	9.1	99
8644.0	4.49e+1	10.0	99
9442.0	2.70e+2	7.6	99
9713.0	2.46e+2	5.2	99
5410.0	1.53e+2	1.2	103
8040.0	4.99e+1	-0.4	103
36.5	8.01e+4	-5.2	122
40.8	8.04e+4	4.2	122
44.2	8.24e+4	7.4	122
47.5	7.99e+4	4.4	122
51.8	7.39e+4	-1.9	122
55.4	7.23e+4	-2.9	122
60.2	7.22e+4	-1.8	122
67.9	7.09e+4	-0.8	122
73.1	6.87e+4	-0.9	122
76.1	6.55e+4	-3.6	122
78.4	6.18e+4	-7.9	122
80.8	6.75e+4	1.8	122
82.5	6.83e+4	4.0	122
87.8	6.63e+4	3.0	122
93.7	6.36e+4	0.2	122
99.5	6.31e+4	0.5	122
2166.0	1.82e+3	4.0	123
2308.0	1.56e+3	5.5	123

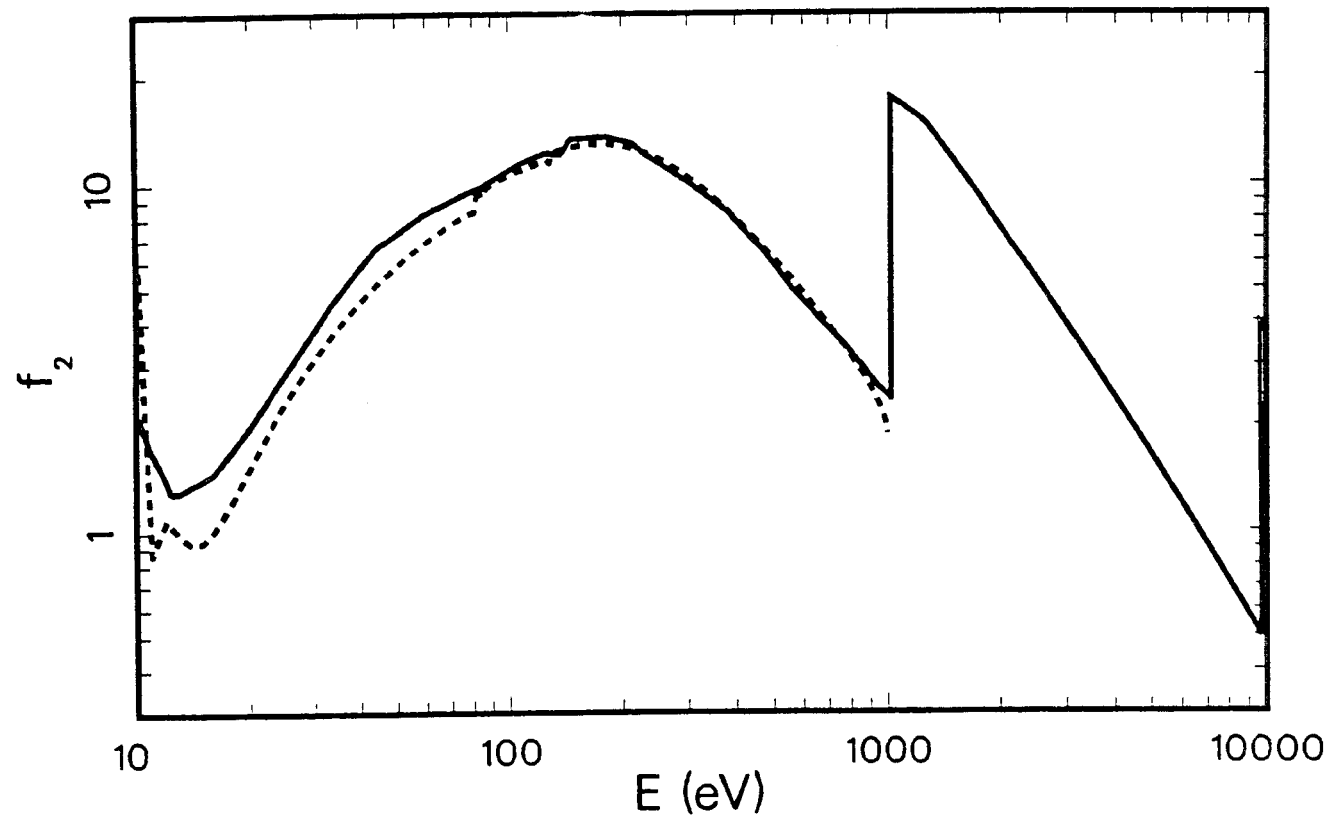
E(eV)	μ(cm^2/g)	% Error	Ref.
2622.0	1.11e+3	4.8	123
3314.0	5.93e+2	4.4	123
3692.0	4.54e+2	6.7	123
4221.0	3.06e+2	3.4	123
4512.0	2.55e+2	3.3	123
4953.0	1.98e+2	3.2	123
5414.0	1.53e+2	1.7	123
5898.0	1.22e+2	2.4	123
6404.0	9.66e+1	1.8	123
6930.0	7.76e+1	1.9	123
7478.0	6.22e+1	1.0	123
8040.0	5.09e+1	1.5	123
8640.0	4.16e+1	1.8	123
4512.0	2.63e+2	6.2	130
5412.0	1.56e+2	3.8	130
6401.0	9.73e+1	2.5	130
8907.0	3.82e+1	-14.5	130
9245.0	2.84e+2	7.6	130
7058.0	7.41e+1	2.4	131
8000.0	5.22e+1	2.6	131
8398.0	4.50e+1	1.7	131
9500.0	2.63e+2	6.4	131
9962.0	2.22e+2	1.2	131
10000.0	2.20e+2	1.1	131
110.0	6.44e+4	4.4	139
120.0	6.25e+4	3.4	139
130.0	5.97e+4	2.3	139
150.0	5.21e+4	-2.7	139
200.0	3.60e+4	-3.2	139
250.0	2.46e+4	-3.7	139
300.0	1.71e+4	-8.4	139
350.0	1.42e+4	1.6	139
400.0	1.14e+4	4.6	139
450.0	8.53e+3	1.3	139
490.0	5.69e+3	-20.3	139
1254.0	7.31e+3	5.4	152
1487.0	4.87e+3	6.9	152
1740.0	3.31e+3	7.8	152
2013.0	1.36e+3	-35.8	152
2307.0	1.61e+3	8.5	152
2621.0	1.14e+3	7.8	152
2984.0	8.12e+2	8.0	152
3313.0	6.10e+2	7.3	152
3691.0	4.56e+2	7.3	152
4012.0	3.56e+2	4.6	152
4508.0	2.67e+2	7.7	152
4949.0	1.98e+2	3.0	152
5411.0	1.57e+2	4.3	152
5895.0	1.23e+2	3.0	152
6400.0	9.89e+1	4.1	152
6926.0	7.98e+1	4.6	152
7473.0	6.41e+1	3.9	152
8040.0	5.21e+1	4.0	152
8630.0	4.25e+1	3.9	152
9570.0	2.52e+2	3.9	152

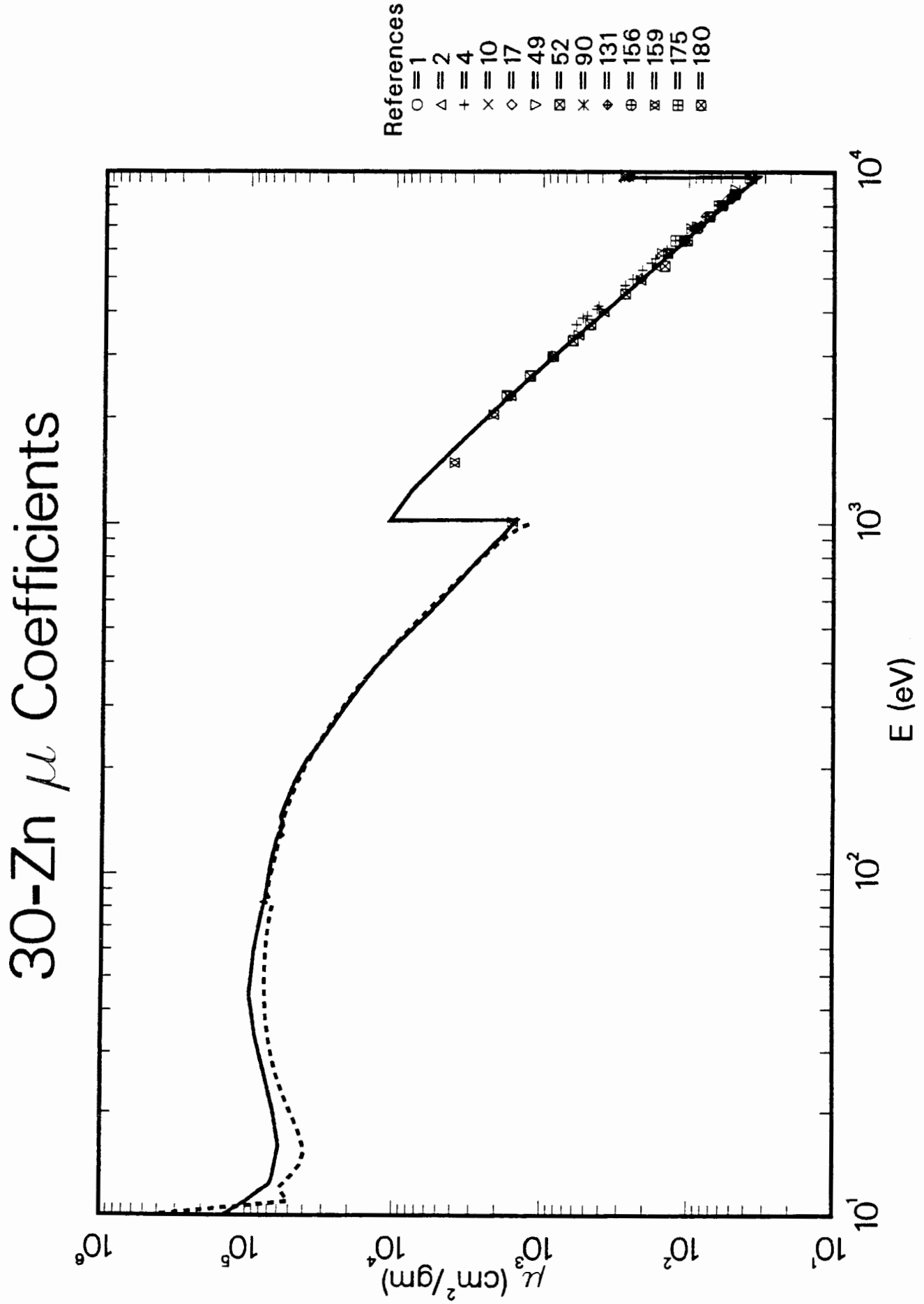
E(eV)	μ(cm^2/g)	% Error	Ref.
9990.0	2.26e+2	3.7	152
8040.0	4.92e+1	-2.0	156
6400.0	1.01e+2	6.6	175
7472.0	7.10e+1	15.1	175
8041.0	5.10e+1	1.8	175
4800.0	2.26e+2	8.1	177
5900.0	1.20e+2	0.9	177
8000.0	5.40e+1	6.2	177
8900.0	4.01e+1	1.4	177
2043.0	2.18e+3	7.2	180
2984.0	7.92e+2	5.4	180
23.0	9.84e+4	3.9	181
24.4	9.54e+4	0.3	181
26.9	9.95e+4	-1.3	181
27.5	9.99e+4	-2.9	181
29.3	9.23e+4	-13.2	181
30.5	8.41e+4	-21.4	181
32.2	7.68e+4	-26.0	181
34.2	7.20e+4	-24.4	181
37.7	6.72e+4	-17.5	181
40.8	6.50e+4	-15.7	181
45.5	6.03e+4	-21.3	181
51.2	5.86e+4	-22.4	181
59.2	5.58e+4	-24.3	181
65.0	5.28e+4	-26.9	181
71.2	5.05e+4	-28.0	181
77.5	4.76e+4	-29.4	181
82.9	5.50e+4	-16.0	181
88.7	5.25e+4	-18.4	181
95.3	4.63e+4	-26.8	181
10.8	9.28e+4	3.3	185
12.0	9.56e+4	0.4	185
13.0	1.00e+5	0.8	185
13.8	1.06e+5	3.3	185
14.6	1.12e+5	5.3	185
15.9	1.19e+5	7.9	185
17.2	1.22e+5	8.1	185
18.2	1.21e+5	8.7	185
19.3	1.16e+5	7.8	185
20.4	1.13e+5	8.3	185
21.6	1.07e+5	9.8	185
23.1	1.01e+5	6.4	185
24.6	9.49e+4	-0.4	185
26.4	9.99e+4	0.8	185
27.8	1.07e+5	3.0	185
29.1	1.17e+5	10.1	185
29.8	1.18e+5	10.6	185
32.5	1.07e+5	3.7	185
33.6	9.13e+4	-7.2	185
37.2	7.98e+4	-2.9	185
43.8	7.79e+4	1.6	185
46.9	7.48e+4	-2.4	185
53.2	7.61e+4	1.6	185
59.0	7.47e+4	1.3	185
64.9	7.20e+4	-0.4	185

E(eV)	μ(cm^2/g)	% Error	Ref.
72.2	7.50e+4	7.7	185
79.1	7.13e+4	6.7	185
83.6	7.11e+4	8.9	185
93.0	8.65e+4	36.1	185
98.8	8.64e+4	37.4	185
5000.0	1.92e+2	2.8	201
5410.0	1.43e+2	-5.2	201
5960.0	1.18e+2	2.4	201
6400.0	9.51e+1	0.1	201
7480.0	6.18e+1	0.5	201
8050.0	5.30e+1	6.1	201
8140.0	4.98e+1	3.0	201
8640.0	5.55e+1	35.9	201
6400.0	9.88e+1	4.0	205
62.1	7.44e+4	1.9	214
66.5	7.16e+4	-0.3	214
71.2	7.02e+4	0.2	214
72.9	7.41e+4	6.8	214
73.3	7.42e+4	7.3	214
74.6	7.06e+4	2.9	214
75.5	7.07e+4	3.7	214
77.3	6.52e+4	-3.4	214
78.3	6.37e+4	-5.1	214
79.8	6.47e+4	-2.8	214
80.6	6.42e+4	-3.1	214
82.1	6.56e+4	-0.3	214
83.7	6.49e+4	-0.7	214
84.1	6.51e+4	-0.1	214
84.9	6.43e+4	-0.9	214
88.3	6.35e+4	-1.2	214
89.5	6.34e+4	-1.1	214
5900.0	1.19e+2	-0.1	216
6400.0	9.50e+1	0.0	216
8100.0	4.82e+1	-1.8	216
1490.0	5.34e+3	17.8	217
1740.0	3.49e+3	13.7	217
4510.0	2.63e+2	6.2	217
8040.0	5.37e+1	7.1	217
500.0	6.51e+3	-5.3	230
520.0	6.32e+3	-0.6	230
552.0	5.41e+3	-3.6	230
580.0	5.00e+3	-1.0	230
600.0	4.61e+3	-1.5	230
630.0	4.23e+3	1.0	230
656.0	3.92e+3	2.8	230
680.0	3.57e+3	2.3	230
700.0	3.34e+3	2.7	230
720.0	3.18e+3	3.9	230
740.0	3.17e+3	9.2	230
760.0	2.94e+3	6.8	230
780.0	2.74e+3	5.0	230
801.9	2.35e+3	-4.3	231
879.4	1.83e+3	-5.6	231
887.1	1.80e+3	-4.4	231
893.0	1.73e+3	-6.4	231
899.0	1.70e+3	-6.5	231
905.0	1.68e+3	-6.4	231
911.1	1.62e+3	-8.0	231
917.3	1.60e+3	-6.5	231
923.7	1.61e+3	-6.7	231
930.1	2.37e+3	-24.9	231
936.5	5.42e+3	-5.6	231
943.2	6.49e+3	-39.3	231
949.9	6.70e+3	-46.2	231
956.6	8.20e+3	-32.8	231
963.3	9.01e+3	-24.6	231
970.6	9.22e+3	-21.1	231
977.6	9.22e+3	-19.5	231
985.0	9.46e+3	-15.6	231
992.3	9.48e+3	-13.6	231
999.7	9.26e+3	-13.8	231
1002.2	9.21e+3	-13.7	231
1055.9	8.46e+3	-9.3	231
1102.5	8.33e+3	-3.9	231
1204.4	7.62e+3	2.2	231
1506.9	4.51e+3	2.5	231
1810.4	2.93e+3	5.7	231
2013.0	2.23e+3	5.7	231

Atomic Scattering Factors, f_1+if_2
30 - Zinc (Zn)






30-Zn μ Coefficients
References
○ = 1
△ = 2
+ = 4
× = 10
◇ = 17
▽ = 49
⊠ = 52
✳ = 90
◆ = 131
⊕ = 156
⊠ = 159
⊞ = 175
⊠ = 180
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Zinc (Zn) — 30

Atomic Weight = 65.38

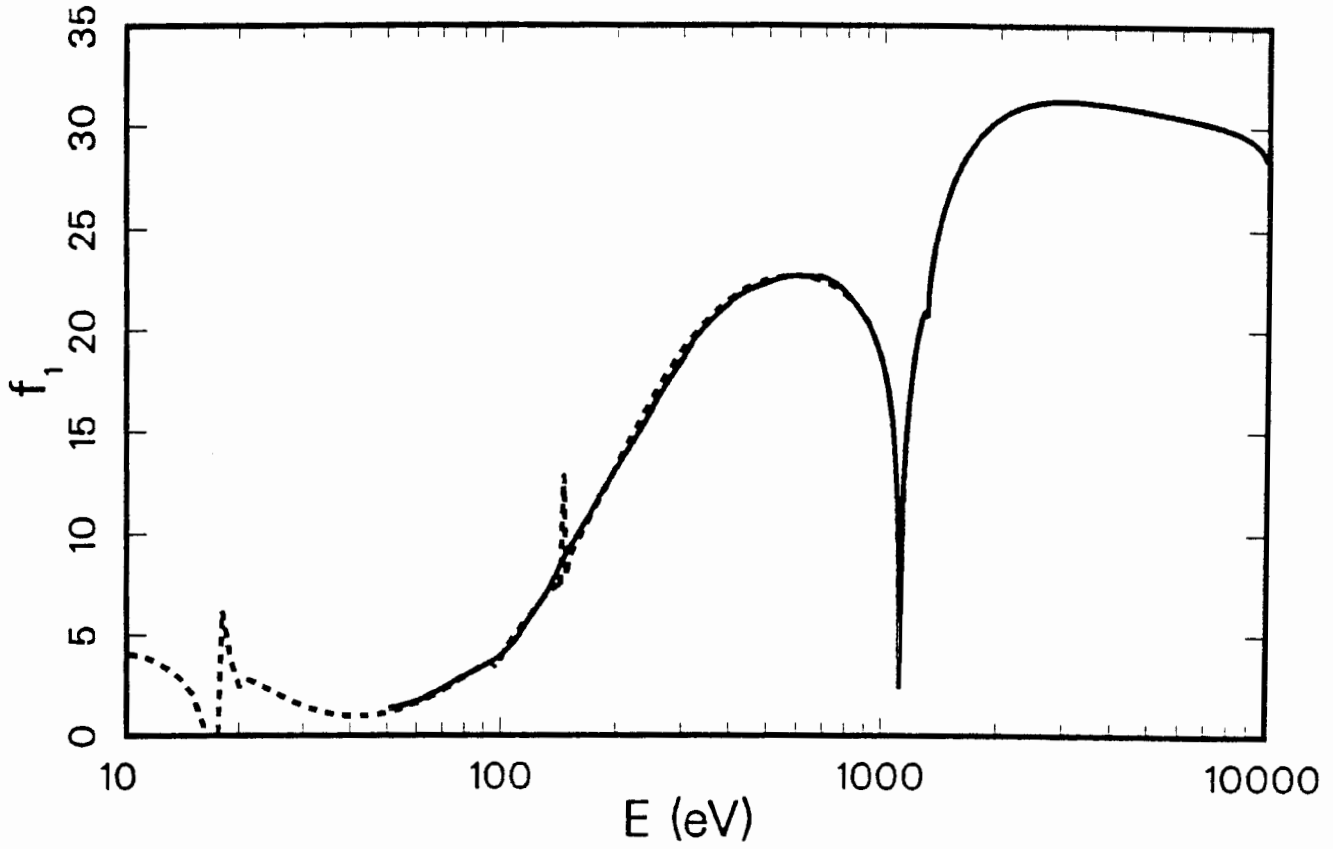
μ (barns/atom) = $\mu(cm^2/g) \times 108.57$

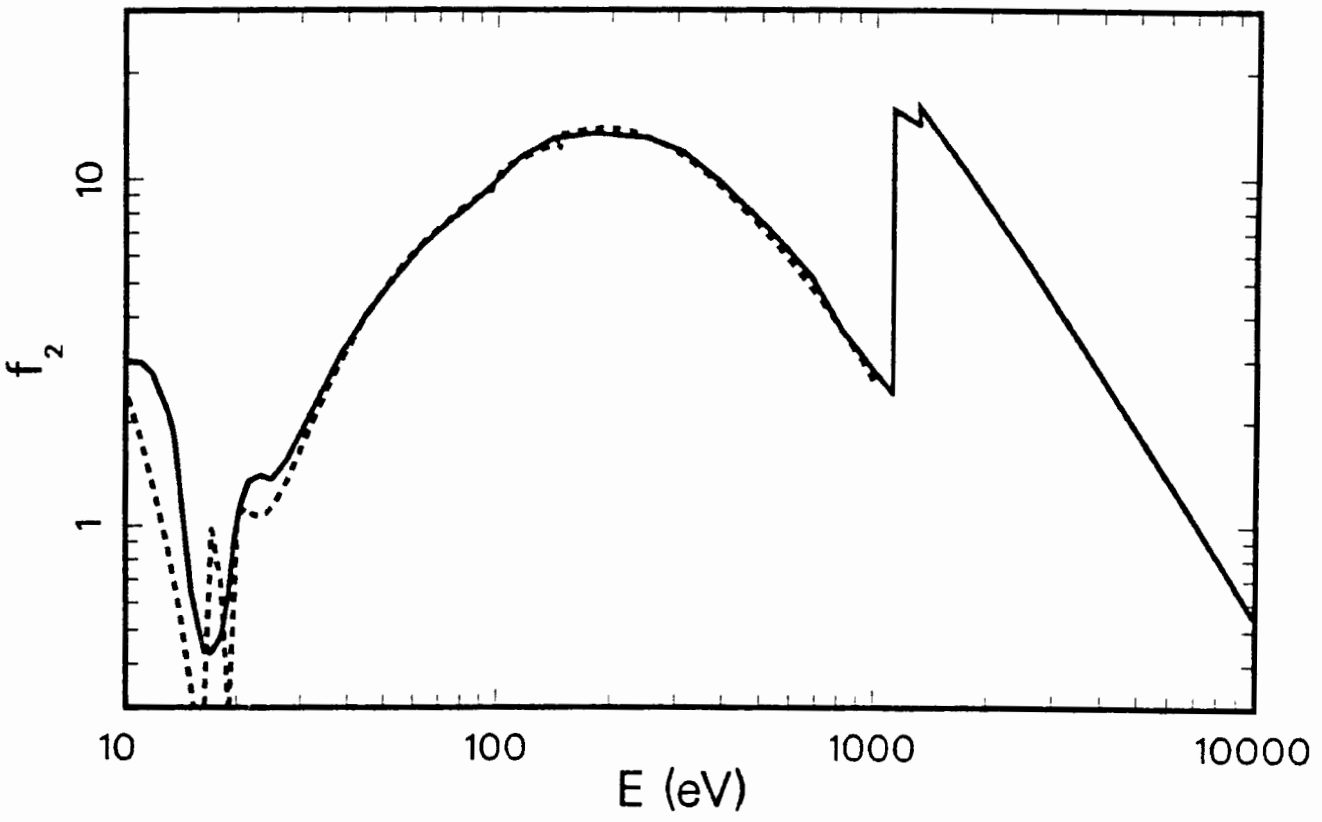
$E\mu(E) = 643.6\, f_2$ keV cm^2/g

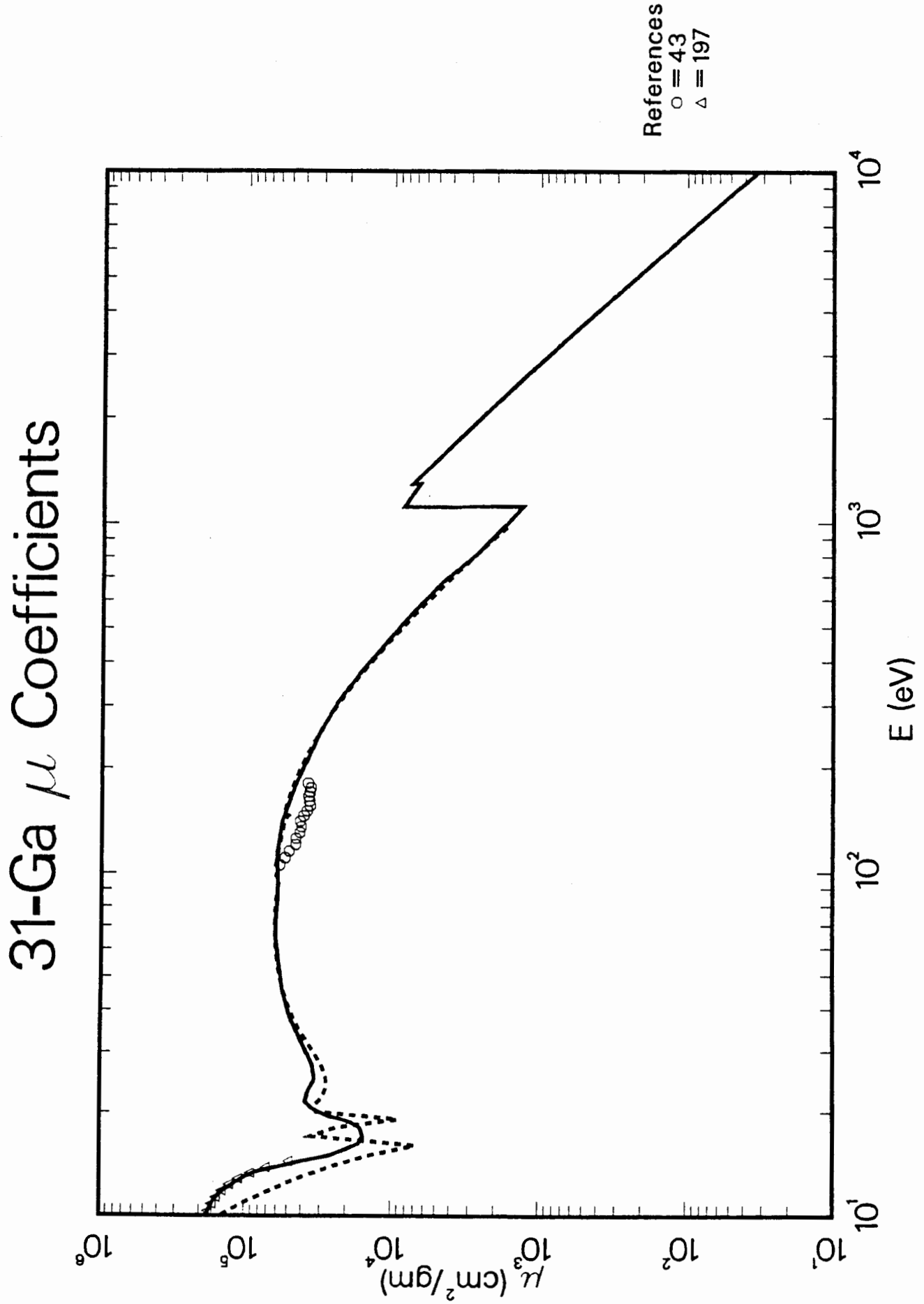
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6400.0	1.10e+2	2.9	1
6930.0	8.66e+1	1.4	1
7470.0	7.11e+1	2.5	1
8040.0	5.78e+1	2.4	1
8630.0	4.75e+1	2.8	1
5410.0	1.70e+2	0.9	2
6400.0	1.12e+2	5.6	2
6930.0	9.15e+1	7.1	2
7480.0	7.44e+1	7.7	2
8050.0	6.09e+1	8.3	2
8640.0	5.01e+1	8.8	2
3680.0	5.90e+2	22.8	4
3850.0	5.34e+2	25.5	4
3900.0	5.00e+2	21.8	4
4080.0	4.30e+2	18.3	4
4170.0	4.20e+2	22.5	4
4770.0	2.76e+2	16.0	4
4980.0	2.46e+2	16.1	4
5280.0	2.10e+2	16.3	4
5530.0	1.82e+2	14.6	4
5690.0	1.72e+2	17.1	4
6020.0	1.44e+2	14.0	4
6410.0	1.15e+2	8.6	4
6420.0	1.16e+2	9.9	4
7040.0	9.00e+1	10.0	4
7490.0	7.60e+1	10.4	4
8070.0	5.89e+1	5.6	4
8550.0	5.10e+1	7.6	4
8660.0	5.05e+1	10.4	4
8930.0	4.49e+1	7.3	4
9590.0	3.79e+1	11.1	4
9683.0	2.62e+2	171.0	10
9699.0	2.82e+2	125.1	10
9715.0	2.77e+2	71.3	10
9734.0	2.87e+2	30.9	10
9756.0	2.70e+2	6.9	10
9785.0	2.85e+2	13.7	10
9813.0	2.69e+2	7.9	10
9853.0	2.78e+2	12.6	10
6404.0	1.06e+2	-0.3	17
7478.0	7.70e+1	11.4	17
8048.0	5.83e+1	3.6	17
8335.0	5.45e+1	6.9	17
8398.0	5.02e+1	0.6	17
8639.0	5.02e+1	9.0	17
9628.0	3.69e+1	-7.4	17
9672.0	2.64e+2	225.4	17
9962.0	2.65e+2	10.4	17
6410.0	1.05e+2	-1.0	49
7000.0	8.80e+1	5.9	49

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8050.0	6.20e+1	10.2	49
8920.0	4.78e+1	13.6	49
9570.0	3.83e+1	11.4	49
9770.0	2.70e+2	7.1	49
2312.0	1.75e+3	6.5	52
2627.0	1.22e+3	3.2	52
3318.0	6.24e+2	-1.5	52
3697.0	4.75e+2	0.2	52
4516.0	2.76e+2	-0.1	52
5420.0	1.47e+2	-12.3	52
5904.0	1.40e+2	5.5	52
6409.0	1.03e+2	-2.9	52
7484.0	7.17e+1	4.0	52
8053.0	5.87e+1	4.5	52
8644.0	4.84e+1	5.3	52
8040.0	5.92e+1	5.0	90
5000.0	2.14e+2	2.2	131
6404.0	1.09e+2	2.6	131
7058.0	8.29e+1	2.1	131
8398.0	5.11e+1	2.5	131
9962.0	2.51e+2	4.6	131
10000.0	2.48e+2	4.2	131
8040.0	5.92e+1	5.0	156
1012.0	1.59e+3	4.7	159
1490.0	3.97e+3	-20.4	159
2040.0	2.15e+3	-5.5	159
2310.0	1.65e+3	-0.2	159
2980.0	8.45e+2	0.0	159
3440.0	5.70e+2	-0.9	159
4010.0	3.87e+2	1.5	159
4950.0	2.16e+2	0.3	159
5900.0	1.54e+2	15.9	159
6930.0	9.70e+1	13.5	159
8050.0	6.23e+1	10.8	159
9570.0	3.70e+1	7.6	159
6400.0	1.25e+2	17.4	175
2984.0	8.63e+2	2.6	180

Atomic Scattering Factors, f_1+if_2
31 - Gallium (Ga)



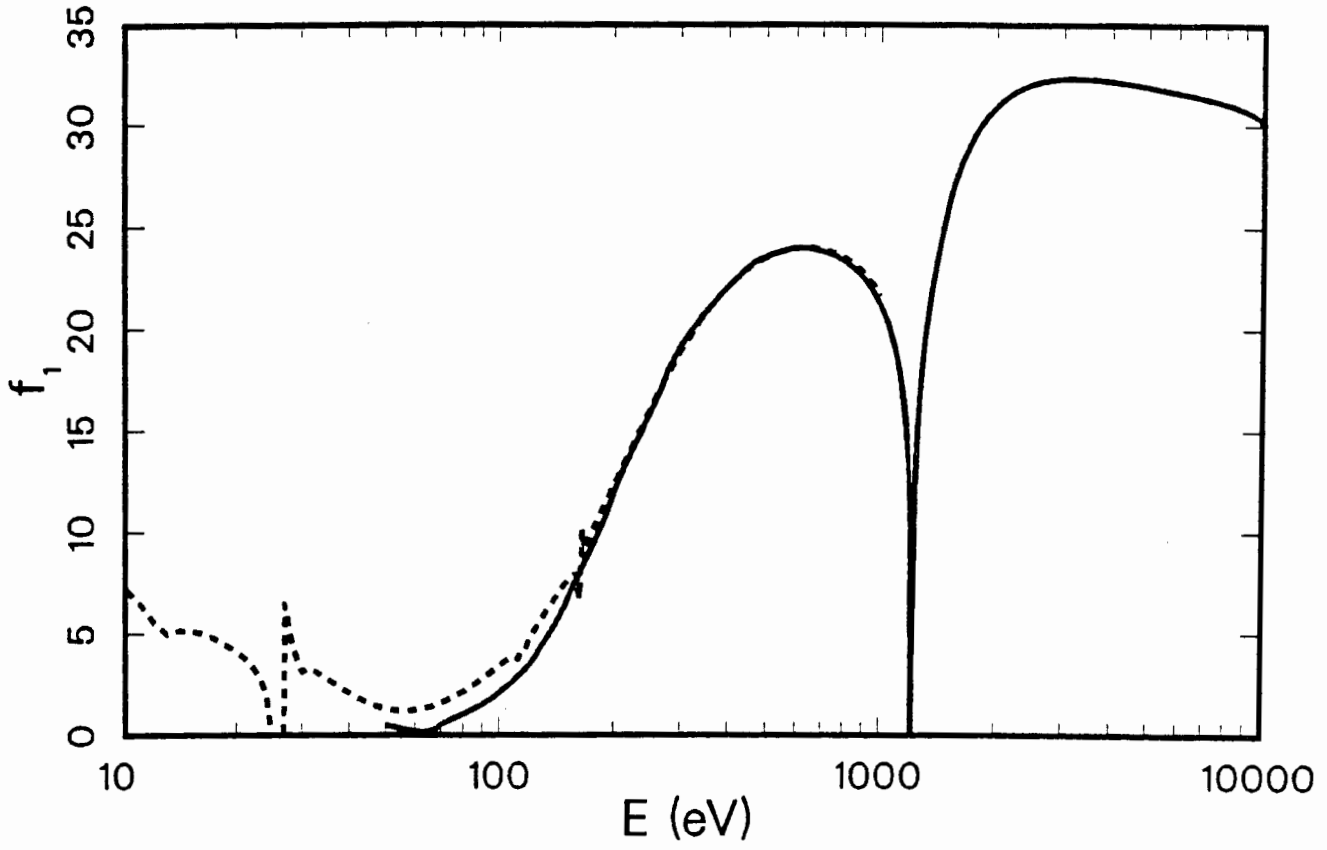


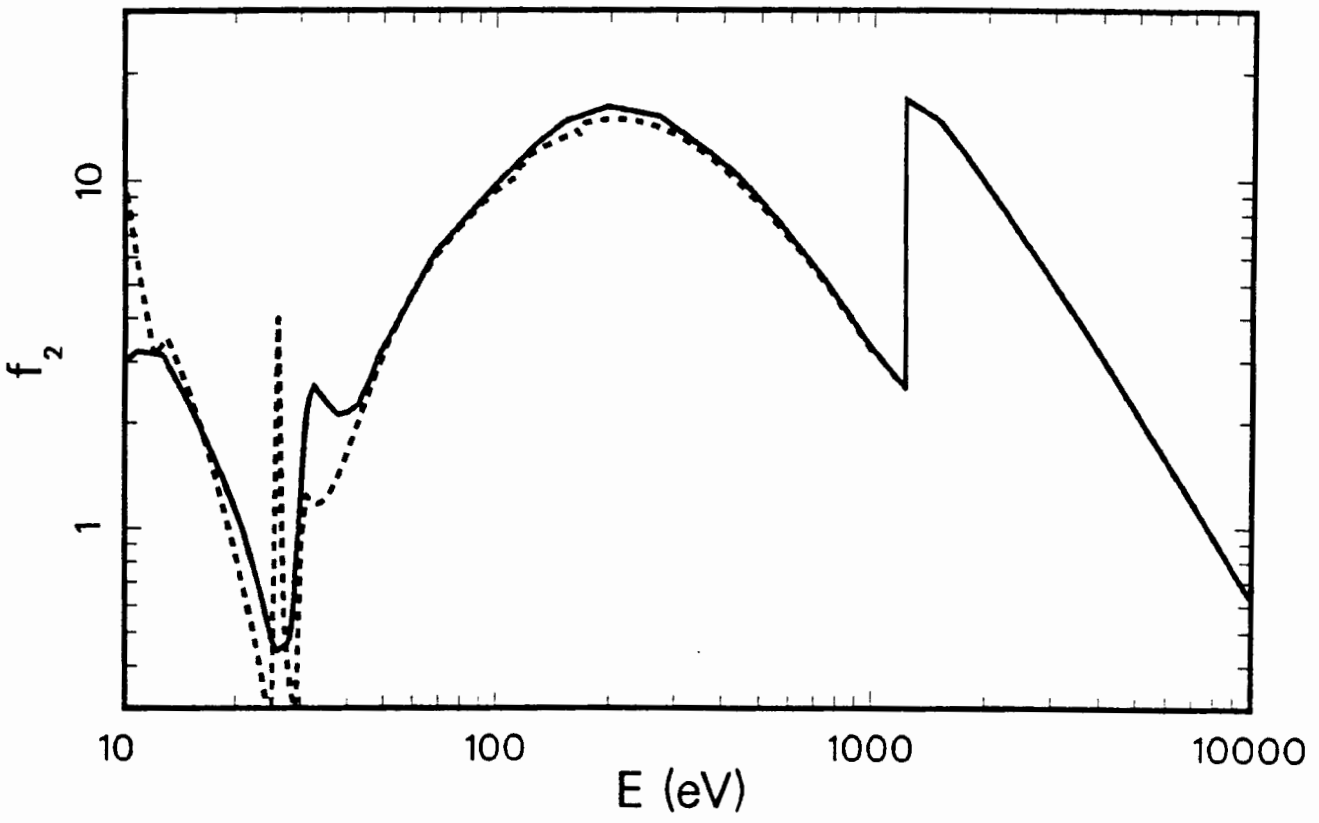

31-Ga μ Coefficients
References
○ = 43
△ = 197
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

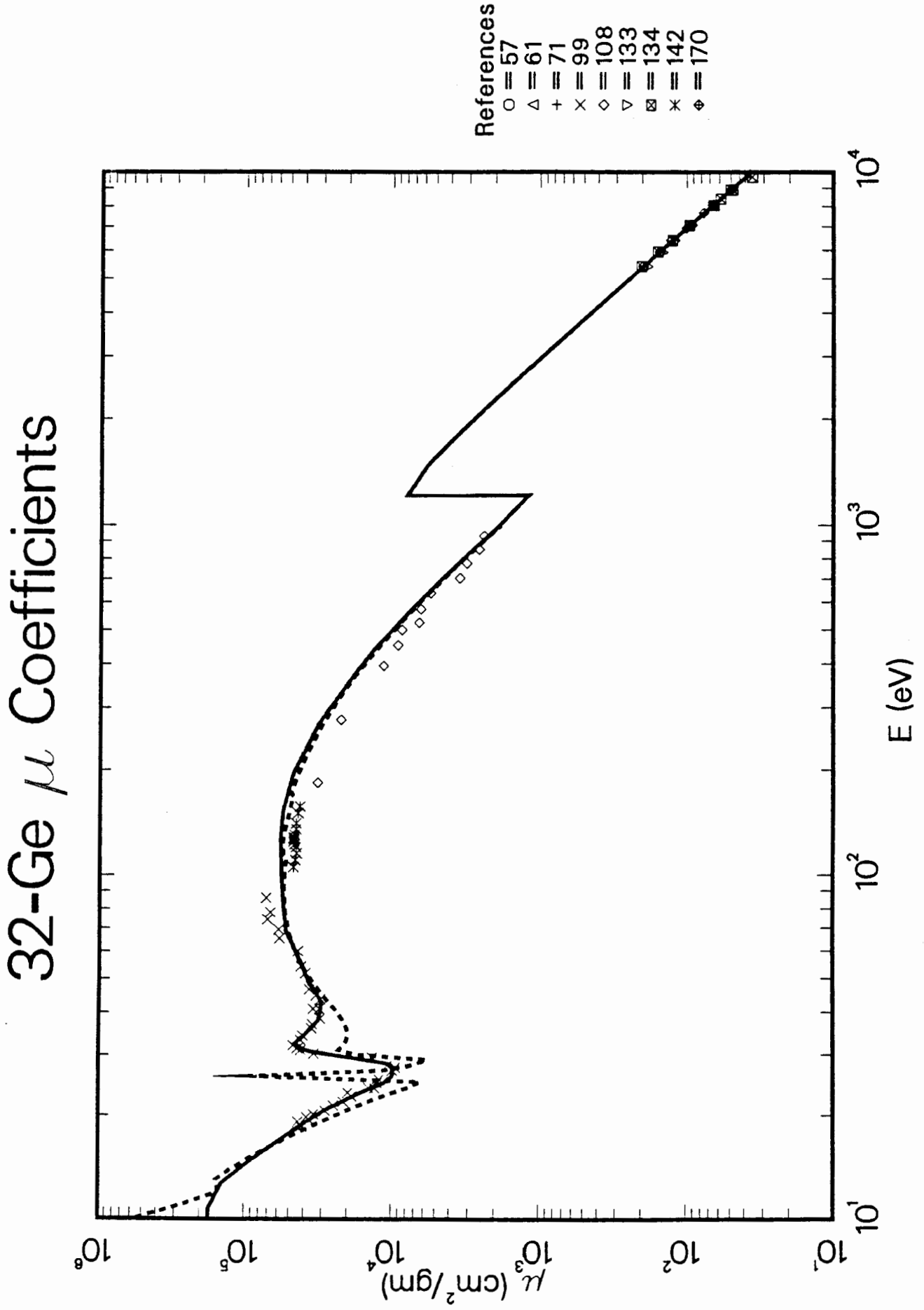
Gallium (Ga) — 31
Atomic Weight = 69.72
μ (barns/atom) = $\mu(cm^2/g) \times 115.77$
$E\mu(E) = 603.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
105.0	5.80e+4	-4.1	43
110.0	5.35e+4	-11.9	43
115.0	5.01e+4	-17.1	43
120.0	4.51e+4	-24.1	43
125.0	4.50e+4	-23.1	43
130.0	4.22e+4	-26.8	43
135.0	4.13e+4	-27.4	43
140.0	4.20e+4	-25.1	43
145.0	3.99e+4	-26.5	43
150.0	3.78e+4	-28.2	43
155.0	3.61e+4	-29.5	43
160.0	3.66e+4	-26.5	43
165.0	3.70e+4	-23.8	43
170.0	3.62e+4	-23.4	43
175.0	3.57e+4	-22.5	43
180.0	3.72e+4	-17.0	43
10.3	1.76e+5	1.0	197
10.8	1.66e+5	0.4	197
11.3	1.55e+5	1.1	197
11.8	1.42e+5	1.1	197
12.3	1.27e+5	5.2	197
12.8	1.10e+5	5.6	197
13.3	9.13e+4	4.7	197
13.8	7.12e+4	13.8	197
14.4	4.93e+4	22.1	197

Atomic Scattering Factors, f_1+if_2
32 - Germanium (Ge)






32-Ge μ Coefficients
References
○ = 57
△ = 61
+ = 71
× = 99
◇ = 108
▽ = 133
⊠ = 134
✳ = 142
✥ = 170
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Germanium (Ge) — 32

Atomic Weight = 72.59

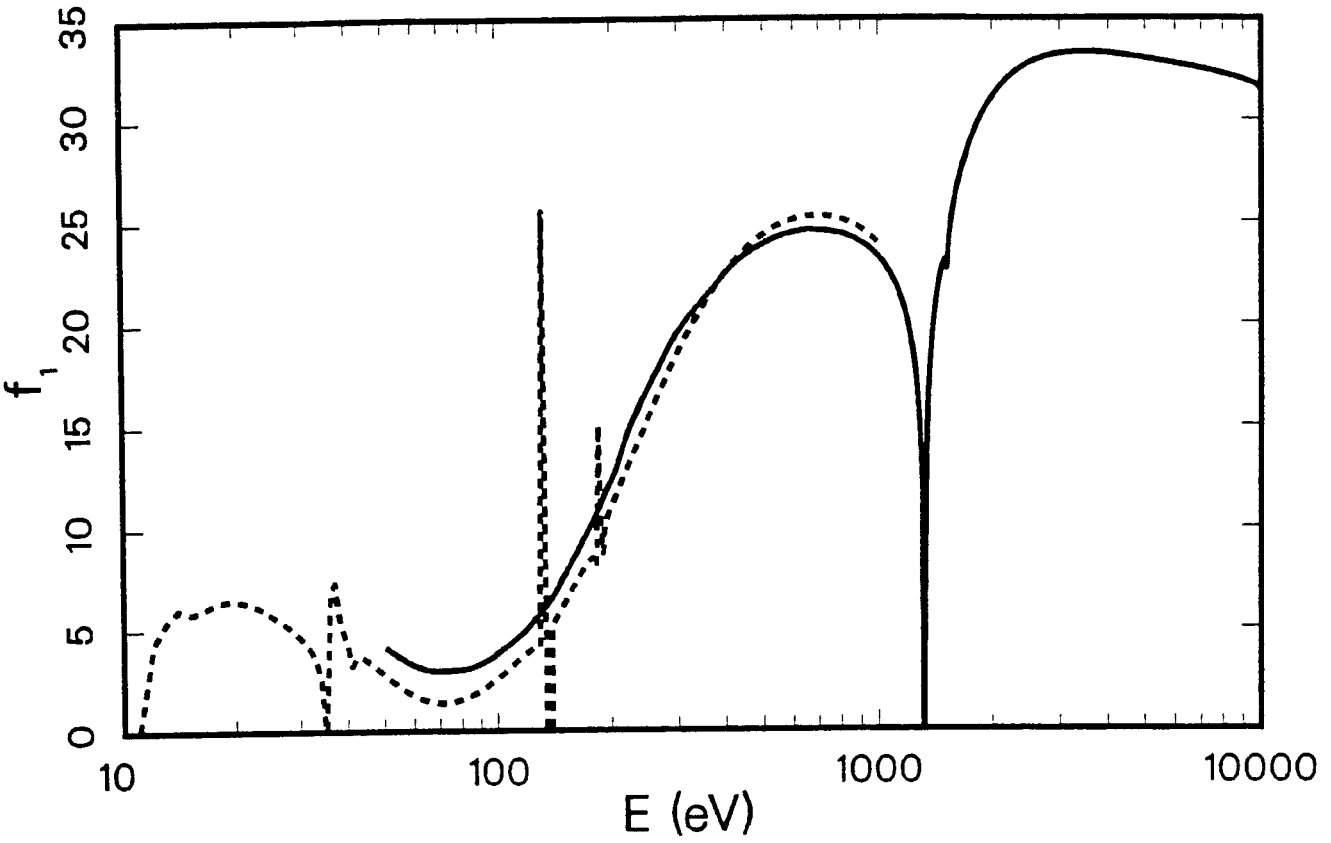
μ (barns/atom) = $\mu(cm^2/g) \times 120.54$

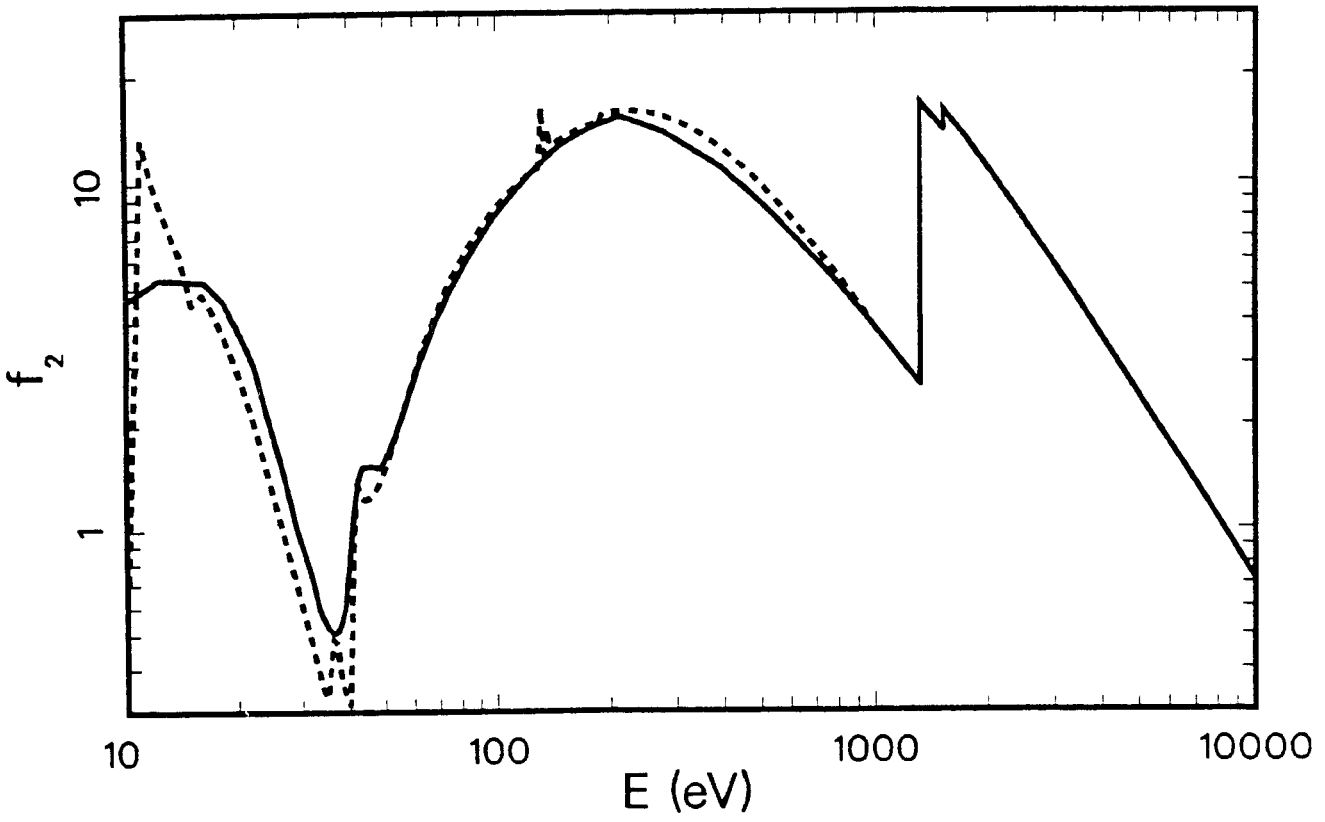
$E\mu(E) = 579.7\, f_2$ keV cm^2/g

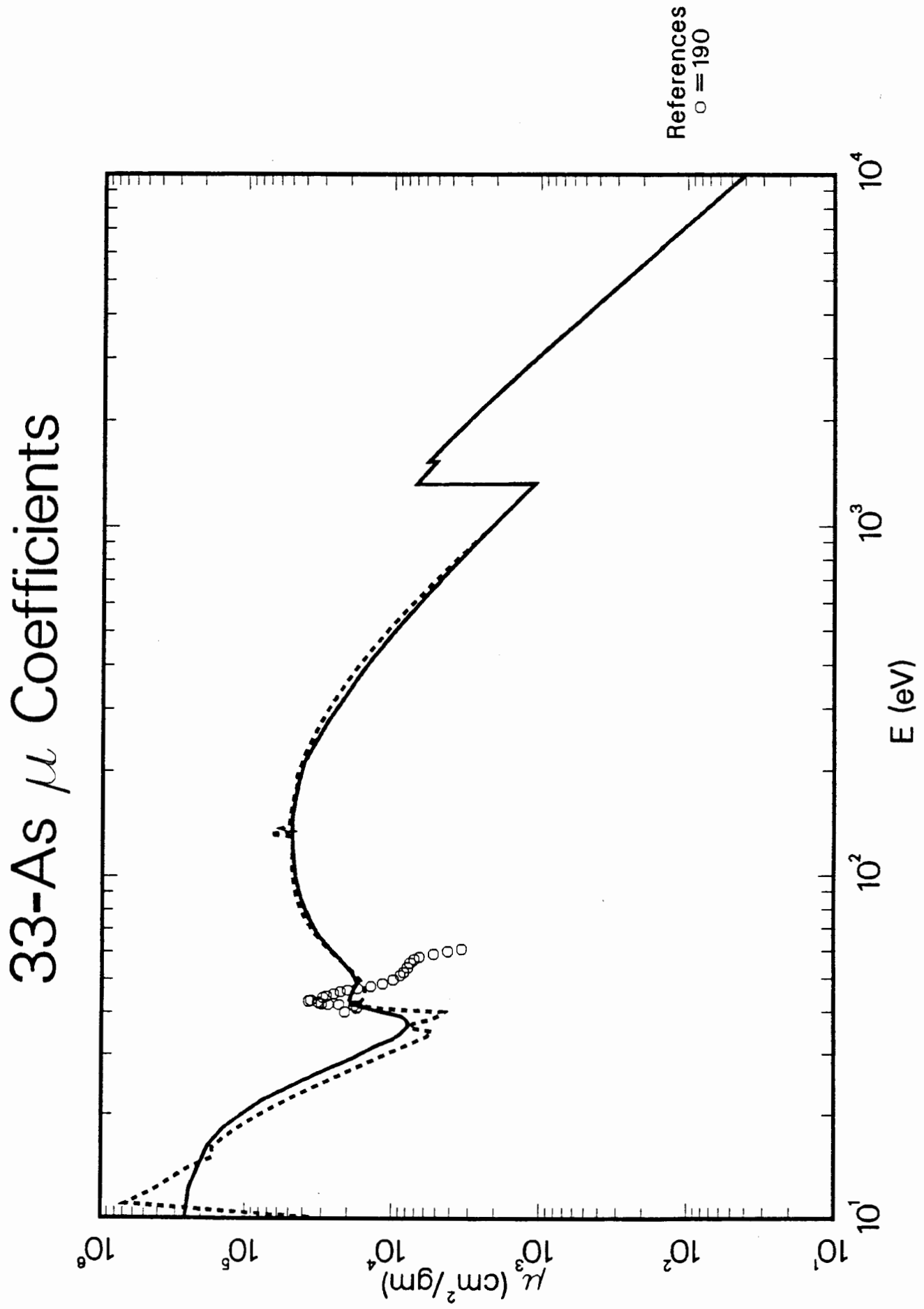
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8050.0	6.62e+1	0.0	57
8040.0	6.61e+1	-0.5	61
9880.0	3.72e+1	-0.3	71
18.5	4.10e+4	-5.1	99
19.1	4.34e+4	13.0	99
19.4	3.69e+4	1.7	99
19.7	3.82e+4	11.6	99
20.1	3.41e+4	7.5	99
20.6	2.84e+4	-1.7	99
21.3	2.50e+4	0.1	99
21.9	2.13e+4	-2.0	99
22.7	1.85e+4	1.7	99
23.2	1.97e+4	20.5	99
23.9	1.30e+4	-7.5	99
24.0	1.43e+4	4.4	99
24.8	1.25e+4	10.1	99
25.4	1.21e+4	14.9	99
27.0	9.83e+3	0.5	99
27.6	9.36e+3	-3.8	99
27.9	1.06e+4	6.0	99
29.4	1.35e+4	-28.5	99
30.2	3.41e+4	20.1	99
30.9	4.17e+4	6.7	99
31.3	4.42e+4	6.4	99
32.0	4.70e+4	6.3	99
33.1	4.21e+4	-3.0	99
34.1	4.05e+4	0.6	99
35.8	3.54e+4	-1.3	99
36.8	3.52e+4	3.9	99
38.3	3.10e+4	-2.6	99
40.8	3.13e+4	1.9	99
40.8	3.46e+4	12.5	99
43.5	3.07e+4	-1.8	99
44.7	3.31e+4	2.6	99
46.5	3.68e+4	8.3	99
51.8	3.90e+4	-0.8	99
54.2	4.17e+4	1.7	99
60.0	4.39e+4	-3.5	99
65.2	5.82e+4	16.7	99
69.2	5.90e+4	11.3	99
74.1	7.03e+4	30.5	99
78.0	6.73e+4	23.6	99
85.8	7.18e+4	29.3	99
183.3	3.28e+4	-33.8	108
277.0	2.26e+4	-27.0	108
395.3	1.15e+4	-29.7	108
452.2	9.21e+3	-26.8	108
500.3	8.63e+3	-14.2	108
524.9	6.60e+3	-27.1	108
572.8	6.41e+3	-13.9	108

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
637.4	5.49e+3	-4.7	108
705.0	3.48e+3	-23.2	108
776.2	3.11e+3	-12.7	108
851.5	2.56e+3	-9.3	108
929.7	2.38e+3	6.1	108
5415.0	1.84e+2	-6.9	133
5946.0	1.44e+2	-5.6	133
7058.0	9.22e+1	-3.2	133
8908.0	5.04e+1	0.9	133
9674.0	4.07e+1	2.9	133
9962.0	3.77e+1	3.6	133
5415.0	2.03e+2	2.8	134
5947.0	1.57e+2	2.8	134
6404.0	1.25e+2	0.3	134
7058.0	9.59e+1	0.7	134
8048.0	6.54e+1	-1.2	134
8398.0	5.87e+1	-0.2	134
8905.0	4.87e+1	-2.5	134
9672.0	3.59e+1	-9.4	134
105.0	4.74e+4	-16.9	142
110.0	4.61e+4	-19.3	142
115.0	4.52e+4	-21.1	142
120.0	4.55e+4	-20.9	142
122.0	4.67e+4	-18.8	142
124.0	4.74e+4	-17.7	142
125.0	4.70e+4	-18.5	142
126.0	4.68e+4	-18.8	142
127.0	4.72e+4	-18.0	142
128.0	4.70e+4	-18.3	142
130.0	4.63e+4	-19.2	142
135.0	4.54e+4	-20.3	142
140.0	4.54e+4	-19.8	142
150.0	4.41e+4	-21.0	142
157.0	4.28e+4	-21.6	142
5412.0	1.97e+2	-0.1	170
5947.0	1.52e+2	-0.1	170
6400.0	1.20e+2	-3.6	170
6400.0	1.28e+2	2.6	170
6925.0	1.01e+2	0.3	170
7058.0	9.62e+1	0.9	170
7060.0	9.20e+1	-3.3	170
7649.0	7.65e+1	0.3	170
8040.0	6.57e+1	-1.0	170
8041.0	6.65e+1	0.2	170
8905.0	5.01e+1	0.4	170
8910.0	4.94e+1	-0.9	170

Atomic Scattering Factors, f_1+if_2
33 - Arsenic (As)



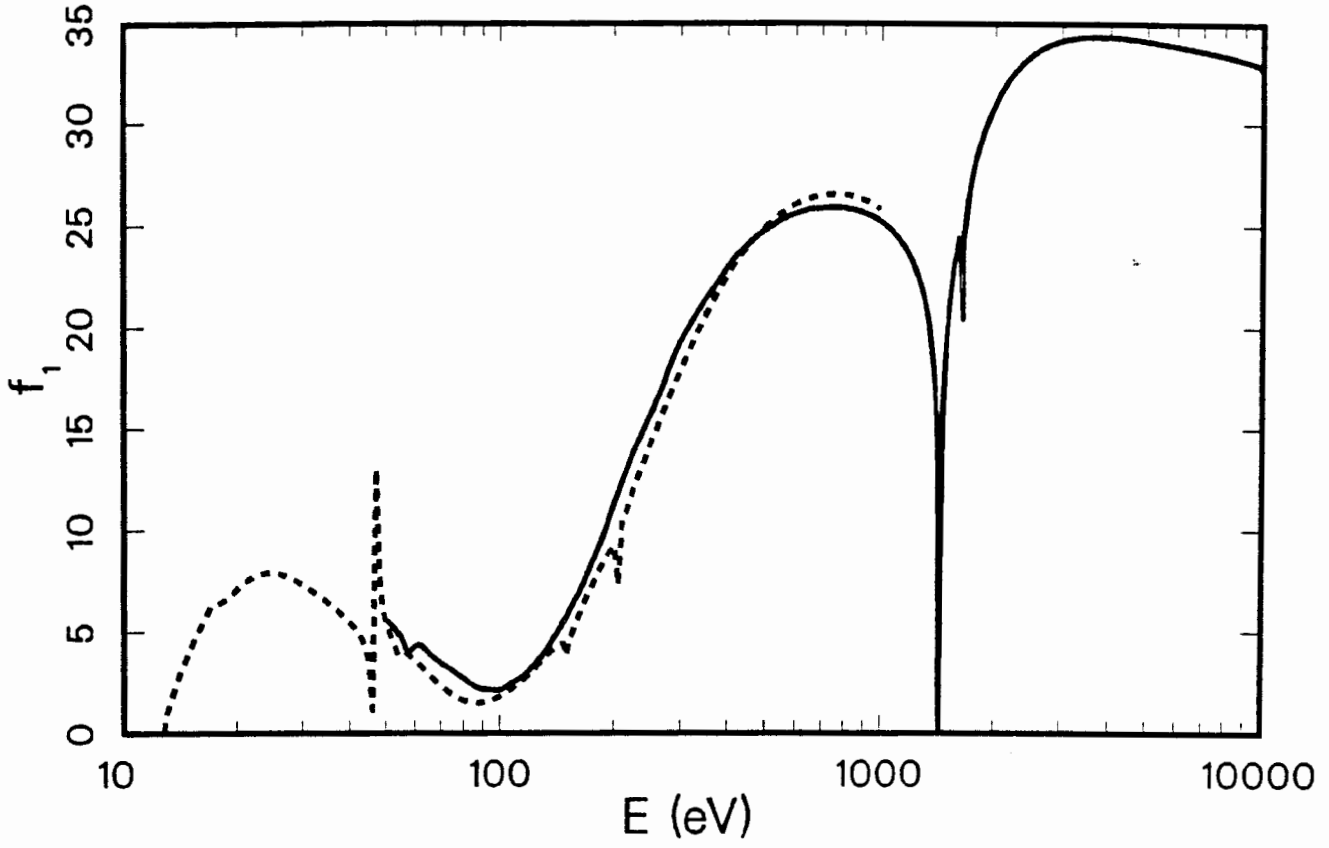


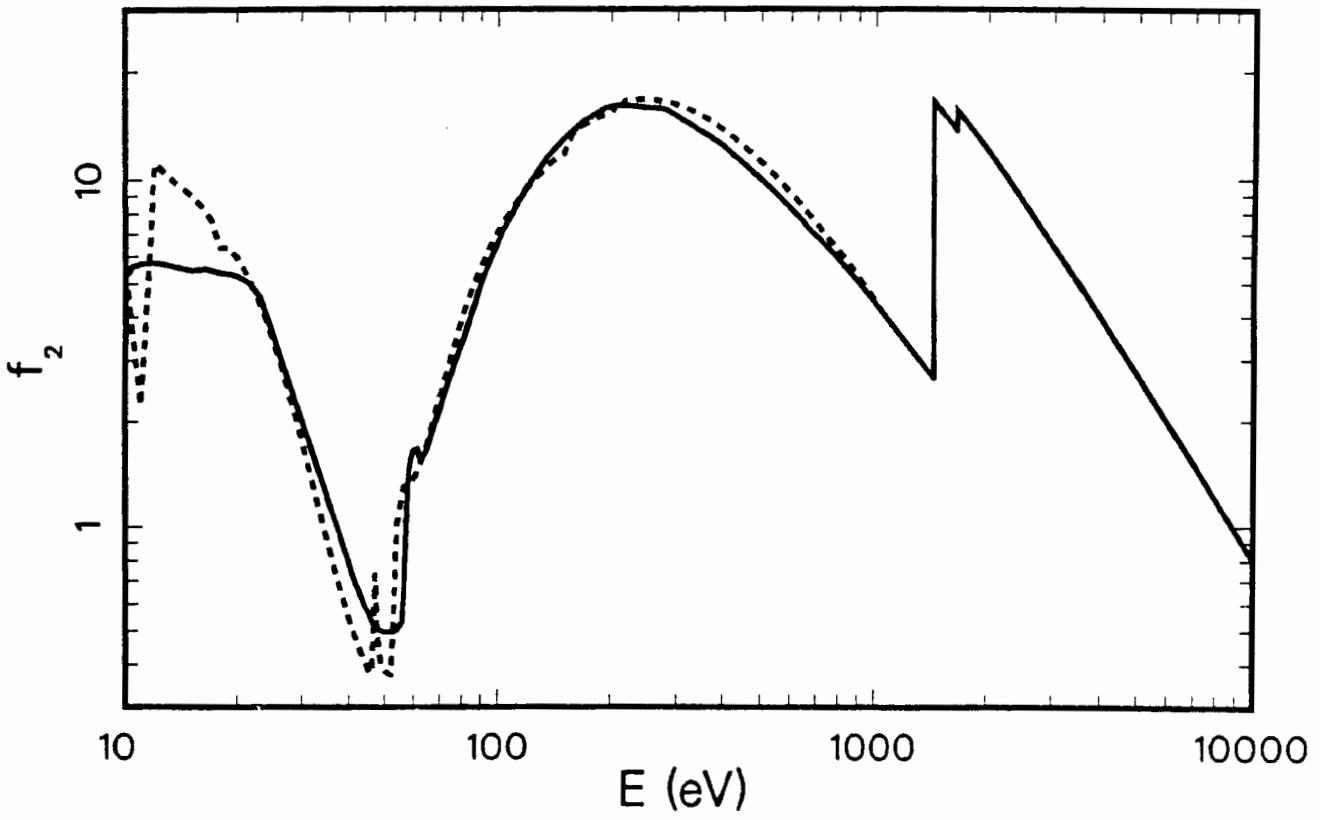

33-As μ Coefficients
References
○ = 190
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴

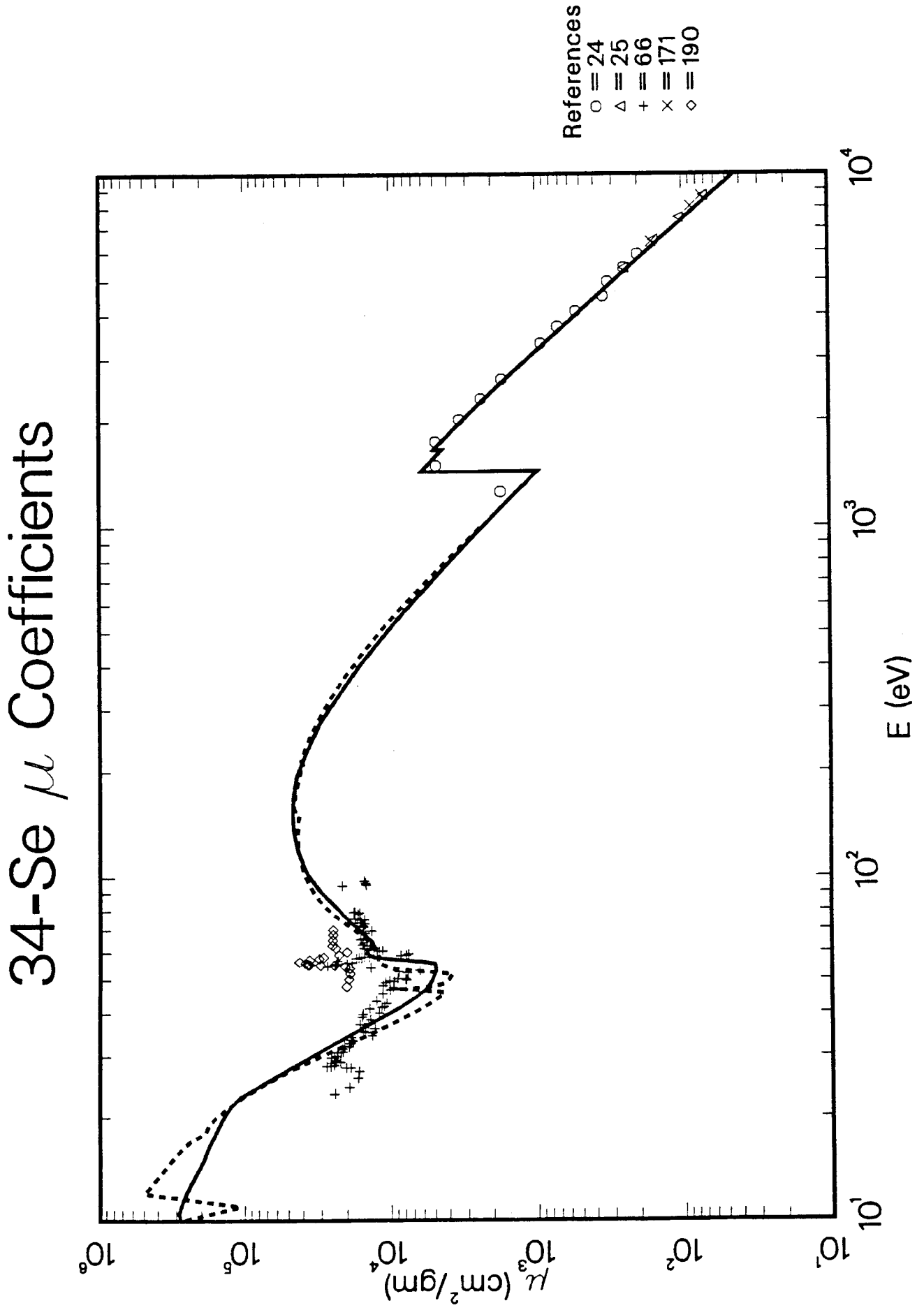
Arsenic (As) — 33
Atomic Weight = 74.92
μ (barns/atom) = $\mu(cm^2/g) \times 124.41$
$E\mu(E) = 561.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
40.1	2.11e+4	78.8	190
41.0	1.74e+4	19.2	190
41.4	1.73e+4	8.5	190
41.8	1.82e+4	4.7	190
42.1	2.30e+4	27.4	190
42.2	2.73e+4	49.9	190
42.3	3.03e+4	64.8	190
42.5	3.15e+4	68.6	190
42.8	3.22e+4	68.3	190
43.1	3.69e+4	88.2	190
43.3	3.56e+4	82.0	190
44.2	2.96e+4	54.0	190
44.6	2.80e+4	46.7	190
45.3	2.50e+4	32.5	190
45.9	2.26e+4	21.2	190
46.4	2.02e+4	9.6	190
46.9	1.72e+4	-5.0	190
47.6	1.39e+4	-21.9	190
48.4	1.15e+4	-33.9	190
49.8	9.81e+3	-45.0	190
51.3	8.79e+3	-52.4	190
52.3	8.36e+3	-56.0	190
54.0	7.86e+3	-61.3	190
55.7	7.54e+3	-65.2	190
57.0	7.10e+3	-68.9	190
57.9	6.54e+3	-72.3	190
59.0	5.24e+3	-78.7	190
60.1	4.18e+3	-83.7	190
61.0	3.36e+3	-87.4	190

Atomic Scattering Factors, f_1+if_2
34 - Selenium (Se)






34-Se μ Coefficients
References
○ = 24
△ = 25
+ = 66
× = 171
◇ = 190
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴

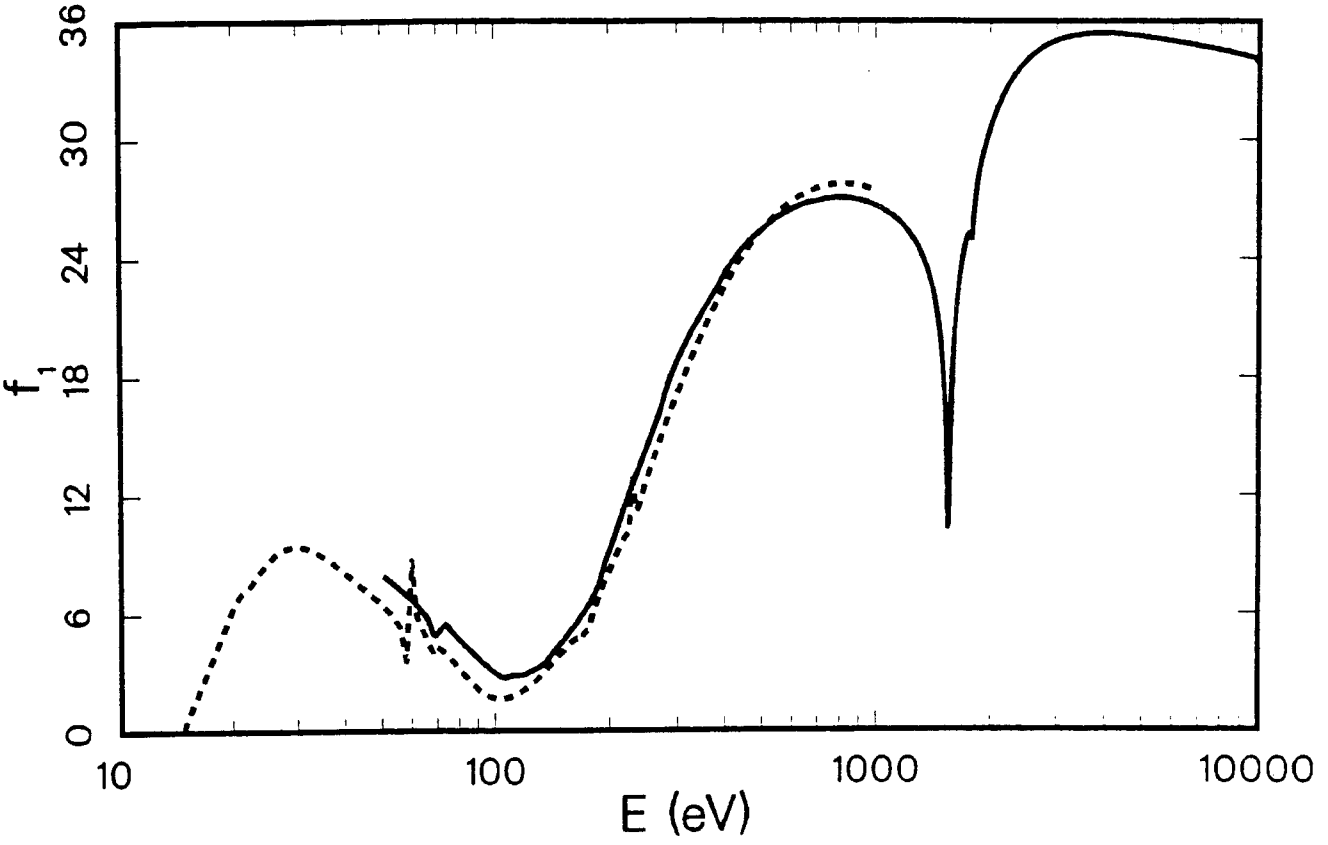
Selenium (Se) — 34
Atomic Weight = 78.96
μ (barns/atom) = $\mu(cm^2/g) \times 131.12$
$E\mu(E) = 532.9\, f_2$ keV cm^2/g

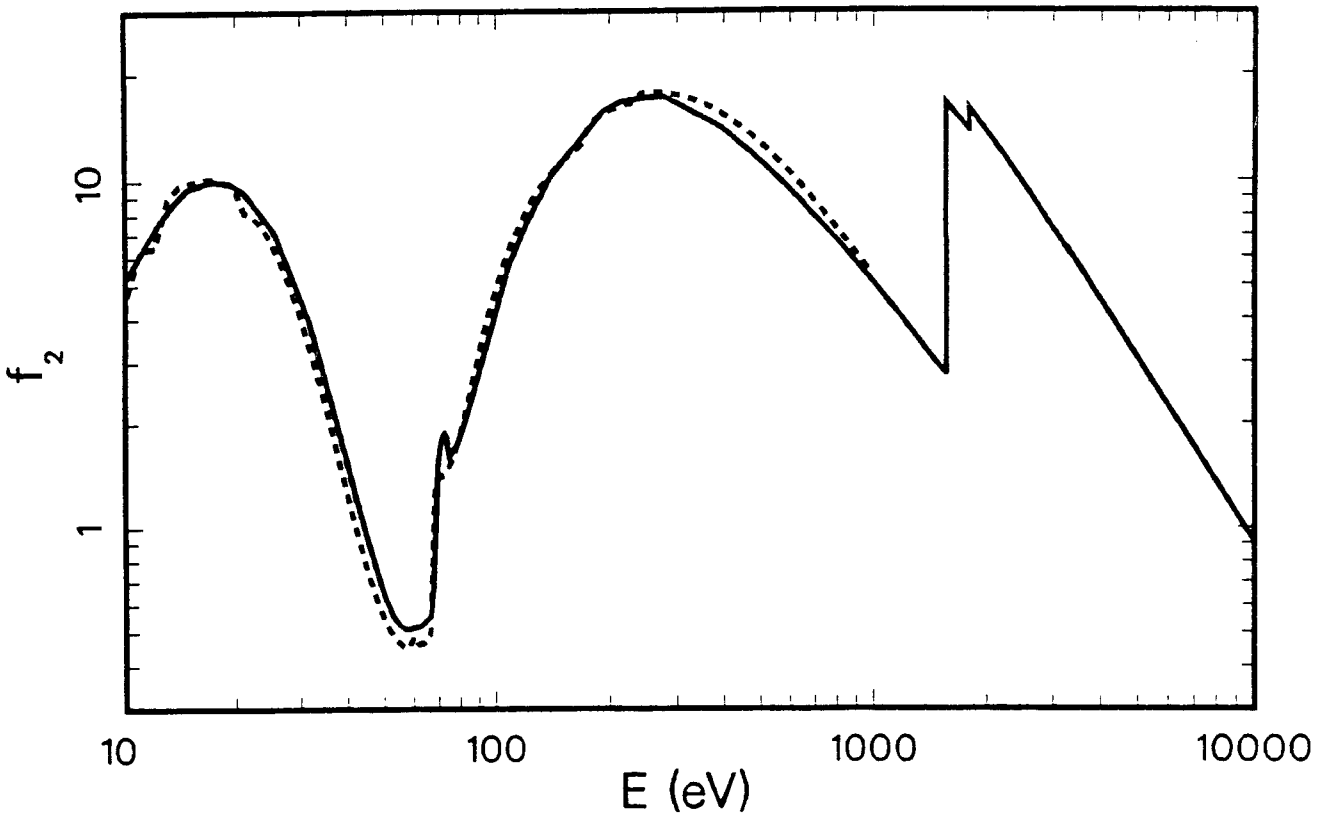
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1256.0	1.74e+3	29.0	24
1490.0	4.86e+3	-13.1	24
1744.0	4.89e+3	10.3	24
2019.0	3.34e+3	6.9	24
2312.0	2.37e+3	6.1	24
2627.0	1.70e+3	5.9	24
3320.0	9.23e+2	6.1	24
3698.0	7.10e+2	8.8	24
4097.0	5.34e+2	7.8	24
4517.0	3.46e+2	-8.9	24
4960.0	3.22e+2	9.1	24
5423.0	2.49e+2	7.5	24
5907.0	2.01e+2	9.5	24
5423.0	2.49e+2	7.6	25
6479.0	1.57e+2	10.3	25
7487.0	1.05e+2	9.6	25
8650.0	7.08e+1	10.5	25
23.4	2.43e+4	-75.1	66
24.4	1.94e+4	-76.5	66
26.0	1.68e+4	-73.4	66
27.2	1.66e+4	-68.5	66
27.8	2.04e+4	-57.6	66
27.8	1.90e+4	-60.5	66
28.1	2.60e+4	-43.5	66
28.1	2.77e+4	-39.9	66
28.3	2.46e+4	-45.0	66
28.7	2.58e+4	-38.8	66
28.9	2.23e+4	-45.6	66
29.0	2.39e+4	-40.9	66
29.3	2.45e+4	-36.9	66
29.8	2.45e+4	-32.3	66
29.8	2.58e+4	-28.7	66
30.1	2.35e+4	-32.3	66
30.8	2.35e+4	-25.7	66
30.9	2.21e+4	-29.0	66
30.9	2.15e+4	-31.2	66
31.6	2.15e+4	-24.3	66
32.0	1.96e+4	-27.2	66
32.1	2.09e+4	-21.4	66
32.7	1.90e+4	-22.7	66
33.3	1.83e+4	-19.5	66
33.5	1.90e+4	-14.3	66
34.1	1.87e+4	-9.2	66
34.5	1.35e+4	-31.1	66
35.2	1.51e+4	-16.0	66
35.5	1.56e+4	-10.1	66
36.2	1.30e+4	-18.5	66
37.1	1.64e+4	14.7	66
37.5	1.44e+4	5.0	66
38.4	1.39e+4	12.6	66

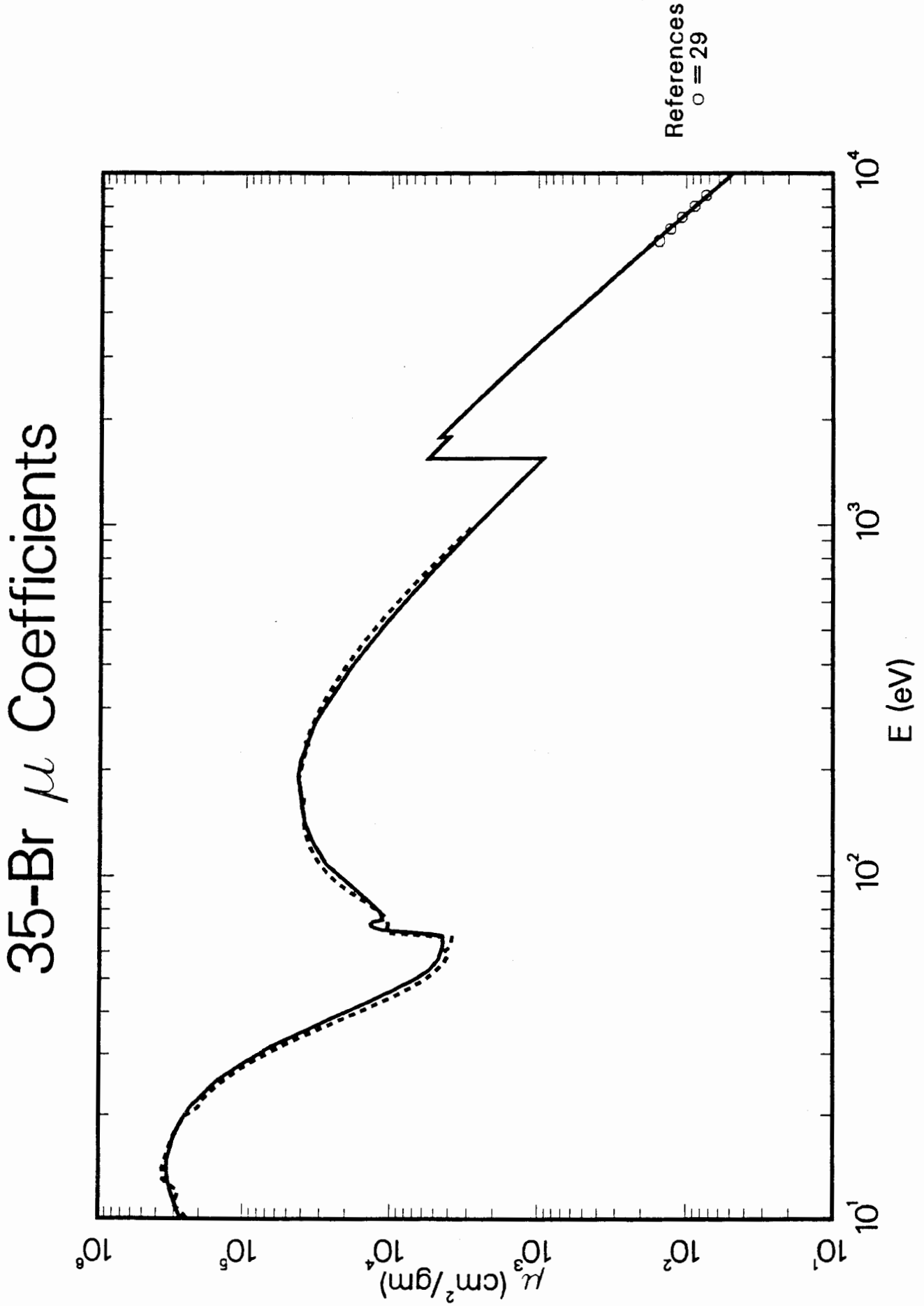
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
39.1	1.59e+4	39.0	66
39.8	1.56e+4	47.7	66
40.1	1.20e+4	17.5	66
41.3	1.40e+4	55.9	66
41.7	1.15e+4	33.2	66
41.9	1.11e+4	30.3	66
42.8	1.07e+4	35.6	66
43.5	1.26e+4	68.6	66
45.6	1.14e+4	79.2	66
46.7	1.01e+4	71.9	66
47.6	9.66e+3	70.2	66
48.1	1.13e+4	102.7	66
49.1	1.09e+4	100.6	66
49.6	9.55e+3	78.6	66
49.8	1.02e+4	92.0	66
50.1	7.84e+3	48.6	66
50.4	8.01e+3	52.5	66
50.5	9.00e+3	71.9	66
52.6	7.70e+3	53.0	66
52.9	8.80e+3	75.2	66
53.4	6.42e+3	28.4	66
54.4	1.38e+4	176.2	66
54.9	2.74e+4	443.6	66
55.2	2.43e+4	381.2	66
55.6	2.38e+4	368.6	66
56.0	2.01e+4	278.1	66
56.1	1.86e+4	243.7	66
56.8	2.31e+4	206.1	66
57.7	1.74e+4	46.6	66
58.0	1.66e+4	28.6	66
58.1	1.59e+4	22.0	66
58.3	1.53e+4	14.6	66
58.4	1.41e+4	4.4	66
58.5	1.32e+4	-2.9	66
58.5	1.25e+4	-8.4	66
58.8	8.58e+3	-38.4	66
59.0	7.88e+3	-44.2	66
59.5	7.64e+3	-47.6	66
60.7	1.21e+4	-16.8	66
60.9	1.14e+4	-21.0	66
61.1	1.40e+4	-3.0	66
61.9	1.53e+4	12.5	66
62.9	1.39e+4	4.5	66
63.2	1.47e+4	9.9	66
63.4	1.57e+4	17.8	66
64.4	1.55e+4	15.6	66
65.6	1.62e+4	15.6	66
66.2	1.55e+4	8.3	66
68.7	1.49e+4	-5.3	66
69.6	1.36e+4	-16.7	66

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
71.5	1.54e+4	-12.1	66
72.2	1.56e+4	-13.3	66
73.2	1.51e+4	-18.5	66
73.7	1.71e+4	-9.0	66
73.9	1.60e+4	-15.2	66
75.1	1.63e+4	-16.6	66
75.4	1.52e+4	-23.0	66
76.0	1.77e+4	-11.5	66
78.3	1.68e+4	-21.3	66
79.0	1.65e+4	-24.4	66
79.2	1.80e+4	-17.7	66
79.6	1.77e+4	-20.2	66
94.6	2.15e+4	-33.4	66
95.2	1.48e+4	-54.7	66
96.5	1.48e+4	-55.6	66
97.8	1.52e+4	-55.4	66
6400.0	1.61e+2	9.7	171
8041.0	8.66e+1	10.4	171
8631.0	7.27e+1	12.8	171
47.8	2.02e+4	258.7	190
50.2	1.95e+4	269.3	190
52.2	1.91e+4	276.6	190
54.0	1.92e+4	286.5	190
54.7	2.07e+4	312.7	190
55.1	2.45e+4	384.9	190
55.2	3.05e+4	504.4	190
55.4	3.60e+4	611.4	190
55.5	3.72e+4	633.3	190
55.9	3.85e+4	632.5	190
56.3	4.23e+4	621.9	190
56.4	4.19e+4	581.0	190
57.1	3.60e+4	309.3	190
57.6	3.10e+4	174.9	190
58.1	2.90e+4	122.5	190
59.0	2.28e+4	61.3	190
60.2	2.00e+4	37.4	190
61.9	2.39e+4	76.1	190
63.1	2.53e+4	89.4	190
65.2	2.51e+4	82.1	190
67.9	2.49e+4	62.7	190
70.0	2.50e+4	50.7	190

Atomic Scattering Factors, f_1+if_2
35 - Bromine (Br)






35-Br μ Coefficients
References
○ = 29
μ (cm²/gm)
E (eV)
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶

Bromine (Br) — 35

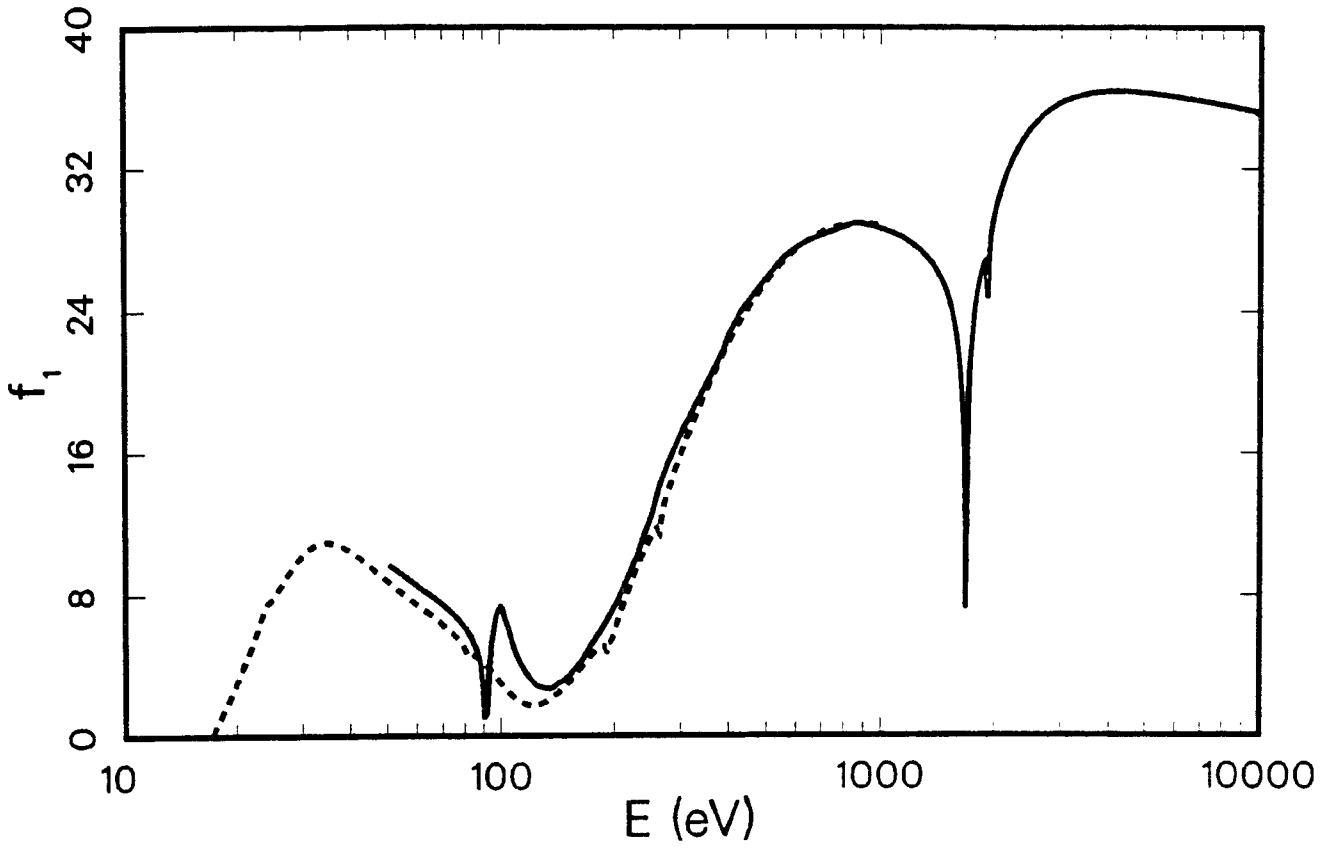
Atomic Weight = 79.90

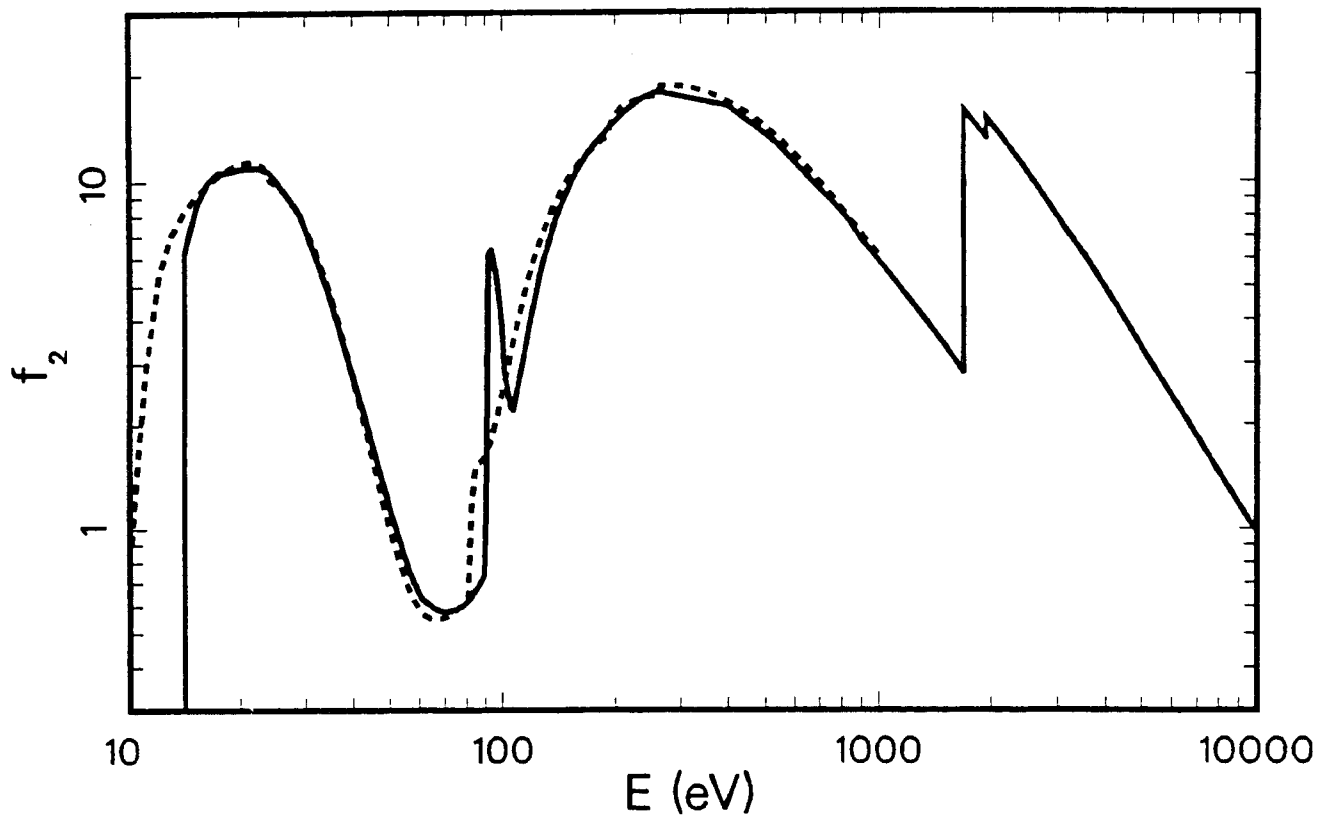
μ (barns/atom) = $\mu(cm^2/g) \times 132.69$

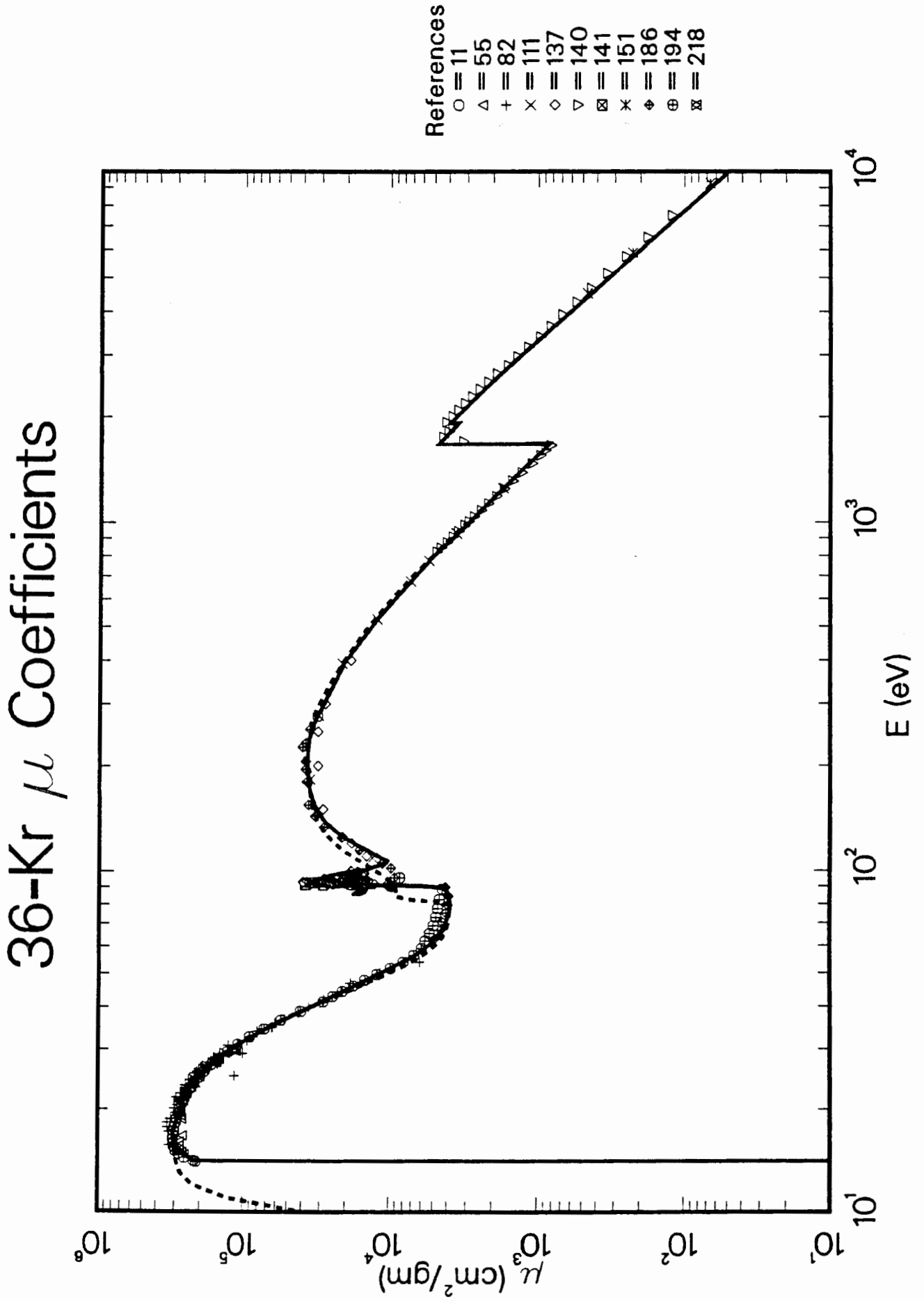
$E\mu(E) = 526.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6403.0	1.53e+2	-5.9	29
6930.0	1.28e+2	-2.3	29
7477.0	1.07e+2	0.8	29
8047.0	8.75e+1	0.7	29
8638.0	7.32e+1	2.4	29

Atomic Scattering Factors, f_1+if_2
36 - Krypton (Kr)






36-Kr μ Coefficients
References
○ = 11
△ = 55
+ = 82
× = 111
◇ = 137
▽ = 140
⊠ = 141
✳ = 151
✥ = 186
⊕ = 194
⊠ = 218
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10⁷
10⁸

Krypton (Kr) — 36
Atomic Weight = 83.80
μ (barns/atom) = $\mu(cm^2/g) \times 139.16$
$E\mu(E) = 502.1\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	3.18e+4	-0.2	11
14.7	2.57e+5	0.9	55
14.9	2.69e+5	1.9	55
15.2	2.77e+5	-0.2	55
15.6	2.82e+5	-2.9	55
16.0	2.80e+5	-6.3	55
16.7	2.66e+5	-13.4	55
18.7	2.68e+5	-6.7	55
19.1	2.73e+5	-3.7	55
19.6	2.76e+5	-0.6	55
20.1	2.72e+5	0.0	55
20.1	2.72e+5	0.1	55
21.1	2.62e+5	0.4	55
22.2	2.48e+5	0.0	55
23.1	2.35e+5	0.2	55
24.1	2.19e+5	-0.4	55
15.7	3.25e+5	11.3	82
17.2	3.27e+5	6.5	82
17.7	3.36e+5	11.4	82
18.3	3.35e+5	14.5	82
18.7	3.18e+5	10.7	82
19.2	2.80e+5	-0.6	82
19.5	2.95e+5	5.8	82
20.1	3.00e+5	10.5	82
20.6	2.85e+5	7.1	82
21.3	2.55e+5	-1.0	82
21.7	2.91e+5	14.8	82
22.3	2.72e+5	10.3	82
23.1	2.50e+5	6.5	82
23.2	2.12e+5	-9.0	82
23.3	2.36e+5	2.0	82
23.6	2.53e+5	11.3	82
24.4	2.31e+5	8.0	82
25.1	1.15e+5	-42.6	82
25.5	2.17e+5	13.0	82
25.8	2.08e+5	11.5	82
27.2	1.51e+5	-8.1	82
28.6	1.46e+5	1.6	82
29.2	9.97e+4	-26.2	82
30.8	1.27e+5	16.1	82
31.8	9.32e+4	-3.2	82
32.6	8.51e+4	-2.3	82
33.9	7.96e+4	6.7	82
34.4	7.45e+4	6.1	82
34.8	6.32e+4	-5.0	82
34.9	6.28e+4	-4.3	82
35.7	6.09e+4	3.3	82
36.7	5.20e+4	0.4	82
38.3	4.20e+4	-0.8	82
39.8	3.59e+4	1.6	82

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
41.1	3.00e+4	-1.1	82
41.9	2.82e+4	1.9	82
44.2	2.16e+4	1.6	82
46.8	1.86e+4	16.5	82
50.1	1.15e+4	0.4	82
53.9	6.19e+3	-24.4	82
108.9	1.30e+4	14.3	111
147.2	3.24e+4	4.3	111
182.6	3.58e+4	-2.1	111
278.0	3.14e+4	-1.0	111
391.4	2.15e+4	3.0	111
526.0	1.23e+4	0.5	111
676.8	7.27e+3	1.1	111
774.9	5.45e+3	0.3	111
928.9	3.55e+3	2.3	111
1254.0	1.71e+3	0.2	111
89.8	9.56e+3	124.3	137
90.1	9.82e+3	88.9	137
90.3	1.02e+4	71.4	137
90.5	9.72e+3	43.8	137
90.9	9.88e+3	12.4	137
91.1	1.04e+4	-62.5	137
91.3	1.26e+4	-58.0	137
91.4	1.72e+4	-44.8	137
91.4	2.46e+4	-20.8	137
91.5	3.50e+4	8.4	137
91.6	2.66e+4	-20.6	137
91.7	1.78e+4	-48.8	137
91.8	2.33e+4	-35.5	137
91.8	2.04e+4	-43.5	137
91.9	2.52e+4	-30.7	137
92.0	2.40e+4	-33.5	137
92.1	2.43e+4	-32.3	137
92.4	2.37e+4	-32.7	137
92.6	2.57e+4	-26.3	137
92.7	2.87e+4	-17.2	137
92.8	3.95e+4	14.7	137
93.0	2.75e+4	-19.0	137
93.1	3.25e+4	-4.0	137
93.2	3.09e+4	-8.1	137
93.4	3.06e+4	-7.7	137
93.8	2.82e+4	-13.0	137
94.0	2.91e+4	-9.1	137
94.3	2.77e+4	-12.0	137
94.5	2.82e+4	-9.5	137
94.7	2.82e+4	-8.2	137
94.8	2.87e+4	-6.1	137
94.9	2.81e+4	-7.4	137
95.1	2.61e+4	-13.2	137
95.2	2.55e+4	-14.7	137

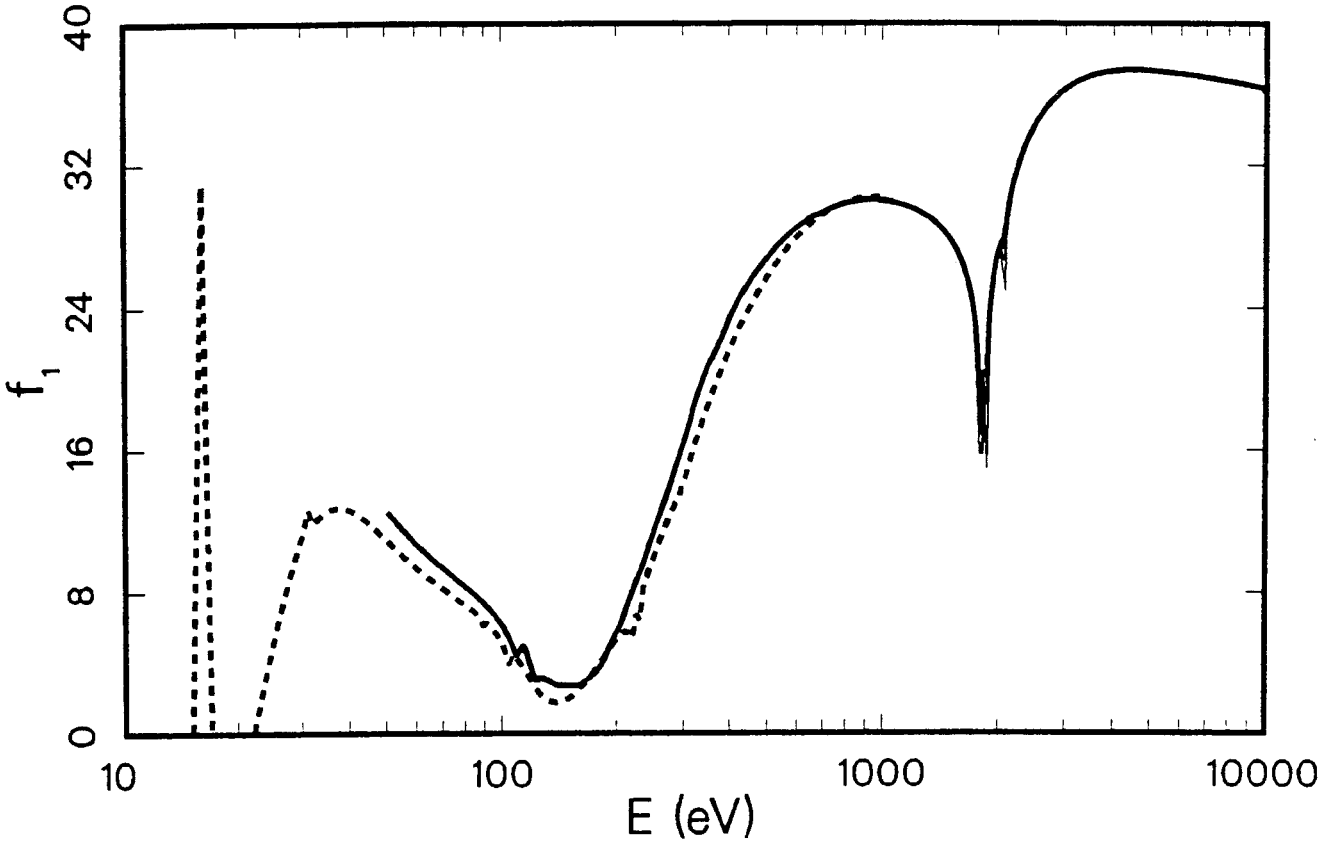
E(eV)	μ(cm^2/g)	% Error	Ref.
95.5	2.28e+4	-22.4	137
95.5	2.28e+4	-22.2	137
95.7	2.41e+4	-17.0	137
95.9	2.35e+4	-17.9	137
96.0	2.29e+4	-19.8	137
96.2	2.31e+4	-18.1	137
96.7	1.74e+4	-35.8	137
96.8	1.77e+4	-33.6	137
97.0	1.67e+4	-35.8	137
97.4	1.56e+4	-37.1	137
97.8	1.49e+4	-36.6	137
98.0	1.52e+4	-33.9	137
98.3	1.48e+4	-33.0	137
98.6	1.64e+4	-23.0	137
98.9	1.62e+4	-21.1	137
99.3	1.67e+4	-14.7	137
99.5	1.67e+4	-12.6	137
99.8	1.83e+4	-0.6	137
100.0	1.85e+4	5.9	137
105.0	1.11e+4	3.6	137
110.0	1.44e+4	20.6	137
115.0	1.60e+4	9.4	137
120.0	1.83e+4	3.2	137
125.0	2.13e+4	1.4	137
150.0	2.91e+4	-8.9	137
200.0	3.16e+4	-14.8	137
250.0	3.16e+4	-10.4	137
300.0	2.80e+4	-3.0	137
400.0	1.87e+4	-7.7	137
825.0	4.79e+3	1.5	140
847.0	4.48e+3	1.2	140
877.0	4.08e+3	1.6	140
910.0	3.72e+3	2.1	140
944.0	3.41e+3	2.0	140
982.0	3.08e+3	1.2	140
1006.0	2.89e+3	0.5	140
1040.0	2.66e+3	0.0	140
1085.0	2.38e+3	-1.1	140
1135.0	2.13e+3	-1.6	140
1190.0	1.88e+3	-2.6	140
1250.0	1.67e+3	-3.1	140
1316.0	1.47e+3	-3.5	140
1390.0	1.27e+3	-4.5	140
1473.0	1.09e+3	-5.6	140
1556.0	9.56e+2	-5.3	140
1607.0	8.84e+2	-5.0	140
1660.0	8.12e+2	-26.9	140
1706.0	3.17e+3	15.5	140
1755.0	4.33e+3	2.7	140
1819.0	4.00e+3	2.8	140
1889.0	3.74e+3	4.9	140
1933.0	4.14e+3	13.4	140
2012.0	3.75e+3	7.1	140
2097.0	3.41e+3	7.4	140
2190.0	3.08e+3	7.6	140

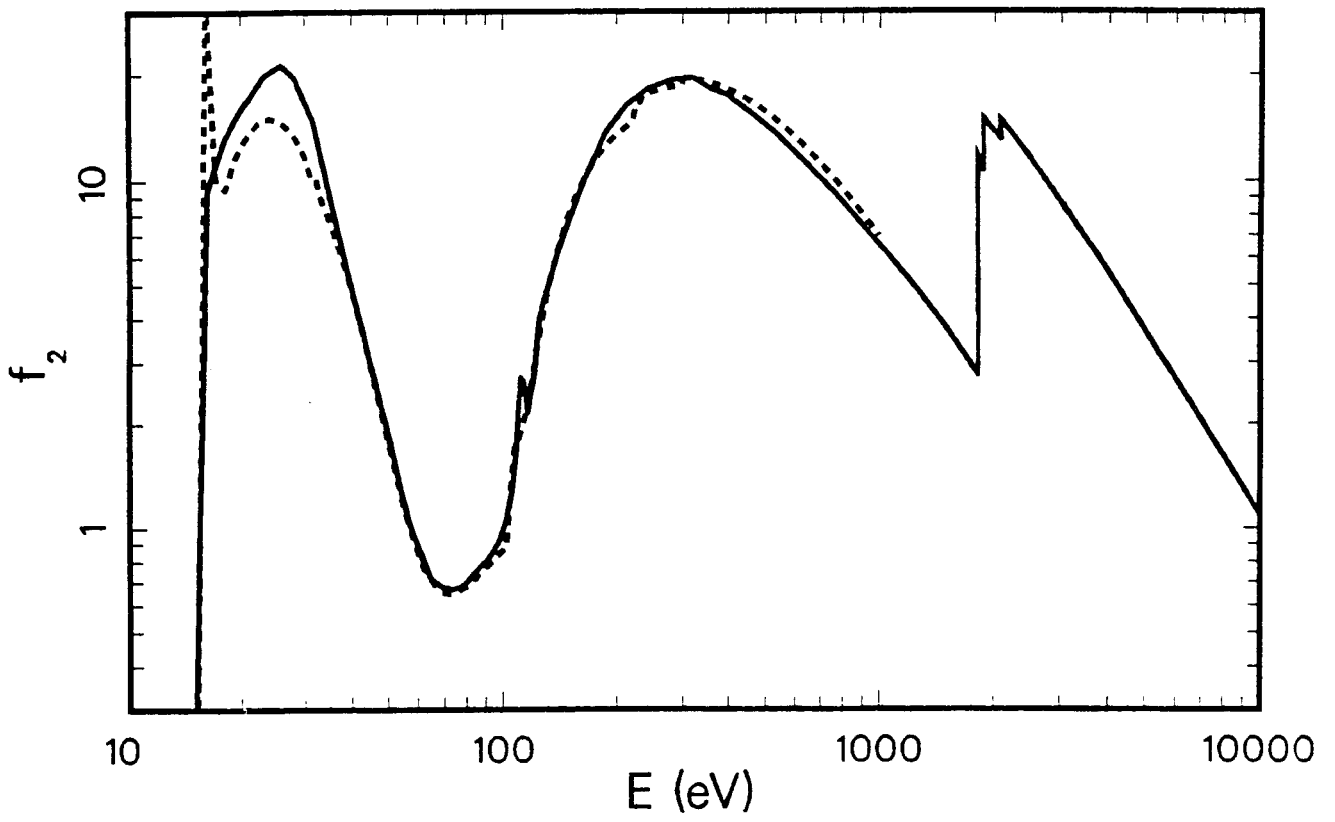
E(eV)	μ(cm^2/g)	% Error	Ref.
2291.0	2.75e+3	7.2	140
2402.0	2.44e+3	6.7	140
2525.0	2.14e+3	6.2	140
2660.0	1.86e+3	5.3	140
2812.0	1.58e+3	3.1	140
2981.0	1.36e+3	3.0	140
3172.0	1.15e+3	2.5	140
3389.0	9.63e+2	2.2	140
3638.0	8.12e+2	4.1	140
3927.0	6.82e+2	7.2	140
4266.0	5.48e+2	7.7	140
4668.0	4.35e+2	- 9.1	140
5154.0	3.35e+2	10.2	140
5754.0	2.49e+2	10.6	140
6511.0	1.77e+2	10.6	140
7497.0	1.21e+2	11.4	140
88.0	1.68e+4	312.5	141
88.3	1.64e+4	300.8	141
89.1	1.57e+4	279.7	141
90.0	1.54e+4	217.5	141
90.8	1.52e+4	84.4	141
91.1	2.88e+4	3.9	141
91.3	3.80e+4	27.2	141
91.4	1.83e+4	-41.0	141
91.6	1.51e+4	-54.9	141
92.0	1.41e+4	-61.0	141
92.3	1.57e+4	-55.7	141
92.4	2.10e+4	-40.3	141
92.5	3.37e+4	-3.7	141
92.6	3.54e+4	1.7	141
92.6	3.34e+4	-4.1	141
92.7	2.73e+4	-21.2	141
92.8	1.92e+4	-44.3	141
92.9	1.48e+4	-56.8	141
93.2	1.78e+4	-46.9	141
93.3	1.60e+4	-52.1	141
93.5	1.65e+4	-49.9	141
93.6	1.65e+4	-49.7	141
93.8	1.77e+4	-45.5	141
93.8	2.04e+4	-37.2	141
93.9	2.27e+4	-29.5	141
94.1	1.75e+4	-45.0	141
94.2	1.66e+4	-47.6	141
94.4	1.89e+4	-39.7	141
94.5	1.74e+4	-44.0	141
94.7	1.80e+4	-41.6	141
94.9	1.78e+4	-41.5	141
4508.0	4.66e+2	6.3	151
5895.0	2.27e+2	8.0	151
9243.0	6.60e+1	8.6	151
62.5	4.97e+3	0.6	186
66.8	4.44e+3	1.0	186
70.6	4.39e+3	6.8	186
74.9	4.12e+3	4.7	186
79.4	4.01e+3	4.0	186

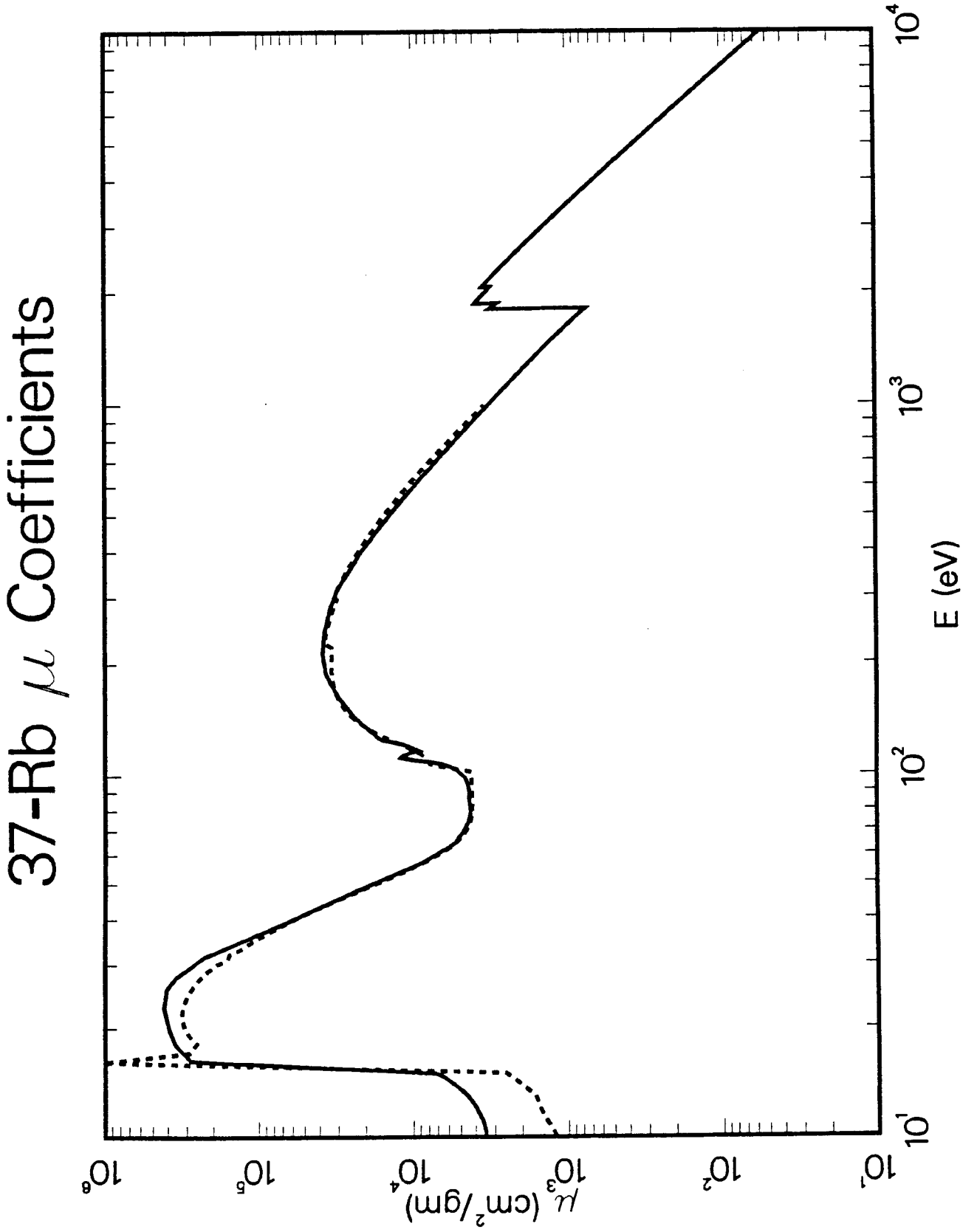
E(eV)	μ(cm^2/g)	% Error	Ref.
84.3	3.96e+3	0.3	186
89.6	4.15e+3	-0.5	186
95.4	9.23e+3	-68.7	186
101.6	9.70e+3	-29.0	186
105.7	1.10e+4	7.3	186
114.5	1.62e+4	12.6	186
124.2	2.15e+4	5.1	186
133.3	2.84e+4	11.2	186
143.3	3.29e+4	10.4	186
154.4	3.67e+4	10.3	186
180.2	3.74e+4	2.8	186
195.6	3.82e+4	3.3	186
206.0	3.82e+4	2.7	186
226.0	4.01e+4	9.2	186
232.0	3.82e+4	4.7	186
254.0	3.59e+4	2.4	186
14.0	2.13e+5	**********	194
14.1	2.21e+5	**********	194
14.4	2.57e+5	8.3	194
14.8	2.81e+5	8.3	194
15.1	2.96e+5	8.5	194
15.5	3.04e+5	5.5	194
15.9	3.08e+5	3.7	194
16.3	3.08e+5	1.1	194
16.8	3.07e+5	0.1	194
17.2	3.03e+5	-1.3	194
17.7	3.00e+5	-0.6	194
18.2	2.95e+5	0.3	194
18.8	2.89e+5	0.9	194
19.4	2.82e+5	0.9	194
20.0	2.75e+5	0.8	194
20.7	2.67e+5	0.5	194
21.4	2.57e+5	-0.1	194
22.1	2.46e+5	-1.1	194
23.0	2.33e+5	-1.5	194
23.8	2.18e+5	-2.6	194
24.8	2.03e+5	-1.5	194
25.8	1.85e+5	-0.8	194
27.0	1.67e+5	-0.3	194
28.2	1.48e+5	-1.1	194
29.5	1.28e+5	-1.5	194
31.0	1.09e+5	1.9	194
32.6	8.98e+4	3.1	194
34.4	7.16e+4	1.9	194
36.5	5.51e+4	3.8	194
38.7	4.07e+4	0.9	194
41.3	2.86e+4	-3.6	194
42.8	2.46e+4	-1.1	194
44.3	2.11e+4	0.2	194
45.9	1.78e+4	0.8	194
47.7	1.47e+4	1.2	194
49.6	1.21e+4	0.7	194
51.7	9.77e+3	-1.3	194
53.9	7.98e+3	-2.7	194
56.4	6.78e+3	1.5	194

E(eV)	μ(cm^2/g)	% Error	Ref.
59.0	6.02e+3	4.8	194
62.0	5.67e+3	12.9	194
65.3	5.30e+3	16.4	194
68.9	5.01e+3	19.3	194
72.9	4.82e+3	20.6	194
77.5	4.69e+3	21.4	194
82.7	4.55e+3	16.7	194
88.6	4.36e+3	6.1	194
95.4	8.48e+3	-71.3	194
21.0	2.77e+5	6.0	218
21.1	2.77e+5	6.5	218
22.4	2.54e+5	3.8	218
22.8	2.47e+5	3.2	218
23.7	2.34e+5	3.4	218
24.5	2.22e+5	4.8	218
24.9	2.00e+5	-1.6	218
25.4	2.01e+5	3.7	218
25.5	1.97e+5	2.4	218
26.2	1.88e+5	4.2	218
26.5	1.83e+5	4.7	218
26.8	1.78e+5	4.2	218
27.4	1.62e+5	0.2	218
27.5	1.56e+5	-2.4	218
27.6	1.53e+5	-3.3	218
27.7	1.55e+5	-1.0	218
28.1	1.47e+5	-2.9	218
28.4	1.48e+5	0.9	218
29.2	1.34e+5	-0.9	218
29.7	1.11e+5	-12.0	218
29.8	1.17e+5	-6.0	218

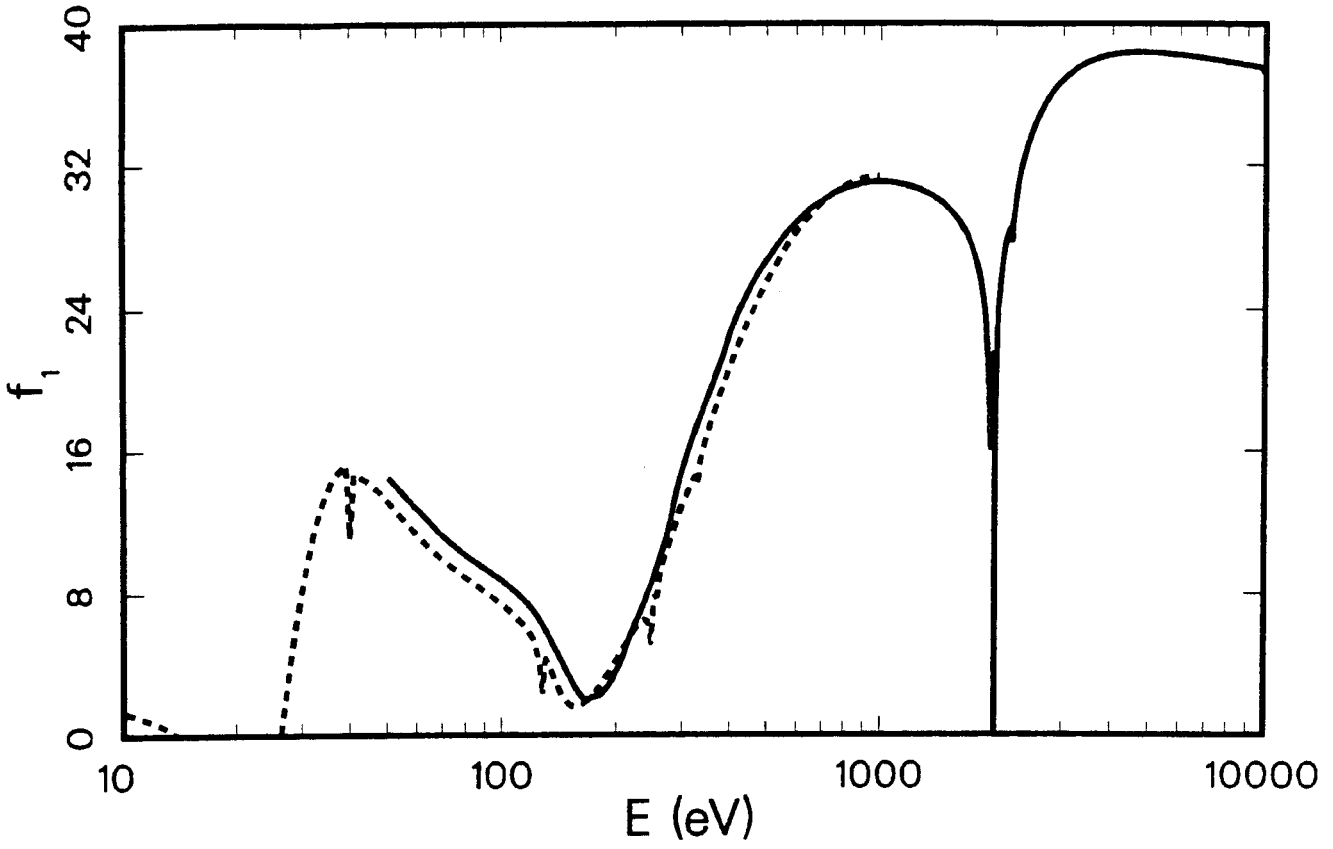
Atomic Scattering Factors, f_1+if_2
37 - Rubidium (Rb)

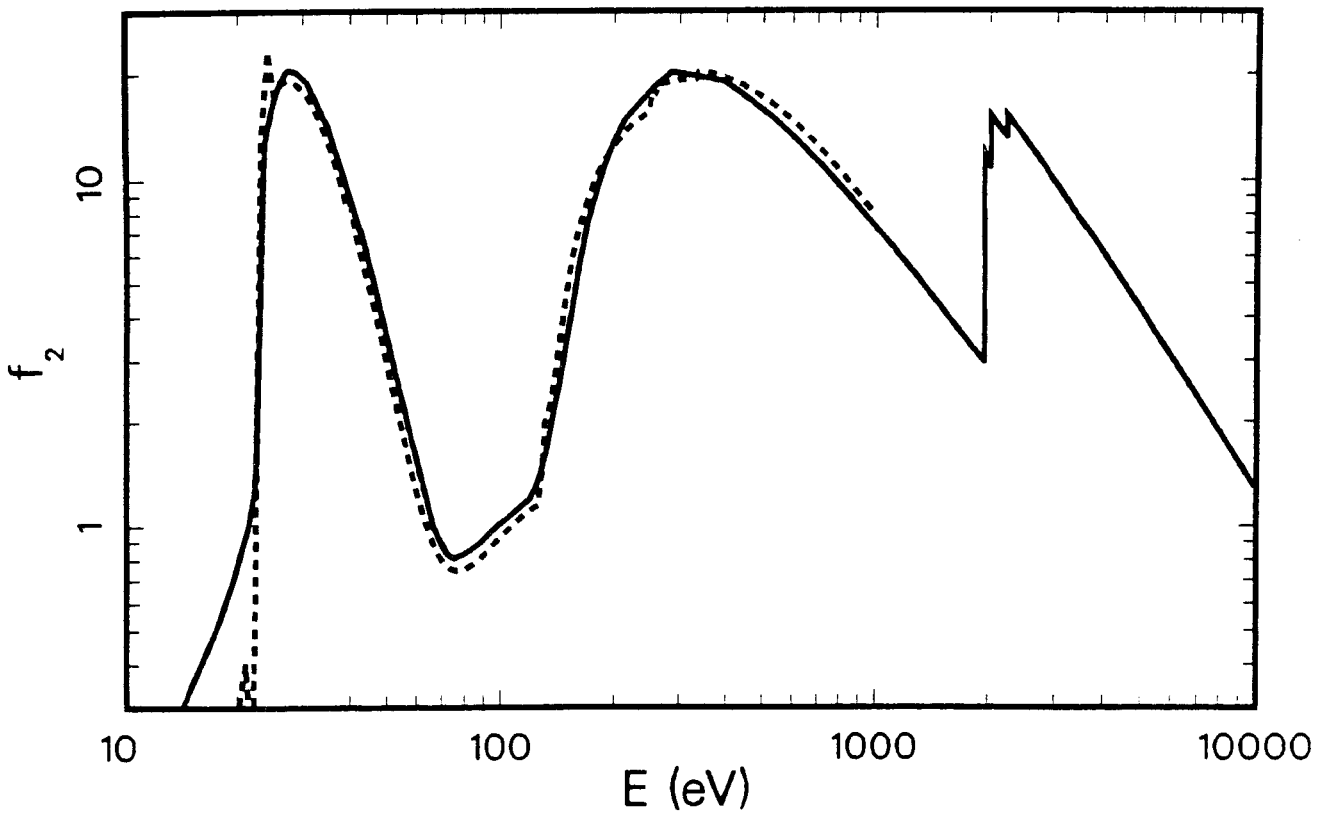


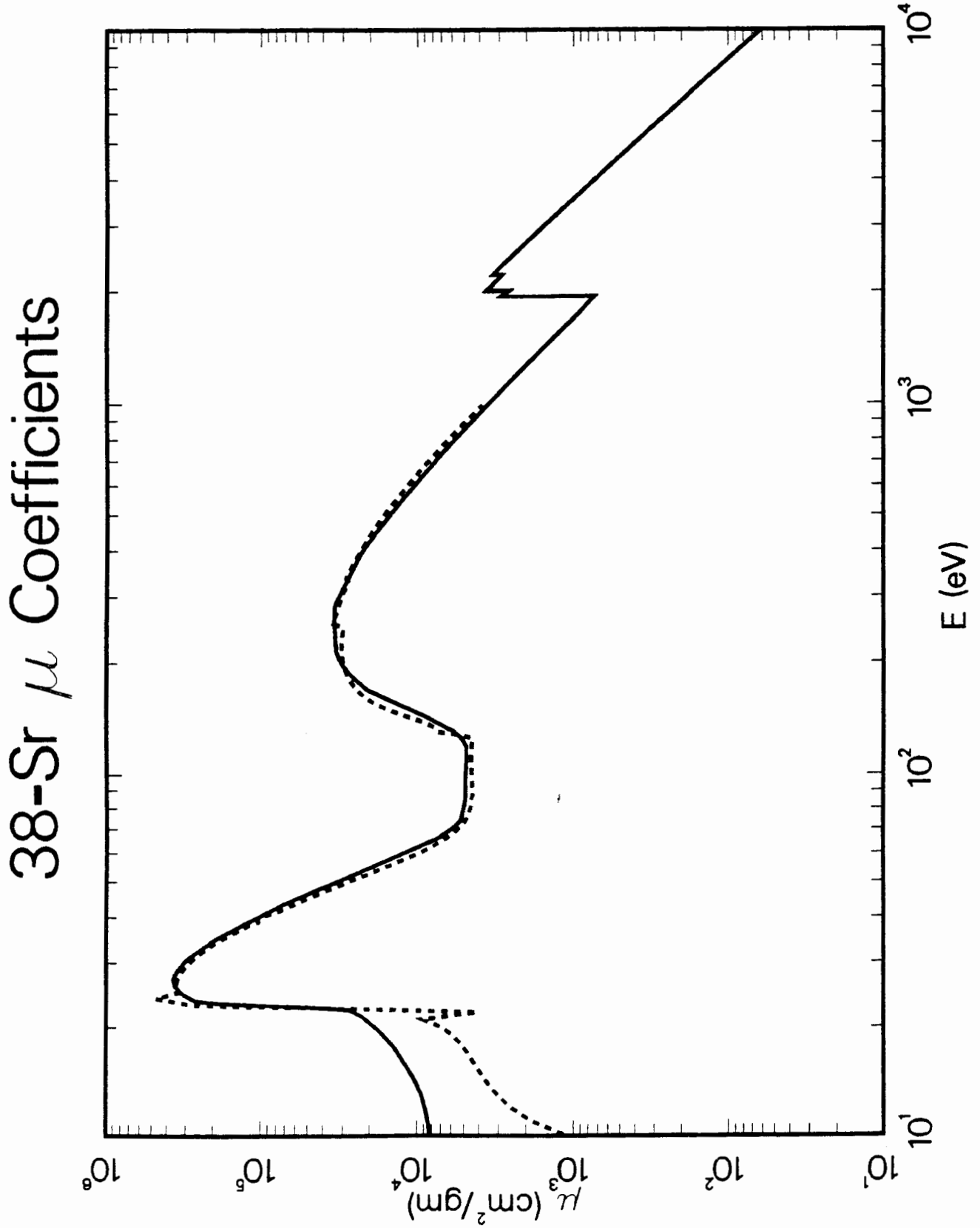



37-Rb μ Coefficients
μ (cm²/gm)
10⁸
10⁵
10⁴
10³
10²
10¹
10¹
10²
10³
10⁴
E (eV)

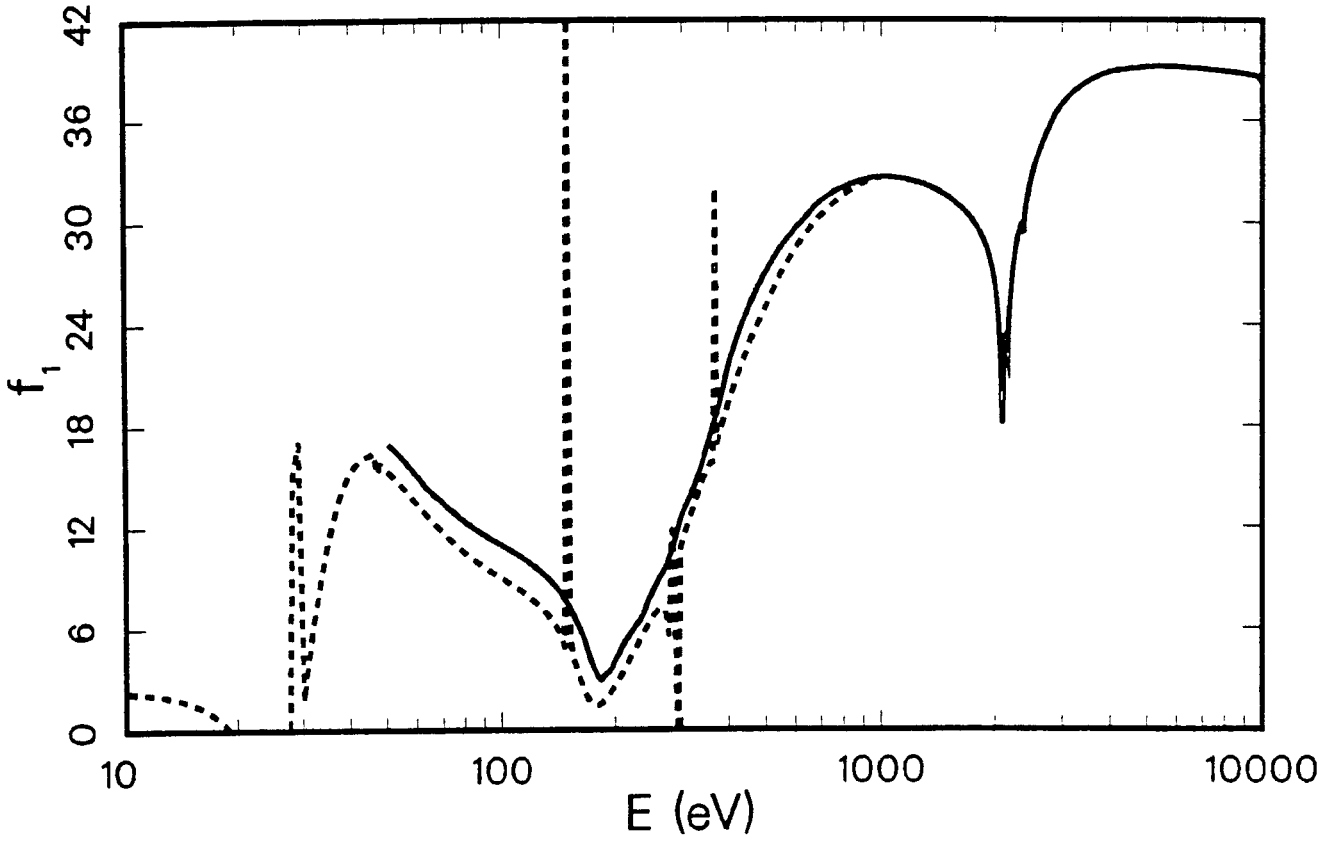
Atomic Scattering Factors, f_1+if_2
38 - Strontium (Sr)

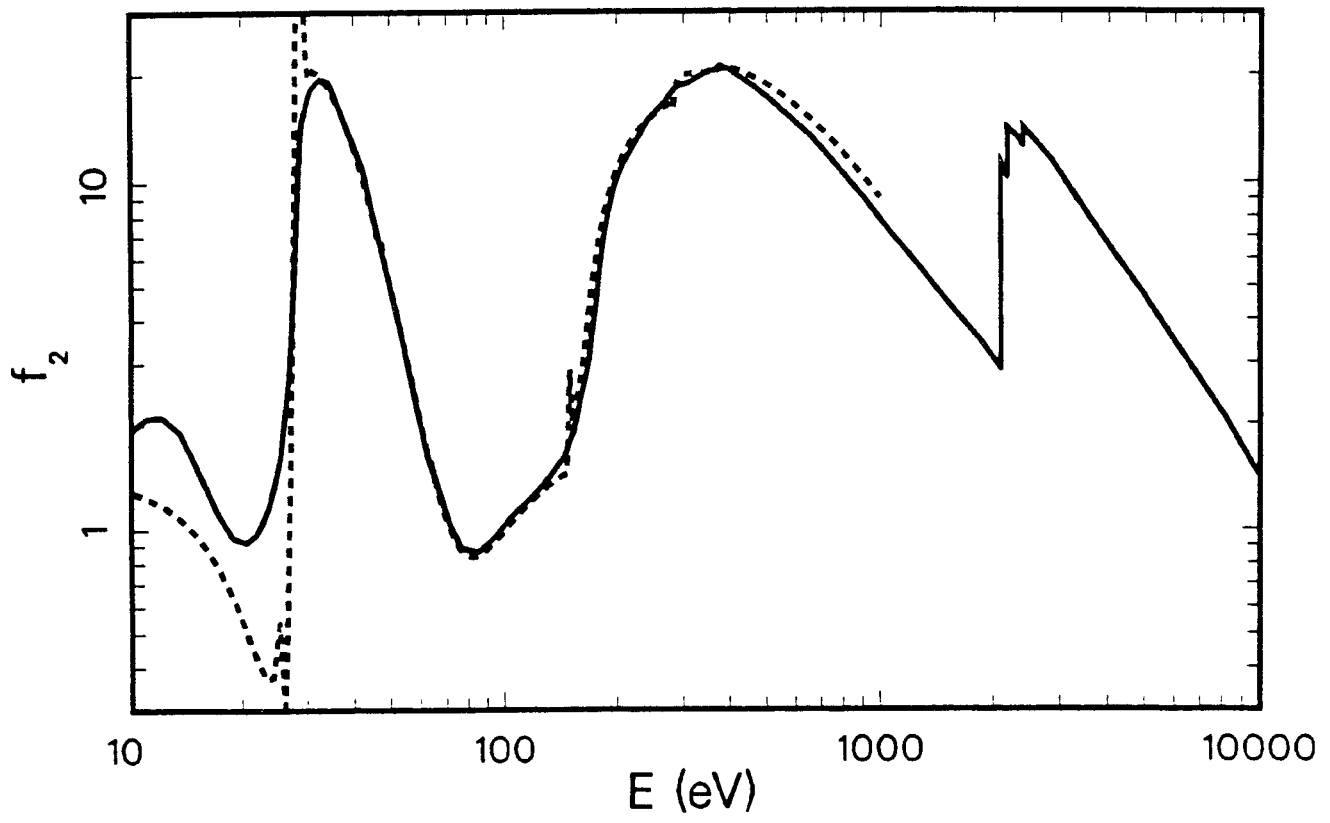


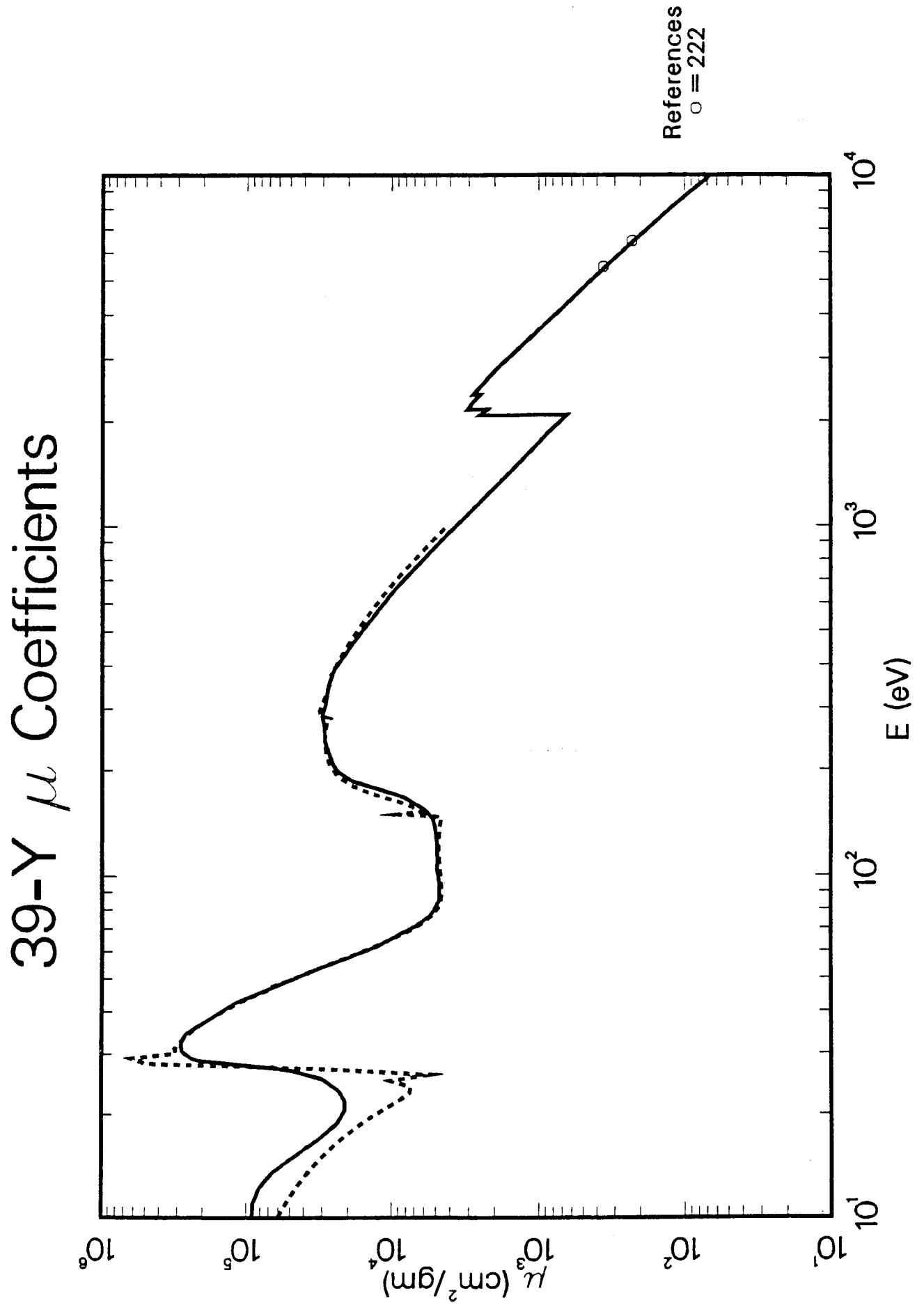



38-Sr μ Coefficients
μ (cm²/gm)
10¹
10²
10³
10⁴
10⁵
10⁶
E (eV)
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
39 - Yttrium (Y)






39-Y μ Coefficients
References
○ = 222
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Yttrium (Y) — 39

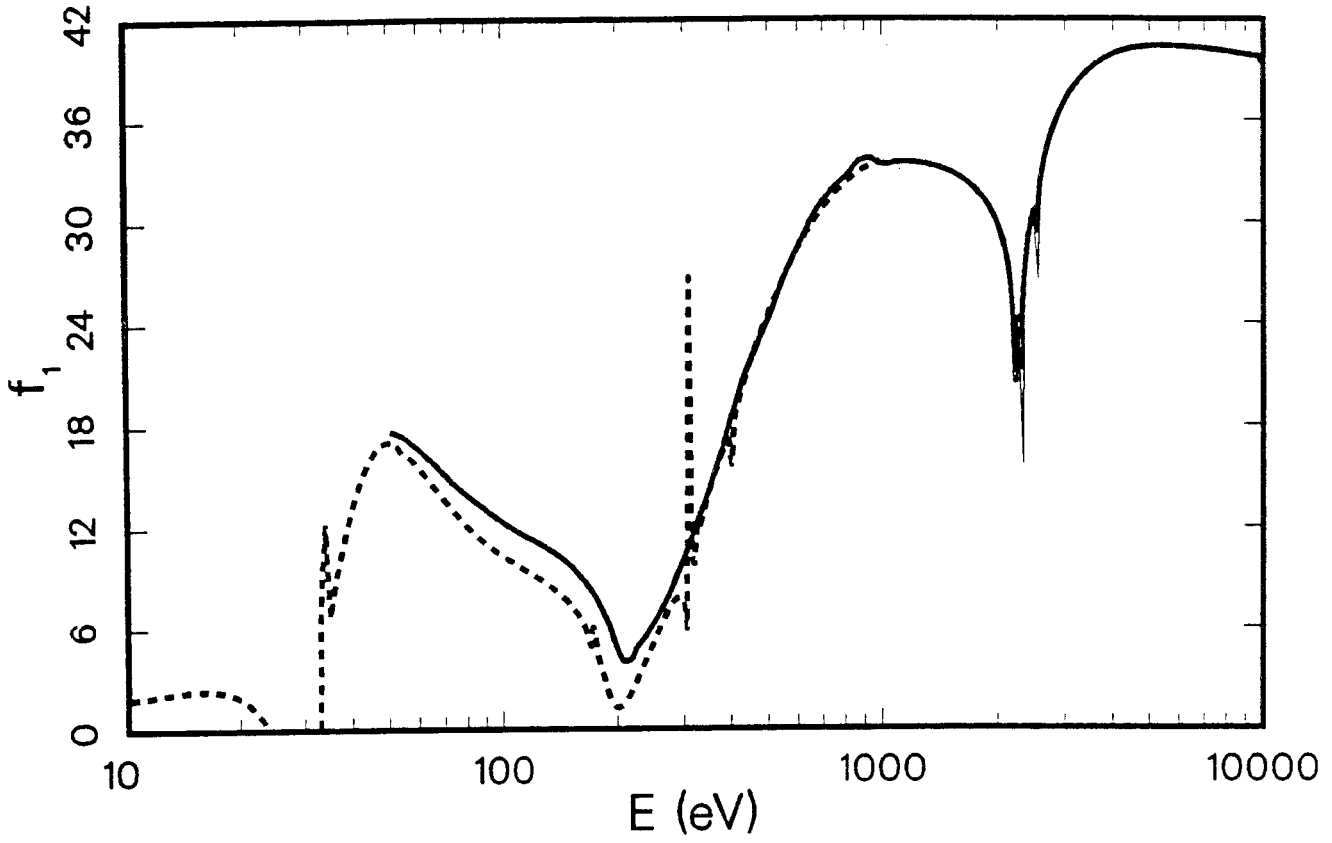
Atomic Weight = 88.91

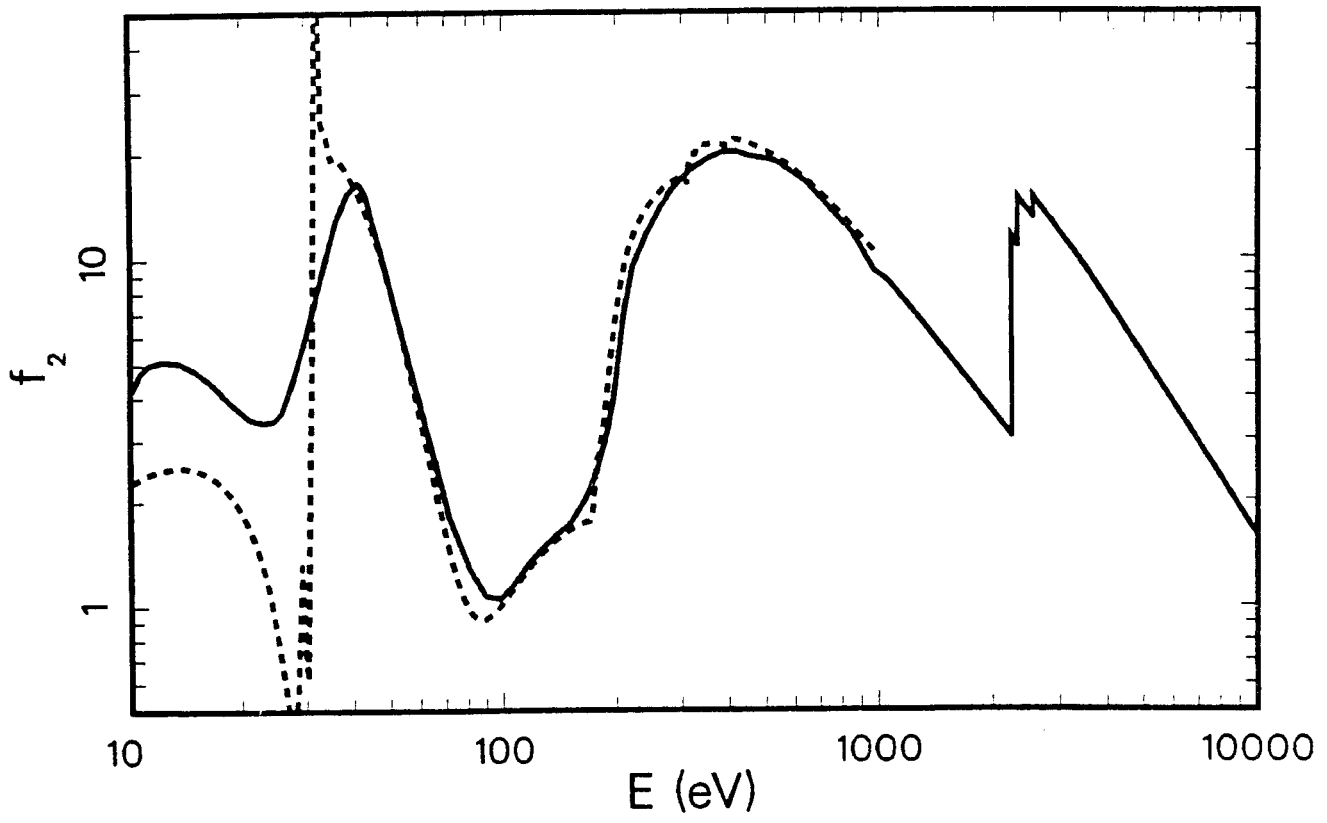
μ (barns/atom) = $\mu(cm^2/g) \times 147.63$

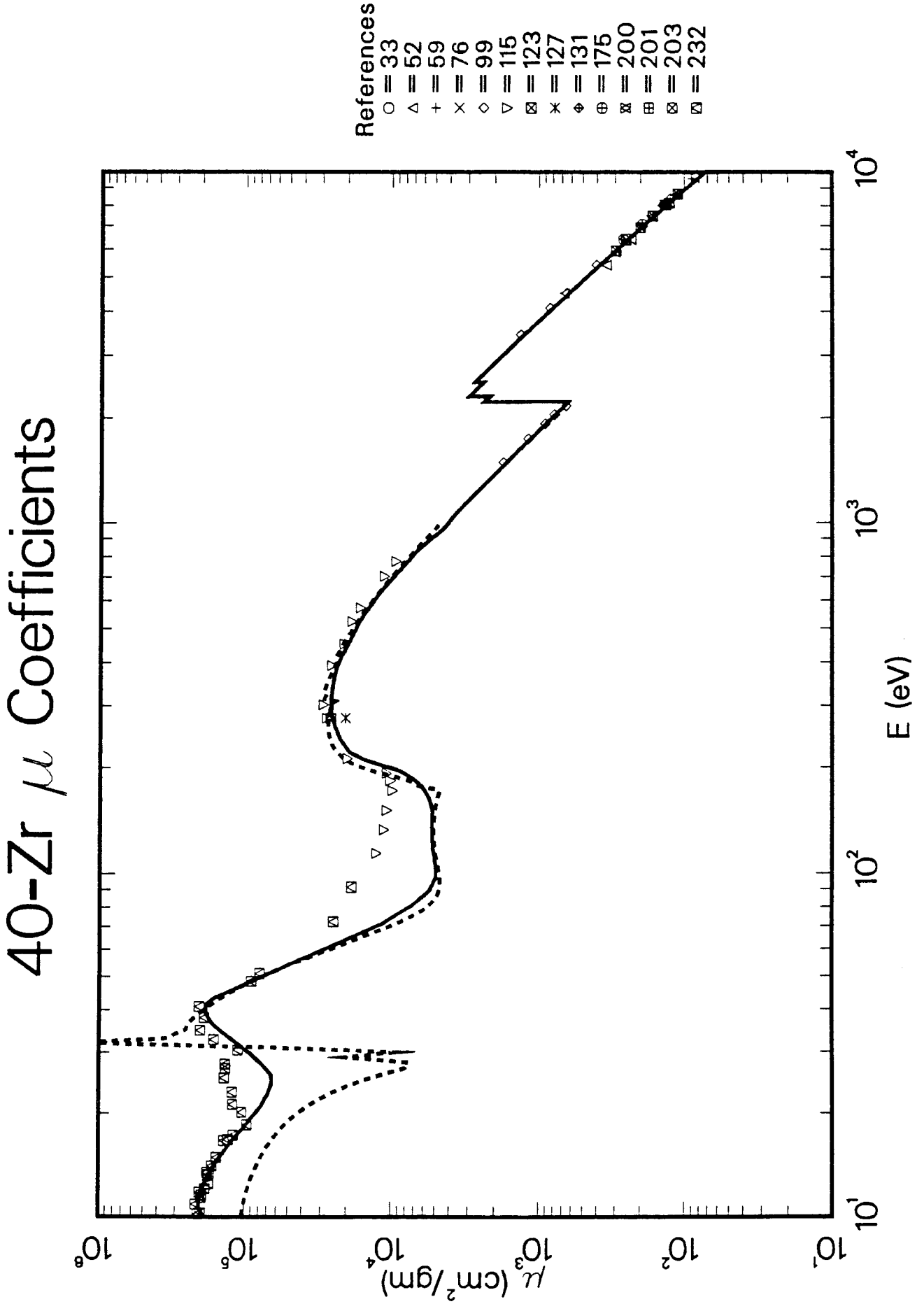
$E\mu(E) = 473.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5470.0	3.61e+2	4.0	222
6470.0	2.28e+2	2.9	222

Atomic Scattering Factors, $f_1 + if_2$
40 - Zirconium (Zr)






40-Zr μ Coefficients
References
○ = 33
△ = 52
+ = 59
× = 76
◇ = 99
▽ = 115
⊠ = 123
✳ = 127
◆ = 131
⊕ = 175
⊠ = 200
⊞ = 201
⊠ = 203
⊠ = 232
μ (cm²/gm)
E (eV)
10⁻¹
10⁰
10¹
10²
10³
10⁴
10⁵
10⁶

Zirconium (Zr) — 40

Atomic Weight = 91.22

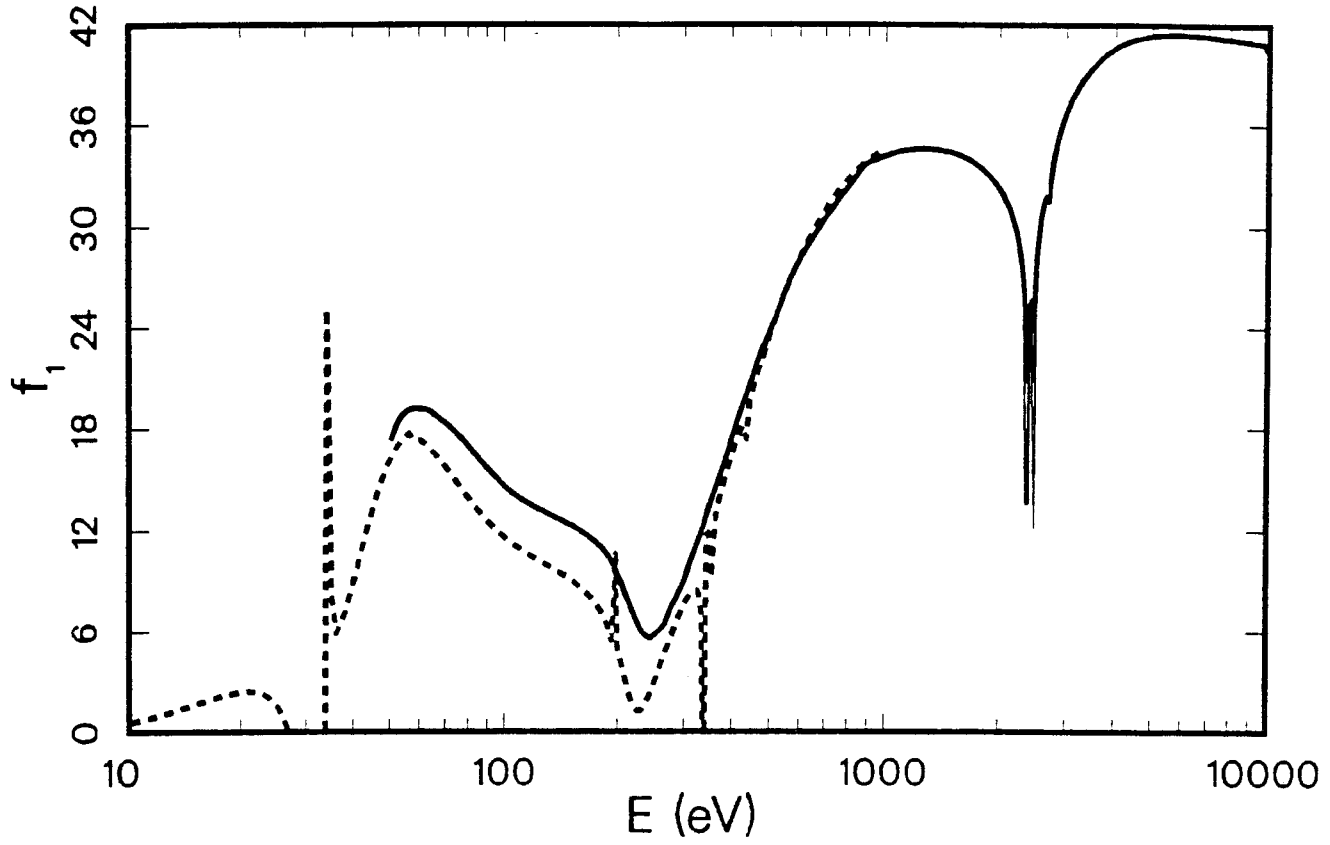
μ (barns/atom) = $\mu(cm^2/g) \times 151.48$

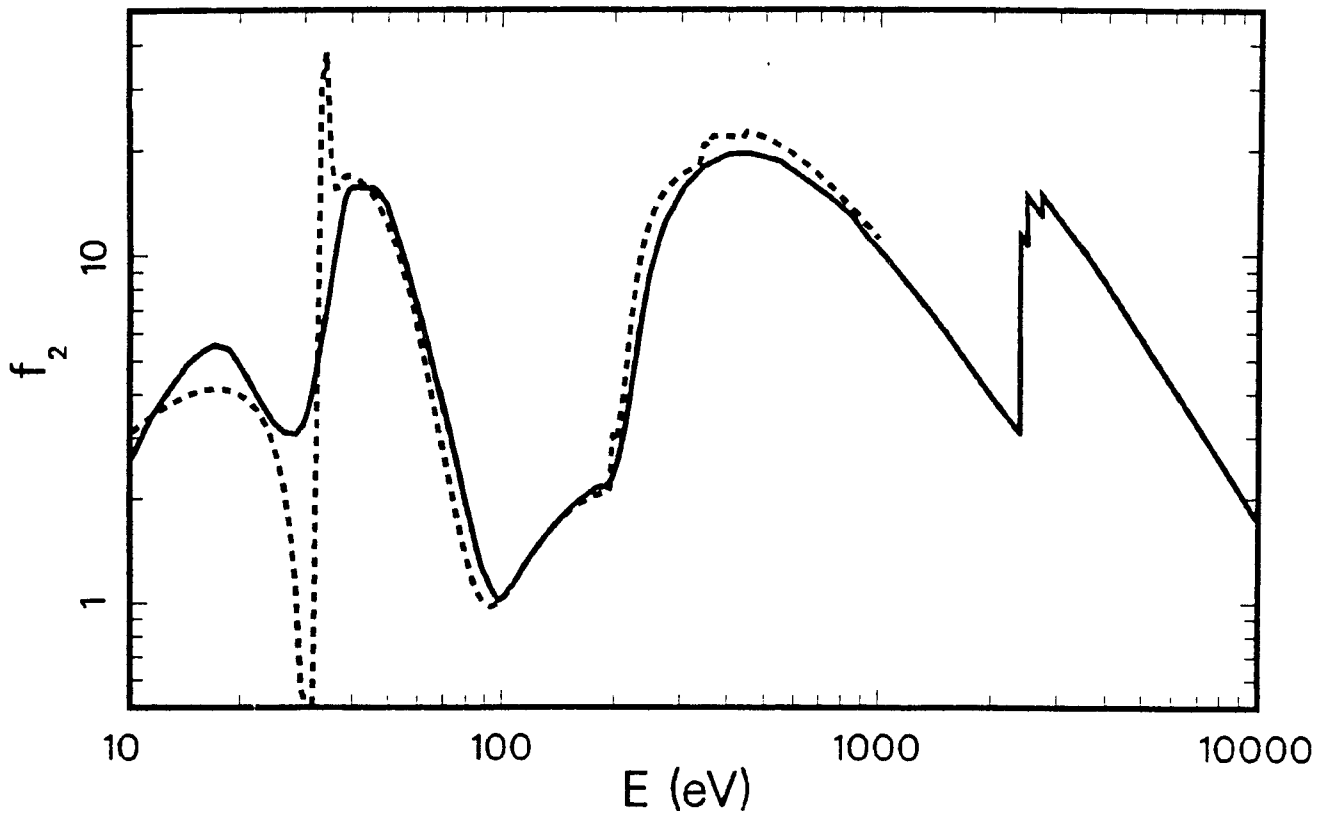
$E\mu(E) = 461.3\, f_2$ keV cm^2/g

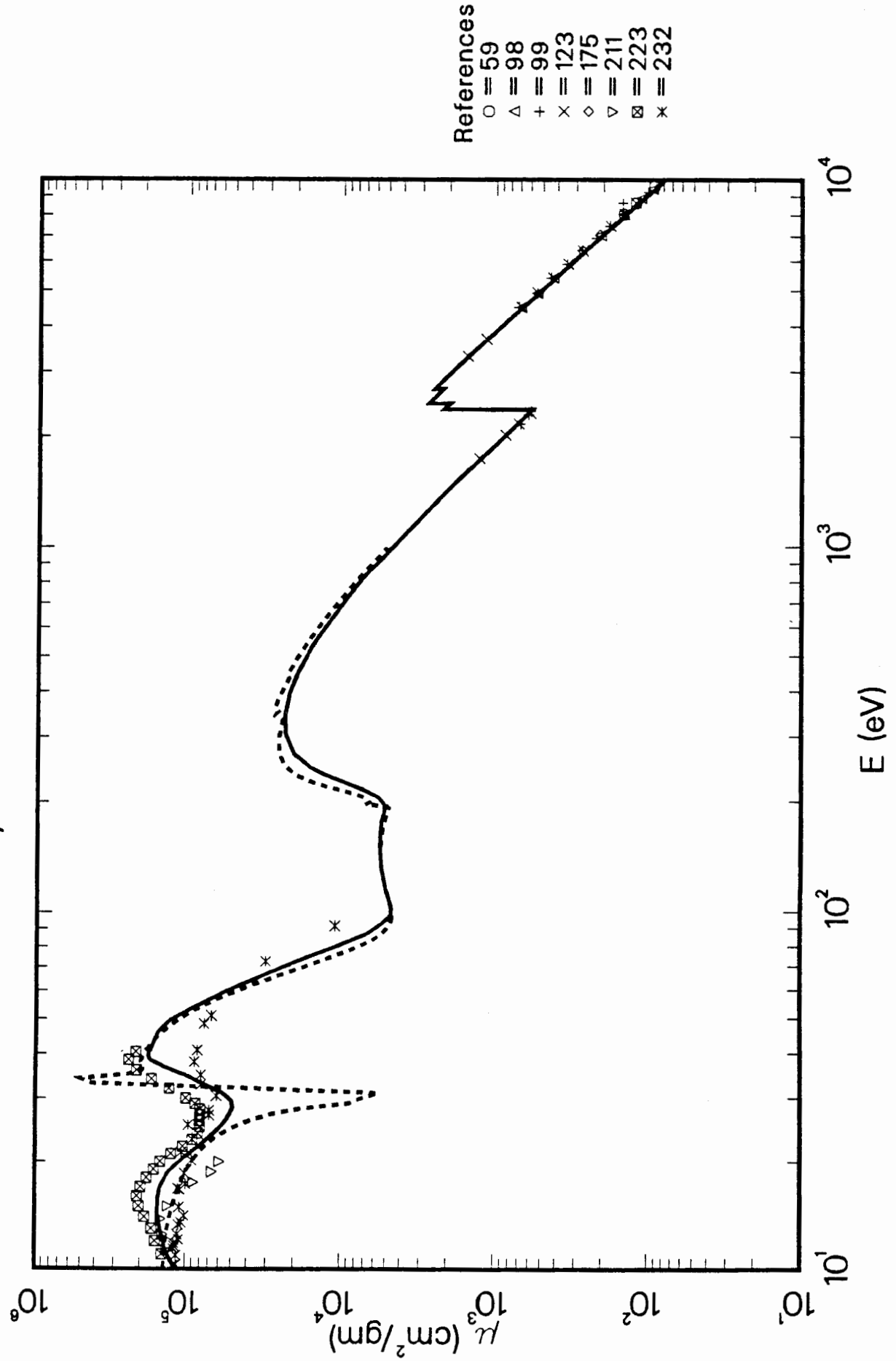
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	1.37e+2	4.8	33
4516.0	6.71e+2	7.8	52
5420.0	3.45e+2	-9.8	52
5904.0	3.01e+2	-0.9	52
6409.0	2.33e+2	-4.1	52
7484.0	1.65e+2	3.3	52
8053.0	1.34e+2	2.8	52
8644.0	1.13e+2	5.2	52
8048.0	1.34e+2	2.6	59
8639.0	1.12e+2	3.9	59
9572.0	8.73e+1	7.5	59
8040.0	1.37e+2	4.6	76
1487.0	1.75e+3	4.6	99
1739.0	1.19e+3	3.3	99
1922.0	9.12e+2	1.2	99
2043.0	7.83e+2	0.8	99
2166.0	6.56e+2	-2.6	99
3444.0	1.33e+3	5.0	99
4089.0	8.42e+2	3.9	99
4510.0	6.49e+2	3.8	99
5414.0	4.03e+2	5.1	99
6404.0	2.57e+2	5.5	99
7478.0	1.69e+2	5.6	99
8040.0	1.38e+2	5.2	99
9940.0	8.82e+1	20.5	99
114.0	1.26e+4	145.6	115
132.8	1.12e+4	111.9	115
151.1	1.07e+4	103.5	115
171.7	9.77e+3	64.6	115
183.3	1.01e+4	46.1	115
192.6	1.07e+4	29.1	115
212.2	2.00e+4	25.2	115
277.0	2.77e+4	9.1	115
302.7	2.92e+4	12.4	115
392.4	2.56e+4	8.9	115
452.2	2.11e+4	6.3	115
524.9	1.86e+4	12.2	115
572.8	1.63e+4	13.9	115
705.0	1.12e+4	16.4	115
776.2	9.31e+3	19.4	115
6404.0	2.52e+2	3.4	123
6930.0	2.00e+2	1.7	123
7478.0	1.65e+2	3.1	123
8040.0	1.35e+2	2.9	123
8640.0	1.11e+2	2.8	123
277.0	2.06e+4	-18.8	127
8000.0	1.41e+2	6.2	131
8398.0	1.25e+2	7.7	131
9962.0	7.74e+1	6.4	131
6400.0	2.63e+2	7.8	175

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
7058.0	1.95e+2	4.3	175
277.0	2.61e+4	2.9	200
5960.0	2.95e+2	-0.2	201
8140.0	1.27e+2	0.2	201
5959.0	2.95e+2	-0.2	203
8136.0	1.27e+2	0.1	203
10.2	2.09e+5	7.0	232
10.3	2.00e+5	1.2	232
10.9	2.17e+5	5.3	232
11.4	1.98e+5	-2.7	232
11.6	1.96e+5	-2.4	232
11.8	2.03e+5	2.4	232
12.1	1.87e+5	-4.1	232
12.5	1.77e+5	-5.8	232
13.3	1.76e+5	0.2	232
13.5	1.81e+5	4.4	232
14.1	1.67e+5	3.3	232
14.9	1.56e+5	5.0	232
16.7	1.39e+5	15.2	232
16.8	1.29e+5	8.8	232
17.3	1.19e+5	6.1	232
18.5	9.57e+4	-1.2	232
20.1	1.04e+5	25.1	232
21.2	1.20e+5	59.6	232
23.0	1.21e+5	78.0	232
25.3	1.37e+5	111.6	232
26.9	1.35e+5	90.2	232
27.7	1.36e+5	78.6	232
30.5	1.11e+5	12.4	232
32.7	1.62e+5	33.0	232
34.8	2.02e+5	36.9	232
37.9	1.89e+5	6.4	232
40.8	2.07e+5	11.8	232
48.4	8.99e+4	-0.3	232
51.0	7.86e+4	14.8	232
72.3	2.49e+4	126.2	232
91.5	1.87e+4	250.9	232

Atomic Scattering Factors, f_1+if_2
41 - Niobium (Nb)






41-Nb μ Coefficients
References
○ = 59
△ = 98
+ = 99
× = 123
◇ = 175
▽ = 211
⊠ = 223
✳ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Niobium (Nb) — 41

Atomic Weight = 92.91

μ (barns/atom) = $\mu(cm^2/g) \times 154.28$

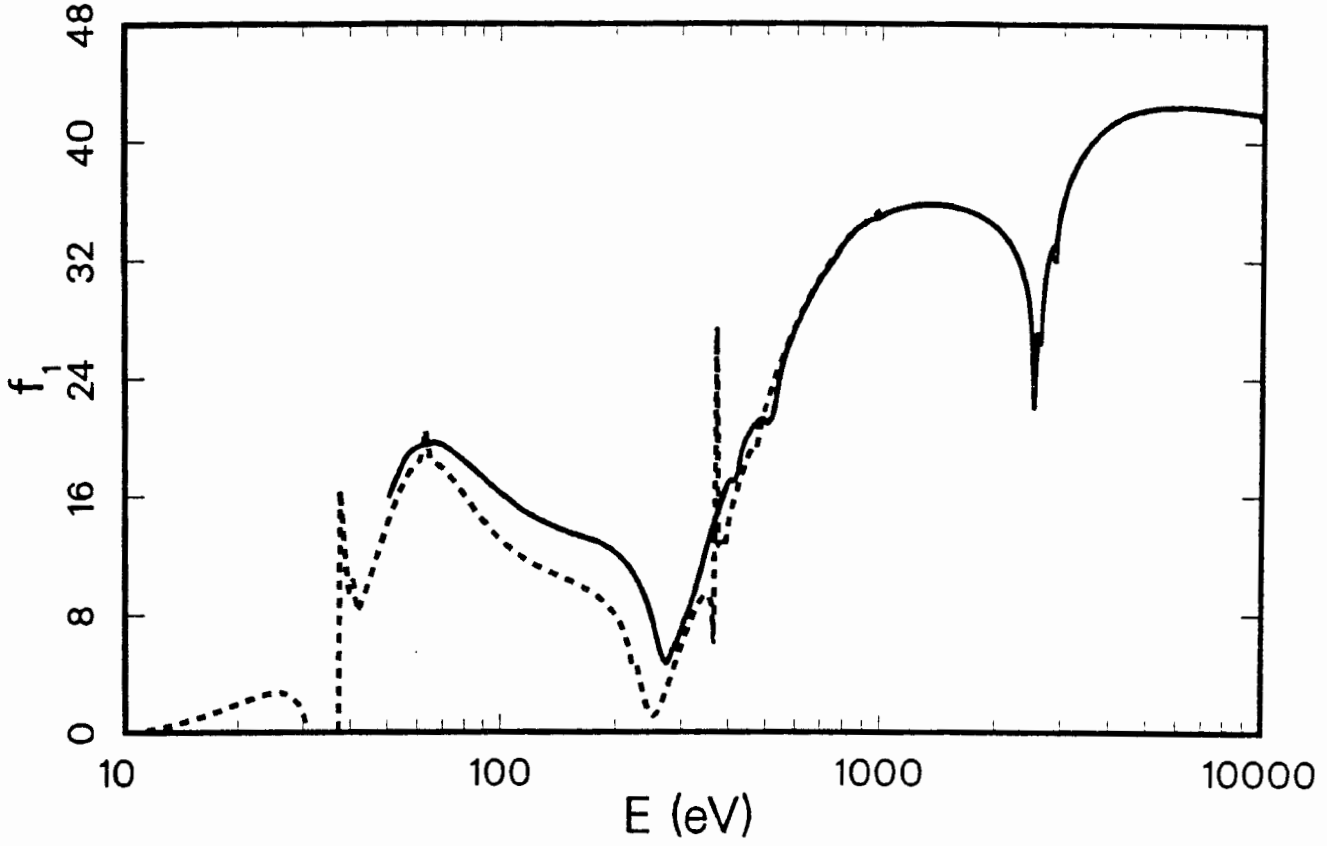
$E\mu(E) = 452.9\, f_2$ keV cm^2/g

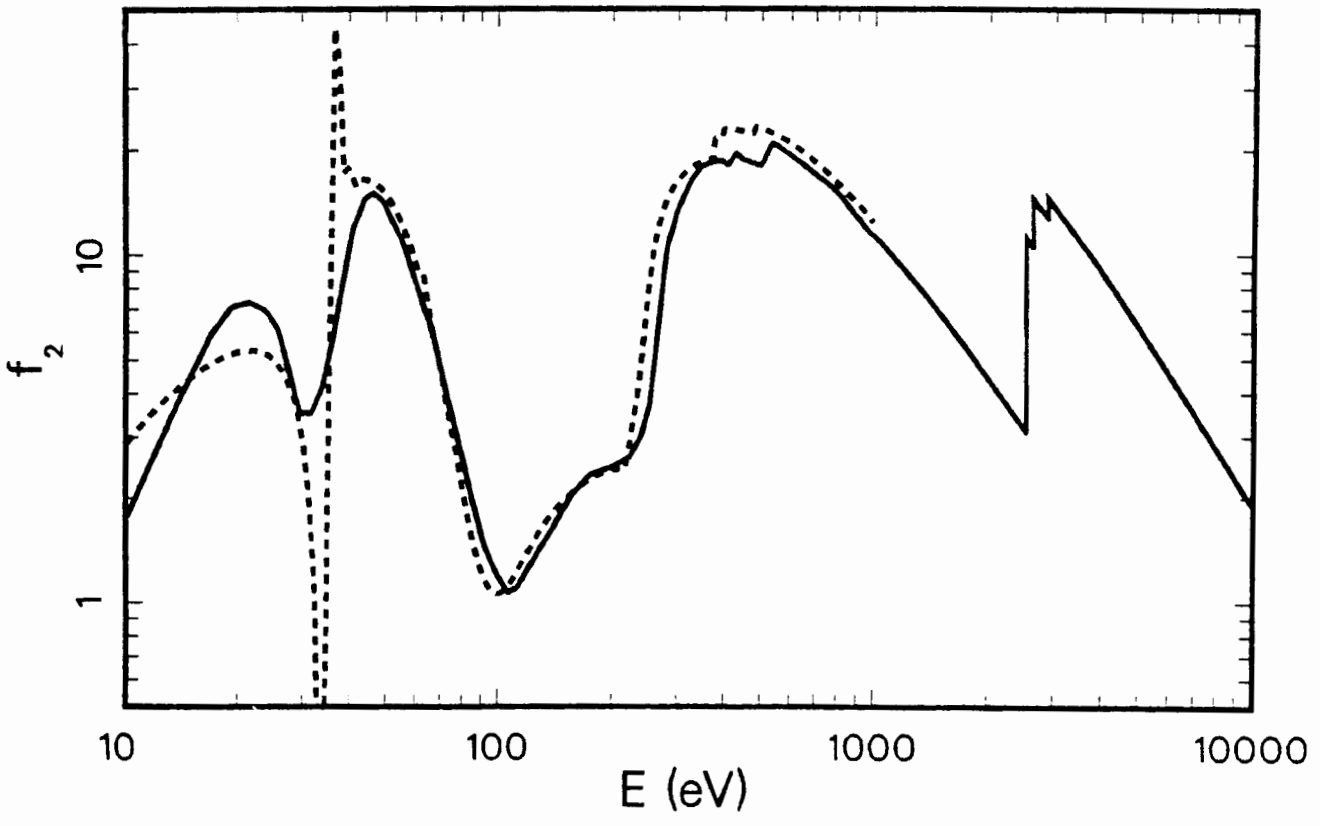
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8048.0	1.47e+2	4.4	59
8639.0	1.22e+2	5.5	59
9572.0	9.21e+1	5.3	59
4511.0	6.97e+2	3.0	98
4932.0	5.49e+2	2.8	98
5415.0	4.29e+2	3.2	98
7058.0	2.10e+2	3.8	98
8048.0	1.47e+2	4.5	98
8905.0	1.13e+2	5.6	98
9442.0	9.44e+1	3.9	98
2166.0	6.99e+2	-3.7	99
2293.0	6.18e+2	-2.5	99
2346.0	5.99e+2	-0.4	99
4510.0	7.16e+2	5.8	99
4949.0	5.45e+2	3.1	99
5414.0	4.44e+2	6.9	99
5898.0	3.47e+2	5.3	99
6404.0	2.78e+2	5.5	99
6930.0	2.24e+2	5.4	99
7478.0	1.82e+2	5.7	99
8040.0	1.50e+2	5.9	99
8640.0	1.50e+2	29.1	99
9245.0	1.02e+2	5.7	99
1740.0	1.28e+3	2.6	123
2014.0	8.72e+2	0.7	123
2166.0	7.16e+2	-1.3	123
2308.0	6.01e+2	-3.7	123
3314.0	1.53e+3	1.3	123
3692.0	1.16e+3	1.9	123
4512.0	6.94e+2	2.7	123
4953.0	5.46e+2	3.5	123
5414.0	4.30e+2	3.5	123
5898.0	3.43e+2	4.0	123
6404.0	2.74e+2	3.9	123
7478.0	1.80e+2	4.6	123
8040.0	1.47e+2	3.8	123
8640.0	1.23e+2	6.0	123
6400.0	2.76e+2	4.6	175
7058.0	2.12e+2	4.9	175
10.0	9.96e+4	-14.3	211
11.3	1.33e+5	-1.8	211
12.5	1.41e+5	-2.4	211
13.8	1.46e+5	-3.6	211
15.0	1.31e+5	-15.0	211
17.5	8.83e+4	-38.0	211
18.7	6.62e+4	-49.0	211
20.0	5.93e+4	-45.6	211
10.0	1.24e+5	7.1	223
11.0	1.43e+5	9.3	223
12.0	1.59e+5	13.1	223

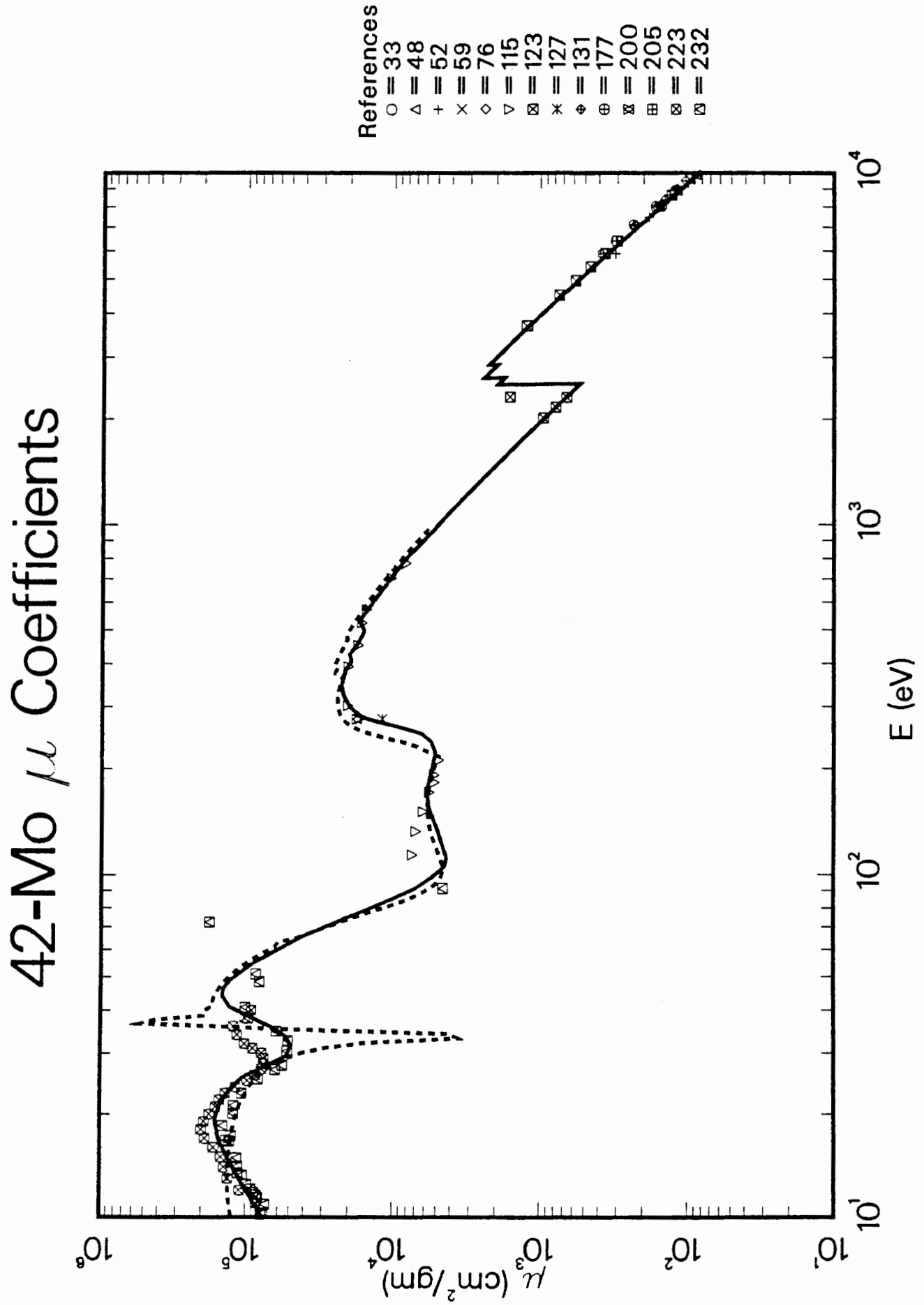
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
13.0	1.68e+5	13.9	223
14.0	1.88e+5	23.1	223
15.0	2.04e+5	33.1	223
16.0	2.11e+5	38.4	223
17.0	2.00e+5	34.9	223
18.0	1.81e+5	32.1	223
19.0	1.62e+5	30.2	223
20.0	1.47e+5	34.9	223
21.0	1.24e+5	31.4	223
22.0	1.04e+5	26.7	223
23.0	9.00e+4	23.8	223
24.0	8.25e+4	27.1	223
25.0	8.00e+4	35.3	223
26.0	8.01e+4	46.5	223
27.0	8.00e+4	54.4	223
28.0	7.97e+4	60.1	223
29.0	8.59e+4	72.7	223
30.0	9.96e+4	91.1	223
32.0	1.29e+5	94.3	223
34.0	1.69e+5	88.4	223
36.0	2.13e+5	71.0	223
38.5	2.42e+5	39.5	223
40.5	2.16e+5	22.7	223
10.2	1.20e+5	0.9	232
10.3	1.15e+5	-4.9	232
10.9	1.14e+5	-11.7	232
11.4	1.20e+5	-12.4	232
11.6	1.19e+5	-14.0	232
11.8	1.19e+5	-14.7	232
12.1	1.10e+5	-22.0	232
12.5	1.13e+5	-21.6	232
13.3	1.11e+5	-25.8	232
13.5	1.06e+5	-29.2	232
14.1	1.01e+5	-33.6	232
14.9	1.10e+5	-28.8	232
16.7	1.08e+5	-27.5	232
16.8	1.12e+5	-25.0	232
17.3	9.90e+4	-31.5	232
18.5	1.01e+5	-23.8	232
20.1	9.04e+4	-16.0	232
21.2	1.06e+5	15.0	232
23.0	8.97e+4	23.4	232
25.3	9.58e+4	65.9	232
26.9	6.95e+4	33.6	232
27.7	6.96e+4	38.2	232
30.5	6.23e+4	14.4	232
32.7	7.87e+4	6.4	232
34.8	7.91e+4	-22.0	232
37.9	8.76e+4	-46.3	232
40.8	8.37e+4	-52.1	232

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
48.4	7.57e+4	-44.5	232
51.0	6.77e+4	-40.6	232
72.3	3.08e+4	54.1	232
91.5	1.10e+4	91.7	232

Atomic Scattering Factors, f_1+if_2
42 - Molybdenum (Mo)






42-Mo μ Coefficients
References
○ = 33
△ = 48
+ = 52
× = 59
◇ = 76
▽ = 115
⊠ = 123
✳ = 127
⊕ = 131
⊕ = 177
⊠ = 200
⊞ = 205
⊠ = 223
⊠ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Molybdenum (Mo) — 42

Atomic Weight = 95.94

μ (barns/atom) = $\mu(cm^2/g) \times 159.31$

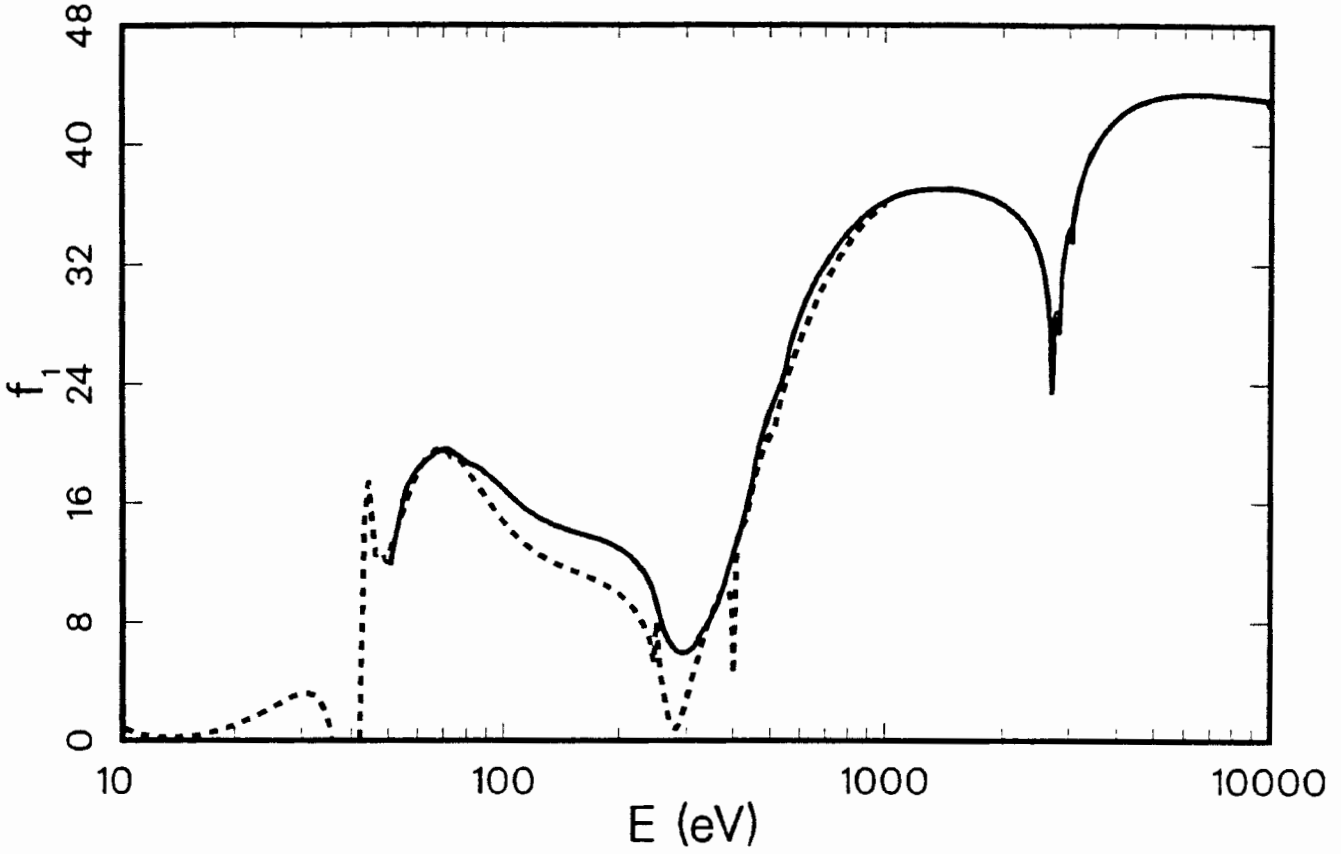
$E\mu(E) = 438.6\, f_2$ keV cm^2/g

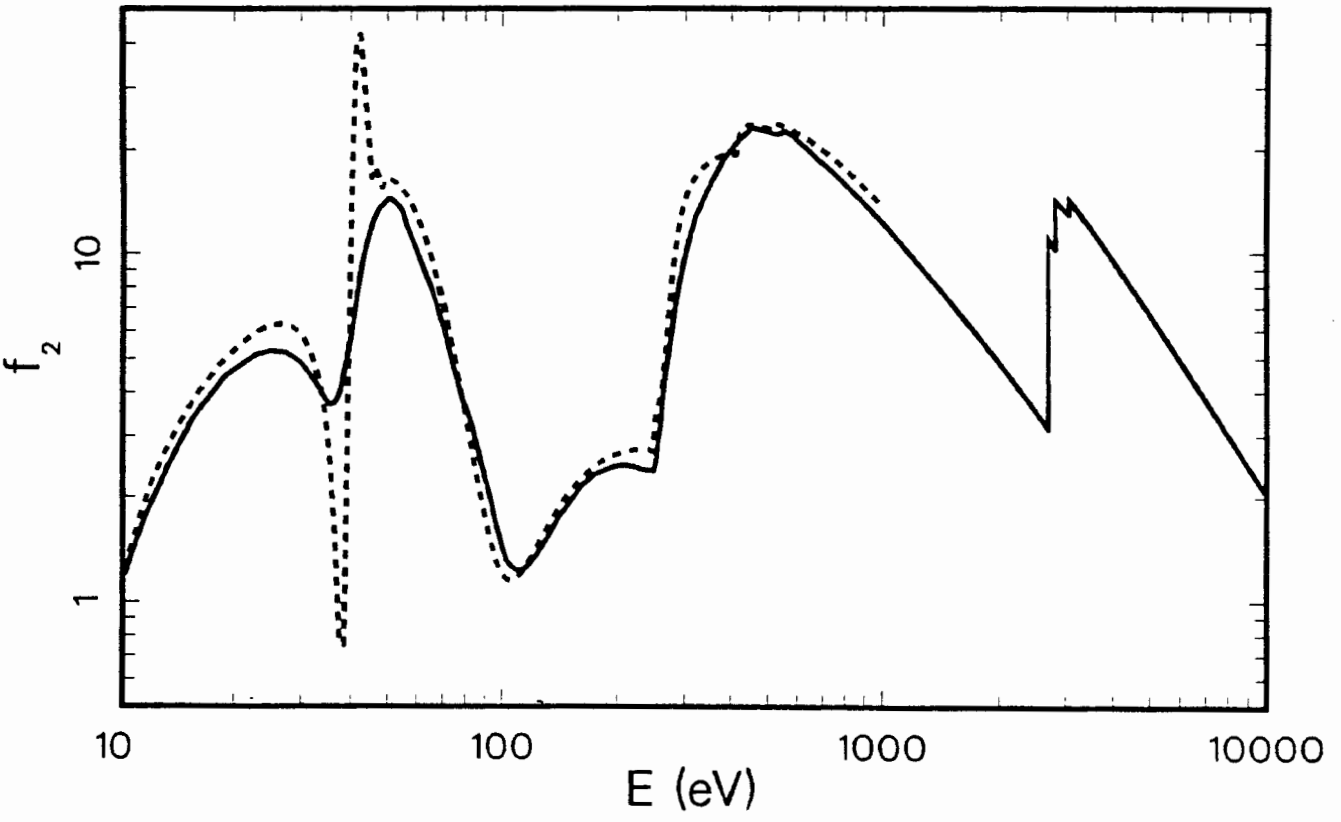
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	1.52e+2	1.4	33
8047.0	1.57e+2	4.5	48
8904.0	1.19e+2	5.0	48
9885.0	8.89e+1	4.4	48
5904.0	3.12e+2	-10.4	52
6409.0	2.84e+2	2.0	52
7484.0	1.84e+2	0.6	52
8053.0	1.58e+2	5.8	52
8644.0	1.34e+2	8.9	52
8048.0	1.55e+2	3.6	59
8639.0	1.29e+2	4.4	59
9572.0	9.77e+1	5.0	59
8040.0	1.57e+2	4.2	76
114.0	7.34e+3	68.0	115
132.8	6.97e+3	40.9	115
151.5	6.21e+3	11.4	115
171.7	5.66e+3	-3.2	115
183.3	5.22e+3	-8.2	115
192.6	5.22e+3	-5.4	115
212.2	4.88e+3	-7.2	115
277.0	1.72e+4	15.2	115
302.7	2.05e+4	1.7	115
392.4	2.04e+4	-1.7	115
452.2	1.75e+4	-3.2	115
524.9	1.65e+4	-2.6	115
572.8	1.54e+4	1.9	115
705.0	1.04e+4	-0.5	115
776.2	8.22e+3	-6.3	115
2014.0	9.64e+2	2.1	123
2166.0	7.89e+2	0.1	123
2308.0	6.68e+2	-0.7	123
2314.0	1.62e+3	142.1	123
3692.0	1.24e+3	3.8	123
4512.0	7.49e+2	5.3	123
4953.0	5.80e+2	4.3	123
5414.0	4.59e+2	4.7	123
5898.0	3.65e+2	4.6	123
8640.0	1.29e+2	4.8	123
277.0	1.20e+4	-19.7	127
7058.0	2.30e+2	7.4	131
8000.0	1.63e+2	7.0	131
8398.0	1.43e+2	7.3	131
9000.0	1.19e+2	7.9	131
9500.0	1.04e+2	9.7	131
9962.0	8.88e+1	6.5	131
10000.0	8.79e+1	6.6	131
5900.0	3.79e+2	8.6	177
6400.0	3.08e+2	10.2	177
7100.0	2.34e+2	11.0	177
8000.0	1.64e+2	7.8	177

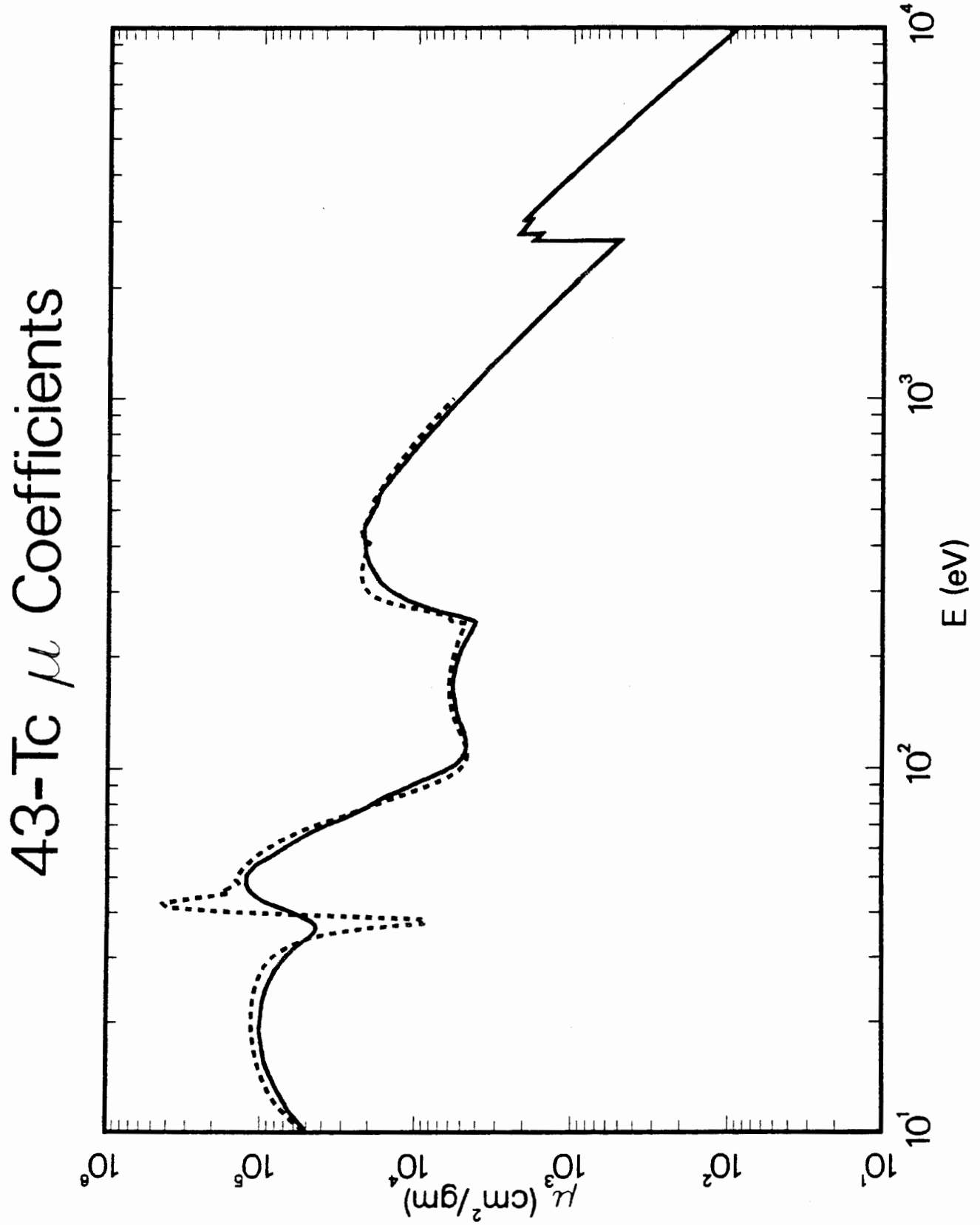
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8900.0	1.22e+2	7.2	177
277.0	1.79e+4	19.8	200
6400.0	3.02e+2	7.9	205
10.0	9.84e+4	29.8	223
11.0	8.42e+4	-3.4	223
12.0	1.10e+5	11.1	223
13.0	1.32e+5	19.1	223
14.0	1.41e+5	15.3	223
15.0	1.48e+5	10.8	223
16.0	1.65e+5	15.2	223
17.0	1.89e+5	23.0	223
18.0	2.00e+5	27.2	223
19.0	1.93e+5	19.6	223
20.0	1.77e+5	12.5	223
21.0	1.61e+5	5.9	223
22.0	1.51e+5	5.1	223
23.0	1.37e+5	2.2	223
24.0	1.17e+5	-6.0	223
25.0	9.69e+4	-13.4	223
26.0	8.53e+4	-13.6	223
27.0	7.78e+4	-4.8	223
28.0	7.51e+4	10.2	223
29.0	7.49e+4	30.9	223
30.0	7.75e+4	50.3	223
31.0	8.93e+4	79.1	223
32.0	1.02e+5	104.8	223
34.0	1.15e+5	108.3	223
36.0	1.22e+5	75.1	223
38.0	1.02e+5	12.8	223
40.0	9.14e+4	-21.3	223
10.2	7.83e+4	0.4	232
10.3	7.77e+4	-1.9	232
10.9	7.35e+4	-14.6	232
11.4	8.19e+4	-10.8	232
11.6	8.37e+4	-11.1	232
11.8	8.76e+4	-9.2	232
12.1	9.12e+4	-8.8	232
12.5	9.79e+4	-6.5	232
13.3	1.05e+5	-8.3	232
13.5	1.12e+5	-3.5	232
14.1	1.13e+5	-7.9	232
14.9	1.15e+5	-13.0	232
16.7	1.29e+5	-14.4	232
16.8	1.35e+5	-11.1	232
17.3	1.26e+5	-18.8	232
18.5	1.43e+5	-10.2	232
20.1	1.22e+5	-22.4	232
21.2	1.20e+5	-20.2	232
23.0	1.06e+5	-21.0	232
25.3	8.18e+4	-24.6	232

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
26.9	6.26e+4	-24.9	232
27.7	5.59e+4	-22.4	232
30.5	5.16e+4	1.7	232
32.7	5.10e+4	-0.7	232
34.8	6.18e+4	2.5	232
37.9	9.61e+4	7.7	232
40.8	1.01e+5	-20.8	232
48.4	8.08e+4	-38.9	232
51.0	8.57e+4	-24.5	232
72.3	1.80e+5	622.2	232
91.5	4.56e+3	-35.1	232

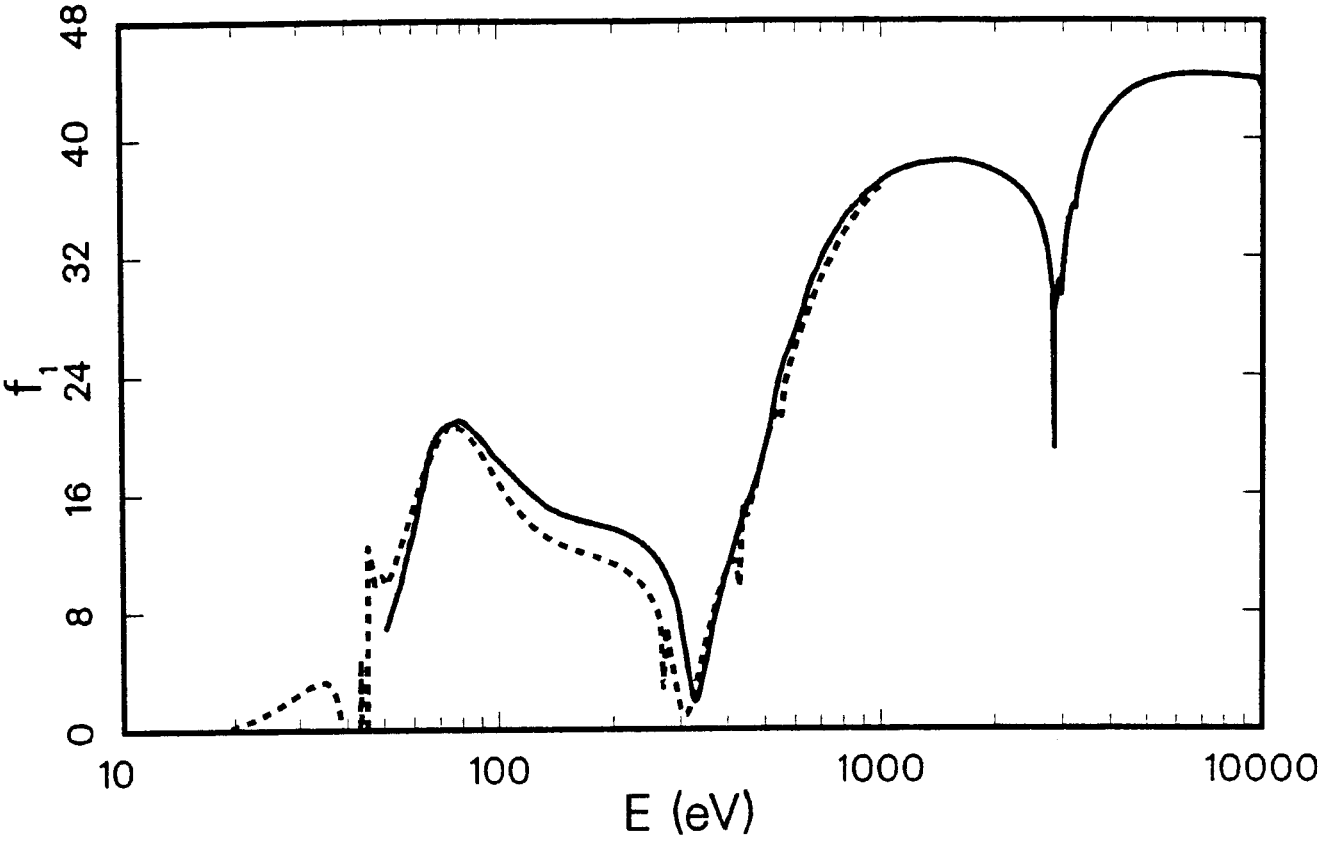
Atomic Scattering Factors, f_1+if_2
43 - Technetium (Tc)

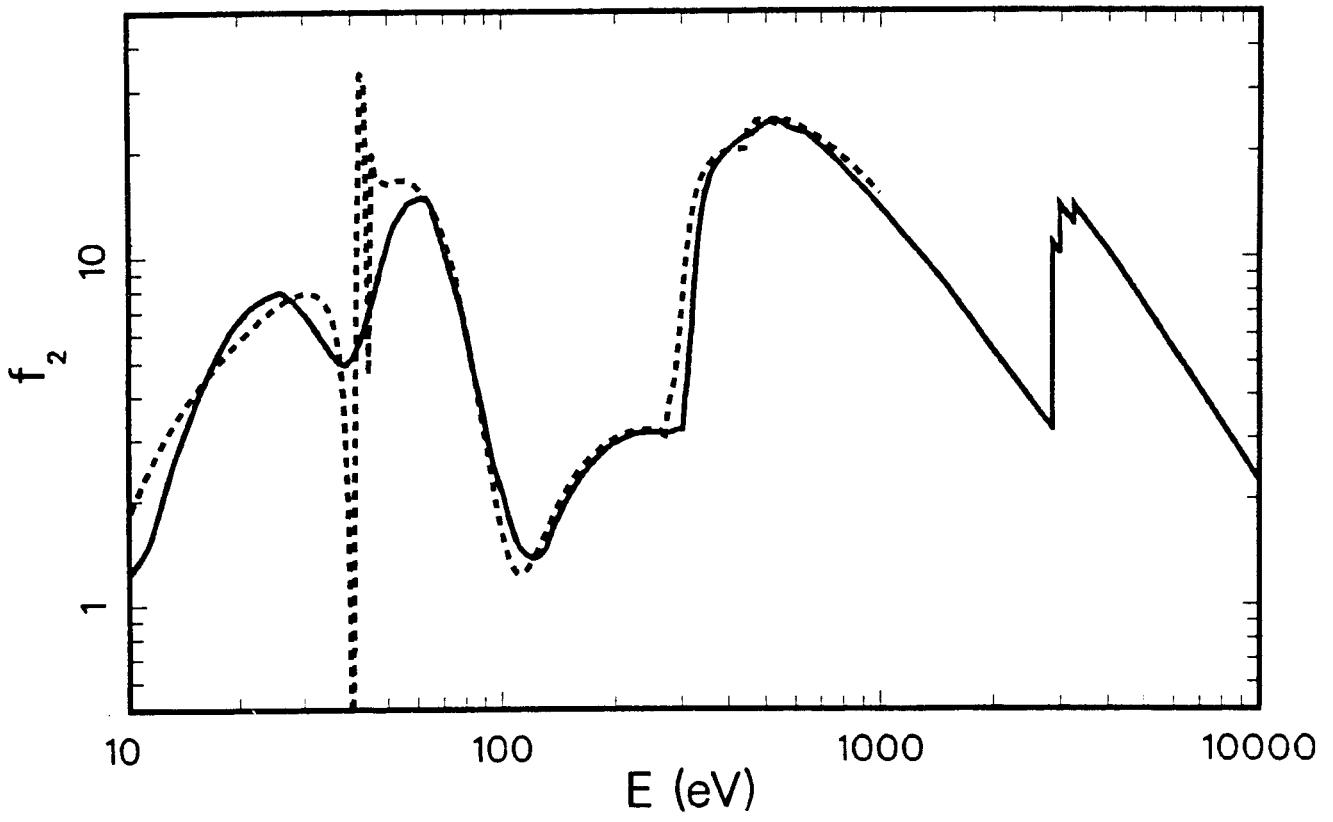


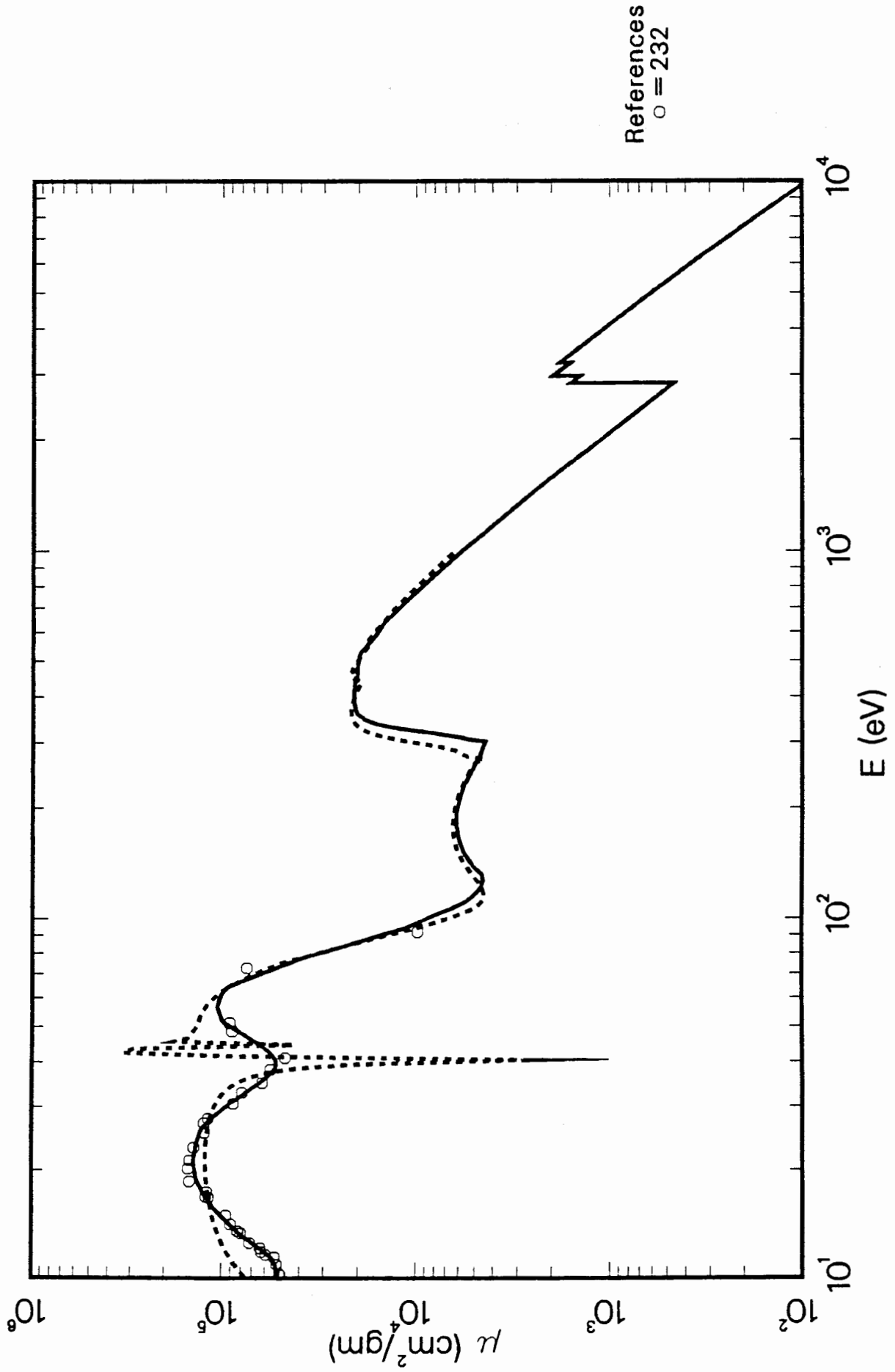



43-Tc μ Coefficients
μ (cm²/gm)
E (eV)
10⁻
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
44 - Ruthenium (Ru)






44-Ru μ Coefficients
References
○ = 232
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Ruthenium (Ru) — 44

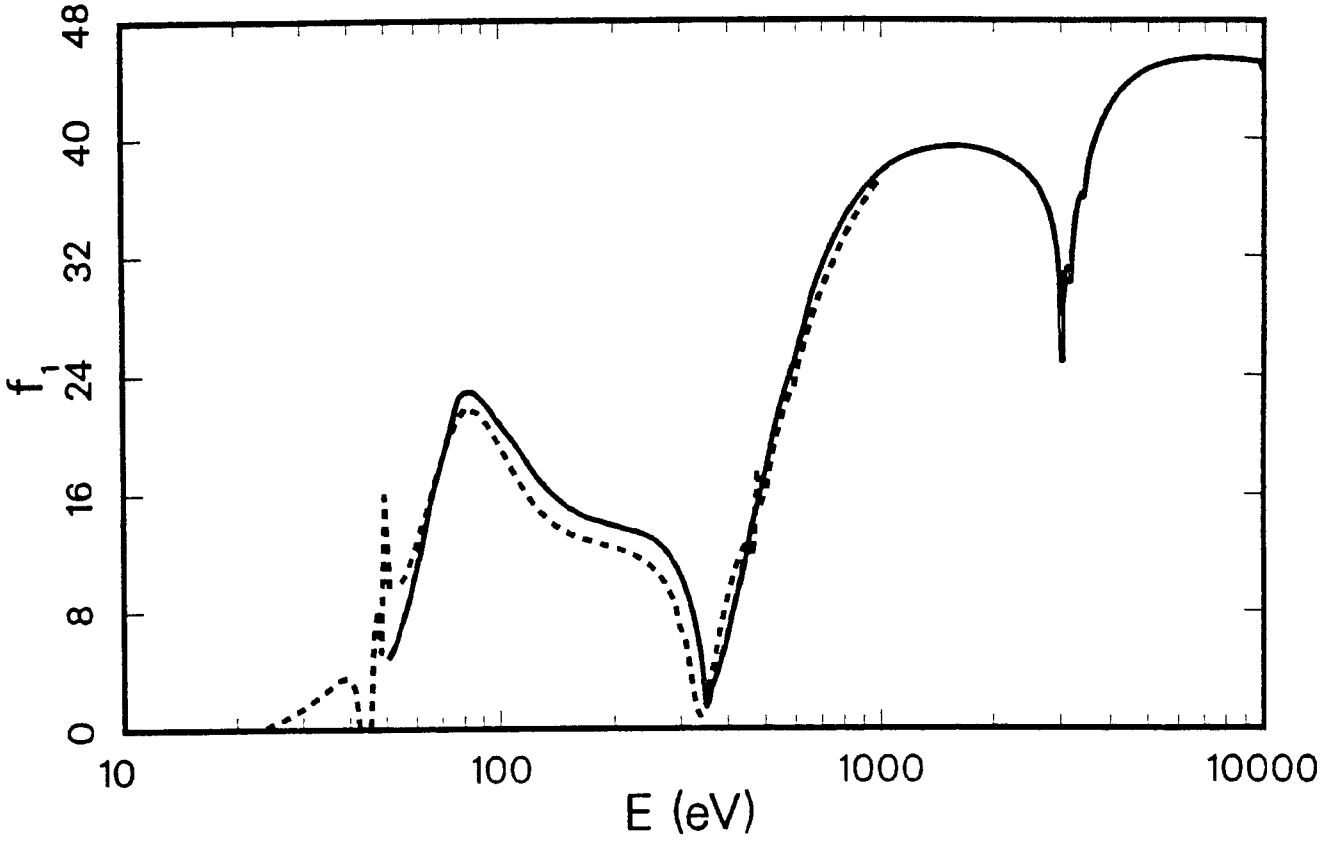
Atomic Weight = 101.07

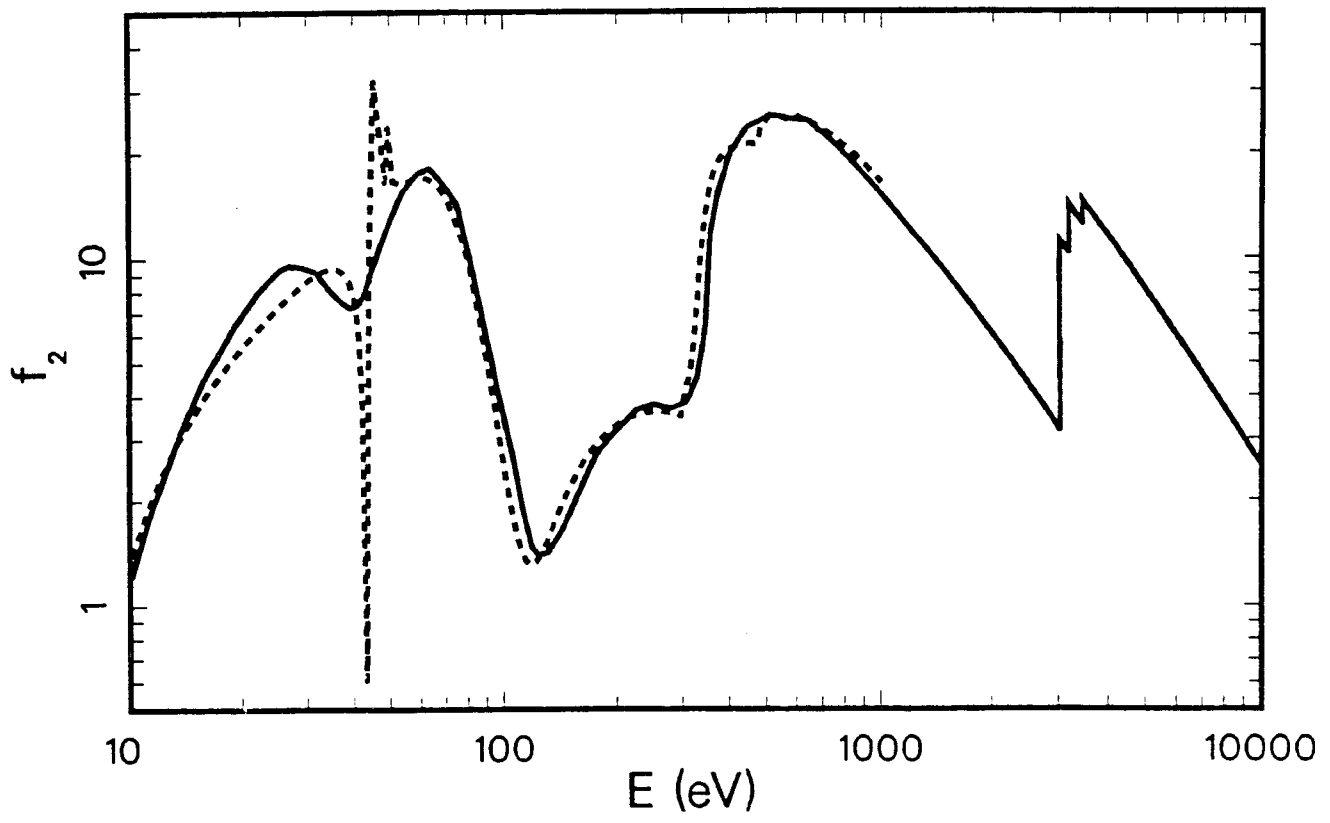
μ (barns/atom) = $\mu(cm^2/g) \times 167.83$

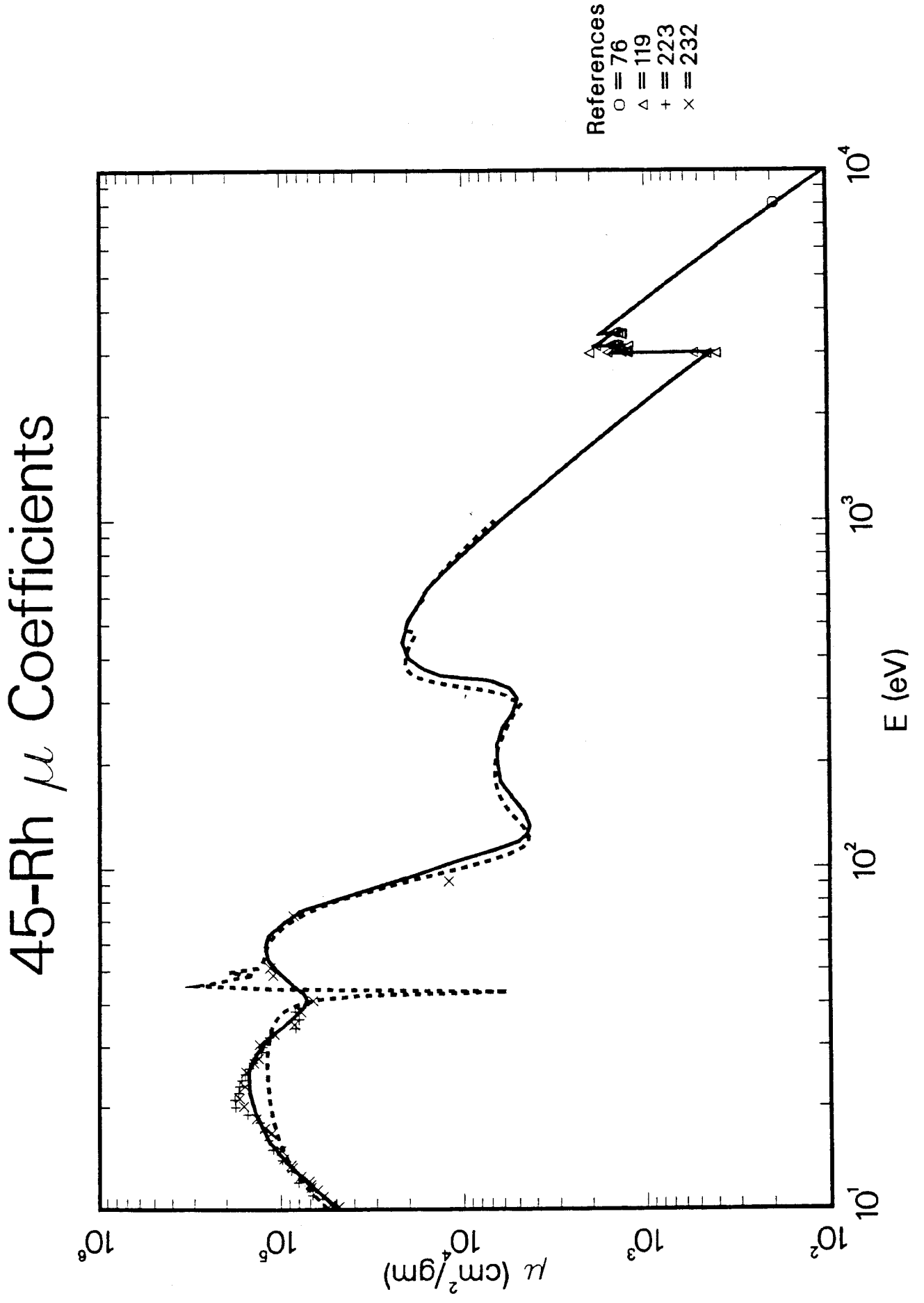
$E\mu(E) = 416.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
10.2	5.00e+4	-2.6	232
10.3	5.05e+4	-2.1	232
10.9	5.21e+4	-2.0	232
11.4	5.35e+4	-4.4	232
11.6	5.95e+4	2.7	232
11.8	6.26e+4	3.5	232
12.1	6.37e+4	-1.2	232
12.5	7.23e+4	2.9	232
13.3	8.03e+4	-2.2	232
13.5	8.34e+4	-1.1	232
14.1	9.06e+4	-1.0	232
14.9	9.53e+4	-5.8	232
16.7	1.17e+5	-2.9	232
16.8	1.21e+5	0.0	232
17.3	1.19e+5	-5.2	232
18.5	1.47e+5	10.1	232
20.1	1.50e+5	7.9	232
21.2	1.46e+5	4.3	232
23.0	1.39e+5	2.0	232
25.3	1.23e+5	-5.7	232
26.9	1.24e+5	3.4	232
27.7	1.18e+5	3.7	232
30.5	8.78e+4	-4.2	232
32.7	7.93e+4	3.8	232
34.8	6.24e+4	-3.8	232
37.9	5.64e+4	4.1	232
40.8	4.75e+4	-12.0	232
48.4	8.88e+4	6.5	232
51.0	9.16e+4	-5.1	232
72.3	7.51e+4	40.7	232
91.5	9.81e+3	-27.0	232

Atomic Scattering Factors, f_1+if_2
45 - Rhodium (Rh)






45-Rh μ Coefficients
References
○ = 76
△ = 119
+ = 223
× = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Rhodium (Rh) — 45

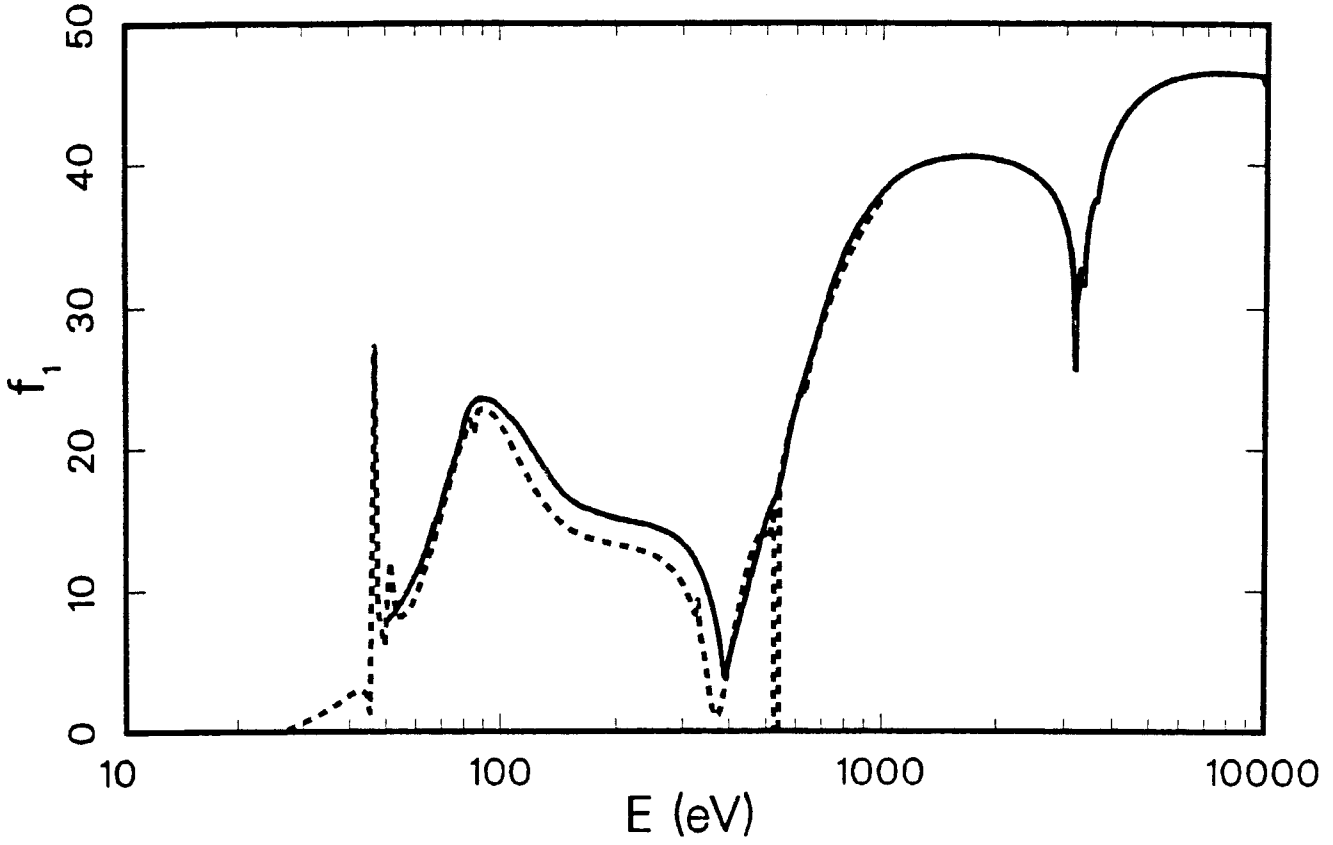
Atomic Weight = 102.90

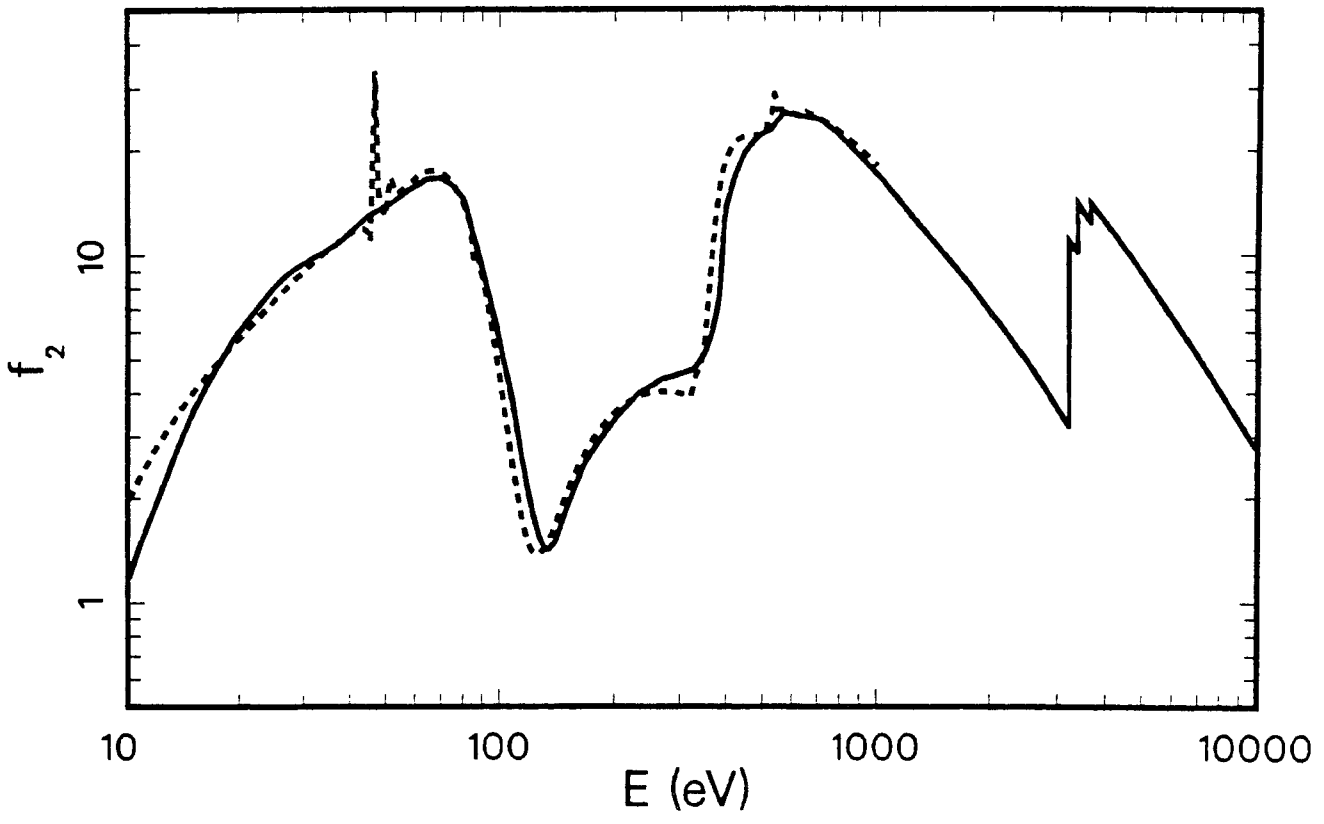
μ (barns/atom) = $\mu(cm^2/g) \times 170.88$

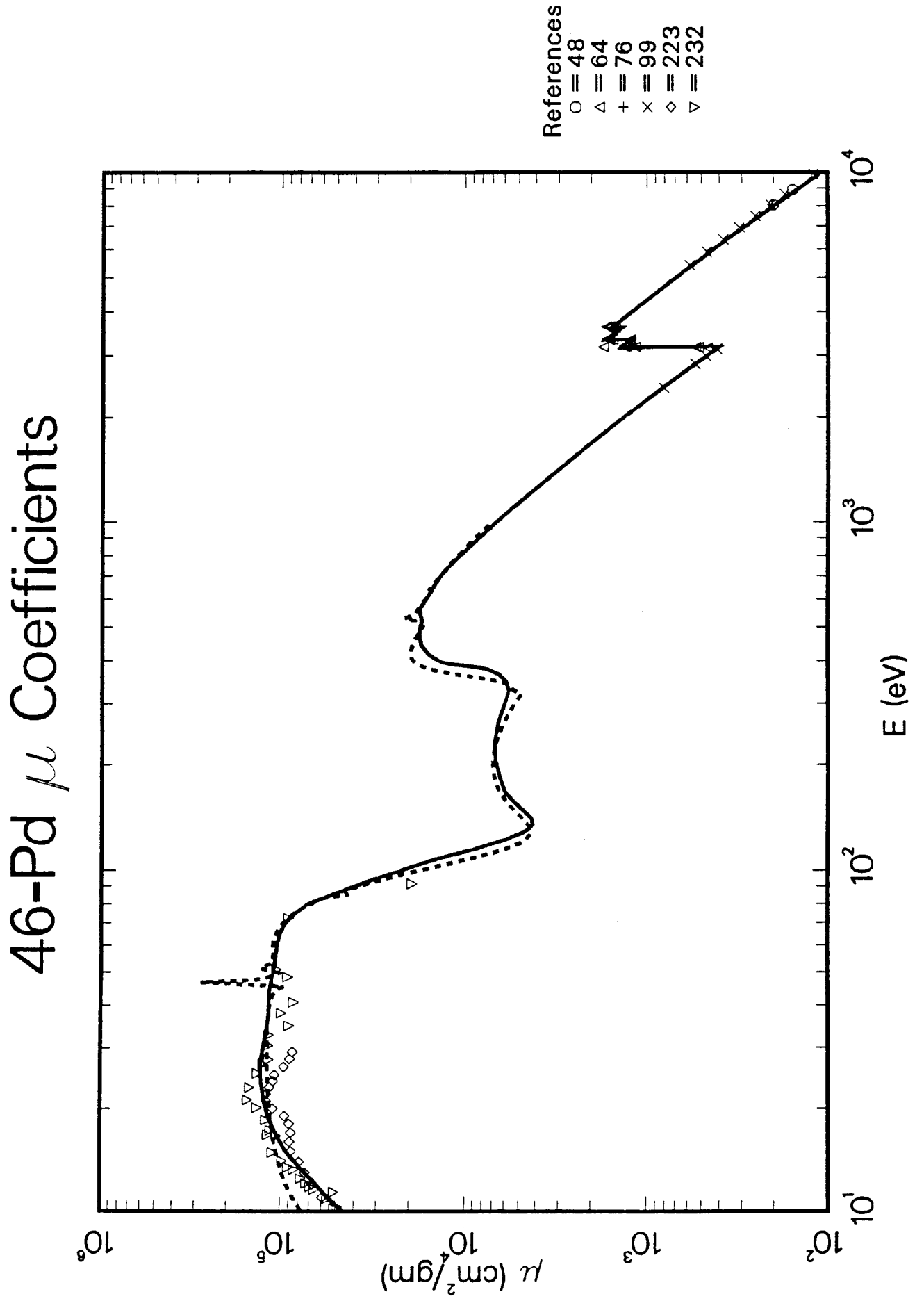
$E\mu(E) = 408.9\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8040.0	1.92e+2	3.5	76
2988.0	4.51e+2	3.2	119
2995.0	3.98e+2	-22.0	119
3000.0	5.33e+2	-10.8	119
3004.0	2.02e+3	198.1	119
3008.0	1.60e+3	108.1	119
3012.0	1.24e+3	42.5	119
3018.0	1.34e+3	27.6	119
3024.0	1.26e+3	-0.7	119
3030.0	1.23e+3	-16.9	119
3036.0	1.26e+3	-14.5	119
3137.0	1.23e+3	-27.1	119
3141.0	1.39e+3	-19.6	119
3149.0	1.85e+3	1.0	119
3153.0	1.56e+3	-15.0	119
3157.0	1.57e+3	-14.4	119
3161.0	1.54e+3	-15.8	119
3168.0	1.42e+3	-21.7	119
3174.0	1.47e+3	-18.8	119
3402.0	1.33e+3	-12.5	119
3410.0	1.35e+3	-11.9	119
3417.0	1.40e+3	-10.5	119
3425.0	1.47e+3	-7.9	119
3440.0	1.49e+3	-10.0	119
3448.0	1.44e+3	-15.0	119
10.0	5.64e+4	17.4	223
11.0	6.83e+4	13.6	223
12.0	8.04e+4	10.9	223
13.0	8.82e+4	4.9	223
14.0	9.84e+4	2.8	223
15.0	1.10e+5	3.7	223
16.0	1.16e+5	-0.2	223
17.0	1.22e+5	-0.7	223
18.0	1.29e+5	-0.1	223
19.0	1.52e+5	11.9	223
20.0	1.78e+5	26.9	223
21.0	1.80e+5	24.9	223
22.0	1.71e+5	15.4	223
23.0	1.69e+5	13.7	223
24.0	1.65e+5	10.2	223
25.0	1.57e+5	4.7	223
26.0	1.49e+5	0.7	223
27.0	1.41e+5	-2.1	223
28.0	1.35e+5	-2.6	223
29.0	1.28e+5	-3.9	223
30.0	1.25e+5	-1.7	223
32.0	1.15e+5	-0.4	223
34.0	8.34e+4	-16.4	223
36.0	7.95e+4	-9.8	223
38.0	8.39e+4	5.8	223
39.0	7.97e+4	5.1	223
10.2	4.85e+4	-3.7	232
10.3	5.44e+4	5.5	232
10.9	5.93e+4	0.7	232
11.4	6.38e+4	-2.5	232
11.6	6.89e+4	1.1	232
11.8	6.91e+4	-1.7	232
12.1	7.10e+4	-3.6	232
12.5	7.82e+4	0.0	232
13.3	8.69e+4	-0.9	232
13.5	8.80e+4	-2.3	232
14.1	9.65e+4	-0.3	232
14.9	9.97e+4	-5.4	232
16.7	1.14e+5	-6.3	232
16.8	1.12e+5	-8.0	232
17.3	1.22e+5	-2.3	232
18.5	1.35e+5	1.8	232
20.1	1.60e+5	13.5	232
21.2	1.69e+5	16.9	232
23.0	1.58e+5	5.9	232
25.3	1.56e+5	4.0	232
26.9	1.40e+5	-3.2	232
27.7	1.32e+5	-5.8	232
30.5	1.31e+5	5.4	232
32.7	1.09e+5	-0.8	232
34.8	8.46e+4	-10.4	232
37.9	7.81e+4	-2.0	232
40.8	6.74e+4	-8.1	232
48.4	1.10e+5	11.6	232
51.0	1.14e+5	5.4	232
72.3	8.57e+4	0.1	232
91.5	1.21e+4	-49.4	232

Atomic Scattering Factors, f_1+if_2
46 - Palladium (Pd)






46-Pd μ Coefficients
References
○ = 48
△ = 64
+ = 76
× = 99
◇ = 223
▽ = 232
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

Palladium (Pd) — 46

Atomic Weight = 106.40

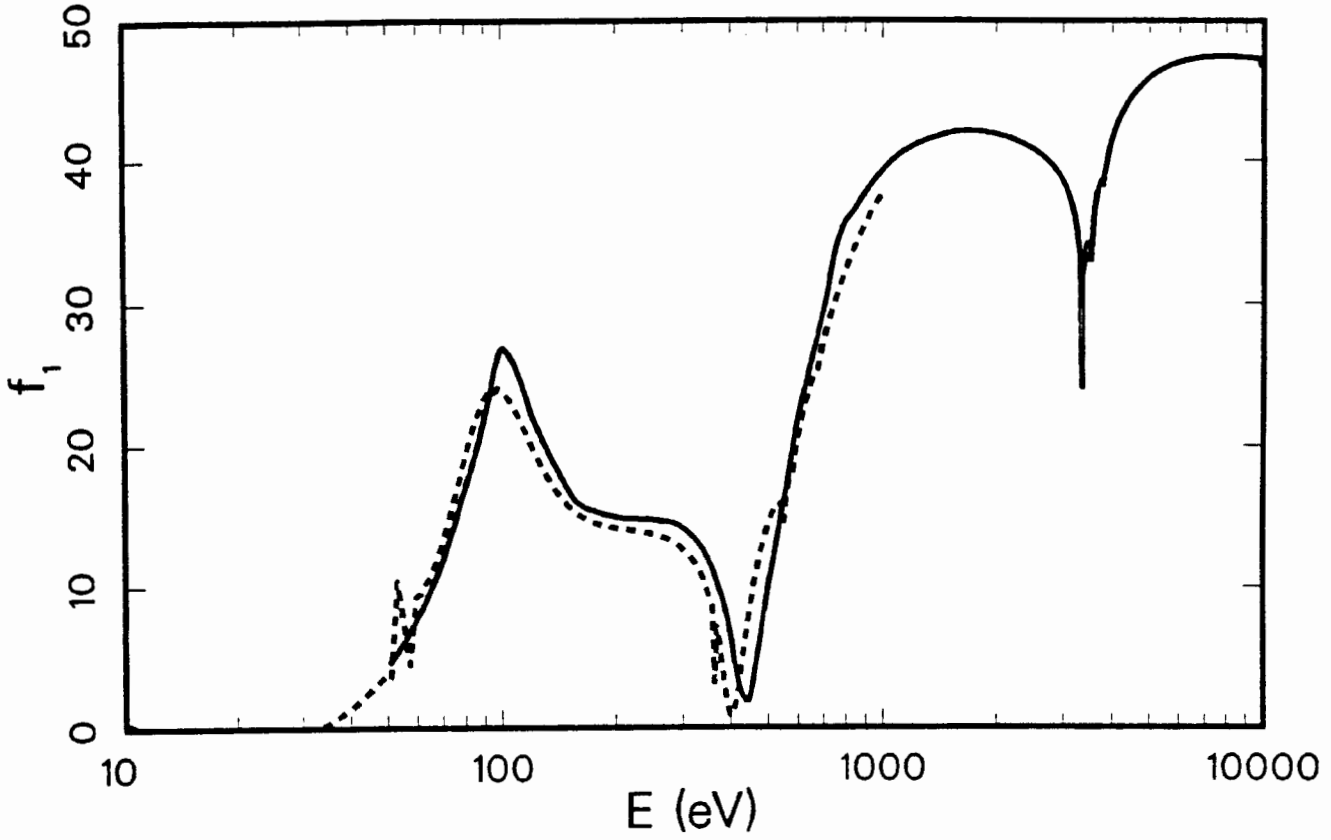
μ (barns/atom) = $\mu(cm^2/g) \times 176.68$

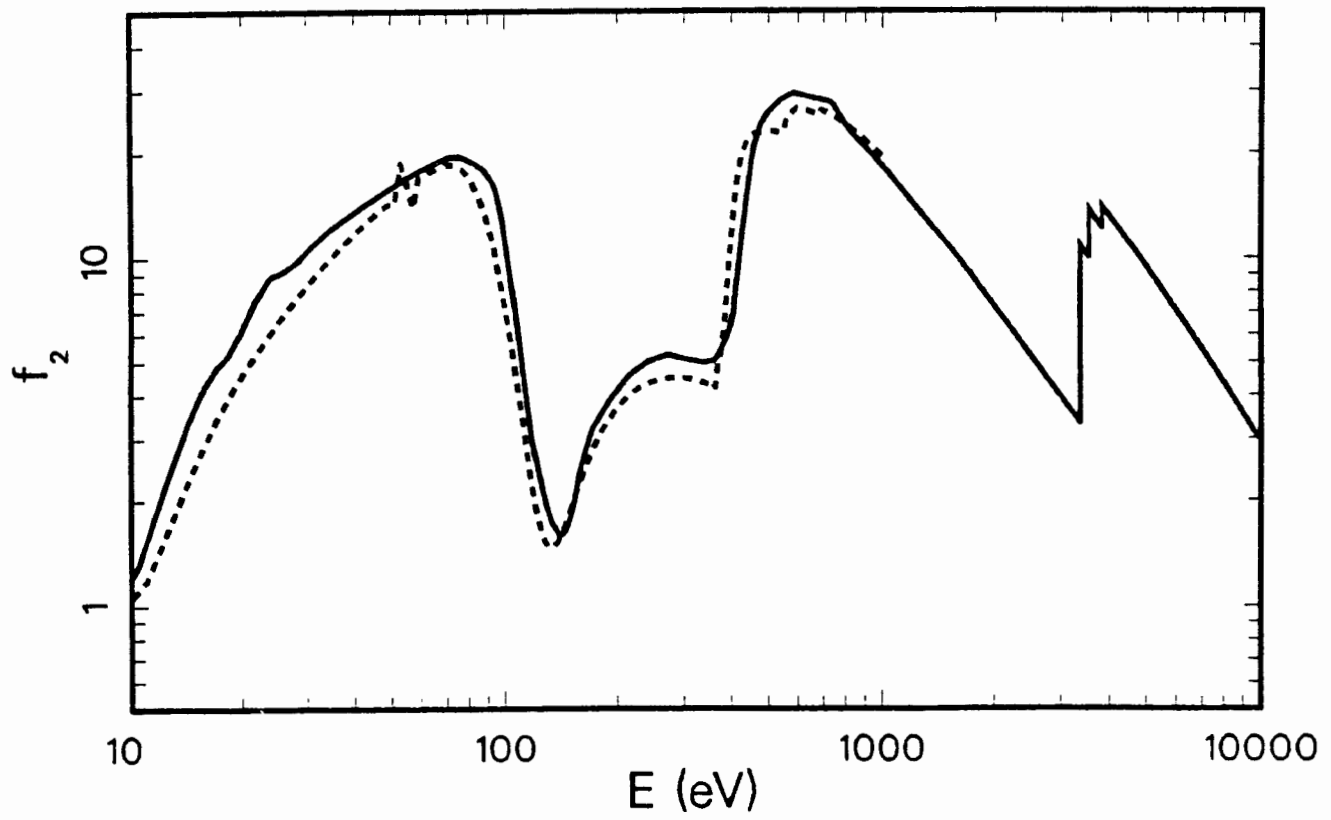
$E\mu(E) = 395.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8047.0	2.00e+2	2.1	48
8904.0	1.56e+2	5.1	48
3159.0	4.64e+2	-12.8	64
3165.0	5.21e+2	-17.9	64
3170.0	5.38e+2	-26.7	64
3175.0	1.72e+3	102.8	64
3180.0	1.15e+3	17.7	64
3185.0	1.33e+3	17.2	64
3193.0	1.31e+3	-3.0	64
3202.0	1.34e+3	0.2	64
3207.0	1.30e+3	-2.8	64
3216.0	1.29e+3	-2.5	64
3317.0	1.25e+3	2.2	64
3326.0	1.23e+3	-5.4	64
3331.0	1.59e+3	18.6	64
3338.0	1.53e+3	8.8	64
3346.0	1.63e+3	10.2	64
3355.0	1.62e+3	3.5	64
3599.0	1.48e+3	3.9	64
3606.0	1.52e+3	5.7	64
3612.0	1.60e+3	9.5	64
3618.0	1.65e+3	11.7	64
3623.0	1.65e+3	11.1	64
3632.0	1.59e+3	5.1	64
8040.0	2.04e+2	3.9	76
2422.0	8.10e+2	-2.0	99
2839.0	5.44e+2	-0.1	99
2984.0	4.73e+2	-0.5	99
3134.0	4.13e+2	-0.4	99
5415.0	5.81e+2	2.8	99
5899.0	4.69e+2	3.9	99
6404.0	3.79e+2	4.4	99
6930.0	3.08e+2	4.9	99
7478.0	2.52e+2	5.4	99
8048.0	2.08e+2	6.2	99
8639.0	1.73e+2	7.1	99
9886.0	1.20e+2	7.7	99
10.0	5.49e+4	20.7	223
11.0	5.95e+4	7.2	223
12.0	6.69e+4	4.3	223
13.0	7.36e+4	-0.2	223
14.0	7.92e+4	-5.1	223
15.0	8.74e+4	-5.9	223
16.0	8.92e+4	-10.4	223
17.0	8.76e+4	-17.4	223
18.0	8.97e+4	-19.5	223
19.0	9.47e+4	-18.9	223
20.0	1.10e+5	-8.3	223
21.0	1.19e+5	-3.0	223
22.0	1.19e+5	-4.5	223

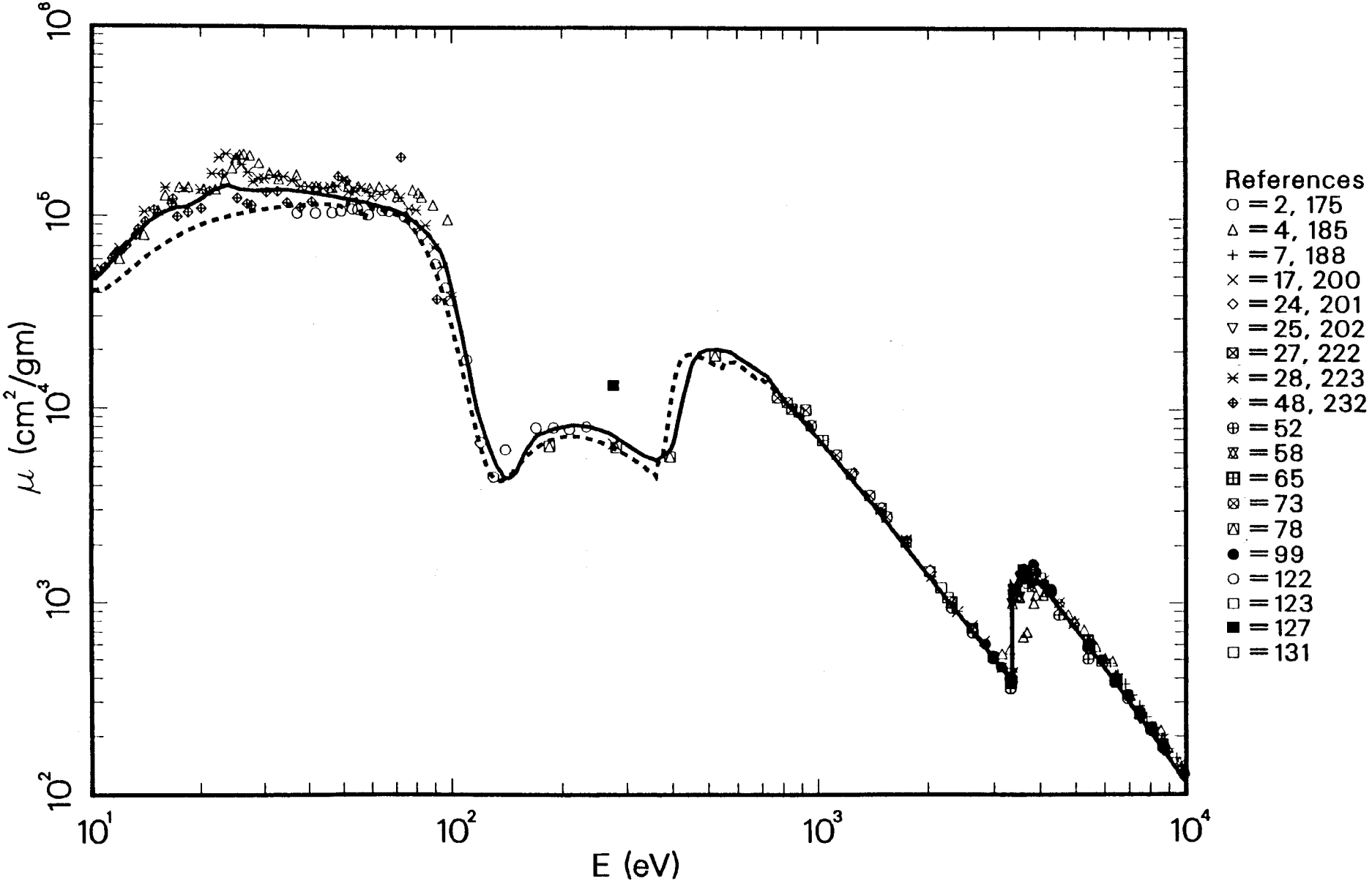
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
23.0	1.15e+5	-9.1	223
24.0	1.09e+5	-14.2	223
25.0	1.08e+5	-15.7	223
26.4	9.59e+4	-25.3	223
27.8	8.92e+4	-30.0	223
29.2	8.63e+4	-31.4	223
10.2	5.10e+4	7.5	232
10.3	4.88e+4	0.9	232
10.9	5.58e+4	2.3	232
11.4	5.14e+4	-12.7	232
11.6	6.54e+4	7.9	232
11.8	6.90e+4	10.7	232
12.1	7.23e+4	11.1	232
12.5	7.76e+4	12.8	232
13.3	8.41e+4	9.6	232
13.5	9.06e+4	15.0	232
14.1	9.72e+4	15.1	232
14.9	1.10e+5	19.7	232
16.7	1.05e+5	0.6	232
16.8	1.17e+5	11.9	232
17.3	1.13e+5	5.3	232
18.5	1.19e+5	4.7	232
20.1	1.34e+5	11.8	232
21.2	1.52e+5	23.8	232
23.0	1.48e+5	17.6	232
25.3	1.34e+5	4.4	232
26.9	1.24e+5	-3.3	232
27.7	1.16e+5	-9.2	232
30.5	1.16e+5	-6.1	232
32.7	1.16e+5	-3.7	232
34.8	9.01e+4	-23.8	232
37.9	9.93e+4	-14.5	232
40.8	8.51e+4	-26.5	232
48.4	9.15e+4	-17.8	232
51.0	1.05e+5	-3.6	232
72.3	9.04e+4	1.5	232
91.5	1.93e+4	-47.2	232

Atomic Scattering Factors, f_1+if_2
47 - Silver (Ag)





47-Ag μ Coefficients



Silver (Ag) — 47
Atomic Weight = 107.87
μ (barns/atom) = μ(cm^2/g) × 179.13
Eμ(E) = 390.1 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
5410.0	5.81e+2	-2.6	2
6400.0	3.81e+2	-0.5	2
6930.0	3.14e+2	1.4	2
7480.0	2.62e+2	3.9	2
8050.0	2.14e+2	3.6	2
8640.0	1.75e+2	2.7	2
3150.0	5.40e+2	20.1	4
3310.0	5.70e+2	43.2	4
3600.0	6.60e+2	-54.3	4
3680.0	7.00e+2	-48.7	4
3850.0	1.00e+3	-28.6	4
3900.0	1.10e+3	-19.0	4
4080.0	1.10e+3	-9.6	4
4170.0	1.15e+3	-0.3	4
4770.0	8.70e+2	5.6	4
4980.0	8.06e+2	9.2	4
5280.0	7.20e+2	13.5	4
5530.0	6.40e+2	13.7	4
5690.0	5.85e+2	12.0	4
6020.0	5.10e+2	13.2	4
6290.0	4.90e+2	22.2	4
6410.0	4.10e+2	7.5	4
6420.0	4.15e+2	9.3	4
7040.0	3.25e+2	9.5	4
8070.0	2.25e+2	9.6	4
8550.0	2.15e+2	22.6	4
8660.0	1.92e+2	13.4	4
8930.0	1.73e+2	11.1	4
9590.0	1.46e+2	13.9	4
6210.0	4.78e+2	15.1	7
6510.0	4.20e+2	14.7	7
6810.0	3.73e+2	15.0	7
7130.0	3.26e+2	13.6	7
7470.0	2.88e+2	14.0	7
7820.0	2.53e+2	13.2	7
8190.0	2.23e+2	13.0	7
8380.0	2.07e+2	11.5	7
8580.0	1.92e+2	10.5	7
8980.0	1.71e+2	11.8	7
9410.0	1.53e+2	13.7	7
9690.0	1.40e+2	12.1	7
9850.0	1.33e+2	12.1	7
9980.0	1.29e+2	12.7	7
8639.0	1.93e+2	13.2	17
9628.0	1.44e+2	13.6	17
9713.0	1.36e+2	9.9	17
9962.0	1.26e+2	9.2	17
1256.0	4.71e+3	11.2	24
1490.0	3.14e+3	9.6	24
1744.0	2.13e+3	8.9	24

E(eV)	μ(cm^2/g)	% Error	Ref.
2019.0	1.50e+3	10.0	24
2312.0	1.01e+3	4.3	24
2627.0	7.28e+2	3.2	24
3320.0	4.14e+2	-3.4	24
3698.0	1.40e+3	3.5	24
4097.0	1.26e+3	4.7	24
4517.0	9.95e+2	5.2	24
4960.0	7.74e+2	3.8	24
5423.0	6.22e+2	5.0	24
5907.0	4.93e+2	4.1	24
5423.0	6.22e+2	5.0	25
6479.0	3.97e+2	7.1	25
7487.0	2.46e+2	-2.2	25
8650.0	1.68e+2	-1.4	25
849.0	1.00e+4	-0.2	27
928.0	9.92e+3	18.7	27
1487.0	3.07e+3	6.5	28
1740.0	2.14e+3	8.9	28
2042.0	1.38e+3	4.1	28
2293.0	1.01e+3	1.9	28
2395.0	9.05e+2	1.8	28
2622.0	7.64e+2	7.7	28
2821.0	6.29e+2	6.5	28
2984.0	5.17e+2	0.6	28
3151.0	4.59e+2	2.2	28
3356.0	4.31e+2	-60.8	28
3691.0	1.45e+3	7.1	28
4090.0	1.32e+3	9.0	28
4510.0	1.01e+3	6.1	28
4952.0	7.79e+2	4.0	28
5414.0	6.12e+2	2.9	28
6403.0	3.94e+2	3.1	28
7477.0	2.64e+2	4.7	28
8047.0	2.17e+2	5.0	28
8047.0	2.16e+2	4.3	48
8904.0	1.66e+2	5.6	48
9885.0	1.27e+2	7.4	48
2312.0	9.42e+2	-3.0	52
2627.0	6.97e+2	-1.2	52
3318.0	3.56e+2	-12.5	52
3697.0	1.27e+3	-5.9	52
4516.0	8.65e+2	-8.6	52
5420.0	5.04e+2	-15.0	52
6409.0	4.01e+2	5.0	52
7484.0	2.59e+2	2.8	52
8053.0	2.20e+2	6.4	52
8644.0	1.73e+2	1.6	52
3337.0	3.80e+2	-43.3	58
3348.0	4.24e+2	-52.4	58
3358.0	9.94e+2	-14.1	58

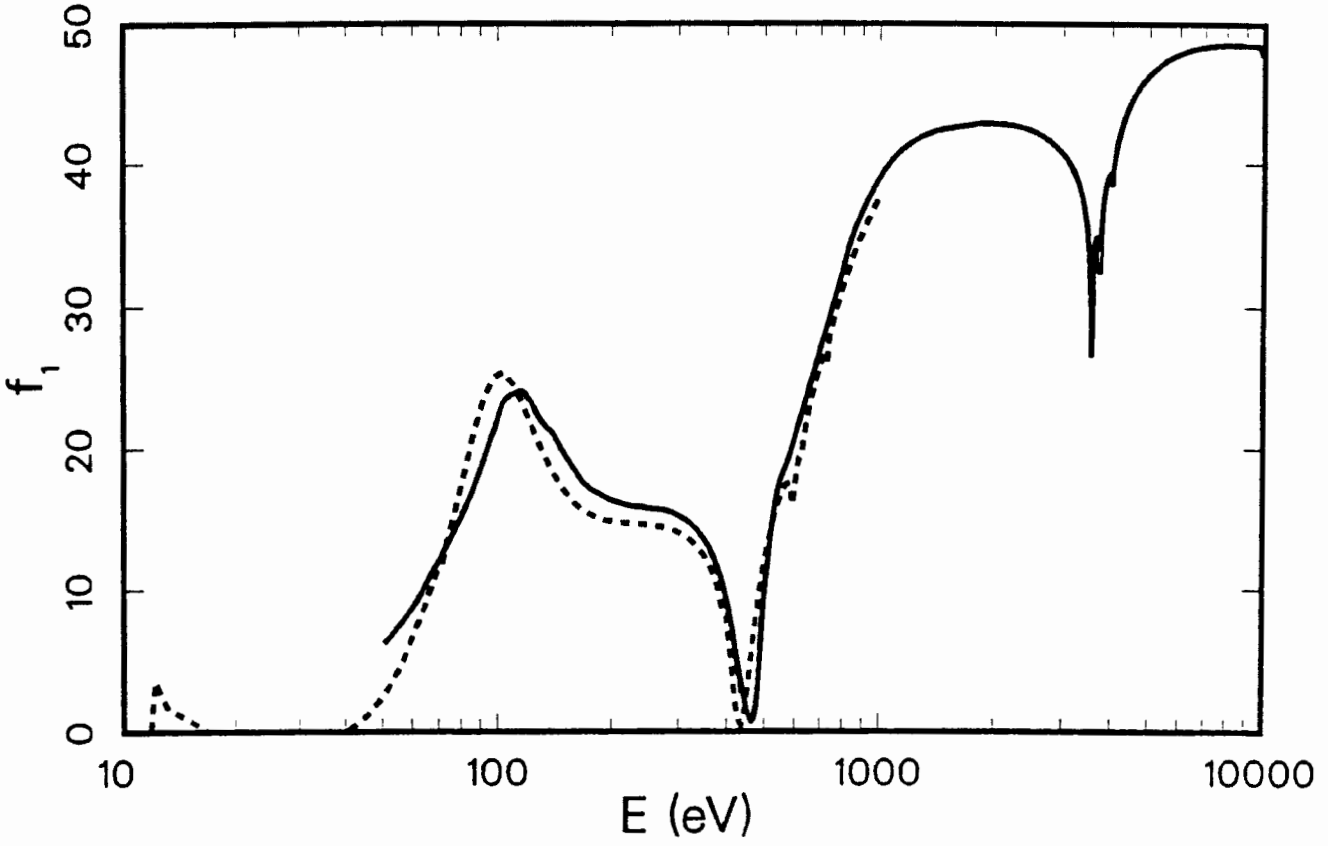
E(eV)	μ(cm^2/g)	% Error	Ref.
3369.0	1.11e+3	-11.1	58
3379.0	1.18e+3	-4.1	58
3393.0	1.15e+3	-5.9	58
3513.0	1.07e+3	-16.0	58
3523.0	1.08e+3	-20.6	58
3534.0	1.36e+3	-6.1	58
3546.0	1.34e+3	-10.6	58
3565.0	1.39e+3	-6.0	58
3583.0	1.37e+3	-6.3	58
3801.0	1.22e+3	-9.1	58
3814.0	1.32e+3	-4.7	58
3826.0	1.37e+3	-3.1	58
3836.0	1.36e+3	-3.9	58
3852.0	1.34e+3	-4.1	58
3877.0	1.36e+3	-1.0	58
1033.0	6.93e+3	4.8	65
775.0	1.15e+4	-8.2	73
824.0	1.09e+4	1.8	73
886.0	9.68e+3	5.1	73
957.0	8.26e+3	5.6	73
1127.0	5.81e+3	7.2	73
1234.0	4.63e+3	5.0	73
1385.0	3.60e+3	6.2	73
1540.0	2.81e+3	6.1	73
1739.0	2.08e+3	5.5	73
185.0	6.41e+3	-17.1	78
282.0	6.34e+3	-11.0	78
395.0	5.68e+3	-8.4	78
525.0	1.89e+4	-7.4	78
2839.0	6.06e+2	4.2	99
2984.0	5.06e+2	-1.5	99
2984.0	5.25e+2	2.1	99
3134.0	4.60e+2	1.0	99
3304.0	3.98e+2	-0.4	99
3314.0	3.96e+2	-0.3	99
3348.0	3.84e+2	-57.0	99
3444.0	1.20e+3	2.1	99
3605.0	1.51e+3	5.2	99
3663.0	1.46e+3	5.5	99
3692.0	1.47e+3	8.7	99
3769.0	1.37e+3	6.2	99
3844.0	1.60e+3	13.5	99
3905.0	1.45e+3	7.2	99
4101.0	1.26e+3	4.6	99
4287.0	1.18e+3	9.8	99
4302.0	1.15e+3	7.2	99
5415.0	6.06e+2	1.9	99
5899.0	4.98e+2	4.8	99
6404.0	4.02e+2	5.2	99
6930.0	3.27e+2	5.6	99
7478.0	2.66e+2	5.4	99
8048.0	2.20e+2	6.4	99
8639.0	1.83e+2	7.1	99
9886.0	1.28e+2	8.4	99
37.2	1.04e+5	-22.9	122

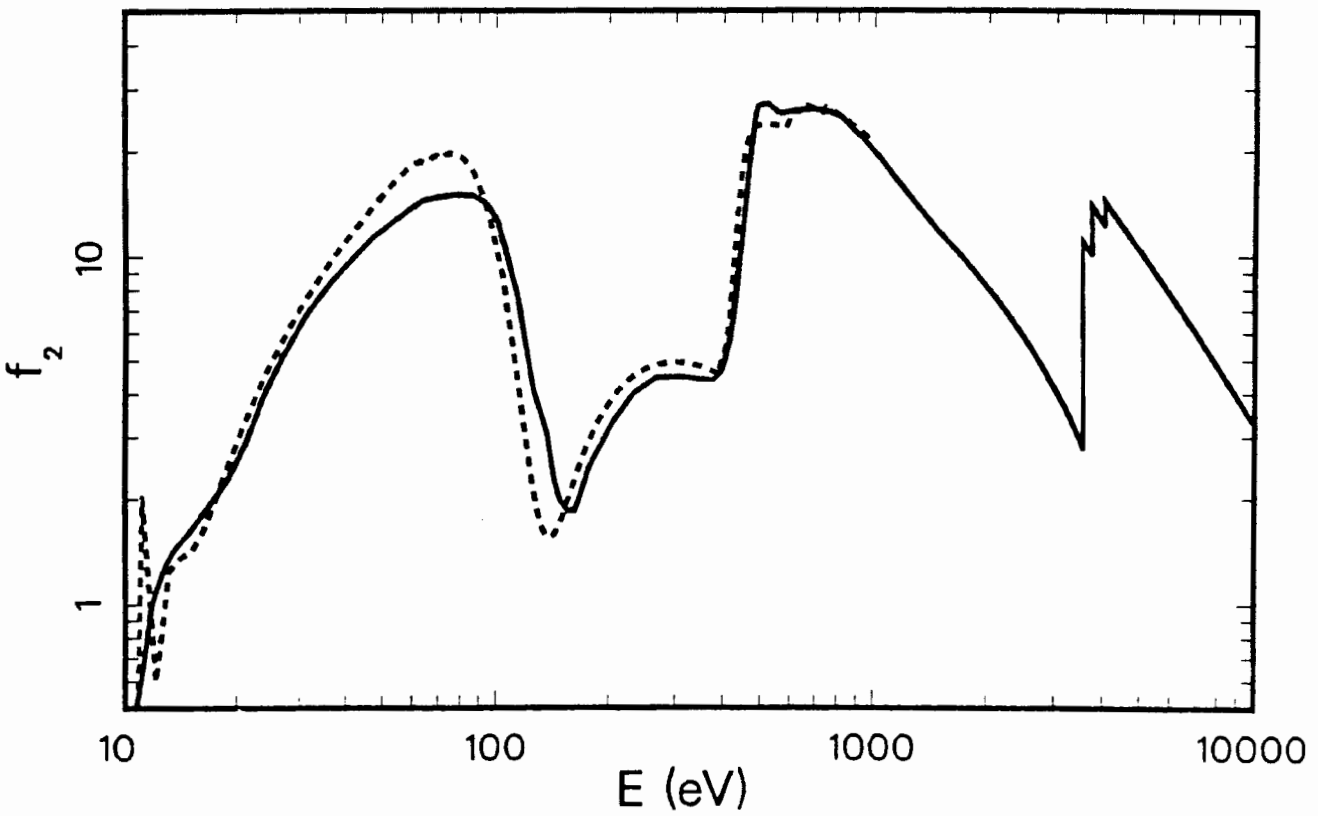
E(eV)	μ(cm^2/g)	% Error	Ref.
41.9	1.04e+5	-20.6	122
46.6	1.05e+5	-17.6	122
49.3	1.07e+5	-14.4	122
53.1	1.09e+5	-10.2	122
55.0	1.09e+5	-9.5	122
58.9	1.02e+5	-12.7	122
64.3	1.07e+5	-4.2	122
67.1	1.06e+5	-3.2	122
74.3	9.95e+4	-2.4	122
79.0	9.10e+4	-3.4	122
83.0	8.10e+4	-7.1	122
90.6	5.72e+4	-21.6	122
96.5	4.29e+4	-24.6	122
99.3	3.66e+4	-20.4	122
110.0	1.79e+4	-3.3	122
120.0	6.70e+3	-23.1	122
130.0	4.47e+3	-20.0	122
140.0	6.14e+3	38.7	122
170.0	7.98e+3	10.8	122
190.0	7.98e+3	1.2	122
210.0	7.87e+3	-4.2	122
234.0	8.10e+3	-0.4	122
1487.0	3.10e+3	7.4	123
1740.0	2.11e+3	7.0	123
2014.0	1.47e+3	7.3	123
2166.0	1.21e+3	5.4	123
2257.0	1.07e+3	3.9	123
2308.0	1.02e+3	4.5	123
2622.0	7.38e+2	4.1	123
3314.0	3.82e+2	-3.7	123
3692.0	1.40e+3	3.7	123
4012.0	1.35e+3	6.4	123
5414.0	6.34e+2	6.6	123
5898.0	4.91e+2	3.3	123
6404.0	3.94e+2	3.0	123
7478.0	2.62e+2	3.8	123
8640.0	1.81e+2	6.1	123
277.0	1.33e+4	82.2	127
8000.0	2.23e+2	6.1	131
9962.0	1.21e+2	5.3	131
6400.0	3.83e+2	0.0	175
6400.0	3.97e+2	3.7	175
6930.0	3.27e+2	5.7	175
7470.0	2.69e+2	6.2	175
8040.0	2.22e+2	7.0	175
8630.0	1.83e+2	7.0	175
10.4	5.31e+4	9.3	185
12.0	6.02e+4	-8.1	185
14.0	8.04e+4	-9.3	185
15.3	1.07e+5	6.0	185
16.0	1.28e+5	21.1	185
17.5	1.41e+5	27.2	185
18.5	1.41e+5	25.4	185
20.4	1.38e+5	10.6	185
22.0	1.38e+5	0.4	185

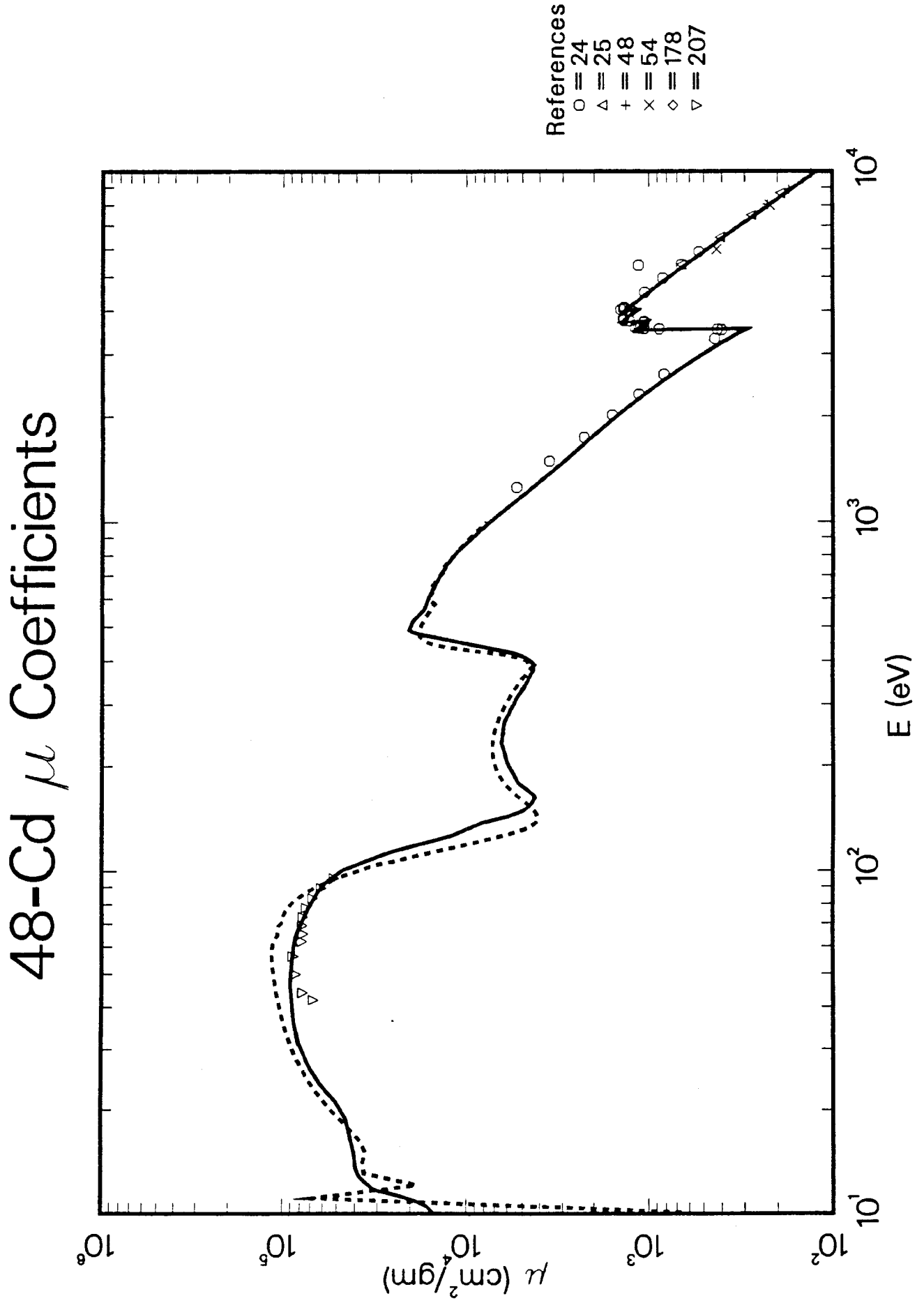
E(eV)	μ(cm^2/g)	% Error	Ref.
23.4	1.55e+5	8.3	185
24.5	1.78e+5	25.3	185
25.1	2.02e+5	44.3	185
25.7	2.10e+5	52.2	185
26.4	2.11e+5	54.2	185
27.4	2.08e+5	53.0	185
29.1	1.90e+5	39.5	185
31.1	1.68e+5	22.4	185
33.0	1.57e+5	14.1	185
37.0	1.65e+5	21.8	185
42.0	1.44e+5	9.9	185
46.6	1.42e+5	11.6	185
51.7	1.43e+5	16.6	185
55.1	1.44e+5	19.8	185
59.4	1.41e+5	20.4	185
63.1	1.43e+5	26.6	185
70.7	1.28e+5	19.4	185
78.1	1.37e+5	43.3	185
81.1	1.33e+5	46.7	185
83.0	1.27e+5	45.1	185
89.2	1.15e+5	51.5	185
97.9	9.68e+4	86.0	185
1486.0	2.96e+3	2.7	188
277.0	6.61e+3	-9.3	200
8140.0	2.06e+2	2.8	201
8136.0	2.06e+2	2.7	202
5470.0	5.92e+2	2.3	222
6470.0	3.82e+2	2.6	222
10.0	5.41e+4	16.9	223
12.0	6.83e+4	4.4	223
14.0	1.05e+5	18.9	223
16.0	1.41e+5	33.1	223
18.0	1.39e+5	24.9	223
20.0	1.37e+5	12.7	223
21.5	1.66e+5	23.8	223
22.5	2.02e+5	45.0	223
23.5	2.11e+5	46.8	223
25.0	2.00e+5	42.8	223
26.0	1.86e+5	35.1	223
27.0	1.69e+5	24.1	223
28.0	1.51e+5	11.7	223
29.0	1.57e+5	15.4	223
30.0	1.56e+5	14.5	223
32.0	1.64e+5	19.2	223
34.0	1.61e+5	17.0	223
36.0	1.53e+5	12.4	223
38.0	1.43e+5	6.5	223
40.0	1.43e+5	7.7	223
42.0	1.42e+5	8.3	223
44.0	1.40e+5	8.5	223
46.0	1.42e+5	11.4	223
48.0	1.44e+5	14.0	223
50.0	1.54e+5	24.3	223
52.0	1.36e+5	10.6	223
54.0	1.36e+5	12.0	223

E(eV)	μ(cm^2/g)	% Error	Ref.
56.0	1.41e+5	17.6	223
58.0	1.34e+5	13.8	223
60.0	1.27e+5	9.7	223
64.0	1.30e+5	15.4	223
68.0	1.38e+5	26.4	223
72.0	1.25e+5	19.0	223
76.0	1.10e+5	10.4	223
80.0	1.08e+5	17.0	223
85.0	9.03e+4	7.6	223
90.0	6.95e+4	-6.3	223
95.0	5.50e+4	-11.1	223
100.0	3.86e+4	-10.8	223
10.2	5.07e+4	6.9	232
10.3	4.88e+4	1.7	232
10.9	5.46e+4	2.9	232
11.4	6.06e+4	3.4	232
11.6	6.34e+4	4.1	232
11.8	6.59e+4	4.3	232
12.1	6.66e+4	0.0	232
12.5	7.09e+4	-0.7	232
13.3	8.02e+4	-0.4	232
13.5	8.55e+4	3.2	232
14.1	9.38e+4	4.4	232
14.9	1.08e+5	10.4	232
16.7	1.16e+5	6.7	232
16.8	1.22e+5	11.9	232
17.3	9.93e+4	-10.4	232
18.5	1.04e+5	-7.4	232
20.1	1.10e+5	-10.6	232
21.2	1.35e+5	2.5	232
23.0	1.66e+5	17.0	232
25.3	1.24e+5	-11.0	232
26.9	1.16e+5	-15.2	232
27.7	1.14e+5	-16.4	232
30.5	1.33e+5	-2.9	232
32.7	1.35e+5	-1.9	232
34.8	1.18e+5	-14.2	232
37.9	1.11e+5	-17.2	232
40.8	1.19e+5	-9.9	232
48.4	1.62e+5	28.6	232
51.0	1.53e+5	23.7	232
72.3	2.05e+5	95.4	232
91.5	3.74e+4	-47.4	232

Atomic Scattering Factors, f_1+if_2
48 - Cadmium (Cd)






48-Cd μ Coefficients
References
○ = 24
△ = 25
+ = 48
× = 54
◇ = 178
▽ = 207
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Cadmium (Cd) — 48

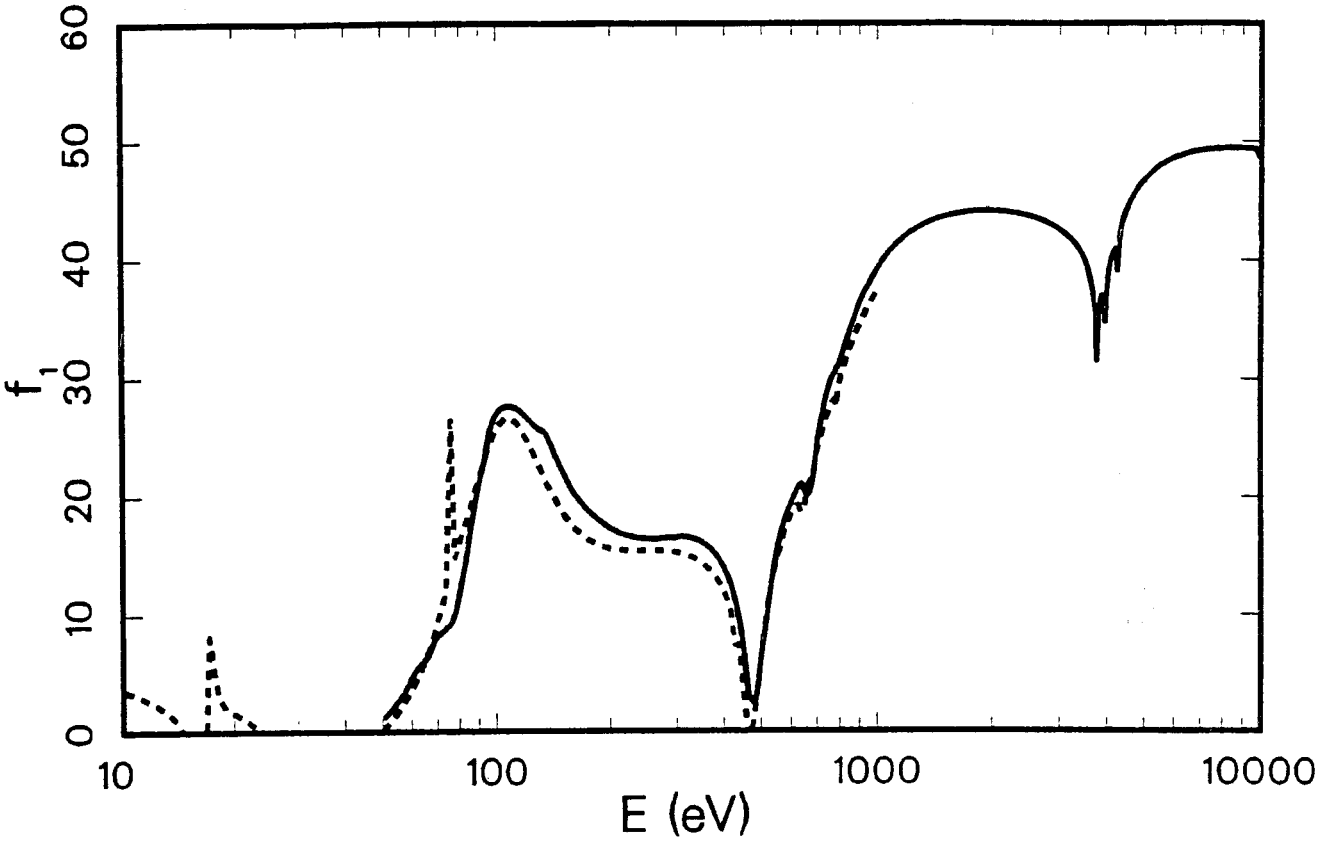
Atomic Weight = 112.40

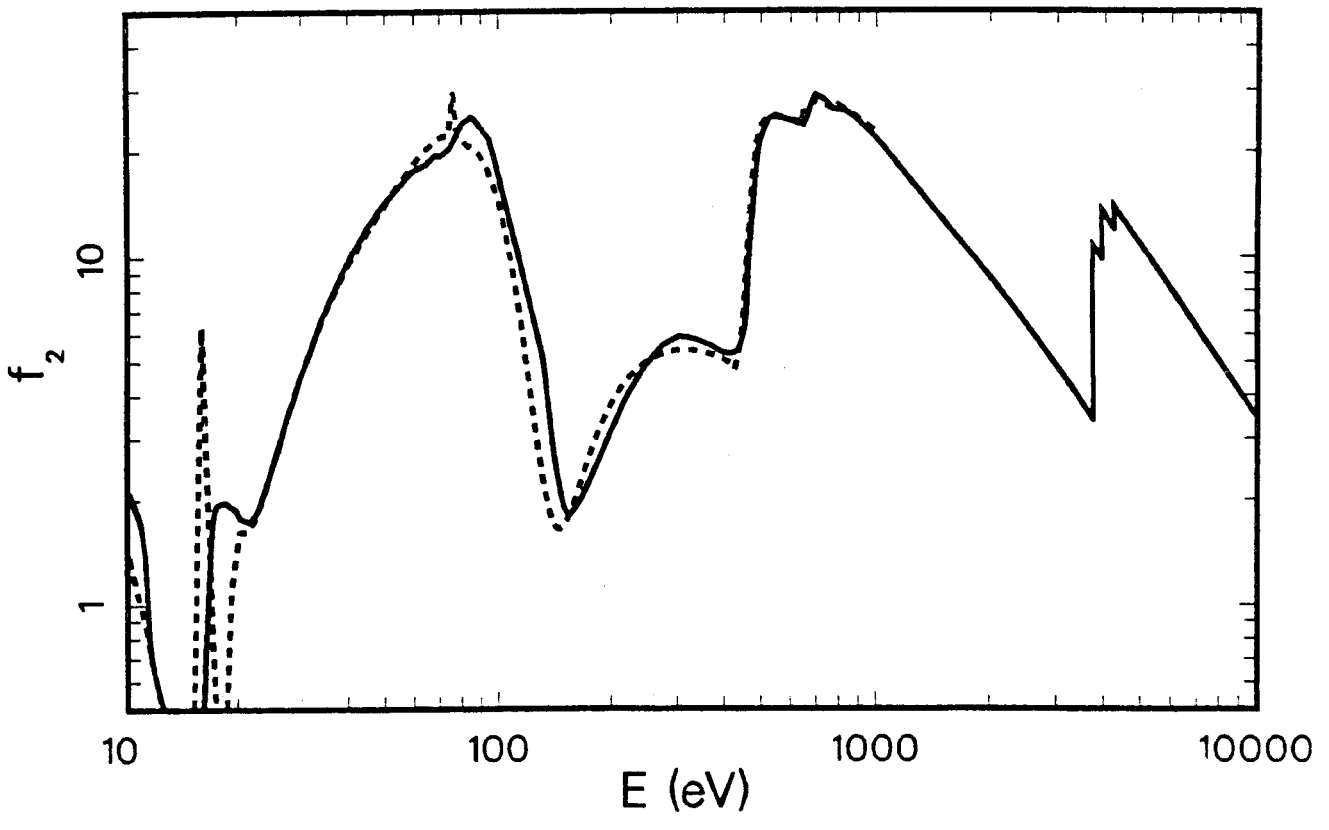
μ (barns/atom) = $\mu(cm^2/g) \times 186.65$

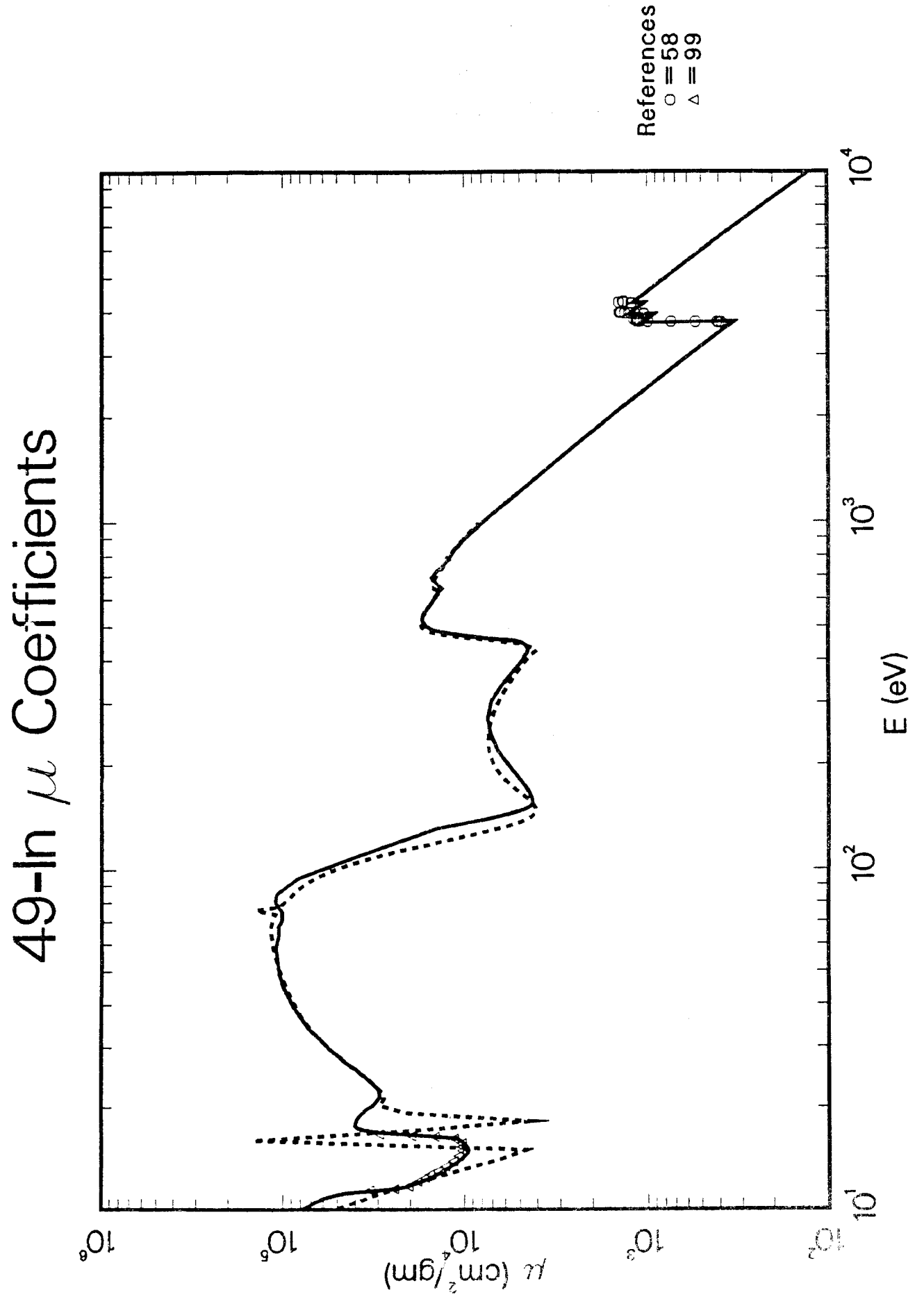
$E\mu(E) = 374.4\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1256.0	5.35e+3	21.6	24
1490.0	3.58e+3	20.8	24
1744.0	2.29e+3	9.7	24
2019.0	1.59e+3	7.5	24
2312.0	1.14e+3	7.6	24
2627.0	8.26e+2	10.0	24
3320.0	4.38e+2	18.6	24
3520.0	4.02e+2	-38.8	24
3534.0	4.23e+2	-56.9	24
3544.0	8.79e+2	-24.4	24
3554.0	1.06e+3	-8.1	24
3564.0	1.11e+3	-2.8	24
3575.0	1.19e+3	4.5	24
3586.0	1.14e+3	0.6	24
3698.0	1.07e+3	-9.4	24
3727.0	1.07e+3	-23.3	24
3738.0	1.28e+3	-8.8	24
3750.0	1.38e+3	-0.3	24
3763.0	1.38e+3	0.7	24
3777.0	1.37e+3	0.8	24
3793.0	1.39e+3	3.2	24
4015.0	1.28e+3	-0.7	24
4029.0	1.43e+3	7.5	24
4044.0	1.38e+3	4.2	24
4066.0	1.36e+3	3.6	24
4090.0	1.38e+3	6.8	24
4097.0	1.37e+3	6.8	24
4517.0	1.05e+3	4.9	24
4960.0	8.38e+2	5.7	24
5397.0	1.14e+3	79.2	24
5423.0	6.65e+2	5.7	24
5907.0	5.33e+2	6.1	24
5423.0	6.65e+2	5.7	25
6479.0	4.10e+2	4.1	25
7487.0	2.79e+2	4.3	25
8650.0	1.93e+2	6.9	25
8047.0	2.25e+2	2.5	48
8904.0	1.73e+2	3.5	48
9885.0	1.30e+2	3.0	48
6000.0	4.27e+2	-11.5	54
8000.0	2.20e+2	-1.5	54
10000.0	1.18e+2	-3.3	54
4012.0	1.21e+3	-5.6	178
42.1	6.78e+4	-23.8	207
44.2	7.75e+4	-13.6	207
50.0	8.46e+4	-5.8	207
56.5	8.73e+4	-0.7	207
62.4	7.84e+4	-8.8	207
65.7	7.73e+4	-7.5	207
69.5	7.79e+4	-2.8	207
73.5	7.73e+4	1.2	207
78.3	7.46e+4	3.2	207
83.7	6.85e+4	1.7	207
89.4	6.16e+4	-0.4	207
95.4	5.25e+4	-3.6	207

Atomic Scattering Factors, f_1+if_2
49 - Indium (In)



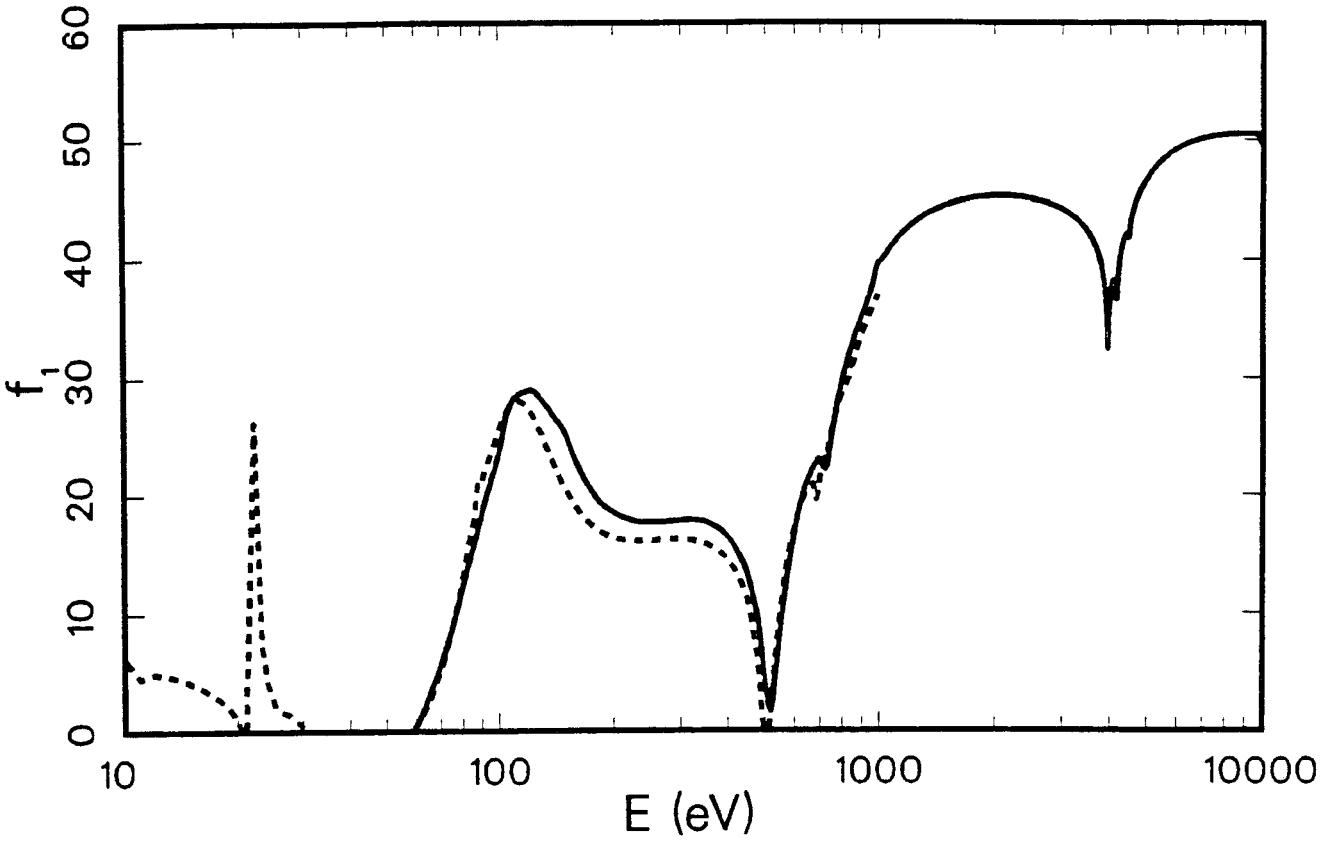


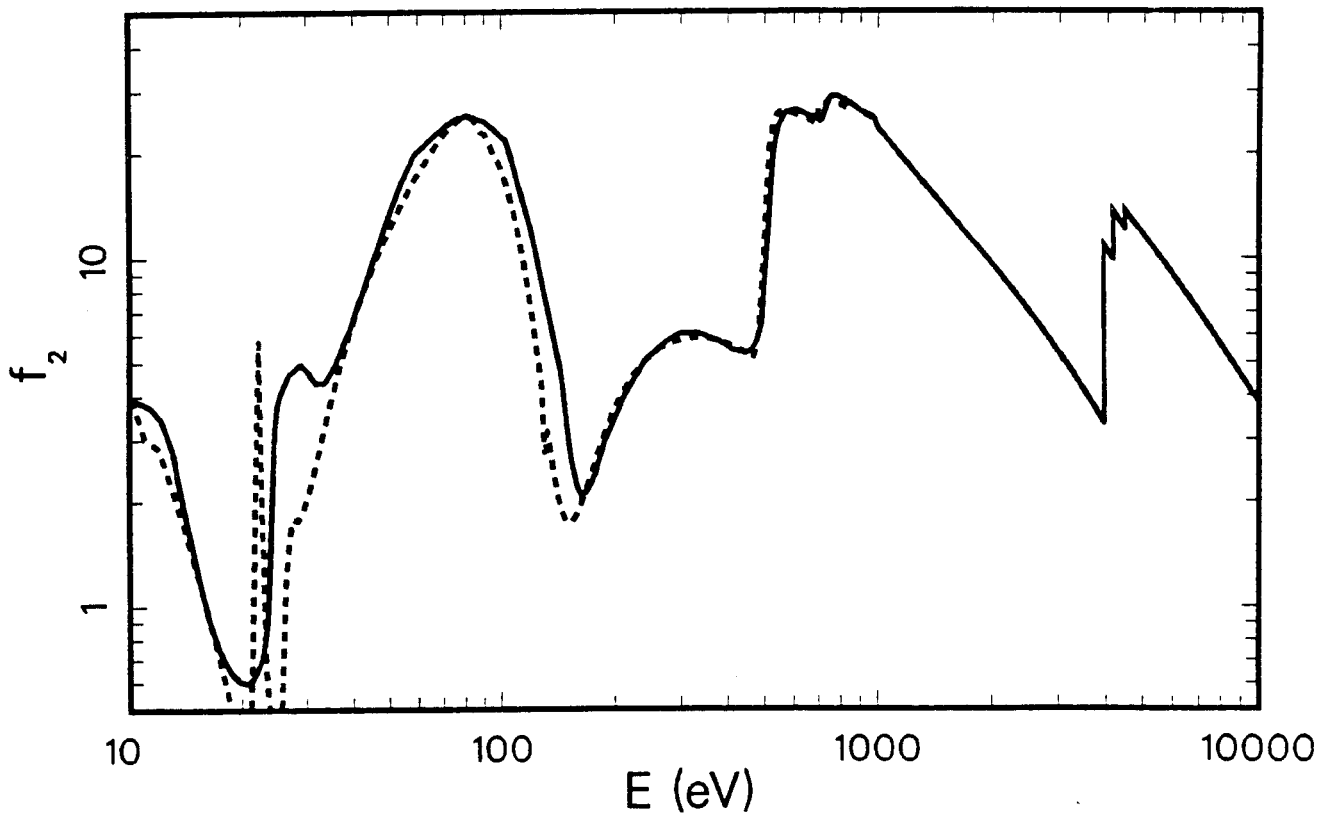

49-In μ Coefficients
References
○ = 58
△ = 99
μ (cm²/gm)
E (eV)
10⁸
10⁶
10⁴
10³
10²
10¹
10⁴
10³
10²

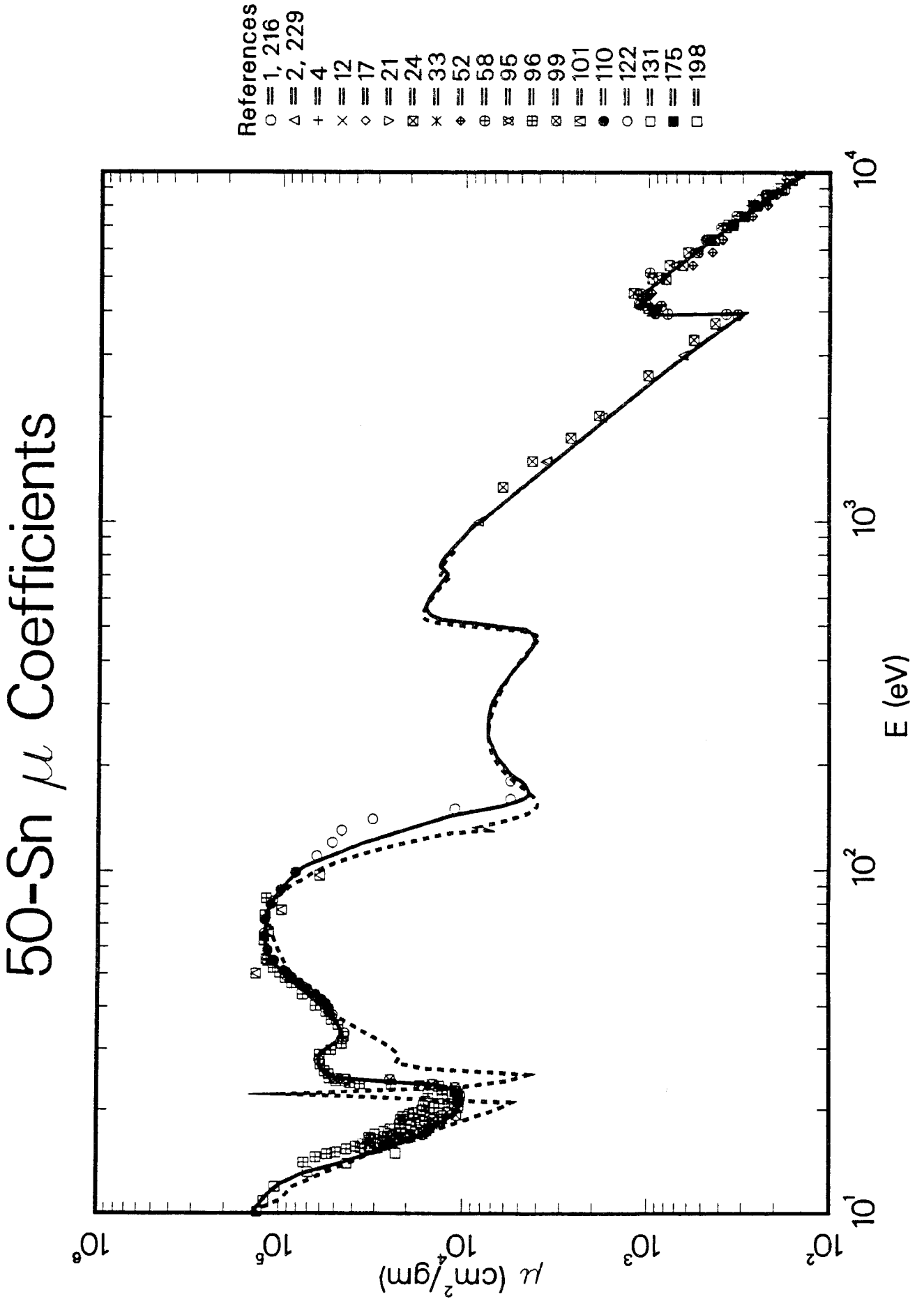
Indium (In) — 49
Atomic Weight = 114.82
μ (barns/atom) = $\mu(cm^2/g) \times 190.67$
$E\mu(E) = 366.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
3712.0	3.99e+2	18.6	58
3721.0	3.88e+2	16.2	58
3726.0	4.09e+2	22.9	58
3731.0	5.40e+2	55.2	58
3736.0	7.40e+2	89.0	58
3741.0	9.91e+2	125.3	58
3749.0	1.12e+3	111.7	58
3755.0	1.09e+3	78.9	58
3764.0	1.15e+3	52.8	58
3777.0	1.15e+3	13.0	58
3789.0	1.18e+3	17.0	58
3801.0	1.13e+3	12.7	58
3930.0	1.04e+3	10.9	58
3935.0	1.05e+3	9.0	58
3940.0	1.16e+3	17.2	58
3946.0	1.23e+3	20.6	58
3951.0	1.32e+3	25.8	58
3958.0	1.39e+3	27.4	58
3964.0	1.39e+3	23.3	58
3971.0	1.42e+3	21.4	58
3978.0	1.39e+3	14.3	58
4220.0	1.22e+3	7.8	58
4232.0	1.22e+3	5.3	58
4238.0	1.35e+3	14.7	58
4244.0	1.43e+3	20.4	58
4257.0	1.36e+3	14.8	58
4272.0	1.35e+3	14.9	58
11.4	3.37e+4	11.8	99
11.5	2.46e+4	-2.3	99
11.7	2.05e+4	-2.1	99
12.1	1.83e+4	4.5	99
12.4	1.66e+4	7.7	99
12.7	1.56e+4	9.8	99
13.0	1.41e+4	7.3	99
13.4	1.28e+4	7.3	99
13.9	1.15e+4	7.0	99
14.4	1.08e+4	8.9	99
14.9	1.04e+4	9.0	99
15.3	1.03e+4	7.1	99
15.7	1.04e+4	2.6	99
16.2	1.15e+4	4.0	99
16.4	1.47e+4	6.8	99
16.5	1.99e+4	12.0	99
16.7	2.96e+4	26.7	99

Atomic Scattering Factors, f_1+if_2
50 - Tin (Sn)






50-Sn μ Coefficients
References
1, 216
2, 229
4
12
17
21
24
33
52
58
95
96
99
101
110
122
131
175
198
μ (cm²/gm)
E (eV)
10⁸
10⁶
10⁴
10³
10²
10¹
10²
10³
10⁴

Tin (Sn) — 50
Atomic Weight = 118.69
μ (barns/atom) = μ(cm^2/g) × 197.09
Eμ(E) = 354.5 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
6400.0	4.80e+2	7.7	1
6930.0	3.96e+2	9.5	1
7470.0	3.26e+2	10.0	1
8630.0	2.27e+2	12.8	1
5410.0	7.14e+2	4.5	2
6400.0	4.72e+2	6.0	2
6930.0	3.92e+2	8.4	2
7480.0	3.28e+2	10.9	2
8050.0	2.72e+2	12.0	2
8640.0	2.25e+2	12.0	2
6410.0	4.90e+2	10.5	4
7040.0	3.85e+2	10.9	4
7490.0	3.25e+2	10.3	4
8660.0	2.35e+2	17.8	4
8930.0	2.05e+2	11.6	4
9590.0	1.76e+2	16.4	4
8060.0	2.54e+2	4.9	12
8650.0	2.11e+2	5.4	12
9273.0	1.74e+2	5.1	12
9894.0	1.46e+2	5.1	12
8398.0	2.47e+2	13.9	17
8639.0	2.30e+2	14.4	17
9628.0	1.74e+2	16.3	17
9713.0	1.66e+2	13.6	17
9962.0	1.53e+2	12.2	17
8064.0	2.55e+2	5.5	21
8656.0	2.10e+2	5.0	21
1256.0	6.26e+3	27.7	24
1490.0	4.33e+3	30.6	24
1744.0	2.69e+3	16.1	24
2019.0	1.89e+3	15.0	24
2627.0	1.01e+3	15.9	24
3320.0	5.61e+2	17.9	24
3698.0	4.27e+2	20.2	24
4097.0	1.01e+3	15.6	24
4517.0	1.22e+3	15.0	24
4953.0	8.00e+2	-5.8	24
4960.0	9.58e+2	13.1	24
5414.0	6.48e+2	-5.0	24
5423.0	7.64e+2	12.5	24
5907.0	6.03e+2	10.1	24
6404.0	4.32e+2	-2.8	24
6939.0	3.70e+2	2.6	24
8040.0	2.62e+2	7.6	24
8640.0	2.18e+2	8.6	24
8047.0	2.68e+2	10.0	33
4516.0	9.62e+2	-9.2	52
5420.0	5.69e+2	-16.4	52
5904.0	4.43e+2	-19.2	52
6409.0	3.88e+2	-12.6	52

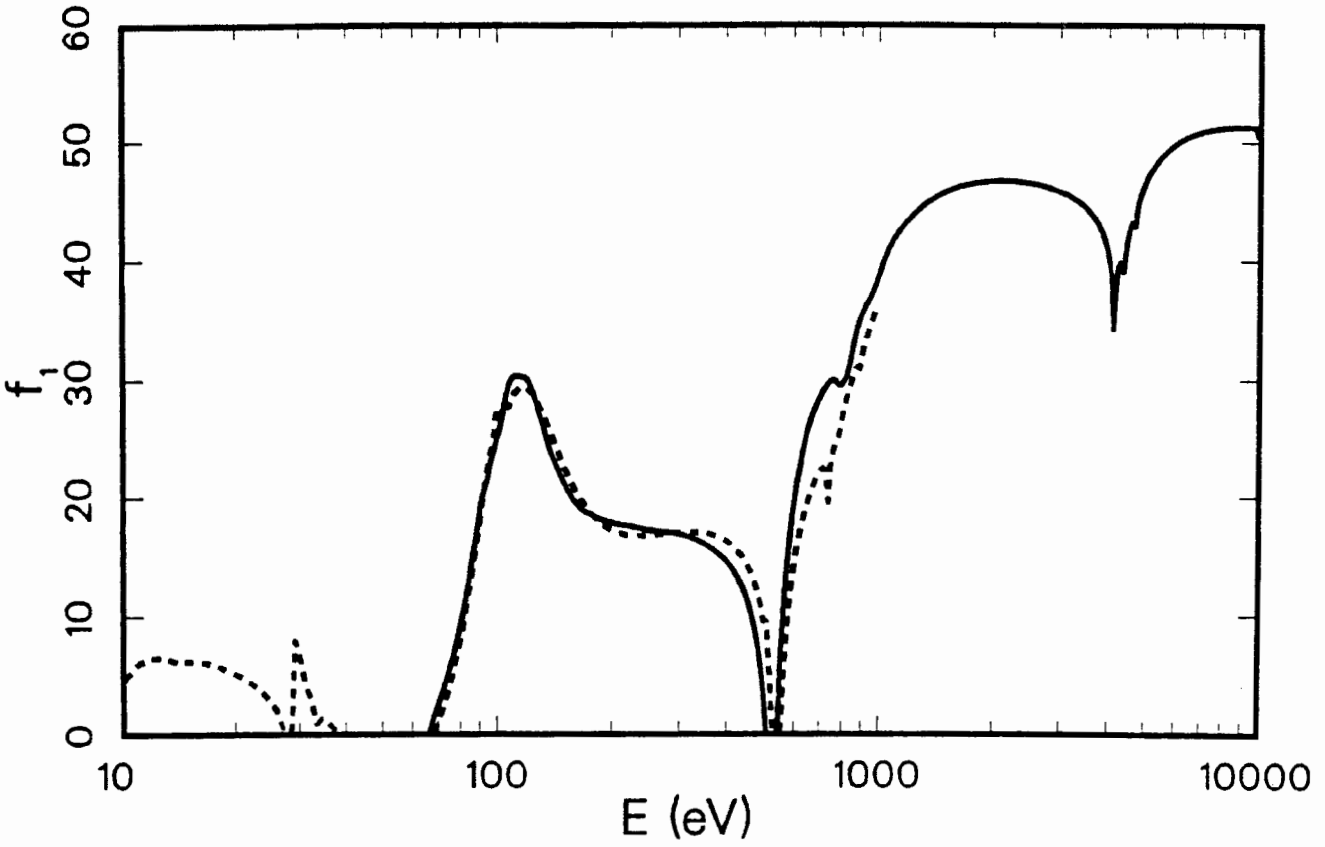
E(eV)	μ(cm^2/g)	% Error	Ref.
7484.0	2.67e+2	-9.6	52
8053.0	2.19e+2	-9.7	52
8644.0	1.94e+2	-3.2	52
3910.0	3.20e+2	5.3	58
3928.0	3.70e+2	20.8	58
3938.0	7.81e+2	104.1	58
3951.0	9.18e+2	80.0	58
3968.0	9.18e+2	23.8	58
3995.0	9.49e+2	1.5	58
4146.0	8.52e+2	-4.8	58
4164.0	1.03e+3	4.6	58
4177.0	1.12e+3	6.4	58
4198.0	1.14e+3	1.1	58
4460.0	1.02e+3	-4.3	58
4472.0	1.15e+3	6.2	58
4496.0	1.11e+3	3.8	58
5162.0	9.89e+2	28.8	58
8048.0	2.53e+2	3.9	95
10000.0	1.50e+2	11.3	95
14.1	7.31e+4	58.2	96
14.6	6.32e+4	68.2	96
14.9	5.47e+4	64.4	96
15.1	4.93e+4	60.7	96
15.4	4.28e+4	56.3	96
15.5	3.60e+4	36.0	96
15.7	3.83e+4	55.2	96
15.7	3.20e+4	29.7	96
15.9	3.49e+4	51.2	96
16.0	2.96e+4	32.8	96
16.3	2.70e+4	33.9	96
16.3	3.22e+4	59.5	96
16.5	3.13e+4	64.9	96
16.6	2.56e+4	38.3	96
16.6	3.23e+4	74.4	96
16.8	2.42e+4	37.4	96
17.0	2.25e+4	34.2	96
17.0	2.98e+4	77.4	96
17.2	2.15e+4	34.5	96
17.3	2.67e+4	71.2	96
17.6	2.01e+4	36.7	96
17.6	2.45e+4	66.9	96
18.0	1.87e+4	36.7	96
18.1	2.18e+4	62.1	96
18.3	2.14e+4	64.9	96
18.4	1.76e+4	38.2	96
18.7	1.69e+4	38.0	96
18.7	2.15e+4	75.8	96
19.1	1.58e+4	35.4	96
19.1	2.09e+4	78.7	96
19.4	1.92e+4	70.1	96

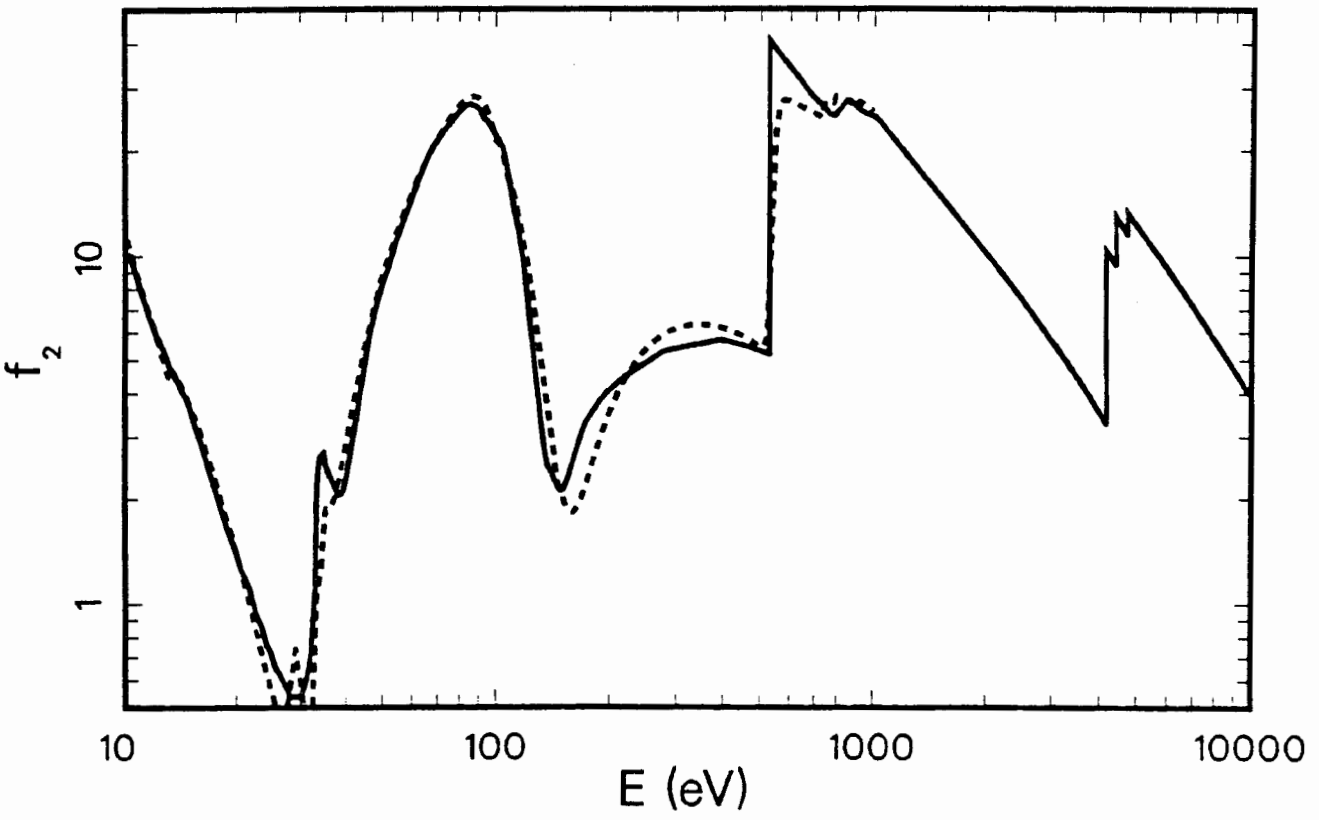
E(eV)	μ(cm^2/g)	% Error	Ref.
19.6	1.48e+4	34.5	96
19.6	1.83e+4	65.4	96
20.0	1.65e+4	54.4	96
20.3	1.41e+4	34.8	96
20.6	1.61e+4	56.5	96
20.9	1.32e+4	30.7	96
21.2	1.57e+4	54.3	96
21.5	1.27e+4	23.5	96
22.3	1.27e+4	19.4	96
22.3	1.52e+4	42.2	96
22.8	1.28e+4	14.6	96
23.4	1.33e+4	2.8	96
23.5	1.70e+4	27.8	96
23.7	2.42e+4	58.3	96
23.8	3.63e+4	109.7	96
23.9	4.11e+4	110.2	96
23.9	4.15e+4	112.2	96
24.2	4.90e+4	73.5	96
24.6	4.83e+4	4.2	96
24.7	5.34e+4	5.3	96
25.4	5.38e+4	-4.1	96
25.9	5.67e+4	-1.8	96
27.1	5.98e+4	-1.8	96
28.9	6.04e+4	-0.1	96
29.8	5.25e+4	-6.9	96
31.1	4.59e+4	-9.7	96
32.6	4.48e+4	-5.5	96
35.3	4.78e+4	-1.1	96
36.6	5.21e+4	2.8	96
38.6	5.57e+4	1.2	96
40.2	6.36e+4	6.5	96
43.4	7.48e+4	6.2	96
46.9	8.57e+4	2.6	96
48.6	9.33e+4	3.2	96
50.4	9.97e+4	3.1	96
52.0	1.09e+5	6.5	96
54.6	1.17e+5	5.8	96
55.2	1.19e+5	6.6	96
62.6	1.22e+5	2.0	96
74.0	1.21e+5	2.9	96
83.4	1.19e+5	11.3	96
15.5	3.13e+4	18.4	99
15.5	2.87e+4	8.4	99
15.8	2.64e+4	10.7	99
16.0	2.60e+4	16.7	99
16.1	2.36e+4	9.5	99
16.3	2.46e+4	22.1	99
16.4	2.17e+4	11.4	99
16.6	2.27e+4	22.8	99
16.6	1.95e+4	5.5	99
16.7	1.89e+4	4.9	99
16.7	2.21e+4	22.2	99
17.0	1.89e+4	12.7	99
17.0	1.63e+4	-3.1	99
17.2	1.68e+4	4.9	99

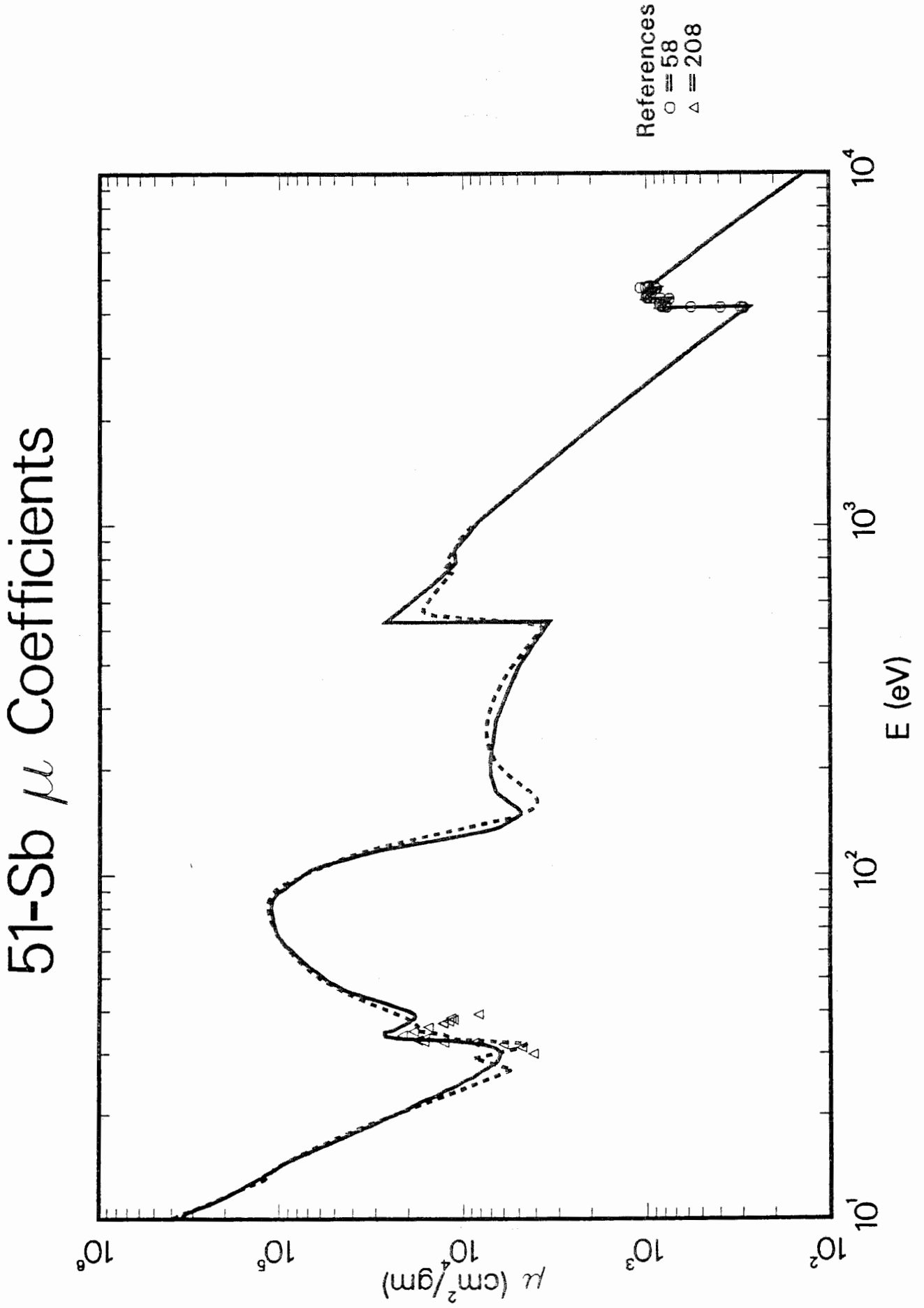
E(eV)	μ(cm^2/g)	% Error	Ref.
17.3	1.61e+4	3.1	99
17.4	1.55e+4	1.8	99
17.7	1.49e+4	3.2	99
18.1	1.51e+4	11.9	99
18.2	1.44e+4	9.0	99
18.4	1.39e+4	9.3	99
18.7	1.43e+4	16.4	99
18.8	1.27e+4	5.2	99
19.2	1.28e+4	10.4	99
19.3	1.08e+4	-5.8	99
19.7	1.20e+4	9.6	99
20.3	1.05e+4	0.6	99
20.6	1.10e+4	6.5	99
20.8	1.13e+4	11.1	99
21.1	1.04e+4	2.5	99
21.5	1.06e+4	3.0	99
21.6	1.09e+4	6.4	99
22.0	1.03e+4	-0.9	99
22.3	1.06e+4	-0.9	99
22.6	1.07e+4	-1.9	99
23.2	1.09e+4	-10.8	99
23.7	1.45e+4	-5.2	99
24.4	2.47e+4	-31.8	99
24.5	4.34e+4	5.8	99
24.6	5.00e+4	7.8	99
50.0	1.35e+5	41.6	101
66.2	1.15e+5	-4.3	101
76.7	9.81e+4	-15.3	101
97.0	6.08e+4	-26.9	101
38.5	5.41e+4	-1.3	110
39.6	5.41e+4	-6.3	110
40.8	5.62e+4	-8.8	110
42.0	5.93e+4	-9.6	110
43.4	6.38e+4	-9.3	110
45.1	7.05e+4	-7.9	110
46.9	7.84e+4	-6.2	110
48.7	8.57e+4	-5.7	110
51.0	9.51e+4	-3.7	110
54.6	1.08e+5	-2.3	110
58.6	1.17e+5	-2.5	110
64.4	1.22e+5	1.3	110
71.9	1.21e+5	1.9	110
79.7	1.13e+5	-0.1	110
88.2	9.93e+4	0.2	110
98.8	8.23e+4	2.5	110
24.1	4.41e+4	76.6	122
27.8	6.06e+4	-0.4	122
33.4	4.42e+4	-4.4	122
37.8	5.15e+4	-3.3	122
45.6	7.42e+4	-5.4	122
49.2	9.22e+4	-0.5	122
54.4	1.10e+5	0.4	122
65.5	1.22e+5	1.9	122
81.7	1.09e+5	-0.4	122
110.0	6.34e+4	18.7	122

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
120.0	5.23e+4	50.4	122
130.0	4.67e+4	119.6	122
140.0	3.15e+4	133.4	122
150.0	1.12e+4	48.7	122
160.0	5.58e+3	16.3	122
180.0	5.58e+3	13.4	122
5000.0	8.79e+2	5.8	131
6404.0	4.65e+2	4.6	131
7058.0	3.61e+2	4.8	131
8000.0	2.57e+2	4.0	131
8398.0	2.26e+2	4.3	131
9000.0	1.85e+2	3.0	131
9500.0	1.61e+2	3.7	131
9962.0	1.42e+2	3.9	131
10000.0	1.40e+2	3.9	131
6400.0	4.52e+2	1.5	175
7058.0	3.42e+2	-0.8	175
7472.0	2.97e+2	0.2	175
8041.0	2.65e+2	8.8	175
10.1	1.32e+5	-5.0	198
10.9	1.21e+5	-2.1	198
12.0	1.05e+5	2.3	198
13.2	6.96e+4	-2.1	198
14.0	4.28e+4	-11.3	198
15.0	2.29e+4	-28.3	198
5900.0	5.34e+2	-2.8	216
6400.0	4.72e+2	6.1	216
7100.0	3.37e+2	-0.7	216
8000.0	2.50e+2	1.0	216
8900.0	1.79e+2	-3.4	216
1000.0	8.51e+3	3.1	229
1486.7	3.68e+3	10.4	229
1500.0	3.60e+3	10.2	229
2000.0	1.81e+3	7.8	229
3000.0	6.45e+2	3.9	229
5000.0	8.66e+2	4.3	229
5414.7	7.18e+2	5.3	229
5946.7	5.59e+2	3.8	229
6000.0	5.41e+2	2.8	229
6399.5	4.66e+2	4.6	229
7058.0	3.62e+2	4.9	229
8000.0	2.57e+2	4.0	229
8397.6	2.26e+2	4.3	229
9000.0	1.85e+2	3.0	229
9500.0	1.61e+2	3.7	229
9961.5	1.42e+2	3.9	229
10000.0	1.40e+2	3.9	229

Atomic Scattering Factors, f_1+if_2
51 - Antimony (Sb)






51-Sb μ Coefficients
References
○ = 58
△ = 208
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Antimony (Sb) — 51

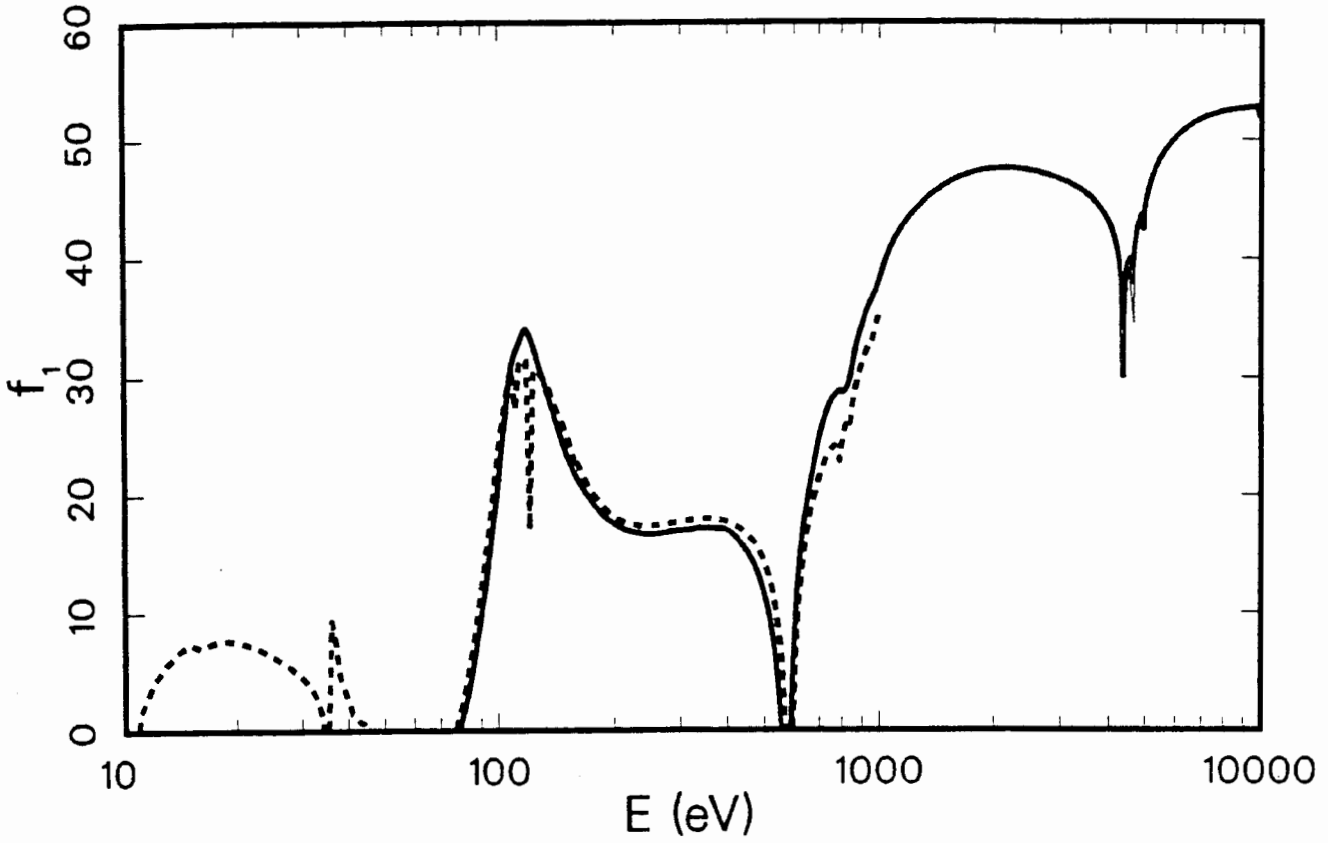
Atomic Weight = 121.75

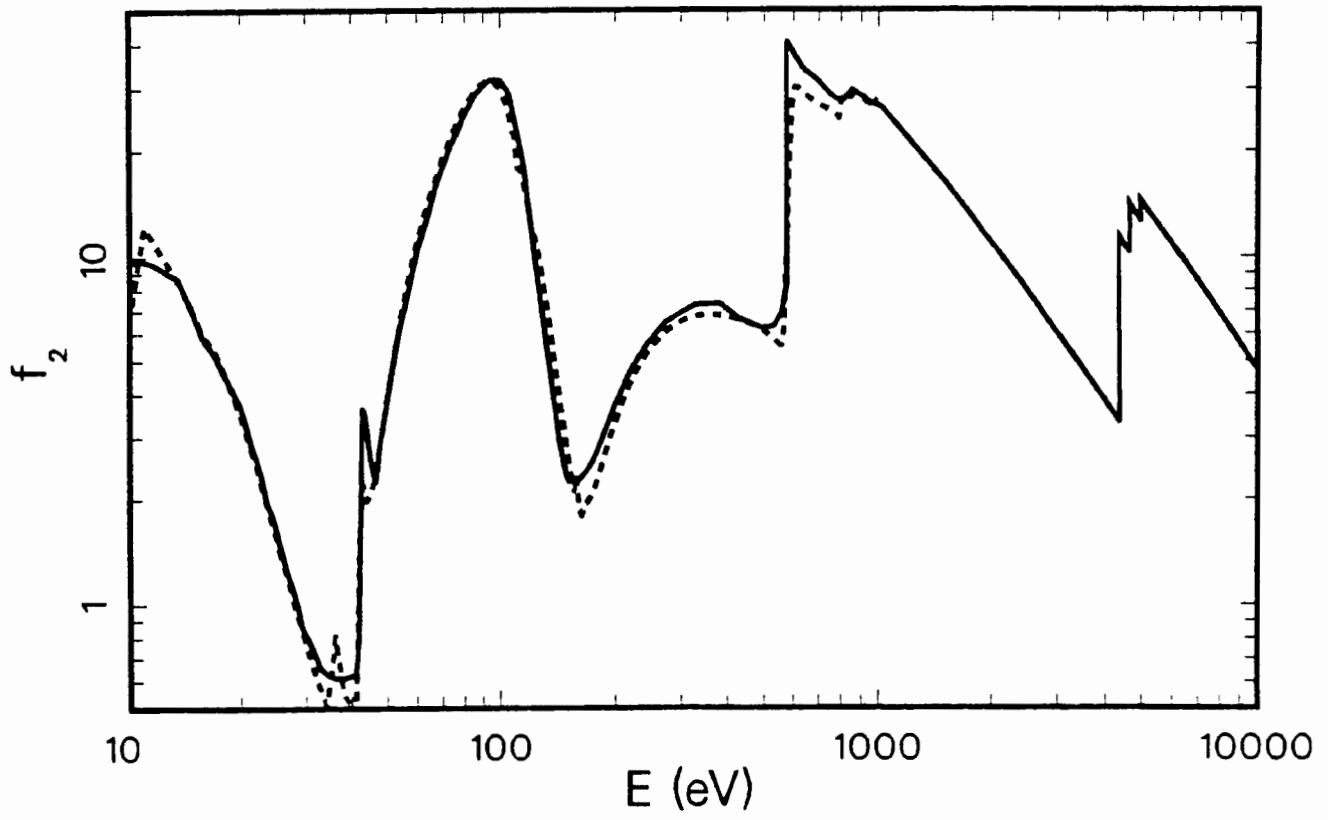
μ (barns/atom) = $\mu(cm^2/g) \times 202.17$

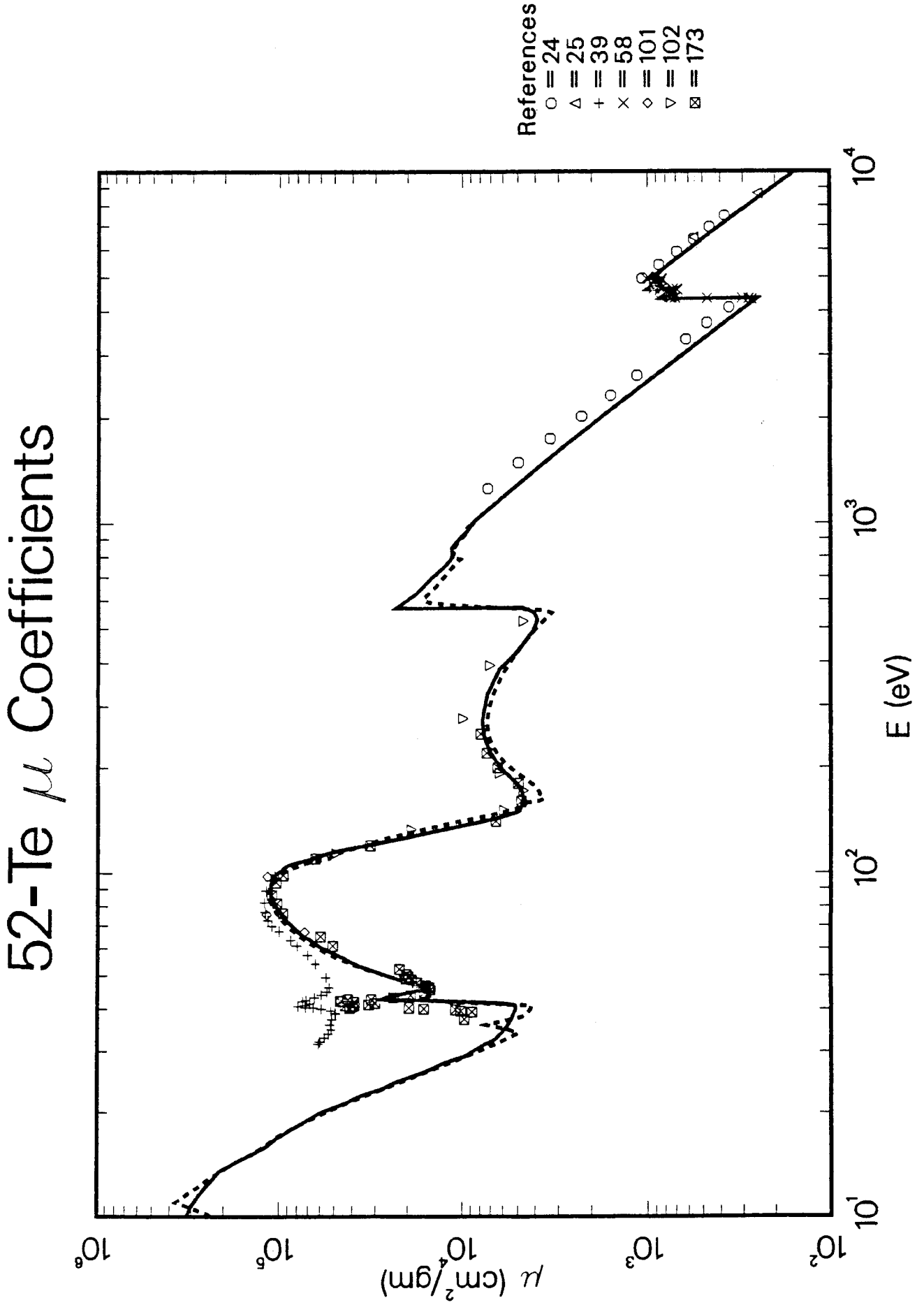
$E\mu(E) = 345.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
4115.0	2.92e+2	-46.9	58
4127.0	3.02e+2	-57.1	58
4133.0	3.91e+2	-50.8	58
4138.0	5.69e+2	-34.0	58
4143.0	7.72e+2	-10.2	58
4150.0	8.21e+2	-4.0	58
4158.0	8.31e+2	-2.4	58
4171.0	7.91e+2	-6.3	58
4186.0	8.21e+2	-1.9	58
4201.0	8.51e+2	2.6	58
4216.0	8.41e+2	2.3	58
4371.0	7.52e+2	-7.4	58
4385.0	8.41e+2	-3.5	58
4390.0	9.50e+2	6.3	58
4398.0	9.79e+2	5.3	58
4407.0	9.99e+2	2.7	58
4423.0	9.99e+2	-0.3	58
4682.0	8.80e+2	-5.5	58
4695.0	8.90e+2	-6.6	58
4700.0	1.08e+3	12.2	58
4705.0	1.01e+3	4.1	58
4713.0	9.79e+2	0.3	58
4723.0	9.79e+2	0.8	58
4742.0	9.79e+2	1.8	58
4761.0	9.60e+2	0.8	58
30.0	4.15e+3	-33.5	208
31.4	4.81e+3	-30.5	208
32.0	6.04e+3	-22.7	208
32.4	1.28e+4	37.0	208
32.4	8.72e+3	-6.8	208
32.6	1.64e+4	64.1	208
32.9	1.78e+4	49.1	208
33.0	1.78e+4	-3.6	208
33.4	1.63e+4	-30.7	208
34.1	2.16e+4	-20.1	208
35.0	1.88e+4	-27.0	208
36.0	1.56e+4	-30.7	208
36.9	1.30e+4	-36.7	208
37.0	1.30e+4	-36.3	208
37.5	1.21e+4	-38.0	208
37.9	1.14e+4	-39.8	208
38.3	1.17e+4	-36.5	208
39.3	8.26e+3	-55.5	208

Atomic Scattering Factors, f_1+if_2
52 - Tellurium (Te)






52-Te μ Coefficients
References
○ = 24
△ = 25
+ = 39
× = 58
◇ = 101
▽ = 102
⊠ = 173
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

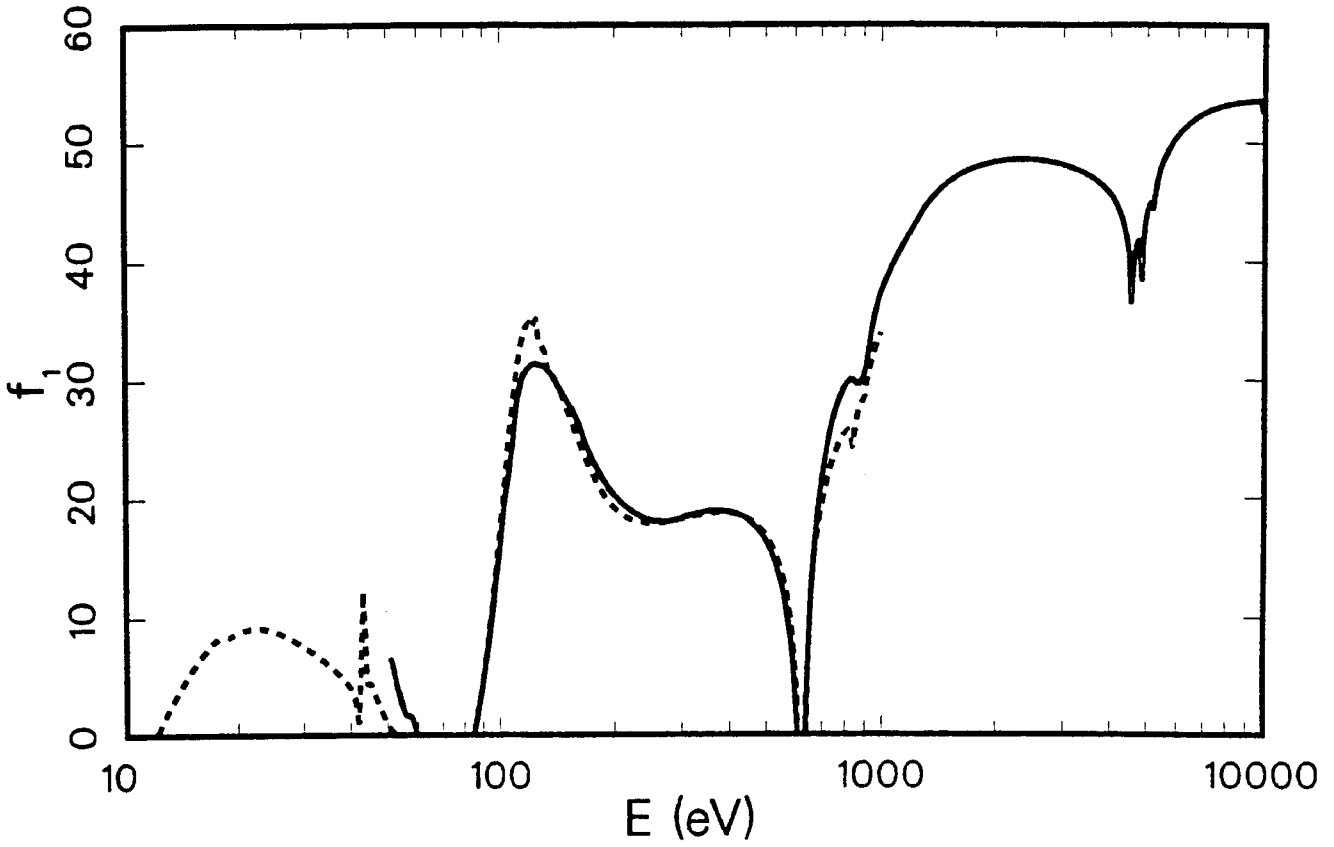
Tellurium (Te) — 52
Atomic Weight = 127.60
μ (barns/atom) = μ(cm^2/g) × 211.89
Eμ(E) = 329.8 f_2 keV cm^2/g

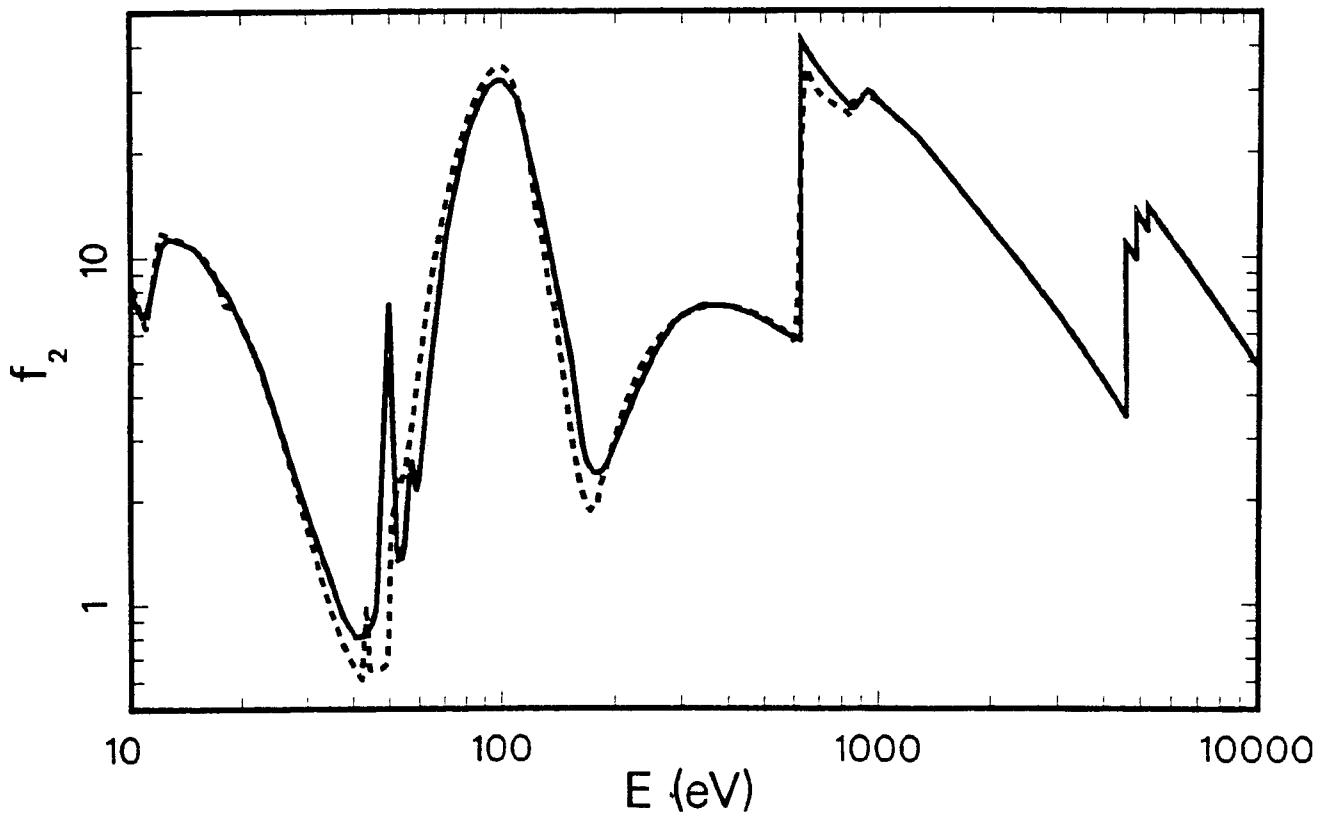
E(eV)	μ(cm^2/g)	% Error	Ref.
1256.0	7.30e+3	37.4	24
1490.0	4.96e+3	37.4	24
1744.0	3.34e+3	33.8	24
2019.0	2.27e+3	29.3	24
2312.0	1.58e+3	26.3	24
2627.0	1.14e+3	25.9	24
3320.0	6.19e+2	23.5	24
3698.0	4.75e+2	24.9	24
4097.0	3.57e+2	22.1	24
4517.0	8.54e+2	9.6	24
4960.0	1.07e+3	12.1	24
5423.0	8.68e+2	13.0	24
5907.0	6.93e+2	11.8	24
6412.0	5.61e+2	11.6	24
6939.0	4.59e+2	12.0	24
7487.0	3.77e+2	12.3	24
6479.0	5.61e+2	14.6	25
8650.0	2.48e+2	8.4	25
31.7	6.15e+4	727.4	39
32.1	6.01e+4	749.2	39
33.0	5.71e+4	782.3	39
33.9	5.43e+4	782.7	39
34.9	5.23e+4	791.5	39
36.0	5.29e+4	841.8	39
37.3	5.18e+4	856.0	39
38.8	4.93e+4	841.6	39
39.1	4.95e+4	850.3	39
39.6	5.24e+4	916.1	39
40.1	5.91e+4	1056.8	39
40.4	6.55e+4	1178.3	39
40.5	7.20e+4	1304.4	39
40.8	7.92e+4	1442.2	39
41.1	7.26e+4	1302.5	39
41.6	6.84e+4	1026.7	39
42.2	7.51e+4	549.3	39
42.5	7.18e+4	309.9	39
43.3	6.44e+4	139.8	39
44.1	5.91e+4	159.0	39
45.0	5.51e+4	191.1	39
46.3	5.36e+4	246.6	39
49.6	5.59e+4	128.7	39
54.4	6.39e+4	63.2	39
57.7	7.03e+4	44.6	39
61.4	8.04e+4	30.2	39
63.7	8.68e+4	27.2	39
67.7	1.00e+5	25.1	39
70.1	1.10e+5	28.6	39
72.8	1.16e+5	26.0	39
76.9	1.20e+5	21.1	39
82.4	1.21e+5	12.3	39

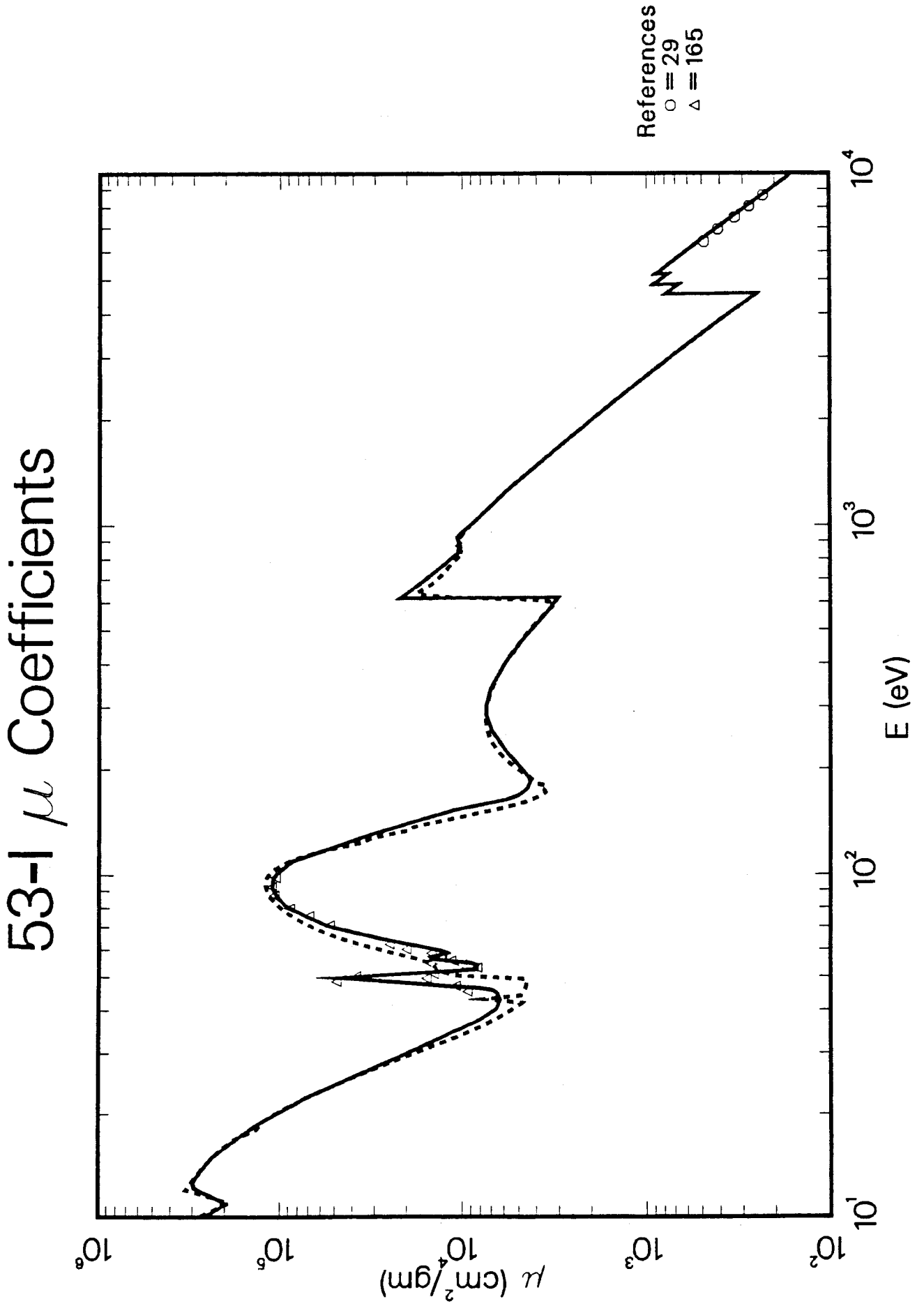
E(eV)	μ(cm^2/g)	% Error	Ref.
89.3	1.18e+5	5.6	39
95.6	1.12e+5	3.0	39
99.2	1.06e+5	1.3	39
4322.0	2.69e+2	-33.6	58
4334.0	2.78e+2	-46.8	58
4341.0	3.02e+2	-50.3	58
4346.0	4.72e+2	-30.2	58
4351.0	7.08e+2	-5.9	58
4359.0	7.41e+2	-13.2	58
4364.0	7.60e+2	-10.8	58
4372.0	7.60e+2	-10.3	58
4378.0	7.41e+2	-12.3	58
4387.0	7.60e+2	-9.5	58
4394.0	7.41e+2	-11.4	58
4403.0	7.60e+2	-8.7	58
4410.0	7.79e+2	-6.0	58
4420.0	7.50e+2	-8.9	58
4437.0	7.50e+2	-8.0	58
4490.0	7.32e+2	-7.5	58
4540.0	7.27e+2	-5.5	58
4593.0	6.89e+2	-9.6	58
4609.0	6.94e+2	-15.6	58
4614.0	7.27e+2	-13.6	58
4619.0	8.40e+2	-2.5	58
4624.0	9.20e+2	4.3	58
4630.0	9.20e+2	1.4	58
4644.0	9.20e+2	-5.0	58
4655.0	9.20e+2	-6.9	58
4674.0	9.11e+2	-6.9	58
4700.0	8.73e+2	-9.5	58
4750.0	8.59e+2	-8.5	58
4800.0	8.59e+2	-5.9	58
4850.0	8.68e+2	-2.3	58
4900.0	8.40e+2	-3.5	58
4930.0	8.31e+2	-8.8	58
4936.0	8.40e+2	-8.6	58
4941.0	1.01e+3	9.0	58
4946.0	9.01e+2	-3.4	58
4963.0	9.01e+2	-5.5	58
4984.0	8.92e+2	-5.5	58
5006.0	8.78e+2	-6.0	58
50.0	2.10e+4	-17.8	101
67.2	7.33e+4	-7.3	101
75.6	1.18e+5	22.0	101
97.7	1.17e+5	9.5	101
114.0	4.91e+4	-9.7	102
132.8	1.90e+4	48.4	102
151.1	5.90e+3	21.2	102
171.7	4.64e+3	-2.2	102
192.6	6.23e+3	8.3	102

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	9.91e+3	27.9	102
392.4	7.03e+3	17.9	102
524.9	4.64e+3	18.2	102
37.4	9.74e+3	80.1	173
39.3	8.84e+3	70.4	173
39.5	1.02e+4	97.4	173
39.9	1.09e+4	112.0	173
40.1	1.63e+4	218.6	173
40.4	1.97e+4	283.7	173
40.4	4.12e+4	704.5	173
40.8	3.99e+4	676.4	173
41.0	4.36e+4	748.3	173
41.1	3.91e+4	655.7	173
41.3	3.26e+4	509.5	173
41.7	3.02e+4	367.0	173
42.0	3.91e+4	368.6	173
42.2	4.59e+4	297.3	173
42.3	4.66e+4	260.9	173
42.4	4.63e+4	213.5	173
42.8	4.22e+4	51.9	173
42.8	3.16e+4	13.8	173
43.3	2.39e+4	-11.3	173
43.9	1.93e+4	-19.0	173
44.8	1.62e+4	-17.6	173
45.6	1.49e+4	-13.8	173
46.3	1.52e+4	-1.4	173
46.5	1.60e+4	0.4	173
46.9	1.59e+4	-5.9	173
47.8	1.78e+4	-10.4	173
48.8	1.90e+4	-14.8	173
49.1	2.04e+4	-11.7	173
49.9	1.98e+4	-21.5	173
50.7	2.03e+4	-25.9	173
52.5	2.22e+4	-33.6	173
61.3	5.13e+4	-16.6	173
65.2	5.99e+4	-18.1	173
76.3	9.55e+4	-2.2	173
82.0	1.03e+5	-3.6	173
86.7	1.10e+5	-1.8	173
94.1	1.04e+5	-6.0	173
98.6	9.51e+4	-9.7	173
110.0	6.42e+4	-5.5	173
120.0	3.21e+4	-5.0	173
140.0	6.56e+3	-16.3	173
160.0	4.77e+3	2.9	173
180.0	4.96e+3	-2.1	173
200.0	6.42e+3	4.5	173
220.0	7.36e+3	4.9	173
250.0	7.98e+3	4.4	173

Atomic Scattering Factors, f_1+if_2
53 - Iodine (I)






53-I μ Coefficients
References
○ = 29
△ = 165
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Iodine (I) — 53

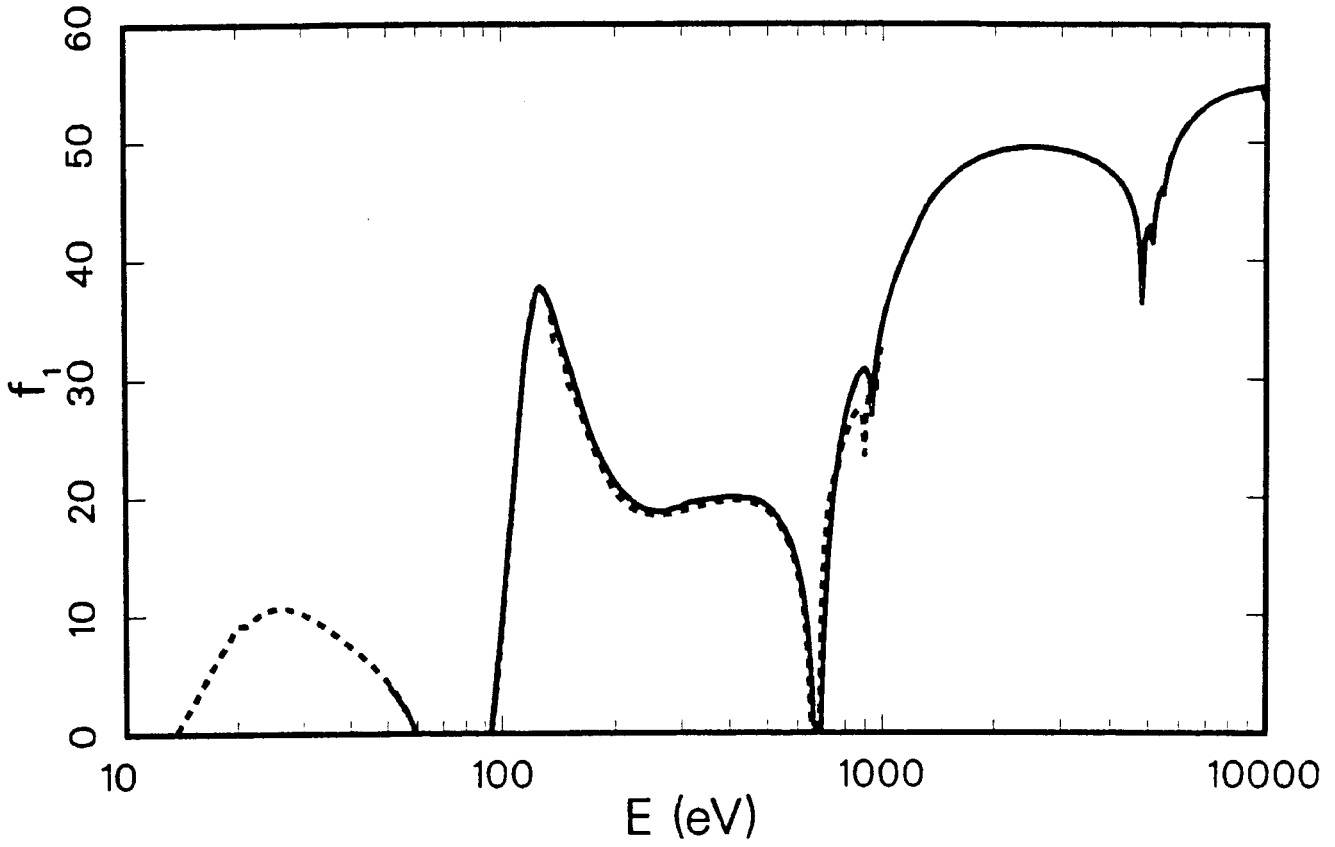
Atomic Weight = 126.90

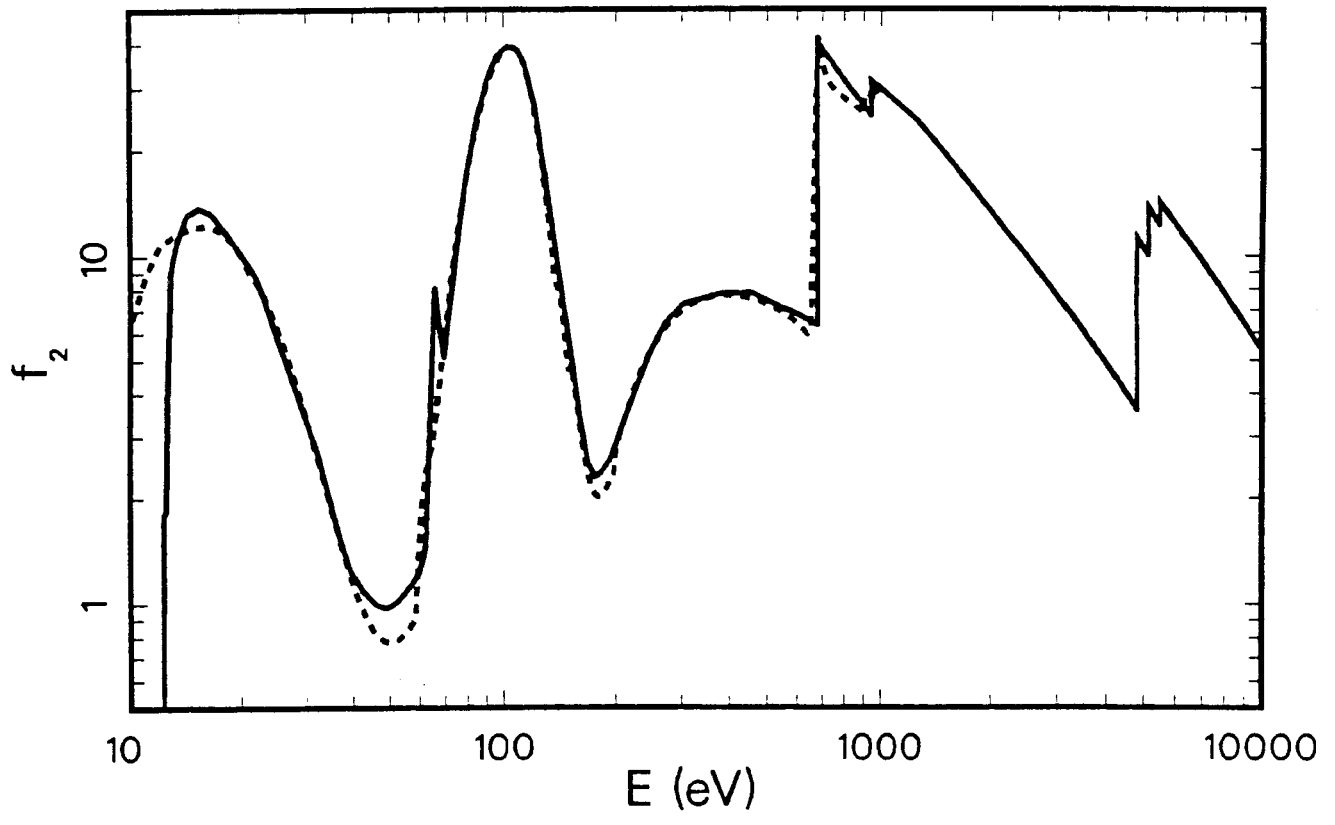
μ (barns/atom) = μ(cm^2/g) × 210.73

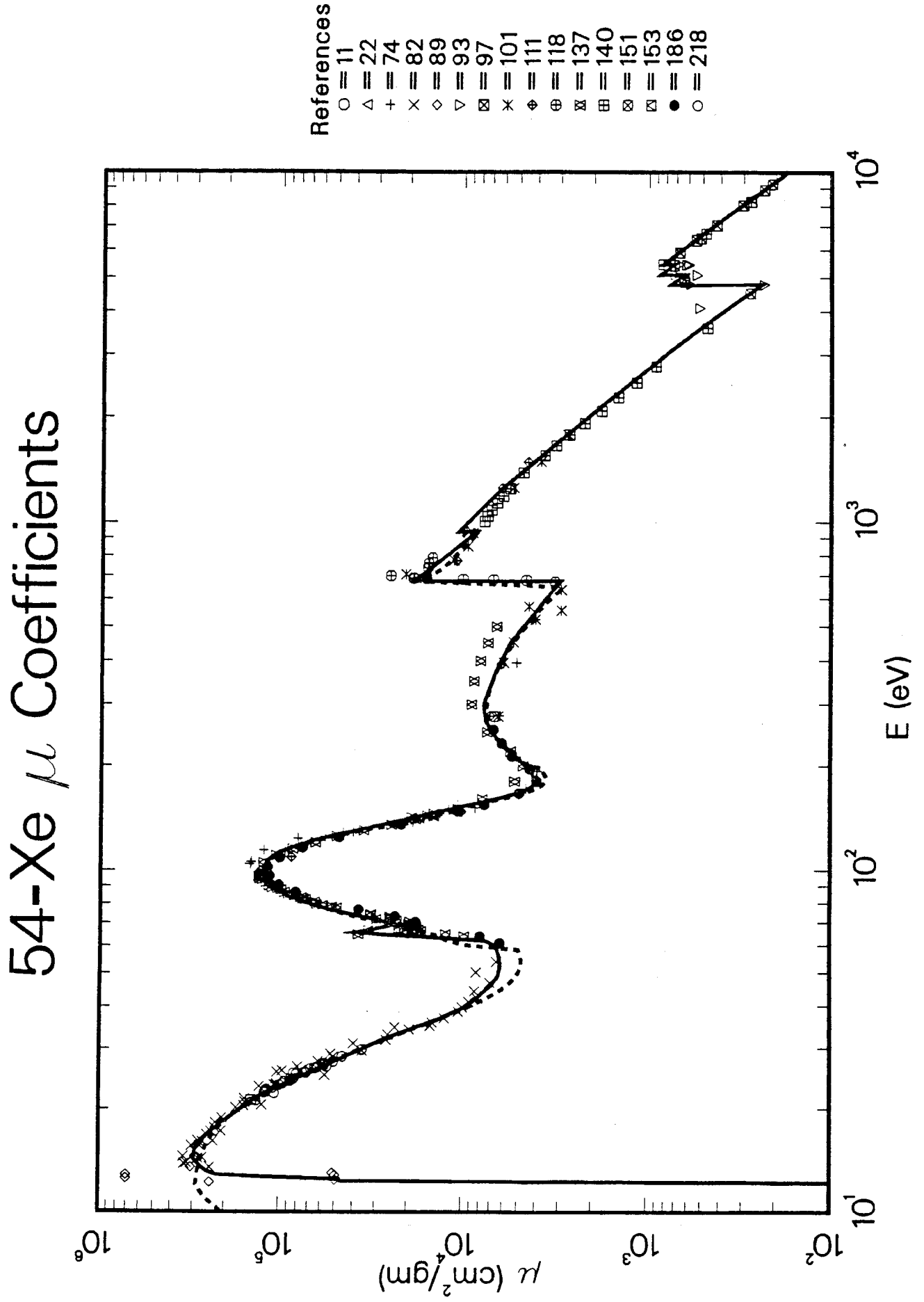
Eμ(E) = 331.6 f_2 keV cm^2/g

E(eV)	μ(cm^2/g)	% Error	Ref.
6403.0	4.87e+2	-6.7	29
6930.0	4.08e+2	-3.9	29
7477.0	3.31e+2	-4.7	29
8047.0	2.76e+2	-3.5	29
8638.0	2.31e+2	-2.2	29
45.4	9.42e+3	39.5	165
47.2	1.09e+4	-12.7	165
48.6	4.92e+4	89.1	165
49.6	1.56e+4	-64.0	165
50.3	3.82e+4	1.0	165
51.1	1.42e+4	-35.1	165
53.2	8.38e+3	-0.3	165
54.4	1.01e+4	20.3	165
54.6	1.48e+4	76.6	165
55.9	1.15e+4	-6.8	165
56.2	1.44e+4	6.0	165
56.2	1.44e+4	6.2	165
56.8	1.29e+4	-18.2	165
57.4	1.30e+4	-10.4	165
58.7	1.47e+4	19.4	165
60.3	2.01e+4	41.8	165
62.5	2.50e+4	25.8	165
71.1	5.37e+4	-4.6	165
75.8	6.97e+4	-5.4	165
80.0	8.91e+4	-0.4	165
87.3	1.08e+5	2.9	165
92.4	1.11e+5	1.0	165
98.4	1.06e+5	-1.2	165

Atomic Scattering Factors, f_1+if_2
54 - Xenon (Xe)






54-Xe μ Coefficients
References
11
22
74
82
89
93
97
101
111
118
137
140
151
153
186
218
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Xenon (Xe) — 54

Atomic Weight = 131.29

μ (barns/atom) = $\mu(cm^2/g) \times 218.02$

$E\mu(E) = 320.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	6.74e+3	-11.1	11
8420.0	2.76e+2	1.4	22
104.0	1.47e+5	22.3	74
105.5	1.44e+5	22.5	74
108.0	1.03e+5	-9.5	74
113.0	9.40e+4	-6.2	74
114.1	1.23e+5	29.3	74
116.5	8.03e+4	-5.5	74
118.5	7.80e+4	0.6	74
123.0	8.03e+4	30.7	74
124.5	5.73e+4	3.4	74
127.5	4.59e+4	1.0	74
128.5	4.04e+4	-5.1	74
136.0	2.39e+4	-9.7	74
137.5	1.88e+4	-21.9	74
145.5	1.33e+4	-11.8	74
149.0	1.19e+4	-3.8	74
151.2	8.51e+3	-22.5	74
154.0	1.05e+4	12.2	74
171.7	4.57e+3	1.7	74
192.7	3.97e+3	-6.9	74
211.9	5.13e+3	-0.3	74
279.2	6.32e+3	-16.7	74
394.8	5.13e+3	-18.7	74
525.3	4.08e+3	-7.2	74
13.5	2.40e+5	-10.6	82
13.8	3.34e+5	19.6	82
13.9	3.23e+5	14.1	82
14.3	2.79e+5	-5.7	82
14.4	2.64e+5	-10.8	82
14.5	3.38e+5	14.5	82
15.0	2.90e+5	-0.4	82
15.6	3.04e+5	7.8	82
15.6	2.73e+5	-3.1	82
16.0	2.64e+5	-2.8	82
16.1	2.79e+5	3.7	82
16.1	2.30e+5	-14.5	82
16.8	2.49e+5	-0.4	82
17.2	2.37e+5	0.3	82
17.2	2.07e+5	-12.5	82
17.6	2.26e+5	0.6	82
18.2	2.23e+5	7.9	82
18.8	2.06e+5	8.1	82
20.1	1.72e+5	7.8	82
20.4	1.56e+5	1.4	82
20.5	1.24e+5	-18.3	82
20.9	1.53e+5	6.0	82
21.4	1.54e+5	13.4	82
23.2	1.28e+5	26.5	82
23.4	1.04e+5	6.2	82

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
23.5	1.07e+5	11.1	82
23.7	1.03e+5	11.2	82
24.6	8.50e+4	6.6	82
25.1	5.66e+4	-22.9	82
25.6	1.03e+5	51.3	82
25.8	9.59e+4	45.9	82
25.9	7.64e+4	18.0	82
26.5	7.90e+4	34.0	82
27.0	5.78e+4	5.7	82
27.5	6.16e+4	21.6	82
28.3	5.12e+4	13.9	82
28.9	5.28e+4	28.1	82
29.5	3.54e+4	-6.3	82
31.0	3.96e+4	28.9	82
31.8	2.61e+4	-5.6	82
32.9	2.56e+4	9.0	82
34.1	1.95e+4	-0.4	82
34.6	2.34e+4	28.9	82
34.9	1.49e+4	-14.2	82
35.7	1.45e+4	-5.9	82
36.8	1.24e+4	-6.0	82
38.5	1.04e+4	-5.0	82
39.7	9.89e+3	1.2	82
41.2	9.13e+3	3.1	82
42.0	8.15e+3	-3.1	82
44.2	8.50e+3	13.1	82
46.8	6.99e+3	3.7	82
50.2	8.35e+3	32.8	82
53.9	6.50e+3	4.2	82
12.2	2.41e+5	417.1	89
12.4	4.95e+4	5.9	89
12.5	7.00e+5	1375.4	89
12.8	7.00e+5	220.4	89
12.8	4.95e+4	-77.3	89
13.0	5.12e+4	-78.4	89
13.5	3.07e+5	14.2	89
14.4	2.90e+5	-2.0	89
4096.0	5.20e+2	42.3	93
4779.0	2.32e+2	-16.6	93
4789.0	5.86e+2	76.5	93
5100.0	5.38e+2	-18.7	93
5110.0	7.13e+2	3.3	93
5448.0	6.00e+2	-20.2	93
5458.0	6.15e+2	-19.4	93
5468.0	6.79e+2	-12.4	93
4952.0	6.41e+2	-6.7	97
5427.0	7.25e+2	-1.5	97
5899.0	6.74e+2	-2.1	97
6404.0	5.46e+2	-2.3	97
6490.0	5.16e+2	-4.4	97

Xenon (Xe) — 54

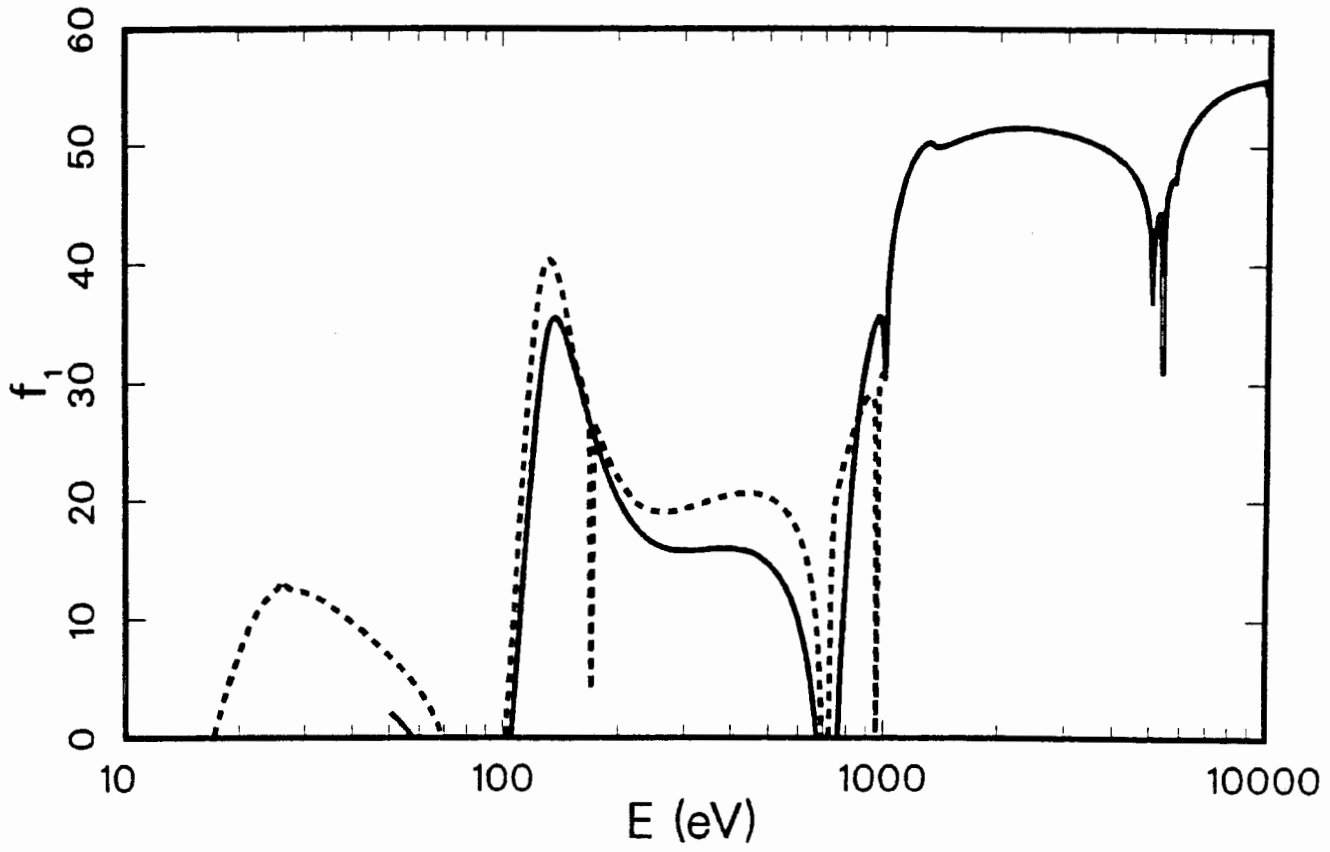
E(eV)	μ(cm^2/g)	% Error	Ref.
7058.0	4.22e+2	-2.8	97
8048.0	3.04e+2	-1.1	97
8905.0	2.32e+2	-1.2	97
277.0	6.46e+3	-14.8	101
395.0	6.03e+3	-4.3	101
453.0	5.37e+3	-2.7	101
525.0	4.08e+3	-7.2	101
557.0	2.96e+3	-26.4	101
572.0	4.43e+3	14.4	101
637.0	2.96e+3	-10.0	101
706.0	2.09e+4	29.3	101
776.0	1.13e+4	-15.7	101
851.0	9.54e+3	-11.5	101
930.0	8.92e+3	-8.8	101
1256.0	5.37e+3	-12.7	101
1490.0	3.84e+3	-8.2	101
1776.0	2.75e+3	-2.1	101
108.9	8.70e+4	-21.9	111
147.2	1.02e+4	-25.7	111
182.6	4.00e+3	-3.8	111
278.0	7.13e+3	-6.0	111
391.4	6.20e+3	-2.5	111
526.0	4.25e+3	-3.0	111
774.9	1.09e+4	-19.1	111
928.7	8.80e+3	-9.9	111
1254.0	6.20e+3	0.6	111
1487.0	4.50e+3	7.1	111
672.0	3.21e+3	-56.4	118
680.0	4.59e+3	-48.4	118
682.0	6.88e+3	-26.2	118
684.0	1.01e+4	3.3	118
686.0	1.61e+4	56.9	118
688.0	1.88e+4	75.5	118
690.0	1.90e+4	69.6	118
694.0	1.61e+4	30.4	118
700.0	2.55e+4	80.3	118
740.0	1.58e+4	4.5	118
760.0	1.56e+4	10.1	118
790.0	1.49e+4	15.8	118
64.0	9.72e+3	-47.9	137
64.8	3.76e+4	36.7	137
64.8	1.23e+4	-55.4	137
65.0	1.89e+4	-37.8	137
65.6	2.00e+4	-49.9	137
66.2	1.68e+4	-54.0	137
66.3	1.86e+4	-48.3	137
66.7	3.30e+4	-2.3	137
66.8	1.74e+4	-47.9	137
66.9	2.25e+4	-31.4	137
67.5	2.24e+4	-25.4	137
68.1	2.04e+4	-25.5	137
68.1	1.79e+4	-34.7	137
68.2	2.09e+4	-22.9	137
68.9	1.98e+4	-19.1	137
69.0	1.93e+4	-19.9	137

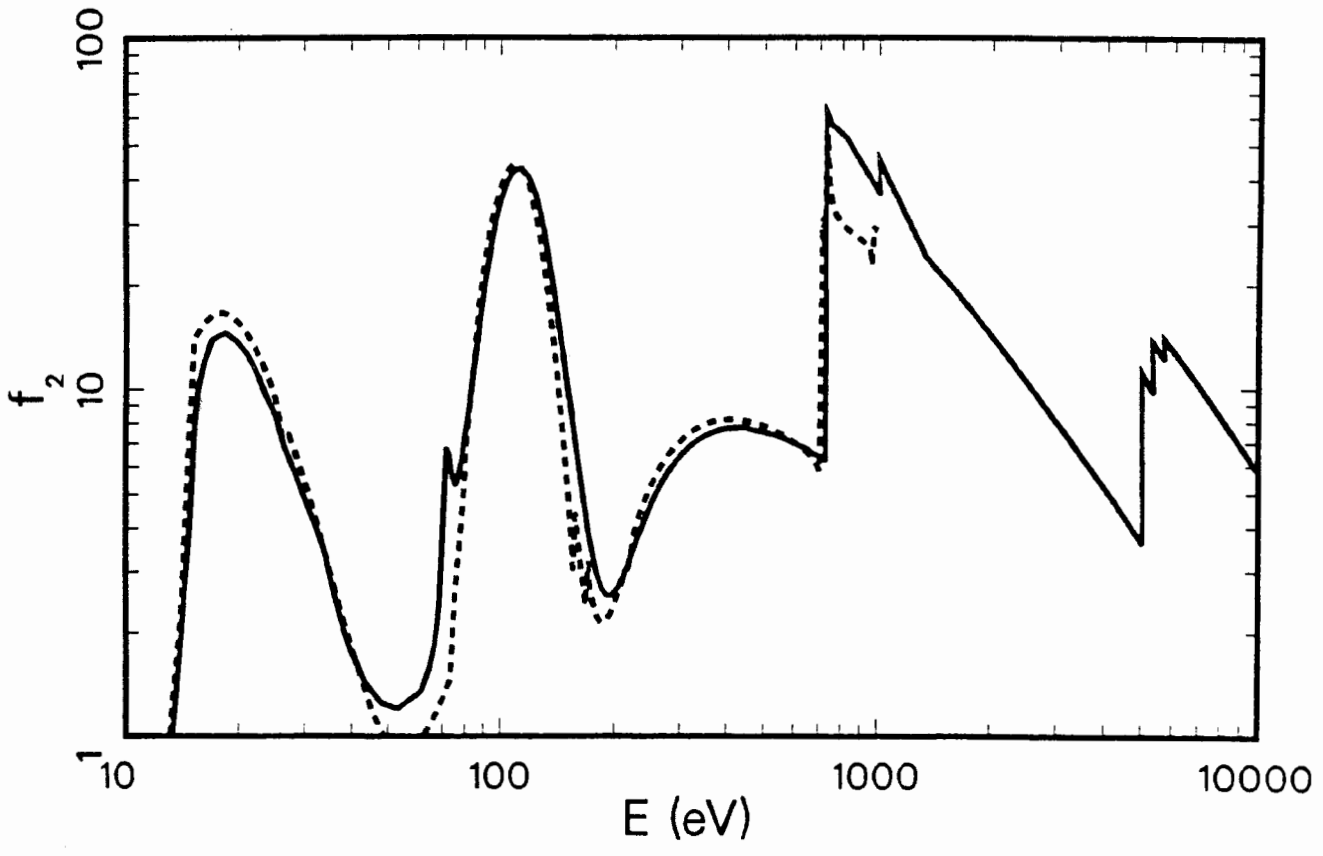
E(eV)	μ(cm^2/g)	% Error	Ref.
69.4	1.96e+4	-16.0	137
70.4	1.95e+4	-26.3	137
71.1	2.29e+4	-20.2	137
71.7	2.98e+4	-3.3	137
72.2	2.47e+4	-24.6	137
72.8	2.51e+4	-28.4	137
73.6	3.23e+4	-16.1	137
74.0	3.20e+4	-20.6	137
77.6	4.95e+4	-15.4	137
78.1	5.28e+4	-13.7	137
79.0	5.89e+4	-10.9	137
79.5	6.36e+4	-7.7	137
81.0	6.53e+4	-13.6	137
82.4	7.34e+4	-10.7	137
82.7	7.53e+4	-10.0	137
83.3	7.73e+4	-10.8	137
84.3	8.40e+4	-8.6	137
85.3	8.99e+4	-5.6	137
86.3	9.48e+4	-3.8	137
87.8	9.89e+4	-4.8	137
88.7	1.04e+5	-3.3	137
89.3	1.10e+5	1.0	137
90.2	1.15e+5	2.1	137
92.5	1.20e+5	1.8	137
94.1	1.26e+5	4.1	137
94.8	1.30e+5	6.3	137
95.9	1.31e+5	6.1	137
96.8	1.29e+5	4.3	137
97.5	1.27e+5	2.5	137
98.1	1.25e+5	1.2	137
98.9	1.23e+5	-0.6	137
99.6	1.22e+5	-0.9	137
105.0	1.24e+5	4.4	137
110.0	1.05e+5	-2.7	137
115.0	8.58e+4	-5.9	137
120.0	6.47e+4	-10.7	137
125.0	4.95e+4	-7.6	137
130.0	3.53e+4	-8.4	137
135.0	2.48e+4	-11.8	137
140.0	1.82e+4	-12.3	137
141.0	1.72e+4	-11.7	137
141.8	1.91e+4	2.4	137
143.0	1.45e+4	-16.7	137
143.7	1.56e+4	-6.6	137
145.0	1.44e+4	-6.8	137
150.0	1.06e+4	-9.3	137
160.0	7.80e+3	15.4	137
180.0	5.23e+3	25.8	137
200.0	4.72e+3	2.9	137
220.0	5.50e+3	-0.7	137
250.0	7.38e+3	6.6	137
300.0	8.94e+3	16.1	137
350.0	8.71e+3	25.5	137
400.0	8.03e+3	28.9	137
450.0	7.34e+3	32.2	137

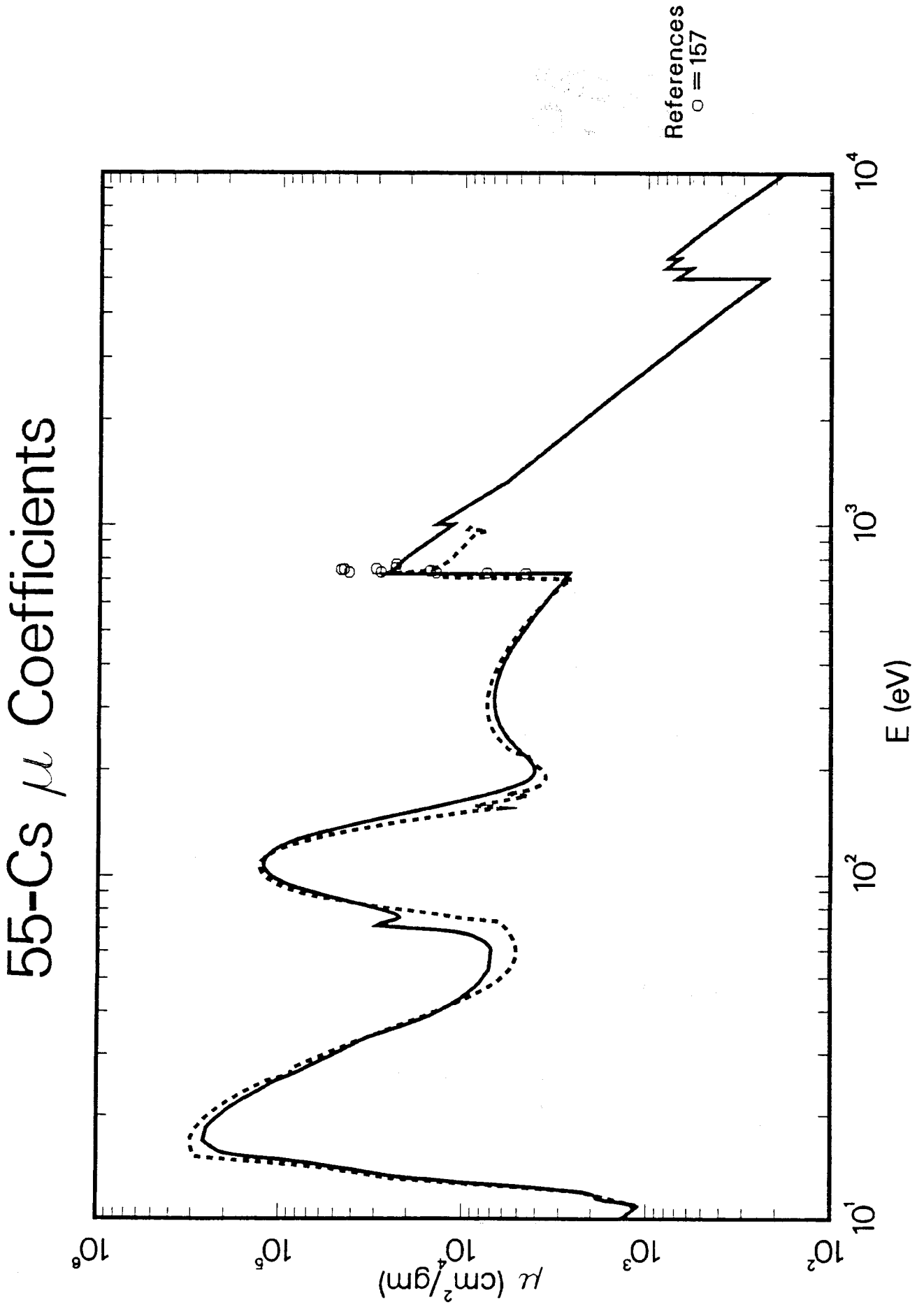
E(eV)	μ(cm^2/g)	% Error	Ref.
500.0	6.60e+3	39.2	137
1006.0	7.71e+3	-17.7	140
1040.0	7.43e+3	-15.5	140
1085.0	7.06e+3	-13.0	140
1135.0	6.60e+3	-11.4	140
1190.0	6.10e+3	-10.5	140
1250.0	5.60e+3	-9.8	140
1390.0	4.77e+3	-2.5	140
1556.0	3.66e+3	-3.5	140
1660.0	3.17e+3	-3.2	140
1780.0	2.70e+3	-3.5	140
1918.0	2.24e+3	-4.8	140
2079.0	1.81e+3	-7.4	140
2270.0	1.47e+3	-7.2	140
2499.0	1.17e+3	-7.3	140
2780.0	9.13e+2	-6.4	140
3586.0	4.72e+2	-8.5	140
4851.0	6.33e+2	-12.8	140
5461.0	8.35e+2	8.9	140
6687.0	4.81e+2	-3.7	140
8247.0	2.75e+2	-4.5	140
4508.0	2.78e+2	-1.6	151
5895.0	6.72e+2	-2.6	151
9243.0	2.10e+2	-1.1	151
21.2	1.42e+5	2.1	153
61.1	6.23e+3	-11.4	186
63.9	7.95e+3	-55.2	186
70.3	1.81e+4	-30.6	186
73.1	2.36e+4	-35.2	186
76.6	3.75e+4	-30.0	186
86.3	8.24e+4	-16.4	186
90.7	1.02e+5	-10.6	186
96.1	1.14e+5	-7.6	186
102.0	1.17e+5	-4.9	186
108.6	1.01e+5	-10.1	186
116.1	7.61e+4	-12.0	186
124.2	4.82e+4	-14.9	186
135.2	2.18e+4	-21.3	186
147.6	1.06e+4	-20.6	186
154.4	7.61e+3	-17.2	186
166.6	4.95e+3	-2.9	186
180.2	4.01e+3	-3.4	186
195.6	4.35e+3	-1.0	186
213.0	5.41e+3	4.1	186
232.0	6.15e+3	0.4	186
254.0	6.83e+3	-3.0	186
21.1	1.33e+5	-5.0	218
22.2	1.06e+5	-12.2	218
22.3	1.20e+5	1.4	218
22.4	1.17e+5	0.5	218
22.5	1.19e+5	3.9	218
22.6	1.17e+5	4.2	218
22.8	1.17e+5	7.9	218
23.0	1.08e+5	3.5	218
23.5	9.95e+4	3.8	218

E(eV)	μ(cm^2/g)	% Error	Ref.
23.7	9.54e+4	3.0	218
24.0	9.36e+4	6.3	218
24.1	8.67e+4	0.1	218
24.4	8.67e+4	5.2	218
24.5	8.30e+4	2.5	218
25.2	8.03e+4	11.0	218
25.4	8.30e+4	18.6	218
25.5	7.15e+4	3.8	218
25.6	7.29e+4	7.5	218
26.2	6.74e+4	9.2	218
26.3	6.42e+4	5.6	218
26.4	6.28e+4	4.9	218
26.5	6.28e+4	6.5	218
26.6	5.55e+4	-4.5	218
26.8	5.73e+4	1.7	218
27.0	5.82e+4	6.5	218
27.1	5.69e+4	5.6	218
27.5	5.09e+4	0.5	218
28.4	4.56e+4	2.9	218
29.7	3.57e+4	-2.9	218
29.8	3.55e+4	-2.0	218

Atomic Scattering Factors, f_1+if_2
55 - Cesium (Cs)






55-Cs μ Coefficients
References
○ = 157
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Cesium (Cs) — 55

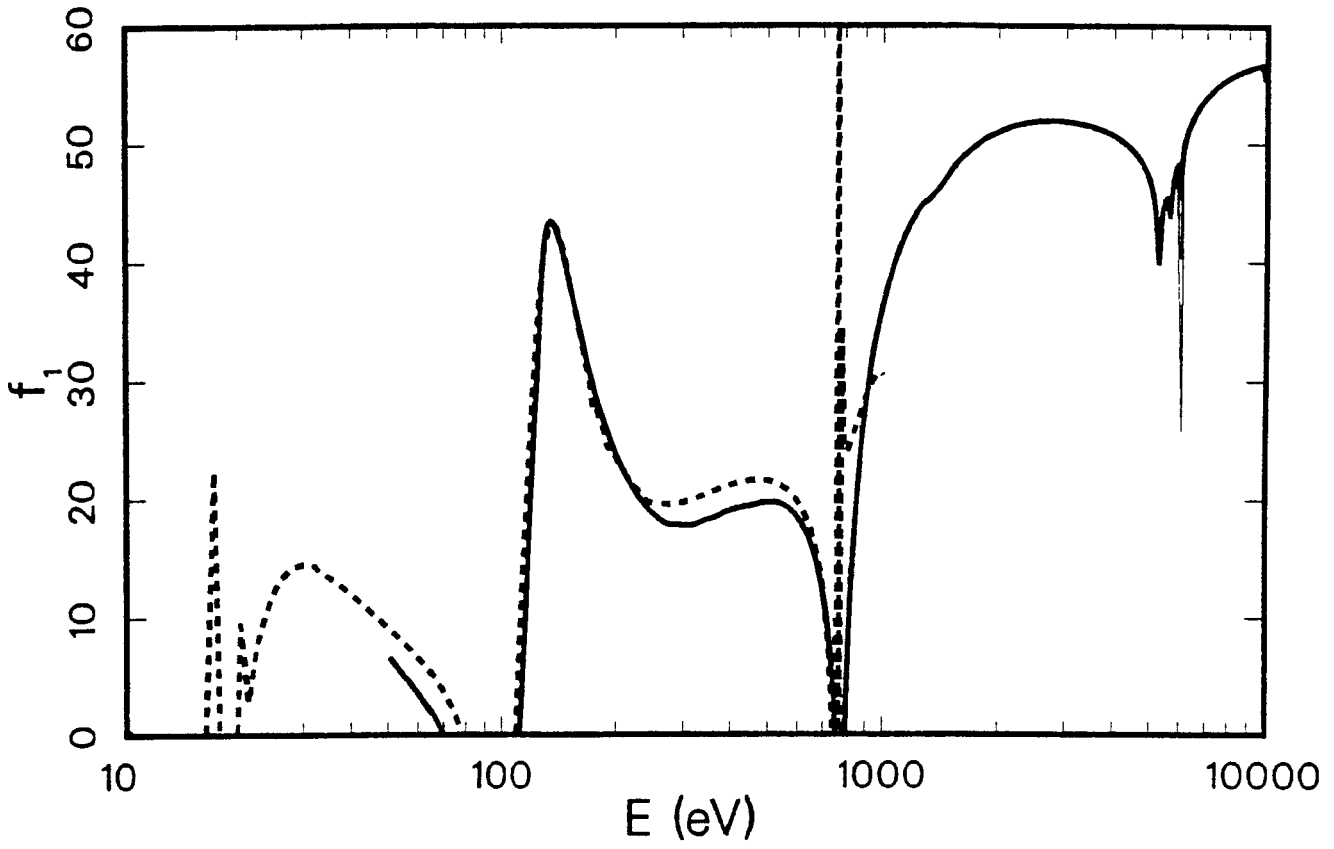
Atomic Weight = 132.90

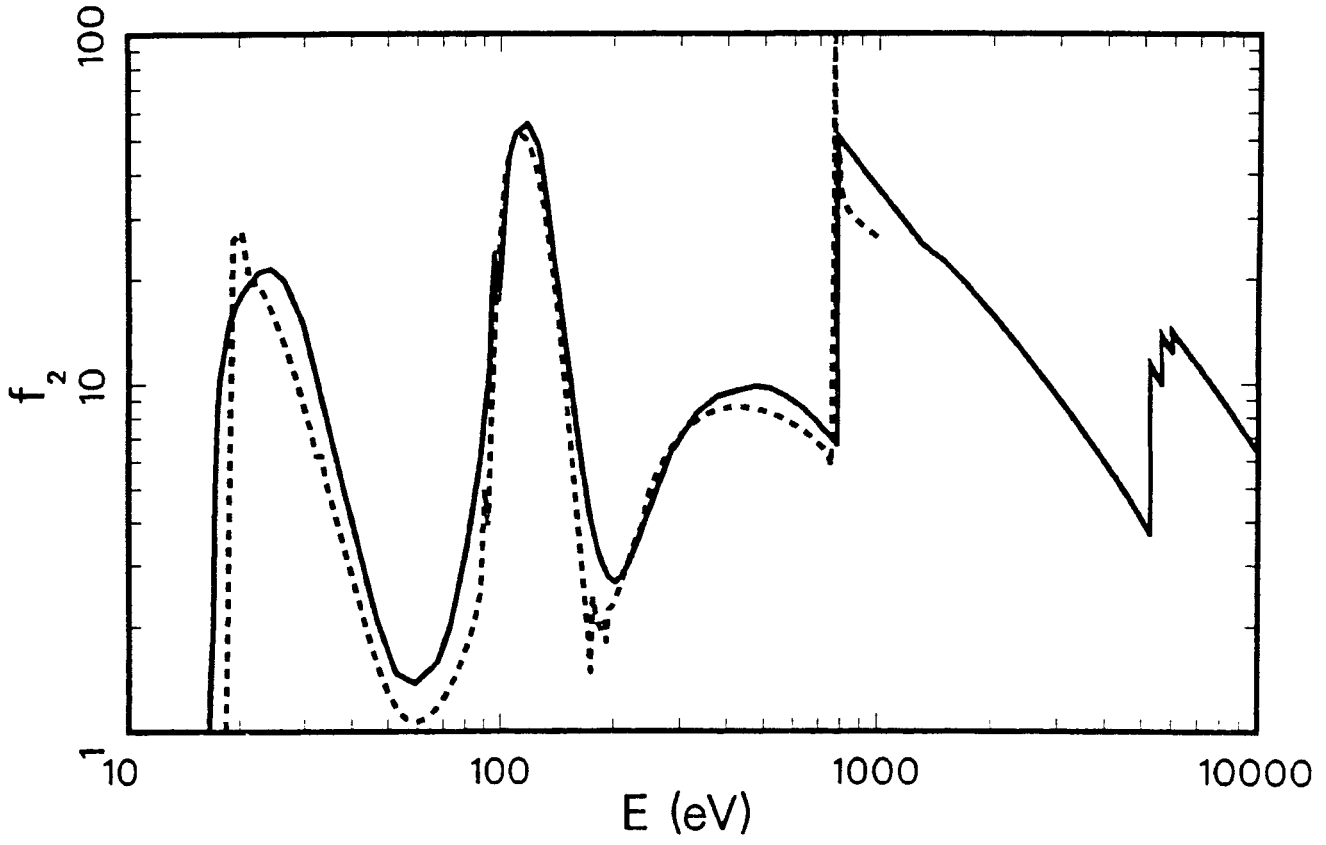
μ (barns/atom) = $\mu(cm^2/g) \times 220.70$

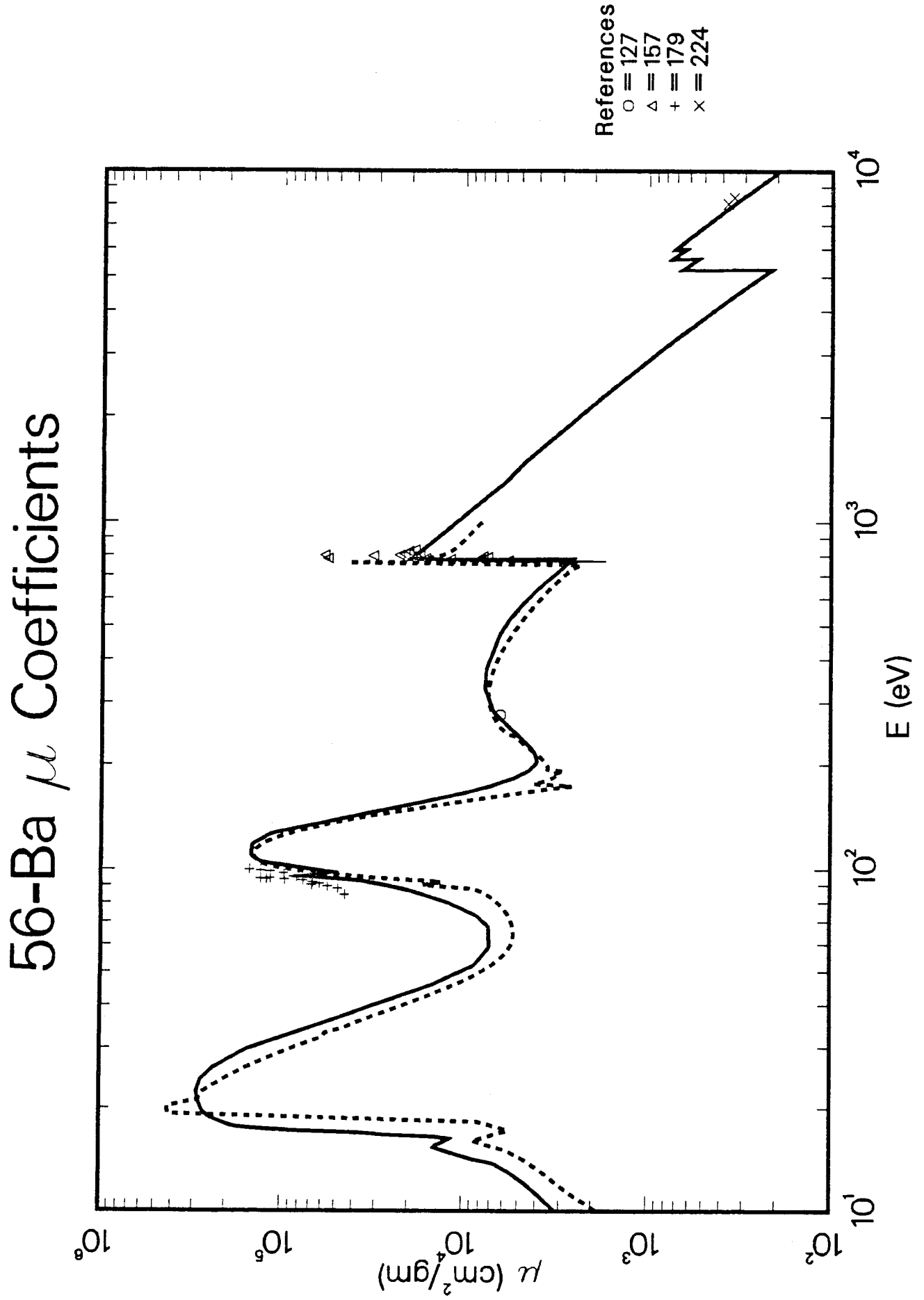
$E\mu(E) = 316.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
726.5	4.62e+3	45.8	157
729.0	7.52e+3	84.9	157
731.0	1.44e+4	189.4	157
732.6	4.30e+4	638.5	157
734.0	2.87e+4	329.4	157
738.0	1.55e+4	56.8	157
742.0	1.55e+4	5.3	157
746.0	4.76e+4	119.6	157
747.0	4.59e+4	92.0	157
750.0	3.04e+4	26.6	157
755.0	2.38e+4	0.6	157
772.0	2.37e+4	4.2	157

Atomic Scattering Factors, f_1+if_2
56 - Barium (Ba)






56-Ba μ Coefficients
References
○ = 127
△ = 157
+ = 179
× = 224
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

Barium (Ba) — 56

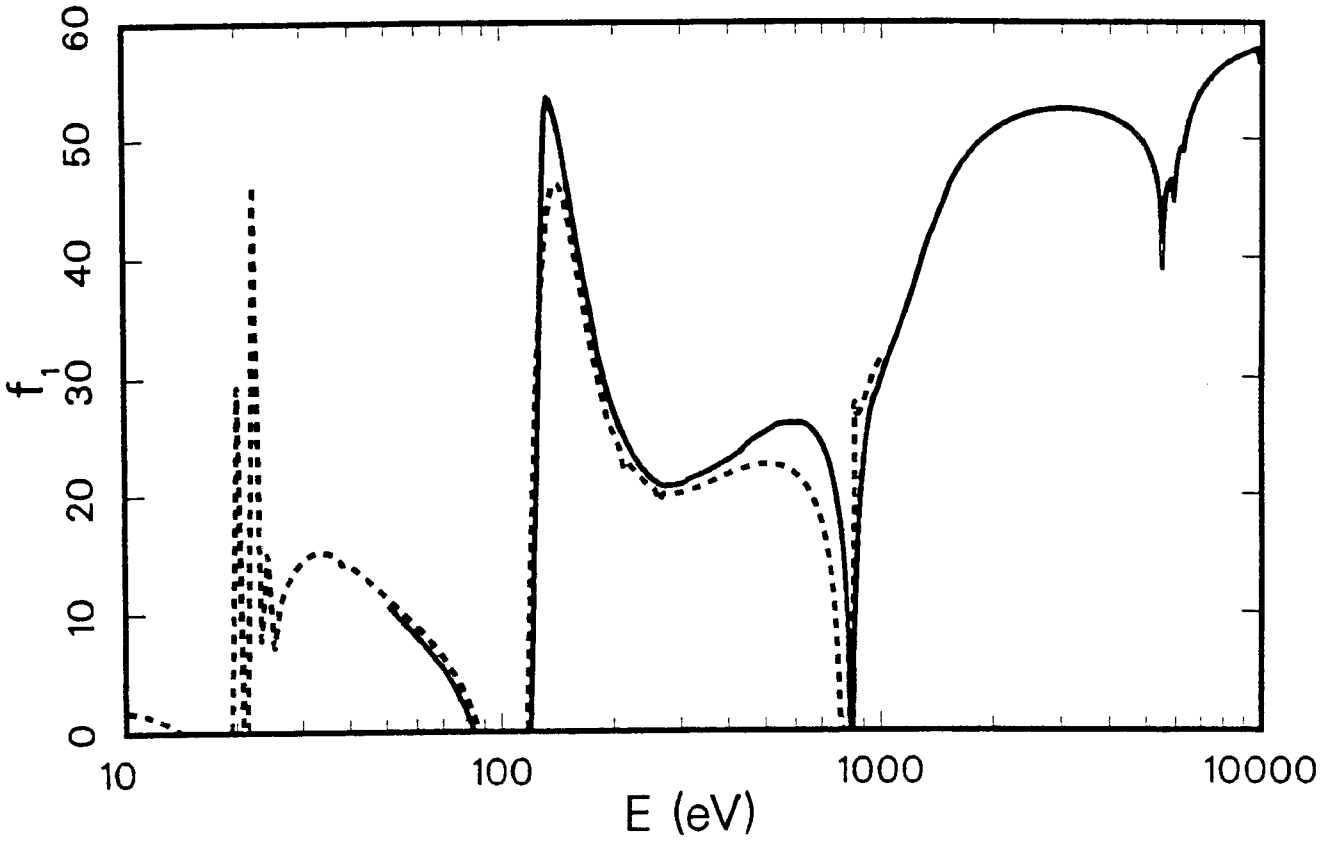
Atomic Weight = 137.33

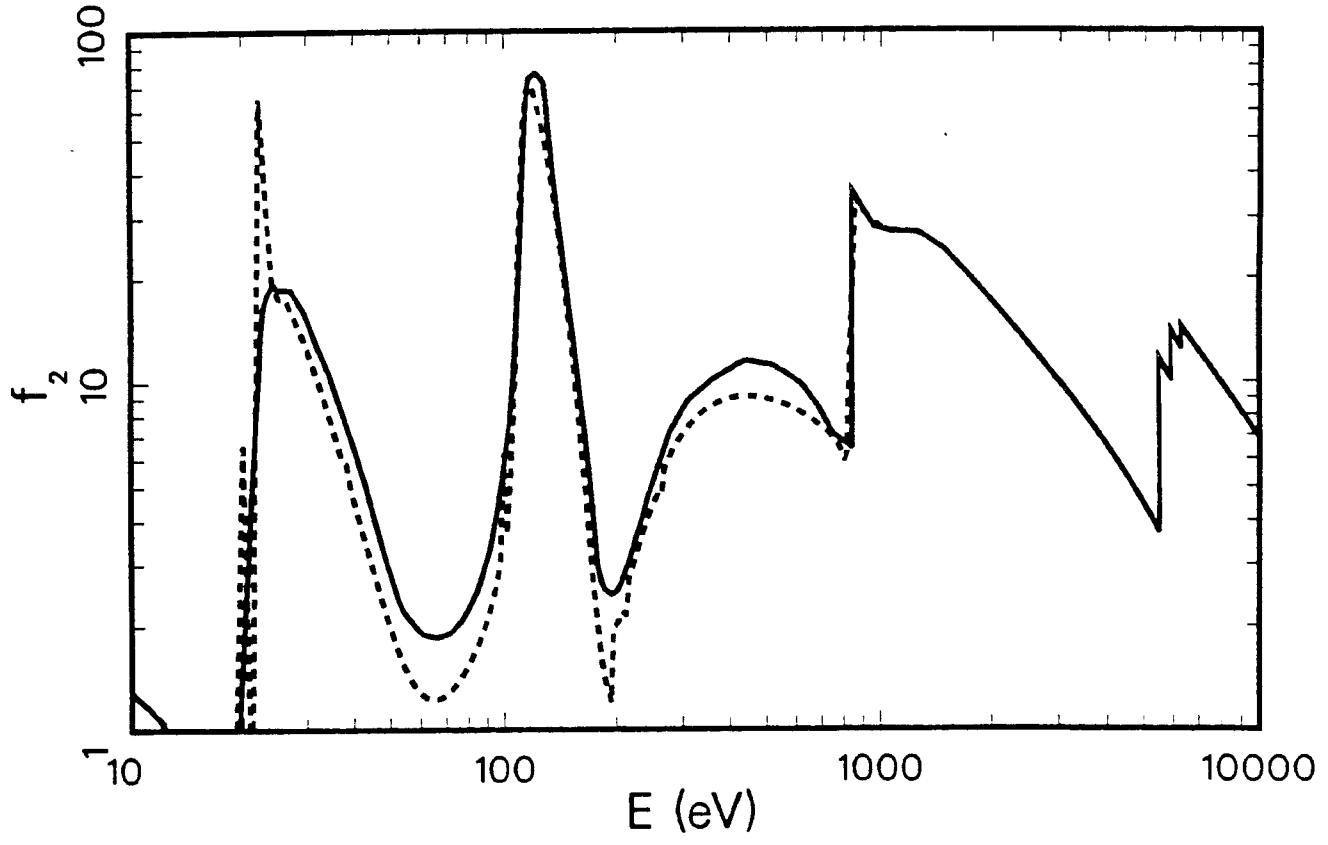
μ (barns/atom) = $\mu(cm^2/g) \times 228.05$

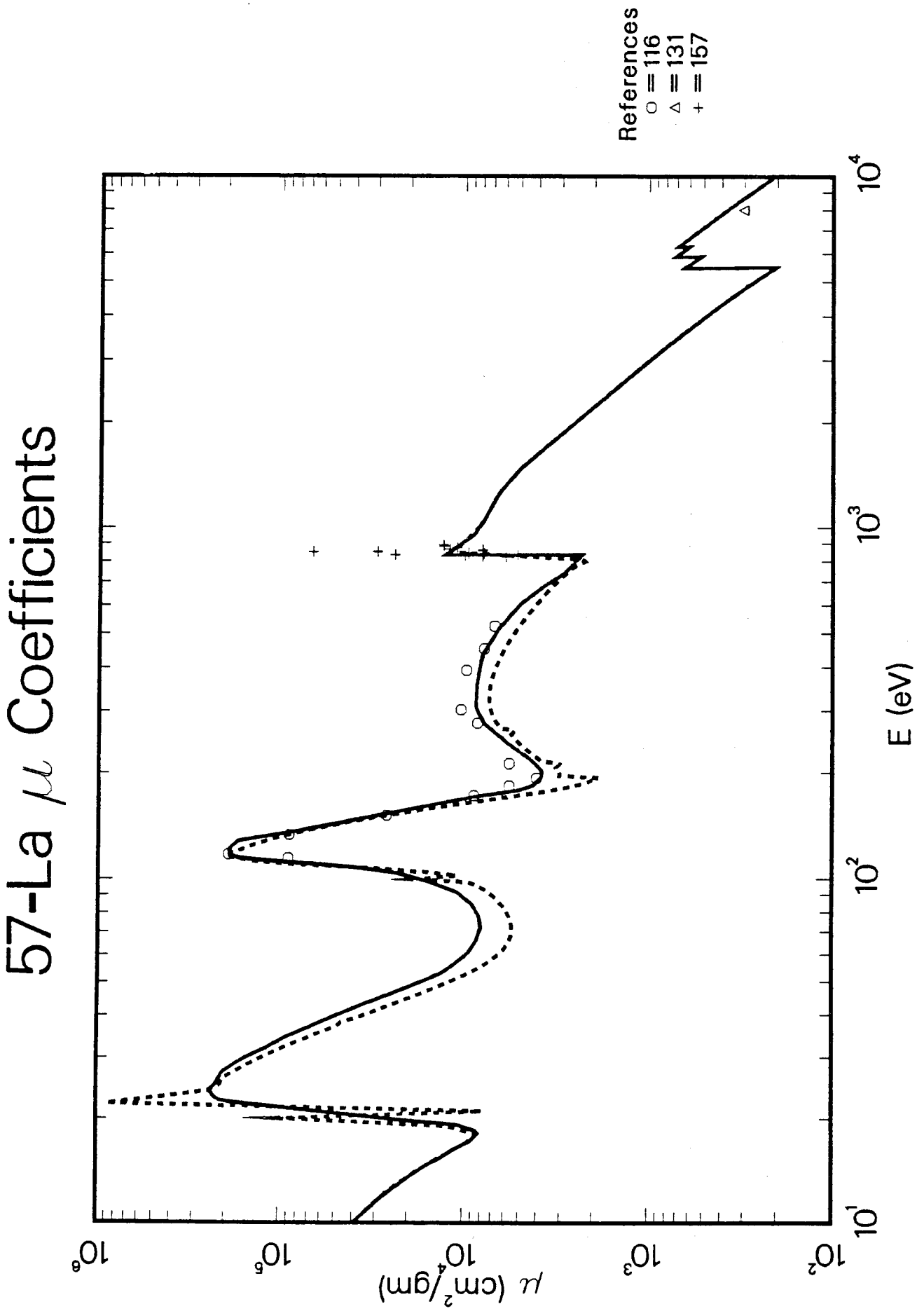
$E\mu(E) = 306.4\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
277.0	6.30e+3	-4.7	127
775.8	5.79e+3	33.8	157
780.0	8.20e+3	75.2	157
782.0	1.20e+4	147.2	157
784.0	5.75e+4	1039.5	157
786.0	1.65e+4	214.8	157
790.0	7.50e+3	32.9	157
794.0	7.98e+3	31.4	157
798.0	3.20e+4	389.6	157
800.0	6.00e+4	784.5	157
802.0	2.31e+4	228.5	157
806.0	2.16e+4	185.7	157
815.0	1.79e+4	101.0	157
823.0	2.05e+4	99.8	157
831.8	1.90e+4	58.2	157
84.7	4.50e+4	165.9	179
88.1	4.91e+4	122.8	179
89.5	5.61e+4	119.0	179
90.2	6.90e+4	150.1	179
91.1	6.25e+4	105.8	179
92.0	6.79e+4	103.6	179
93.0	7.67e+4	99.0	179
93.6	9.63e+4	105.7	179
93.8	1.21e+5	141.6	179
94.1	1.29e+5	135.3	179
94.3	1.15e+5	95.8	179
94.6	8.30e+4	28.4	179
95.2	7.70e+4	-1.5	179
96.0	8.11e+4	14.4	179
97.4	9.73e+4	69.3	179
98.6	1.15e+5	98.4	179
99.2	1.30e+5	106.9	179
100.0	1.48e+5	112.8	179
8050.0	3.73e+2	8.6	224
8380.0	3.44e+2	11.2	224

Atomic Scattering Factors, f_1+if_2
57 - Lanthanum (La)



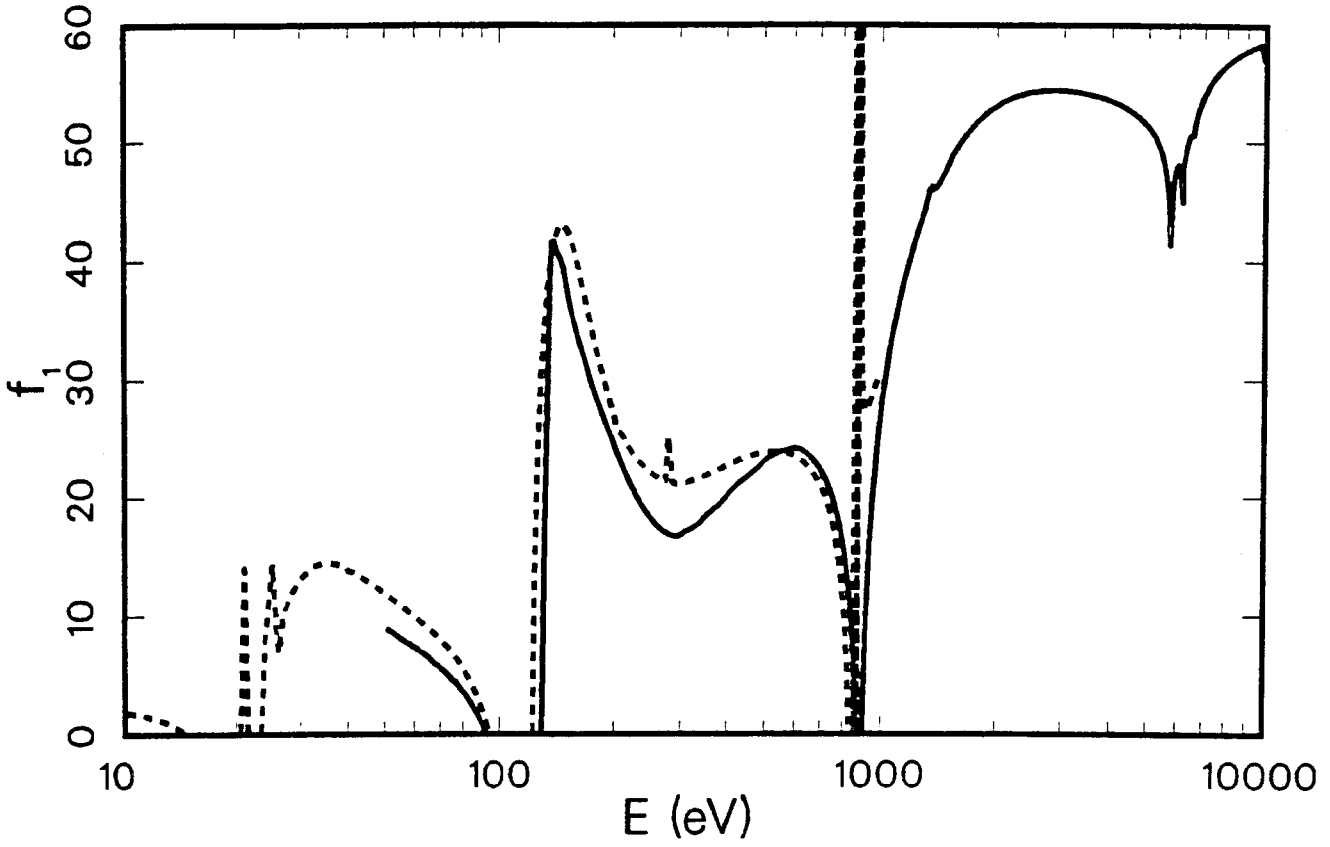


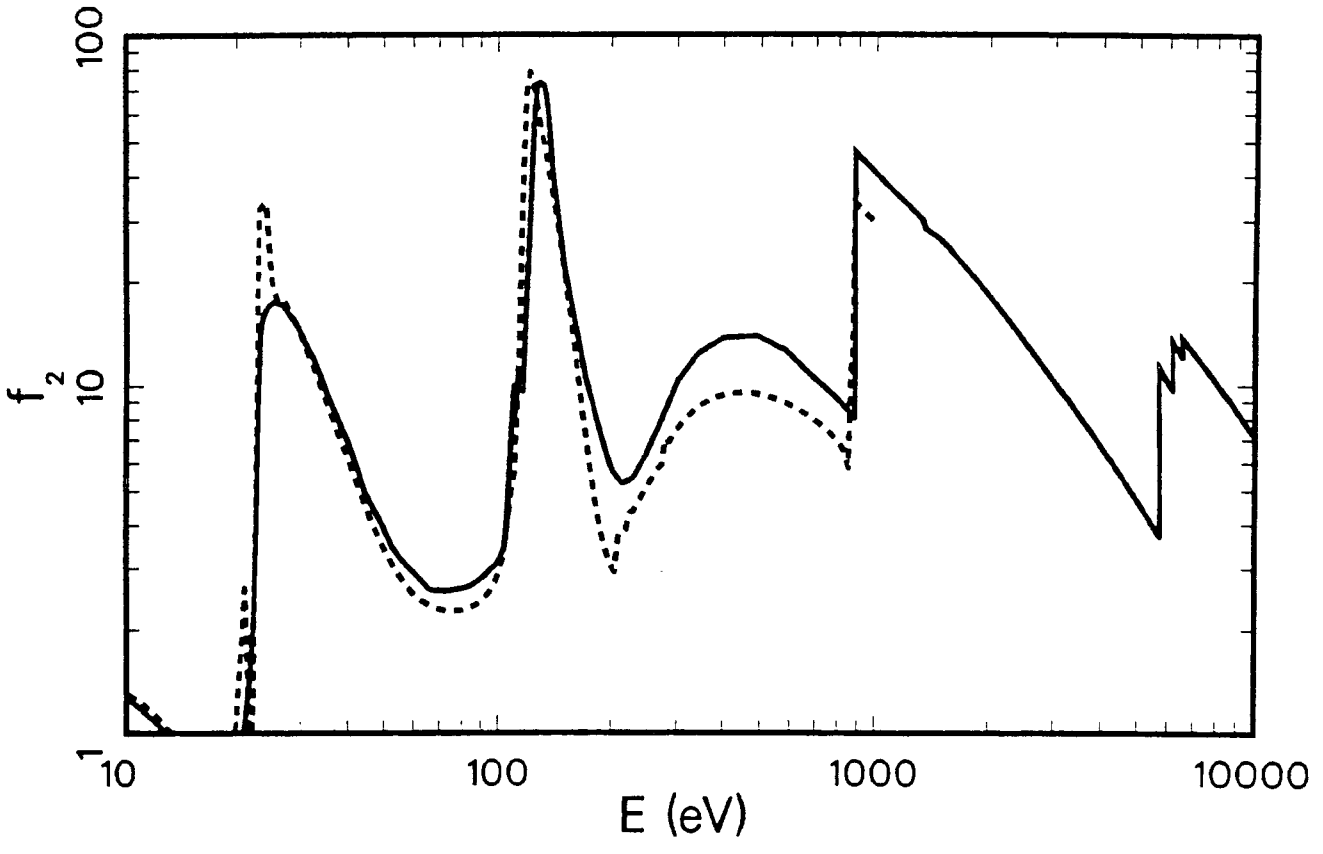

57-La μ Coefficients
References
○ = 116
△ = 131
+ = 157
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

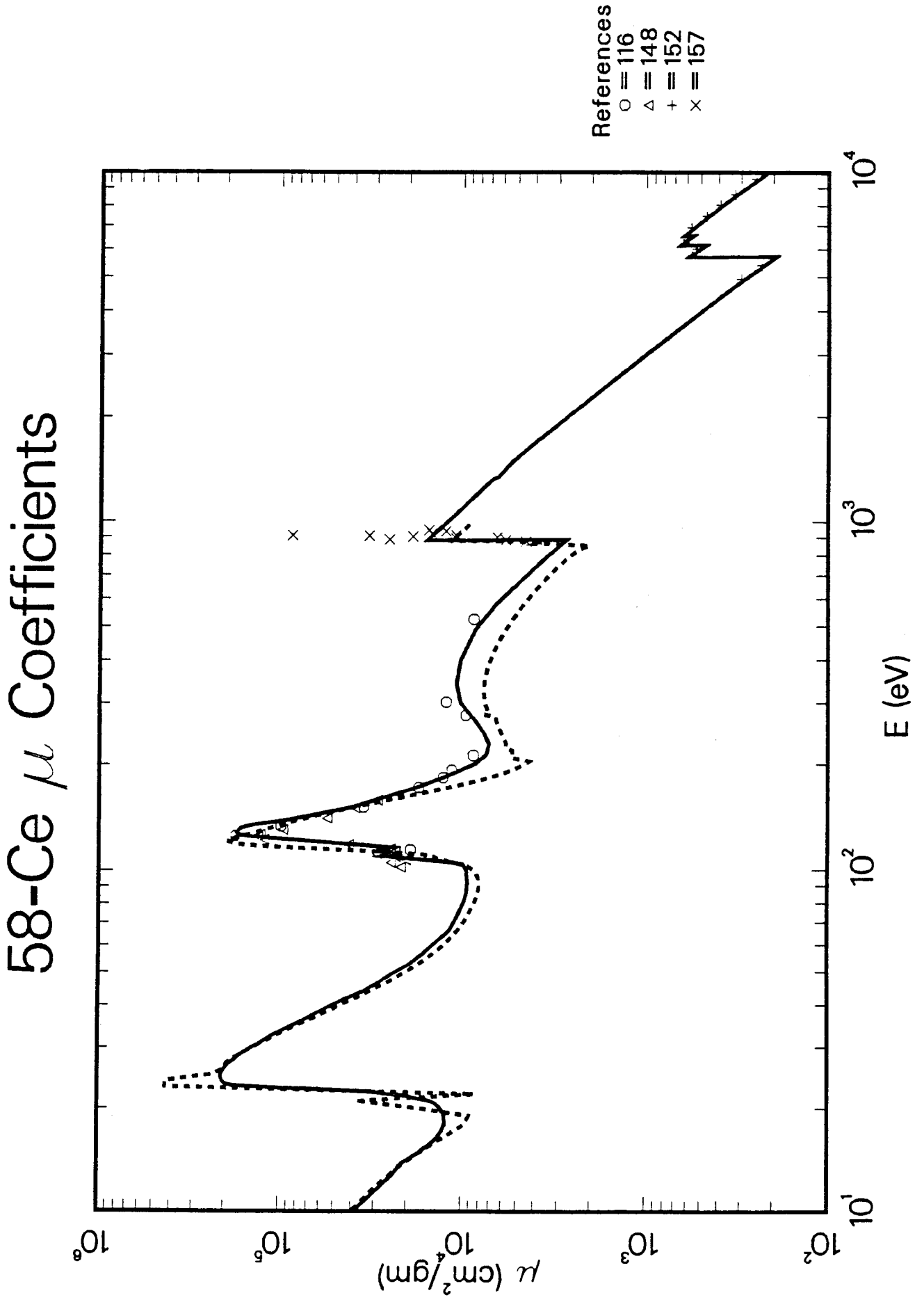
Lanthanum (La) — 57
Atomic Weight = 138.91
μ (barns/atom) = $\mu(cm^2/g) \times 230.67$
$E\mu(E) = 302.9\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	9.06e+4	-42.8	116
117.0	1.93e+5	1.1	116
132.8	8.97e+4	-17.2	116
151.1	2.64e+4	-10.3	116
171.7	8.80e+3	8.6	116
183.3	5.68e+3	31.8	116
192.6	4.07e+3	5.1	116
212.2	5.68e+3	37.3	116
277.0	8.45e+3	8.3	116
302.7	1.04e+4	22.4	116
392.4	9.75e+3	18.1	116
452.2	7.80e+3	2.5	116
524.9	6.85e+3	8.2	116
8000.0	3.05e+2	-18.3	131
9962.0	1.73e+2	-17.4	131
825.0	5.98e+3	74.9	157
830.0	8.02e+3	115.4	157
832.0	1.00e+4	160.1	157
835.5	5.17e+3	26.7	157
837.0	2.40e+4	473.8	157
840.0	9.58e+3	117.8	157
844.0	7.89e+3	67.8	157
848.0	9.58e+3	90.8	157
851.0	3.00e+4	468.6	157
852.5	6.78e+4	1153.9	157
854.0	3.00e+4	441.4	157
858.0	8.02e+3	35.6	157
864.0	8.02e+3	23.0	157
870.0	1.21e+4	68.5	157
876.0	1.10e+4	39.3	157
884.0	1.30e+4	44.9	157
892.0	1.31e+4	28.7	157

Atomic Scattering Factors, f_1+if_2
58 - Cerium (Ce)






58-Ce μ Coefficients
References
○ = 116
△ = 148
+ = 152
× = 157
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Cerium (Ce) — 58

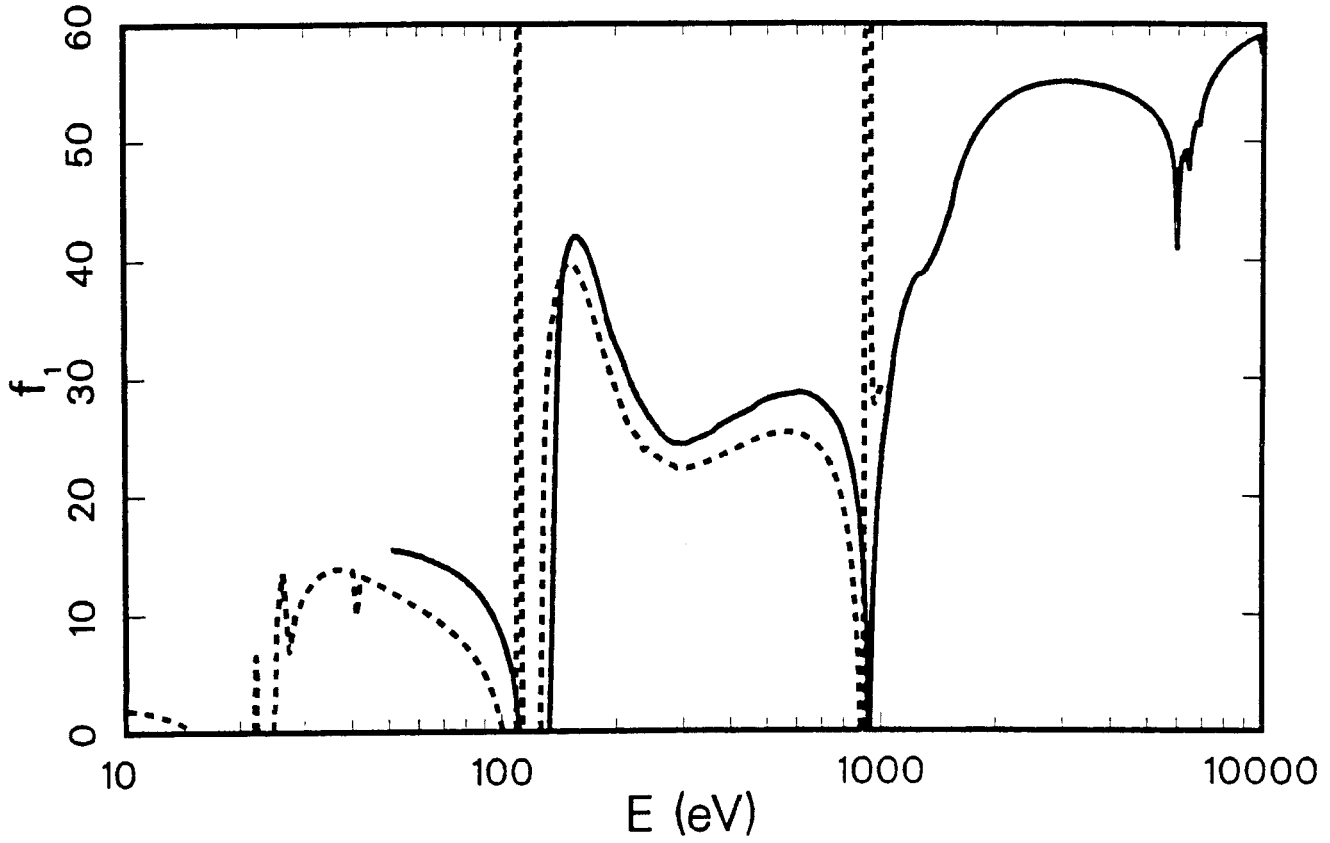
Atomic Weight = 140.12

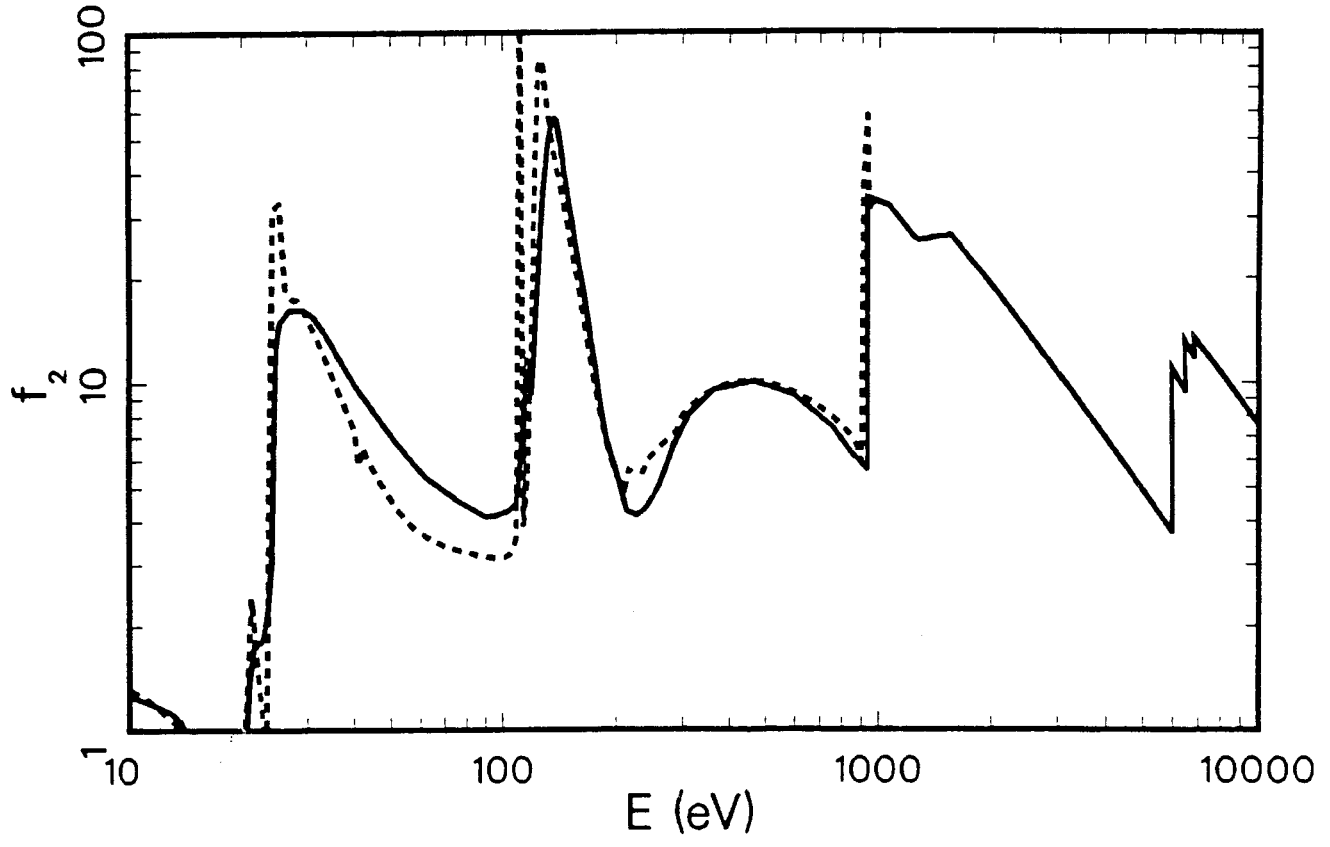
μ (barns/atom) = $\mu(cm^2/g) \times 232.68$

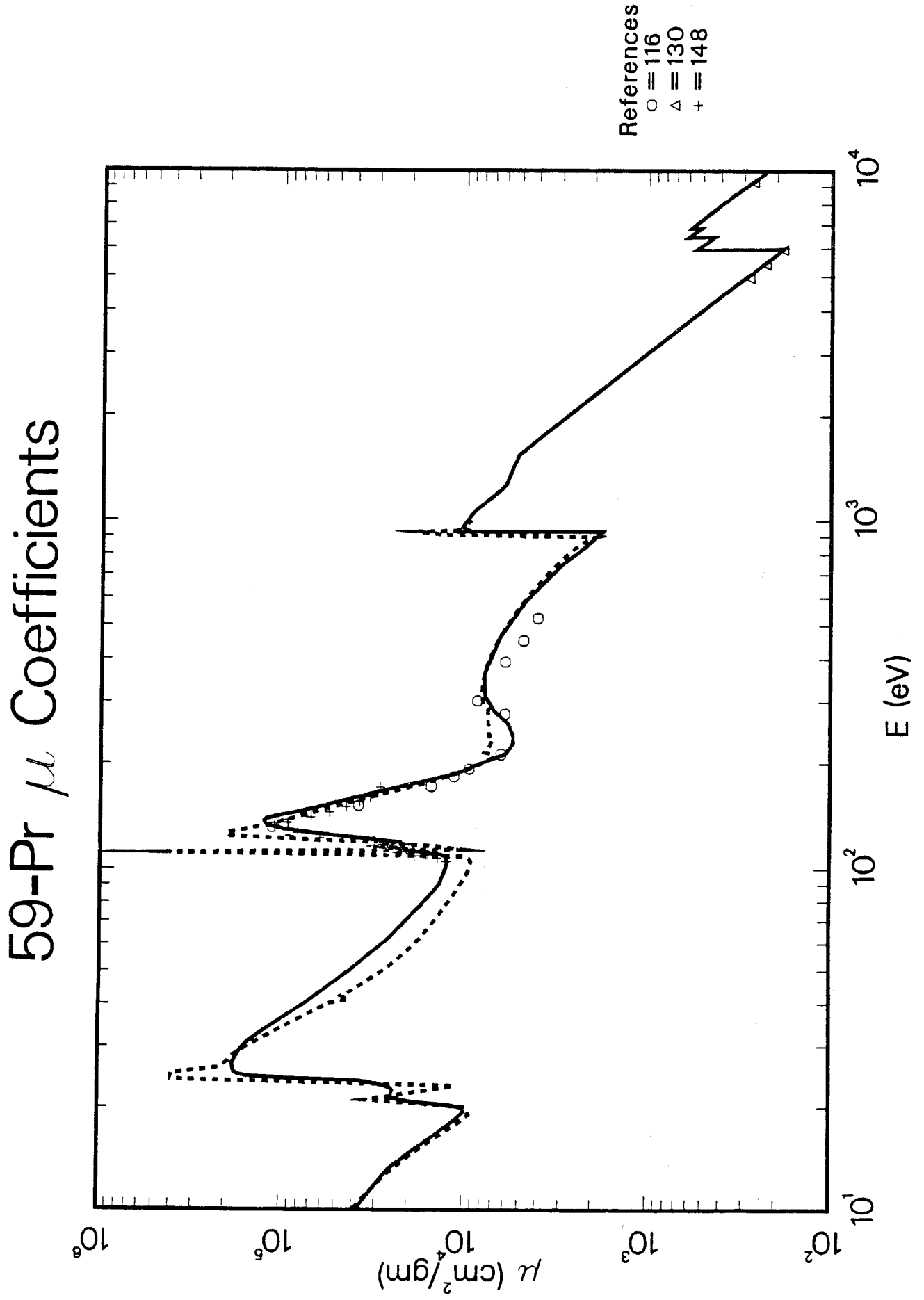
$E\mu(E) = 300.3\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.93e+4	-37.6	116
124.8	1.75e+5	13.3	116
132.8	9.84e+4	-36.2	116
151.1	3.48e+4	-14.7	116
171.7	1.74e+4	-3.0	116
183.3	1.28e+4	-1.3	116
192.6	1.14e+4	11.4	116
212.2	8.68e+3	16.6	116
277.0	9.58e+3	7.0	116
302.7	1.23e+4	20.1	116
524.9	8.68e+3	13.9	116
102.0	2.17e+4	125.0	148
105.0	2.46e+4	128.0	148
107.0	2.03e+4	25.8	148
109.0	2.30e+4	-3.7	148
111.0	2.93e+4	19.9	148
113.0	2.32e+4	-22.5	148
115.0	2.46e+4	0.7	148
118.0	4.20e+4	7.6	148
122.0	1.22e+5	34.5	148
124.0	1.32e+5	-3.1	148
126.0	1.28e+5	-23.8	148
130.0	9.58e+4	-43.0	148
140.0	5.50e+4	-33.2	148
150.0	3.89e+4	-9.5	148
158.0	2.93e+4	-4.2	148
4949.0	3.00e+2	4.8	152
5411.0	2.34e+2	3.4	152
5895.0	5.39e+2	0.2	152
6024.0	5.31e+2	5.0	152
6400.0	6.01e+2	2.0	152
6491.0	5.91e+2	4.0	152
6926.0	5.69e+2	4.1	152
7473.0	4.66e+2	2.9	152
8040.0	3.89e+2	3.2	152
8630.0	3.23e+2	2.7	152
9570.0	2.49e+2	3.5	152
9990.0	2.20e+2	2.5	152
875.0	4.51e+3	9.5	157
881.0	5.80e+3	28.0	157
886.0	2.55e+4	419.3	157
892.0	1.10e+4	104.0	157
898.0	6.49e+3	9.6	157
903.0	1.90e+4	196.8	157
906.0	3.30e+4	392.3	157
908.0	8.65e+4	1151.2	157
912.0	1.10e+4	49.6	157
922.0	1.50e+4	75.1	157
935.0	1.25e+4	20.1	157
945.0	1.55e+4	28.4	157

Atomic Scattering Factors, f_1+if_2
59 - Praseodymium (Pr^1)



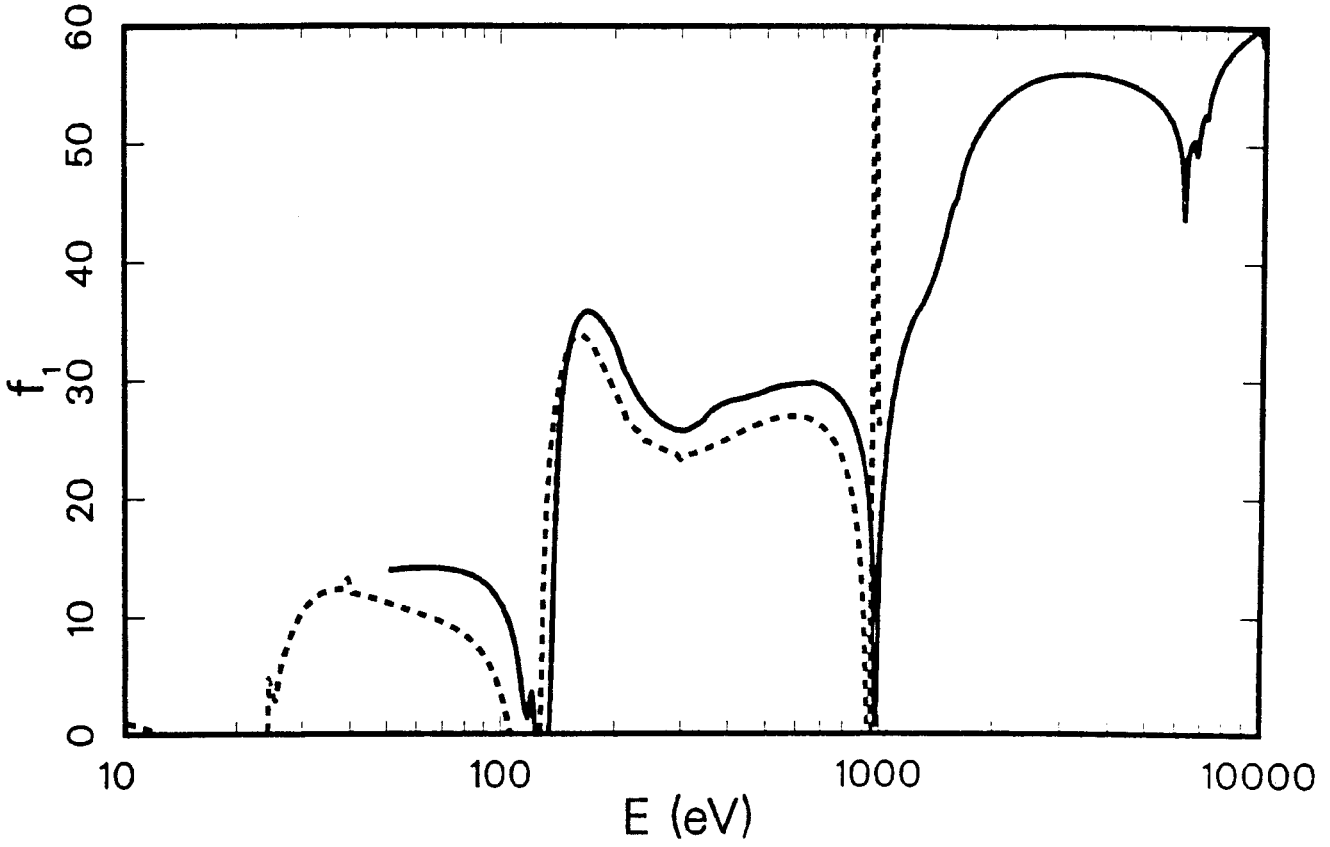


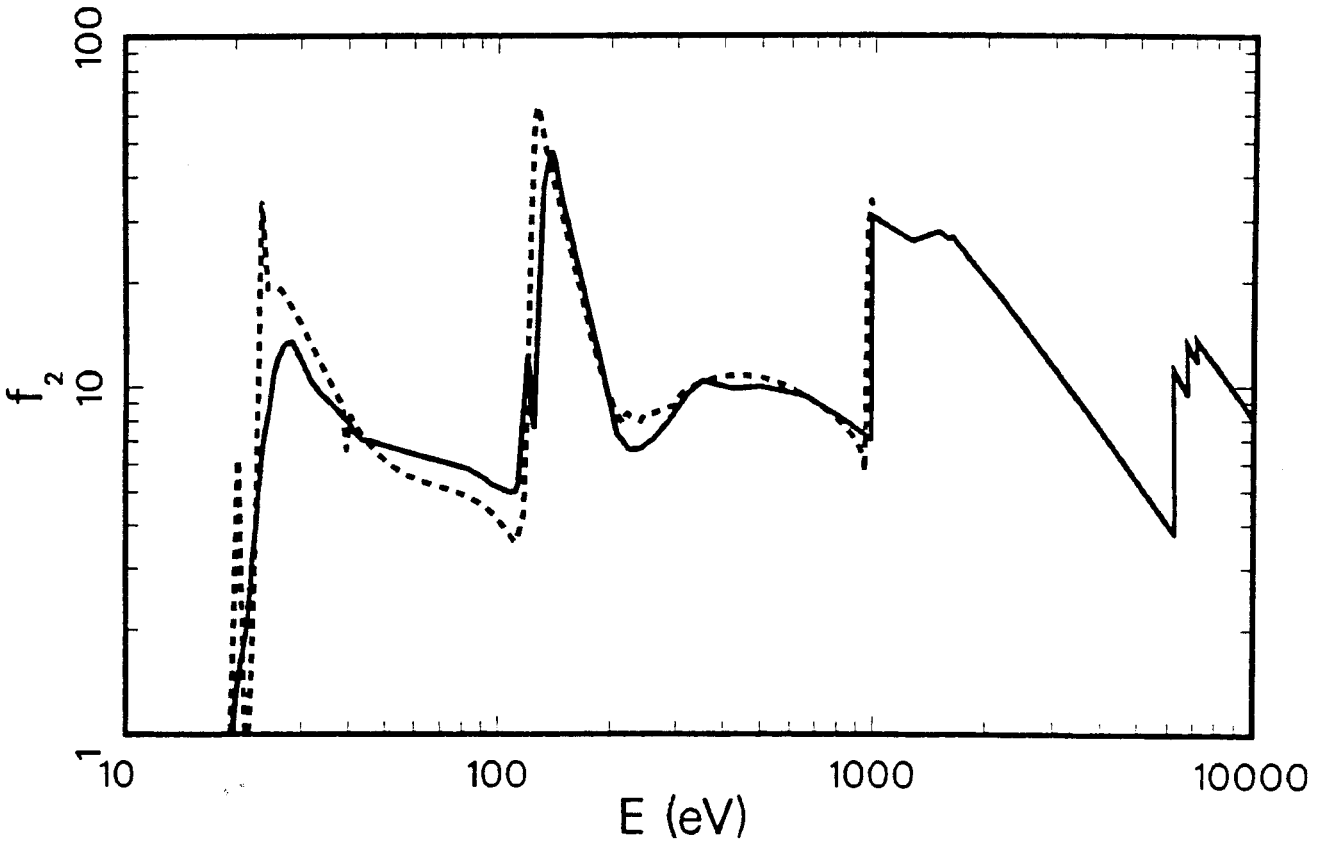

59-Pr μ Coefficients
References
○ = 116
△ = 130
+ = 148
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10⁴
10³
10²
10¹

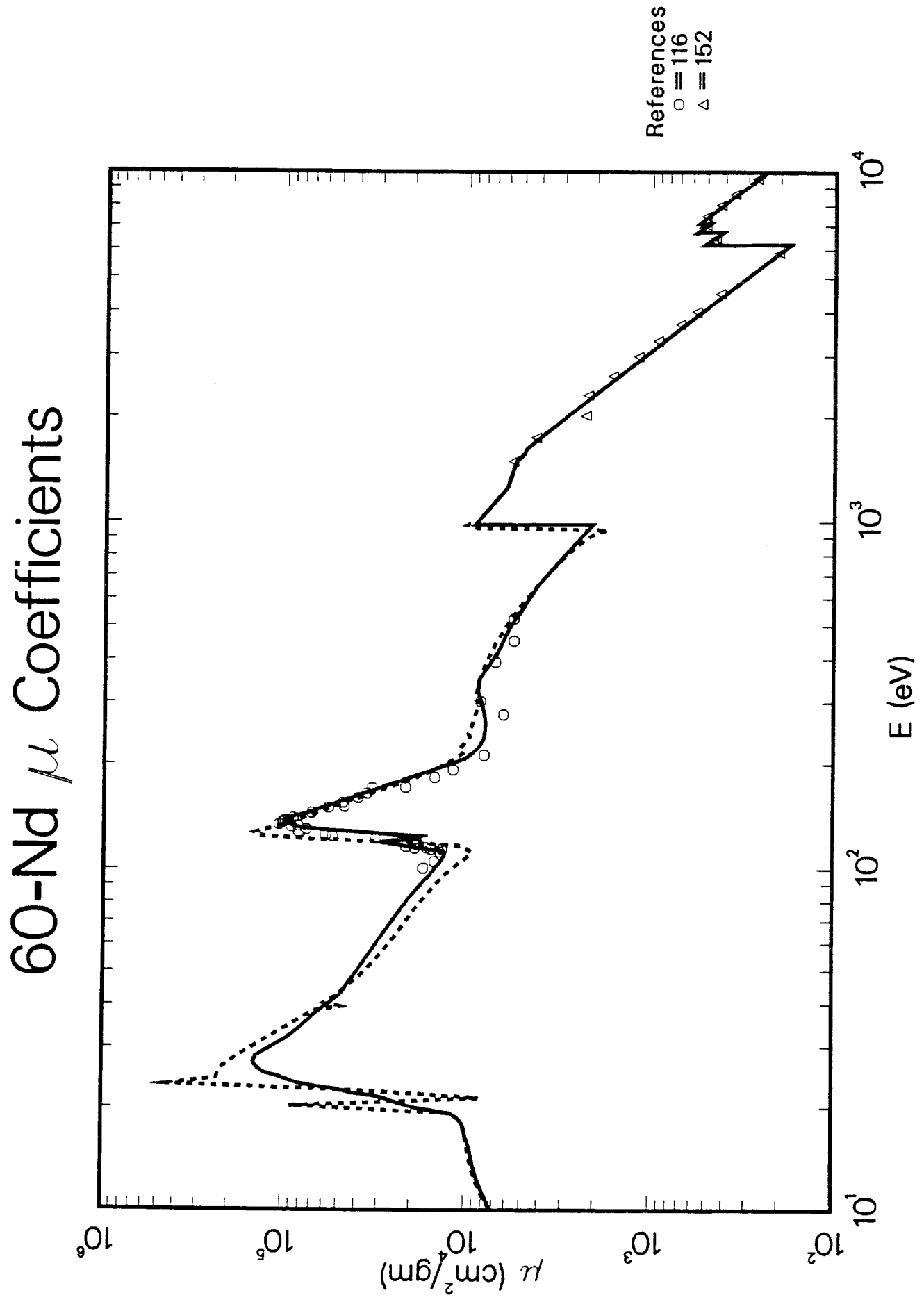
Praseodymium (Pr) — 59
Atomic Weight = 140.91
μ (barns/atom) = $\mu(cm^2/g) \times 233.99$
$E\mu(E) = 298.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.97e+4	-14.4	116
130.8	1.12e+5	5.6	116
132.8	9.70e+4	-18.0	116
151.1	3.80e+4	-36.6	116
171.7	1.51e+4	-32.4	116
183.3	1.14e+4	-13.7	116
192.6	9.40e+3	-4.0	116
212.2	6.33e+3	3.3	116
277.0	6.03e+3	-9.0	116
302.7	8.50e+3	13.5	116
392.4	6.03e+3	-18.0	116
452.2	4.79e+3	-27.2	116
524.9	4.01e+3	-26.2	116
4951.0	2.84e+2	-4.6	130
5412.0	2.32e+2	-2.5	130
5946.0	1.86e+2	-1.1	130
9245.0	2.70e+2	-1.8	130
105.0	1.24e+4	-0.3	148
107.0	1.39e+4	11.9	148
108.8	1.85e+4	48.7	148
109.3	1.56e+4	21.4	148
109.9	1.60e+4	16.9	148
110.2	1.56e+4	10.8	148
111.0	2.32e+4	51.1	148
111.5	1.85e+4	13.0	148
112.0	2.00e+4	14.2	148
112.5	1.88e+4	0.2	148
113.0	2.18e+4	8.0	148
114.0	2.00e+4	-13.1	148
115.0	2.16e+4	-18.3	148
116.0	2.44e+4	-19.3	148
118.0	2.78e+4	22.5	148
119.0	2.78e+4	21.3	148
120.0	3.09e+4	15.4	148
122.0	6.15e+4	69.3	148
124.0	9.02e+4	83.4	148
126.0	8.16e+4	23.3	148
128.0	9.27e+4	8.7	148
132.0	1.09e+5	-4.0	148
135.0	9.27e+4	-24.8	148
140.0	6.92e+4	-39.3	148
145.0	5.47e+4	-33.5	148
150.0	4.44e+4	-29.7	148
155.0	3.74e+4	-24.3	148
160.0	3.24e+4	-16.5	148
165.0	2.96e+4	-3.7	148
171.0	2.85e+4	23.5	148

Atomic Scattering Factors, f_1+if_2
60 - Neodymium (Nd)






60-Nd μ Coefficients
References
○ = 116
△ = 152
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Neodymium (Nd) — 60

Atomic Weight = 144.24

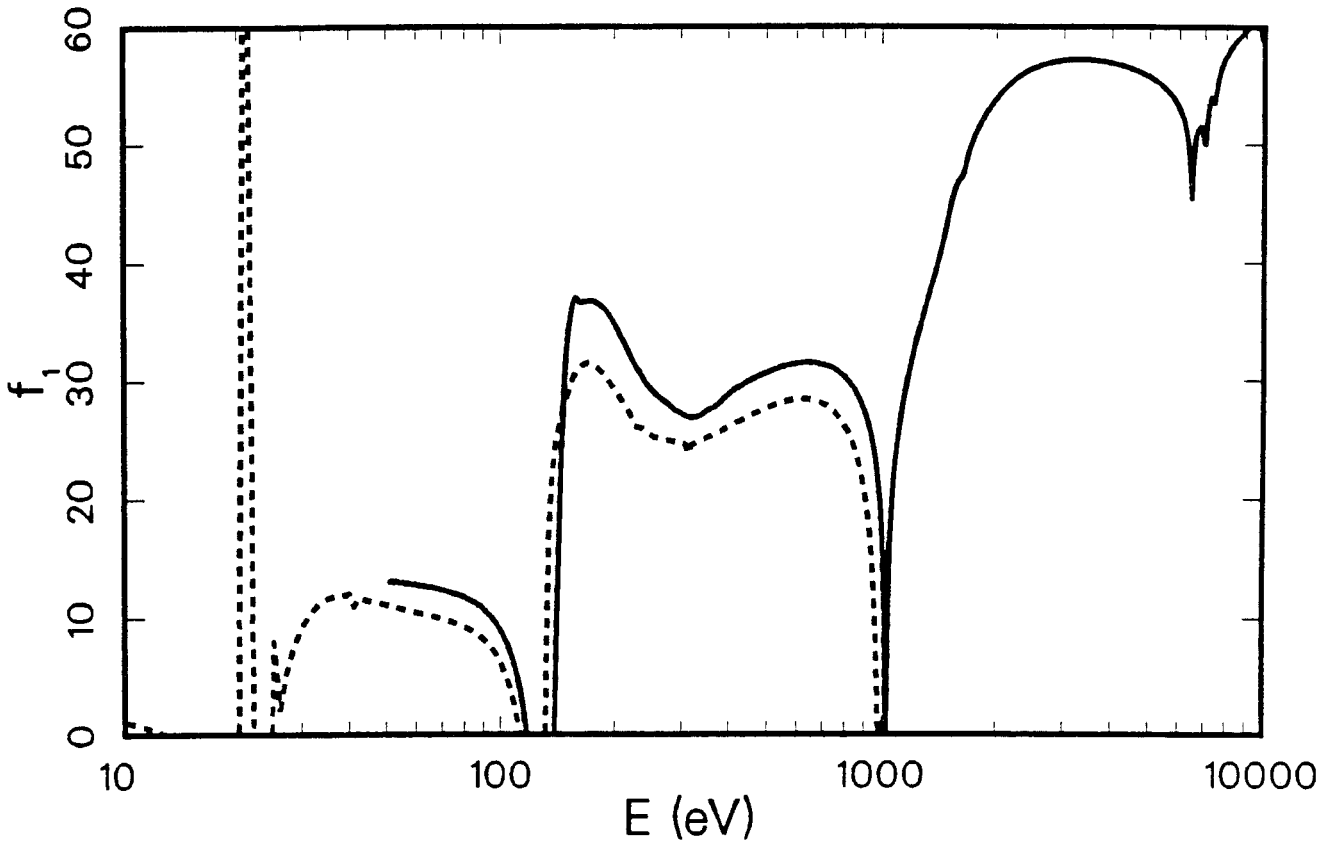
μ (barns/atom) = $\mu(cm^2/g) \times 239.52$

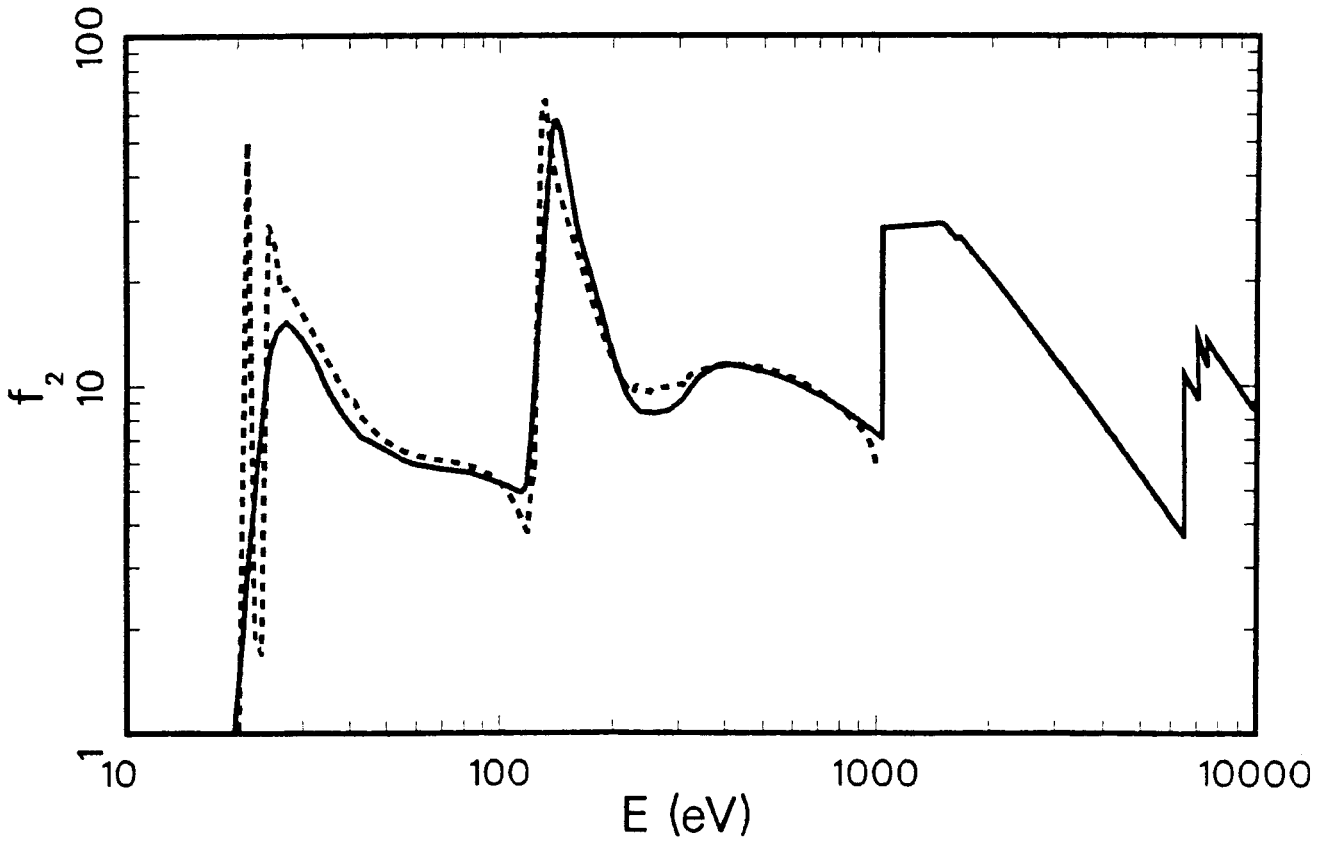
$E\mu(E) = 291.7\, f_2$ keV cm^2/g

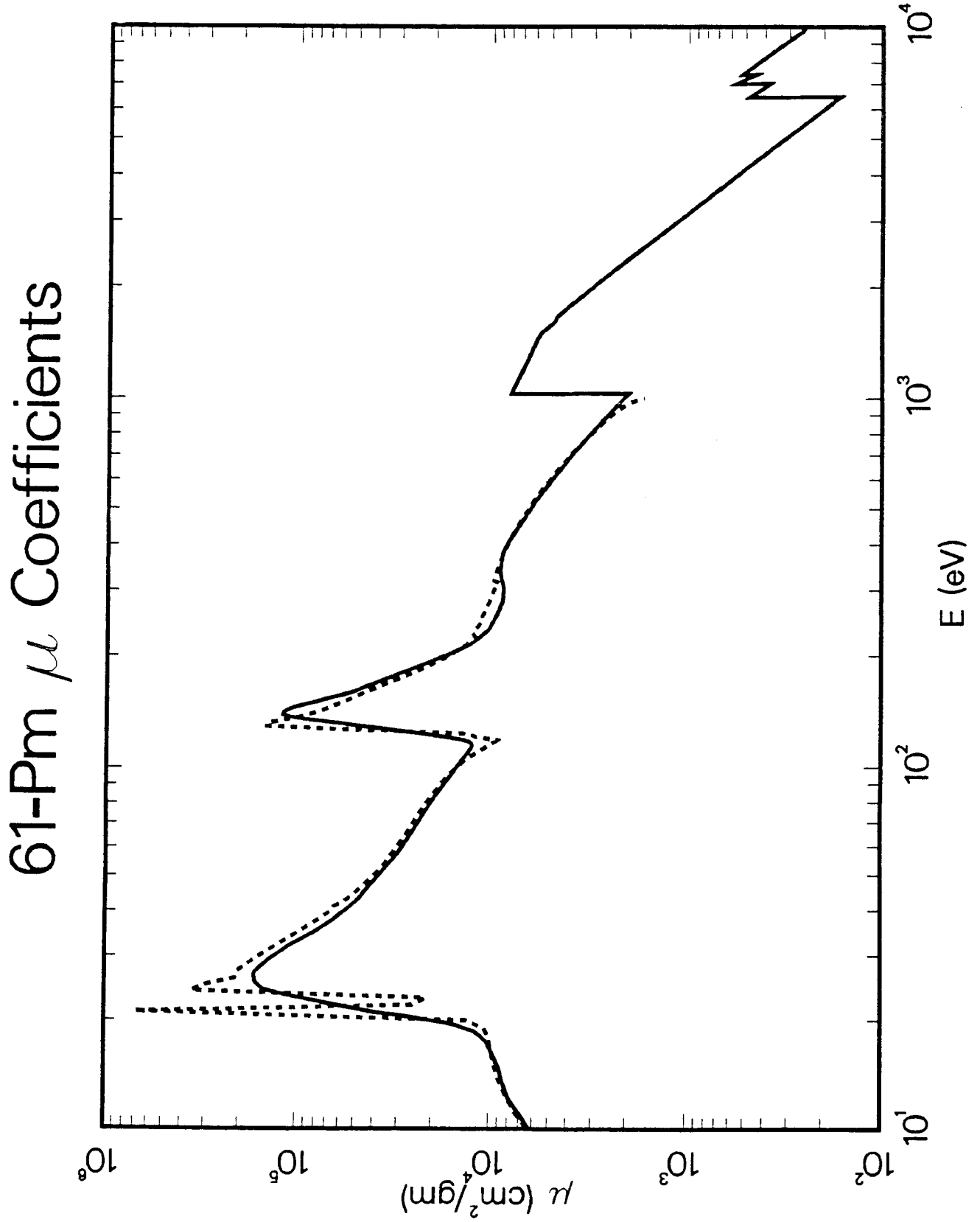
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
100.5	1.73e+4	16.6	116
105.0	1.50e+4	8.0	116
110.0	1.37e+4	3.9	116
112.0	1.40e+4	7.3	116
114.0	1.57e+4	-1.8	116
114.0	1.36e+4	-15.1	116
114.5	1.92e+4	12.9	116
115.0	1.66e+4	-8.0	116
116.0	2.14e+4	5.5	116
117.0	1.86e+4	-18.6	116
118.0	2.00e+4	-22.0	116
119.0	1.86e+4	-35.5	116
120.0	2.11e+4	-30.6	116
121.0	2.14e+4	-16.0	116
122.0	3.14e+4	46.9	116
124.0	5.43e+4	217.6	116
125.0	5.93e+4	174.1	116
127.0	8.14e+4	136.4	116
128.0	8.31e+4	91.7	116
130.0	7.56e+4	10.7	116
132.0	9.02e+4	7.3	116
132.8	8.35e+4	-4.7	116
134.0	1.06e+5	13.3	116
136.0	1.01e+5	4.0	116
137.0	1.00e+5	0.8	116
138.0	9.77e+4	-3.0	116
140.0	8.85e+4	-5.4	116
145.0	7.01e+4	-6.6	116
150.0	5.72e+4	-7.5	116
151.1	4.68e+4	-21.3	116
155.0	4.76e+4	-7.8	116
160.0	3.93e+4	-9.3	116
165.0	3.50e+4	-4.3	116
171.0	3.29e+4	9.3	116
171.7	2.16e+4	-26.5	116
183.3	1.50e+4	-26.9	116
192.6	1.19e+4	-24.0	116
212.2	8.02e+3	-17.2	116
277.0	6.30e+3	-21.4	116
302.7	8.43e+3	0.7	116
392.4	7.01e+3	-5.5	116
452.2	5.55e+3	-12.7	116
524.9	5.55e+3	1.8	116
1487.0	5.66e+3	4.2	152
1740.0	4.28e+3	5.5	152
2013.0	2.31e+3	-19.9	152
2307.0	2.24e+3	7.8	152
2621.0	1.65e+3	8.1	152
2984.0	1.20e+3	7.9	152
3313.0	9.36e+2	9.1	152

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
3691.0	7.04e+2	7.2	152
4012.0	5.74e+2	7.6	152
4508.0	4.25e+2	6.6	152
5895.0	2.05e+2	1.1	152
6400.0	4.68e+2	-1.8	152
6491.0	4.53e+2	-1.0	152
6926.0	5.33e+2	1.4	152
7056.0	5.10e+2	0.4	152
7473.0	5.10e+2	3.3	152
8040.0	4.25e+2	3.1	152
8630.0	3.56e+2	3.2	152
9570.0	2.70e+2	2.1	152
9990.0	2.35e+2	-0.7	152

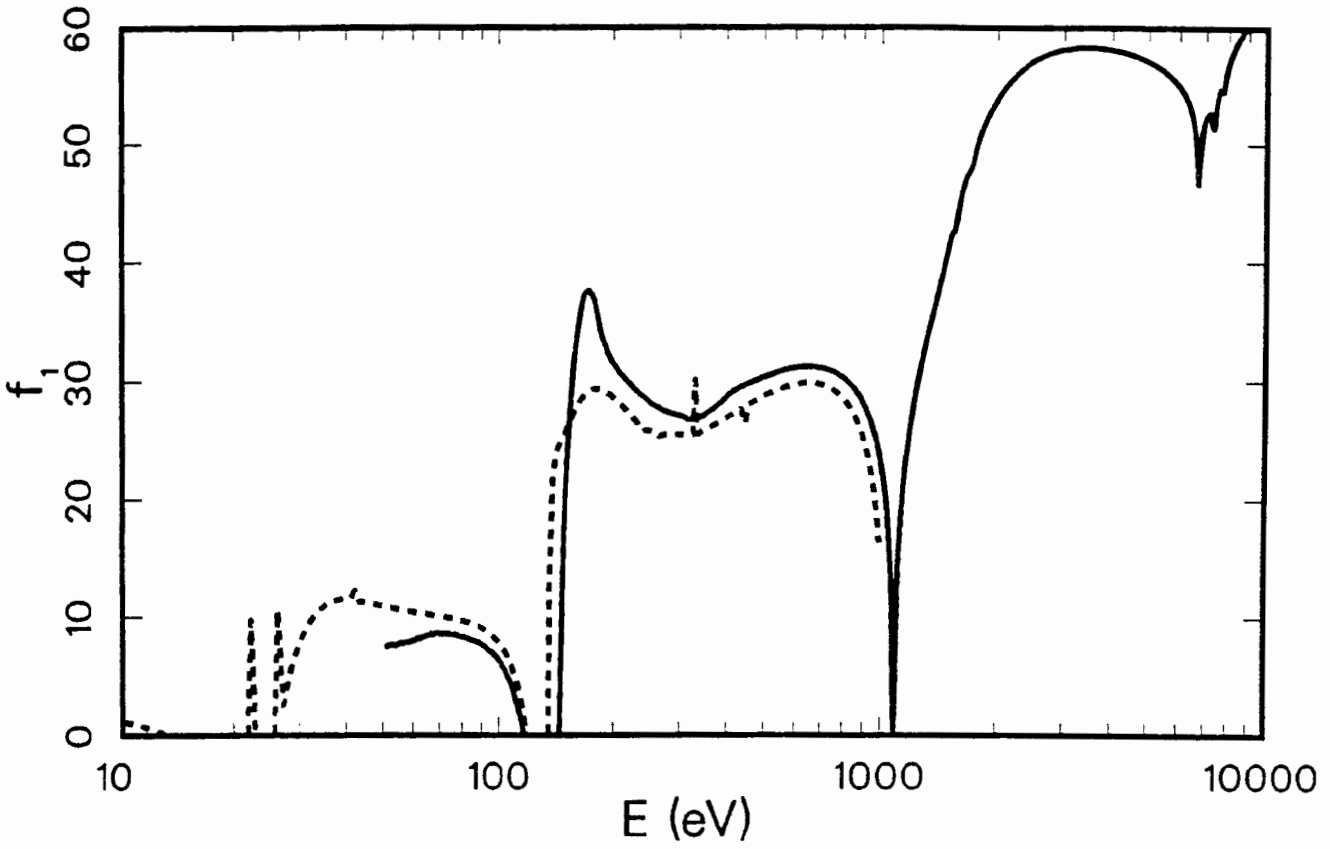
Atomic Scattering Factors, f_1+if_2
61 - Promethium (Pm)

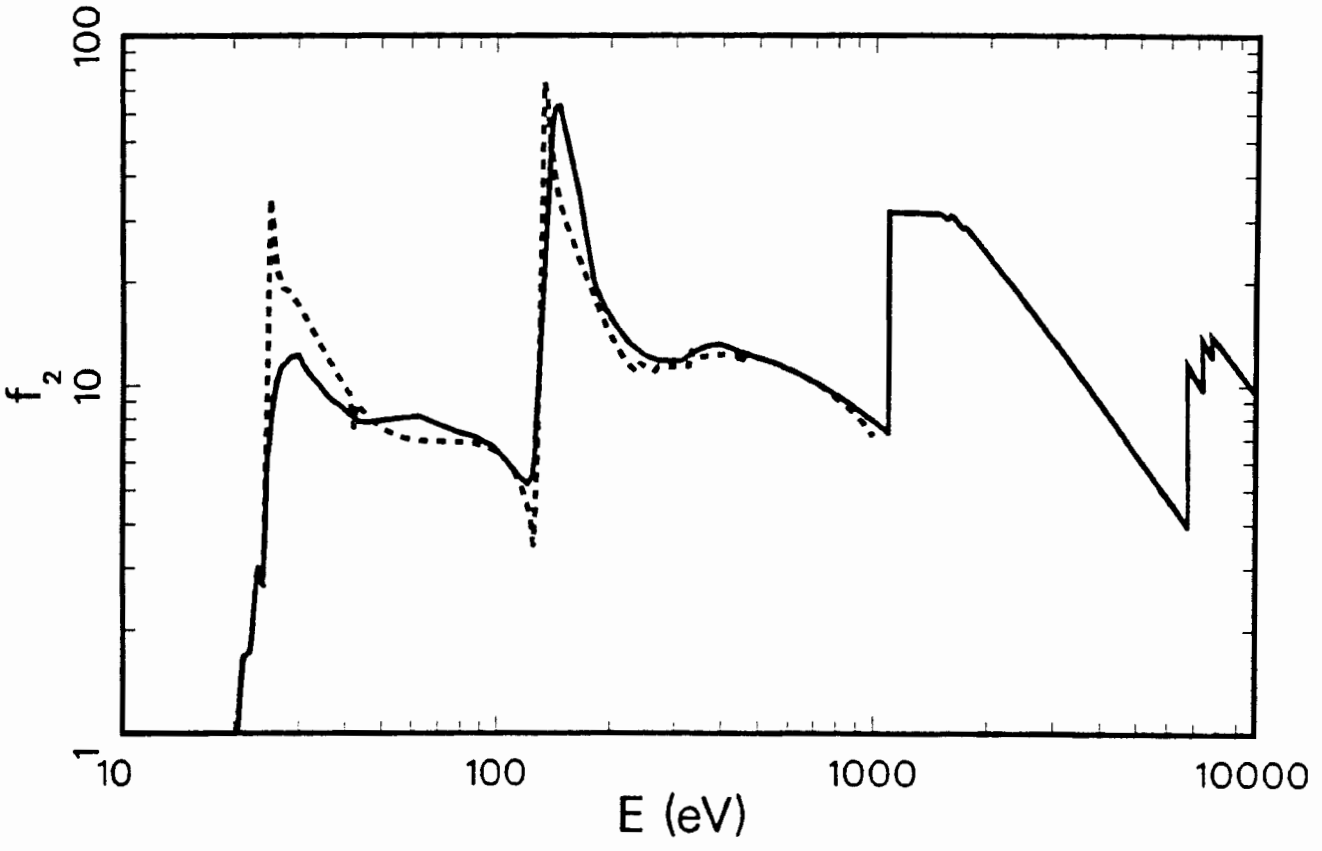


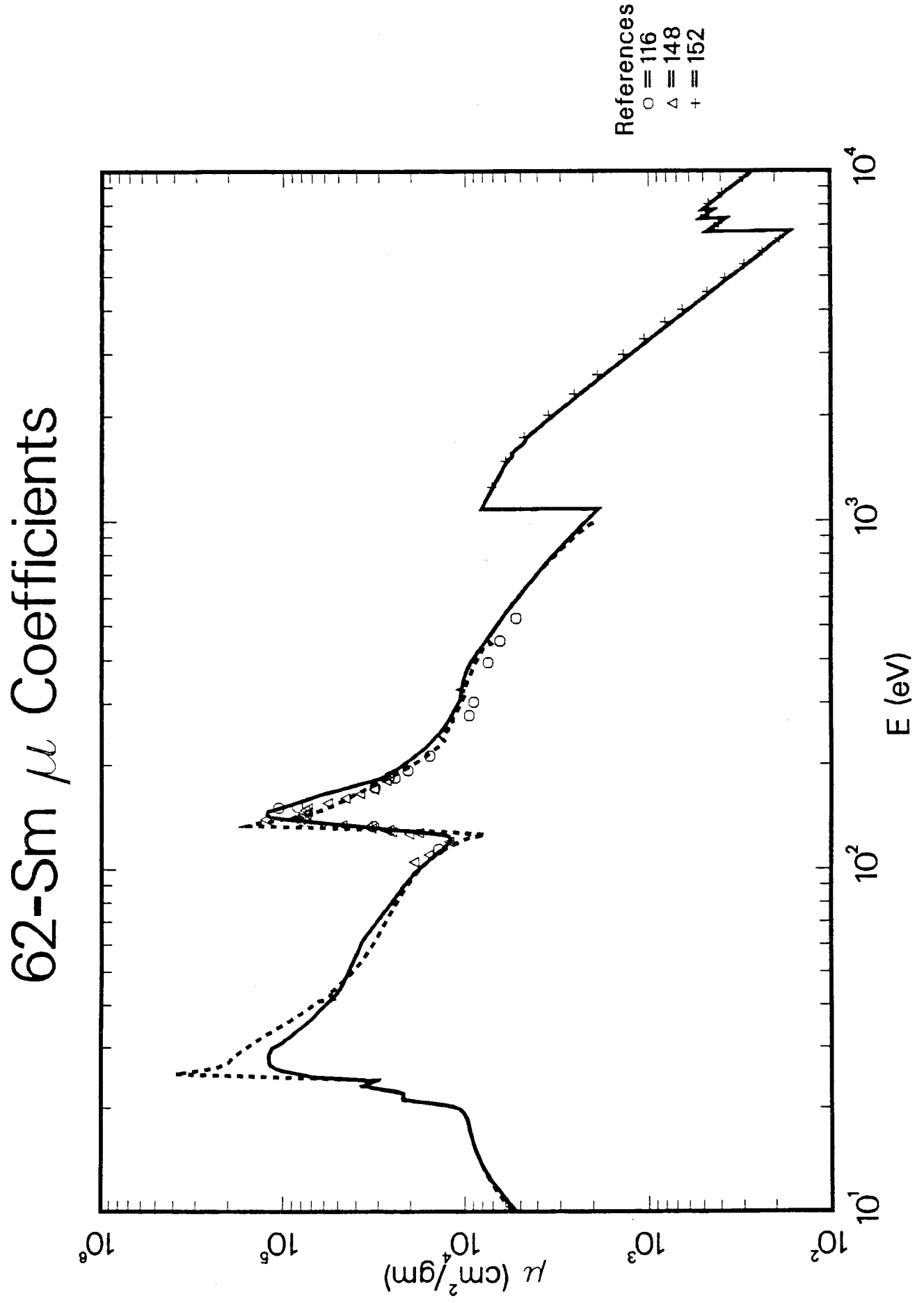



61-Pm μ Coefficients
μ (cm²/gm)
10²
10³
10⁴
10⁵
10⁶
E (eV)
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
62 - Samarium (Sm)






62-Sm μ Coefficients
References
○ = 116
△ = 148
+ = 152
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Samarium (Sm) — 62

Atomic Weight = 150.35

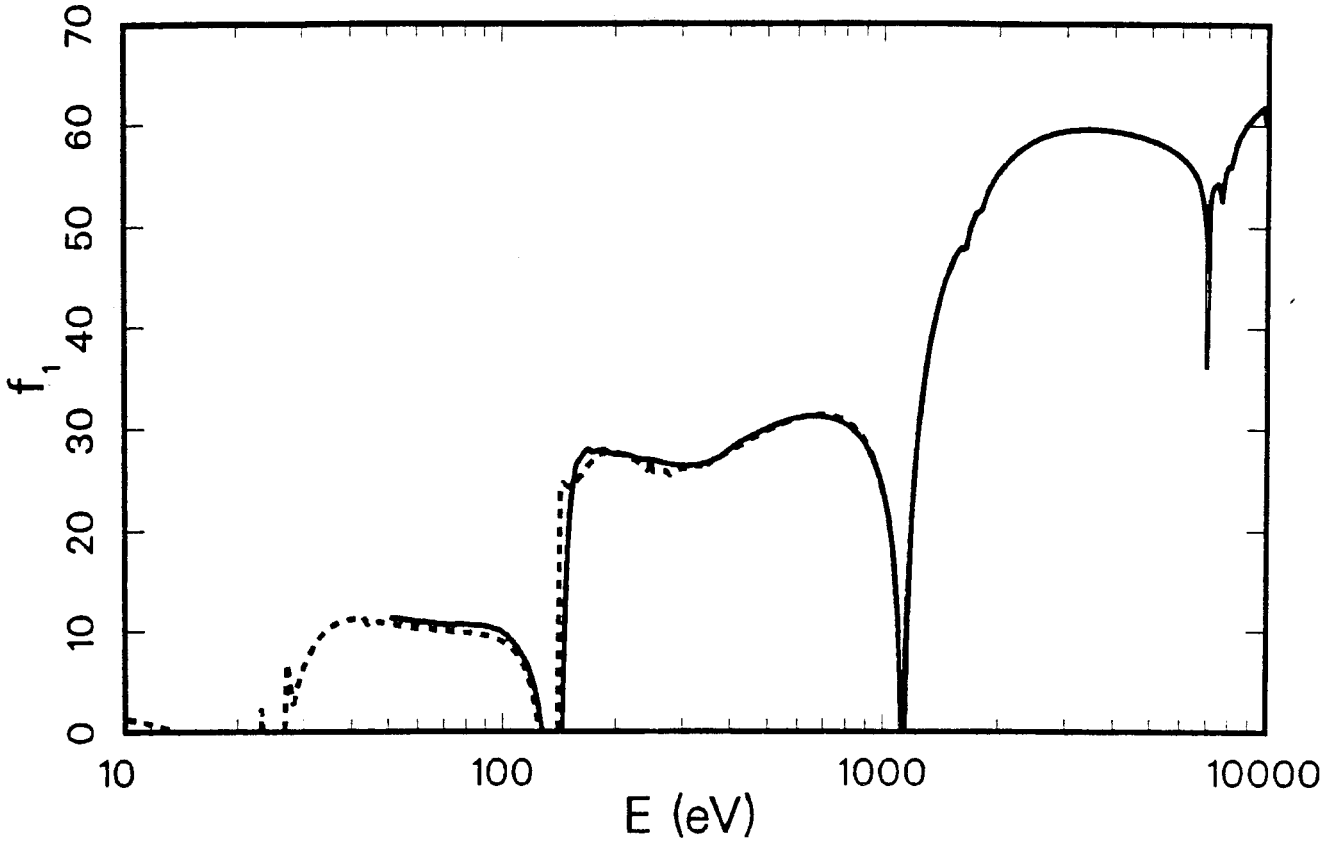
μ (barns/atom) = $\mu(cm^2/g) \times 249.67$

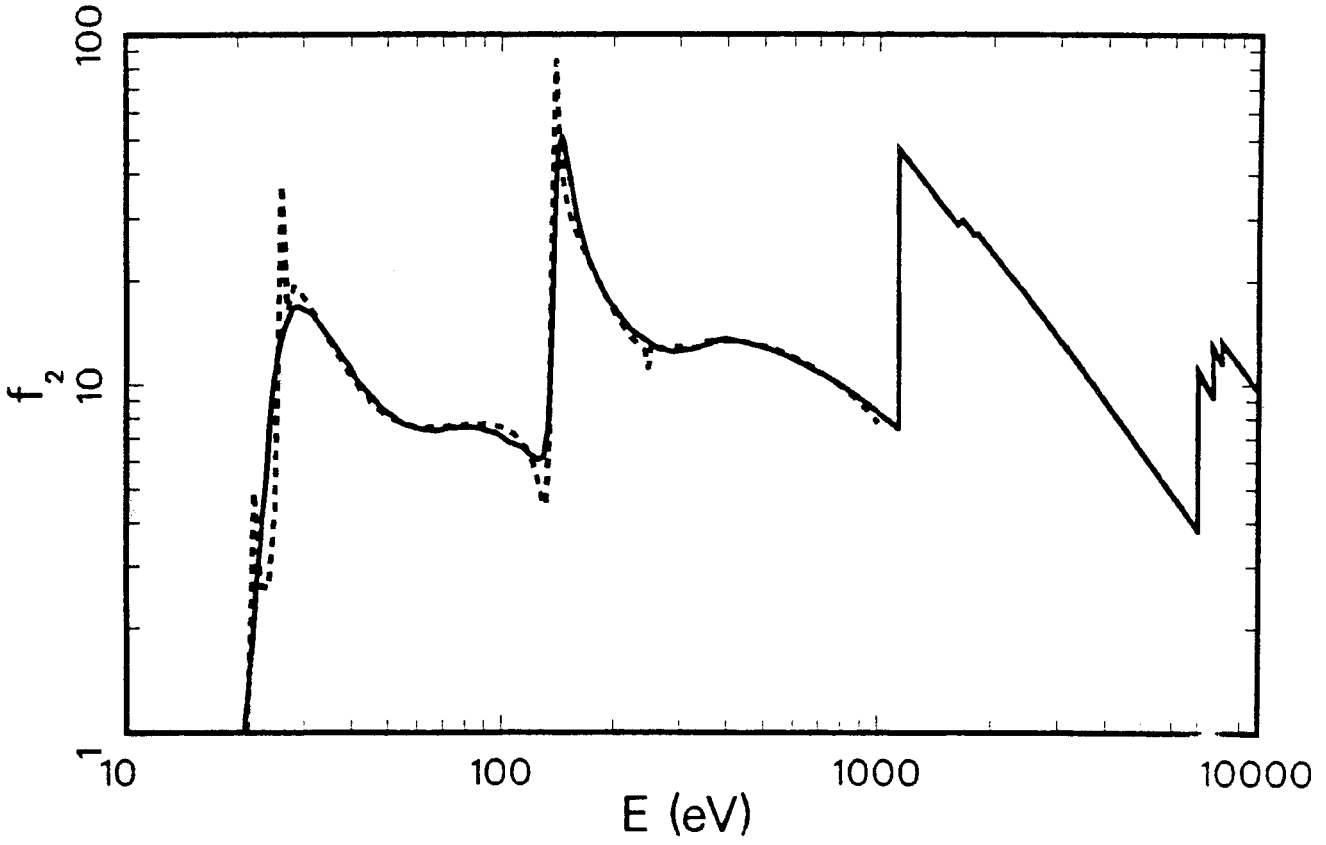
$E\mu(E) = 279.9\, f_2$ keV cm^2/g

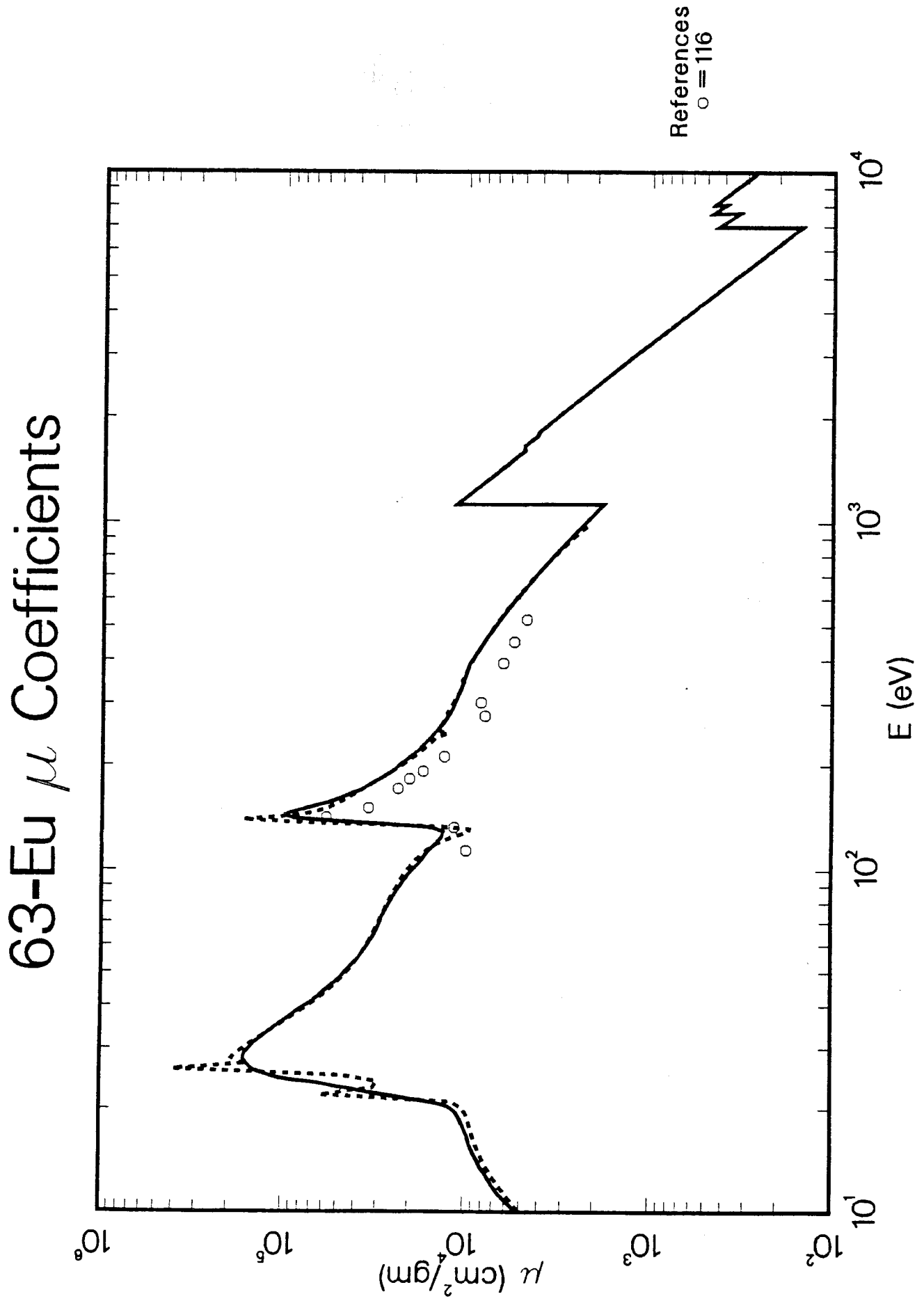
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.41e+4	4.4	116
132.8	3.19e+4	-19.0	116
150.0	1.06e+5	1.5	116
151.1	8.41e+4	-15.8	116
171.7	3.15e+4	-30.4	116
183.3	2.44e+4	-16.5	116
192.6	2.08e+4	-15.5	116
212.2	1.57e+4	-17.3	116
277.0	9.53e+3	-20.4	116
302.7	9.01e+3	-17.6	116
392.4	7.49e+3	-20.4	116
452.2	6.45e+3	-16.3	116
524.9	5.29e+3	-16.1	116
105.0	1.92e+4	18.0	148
110.0	1.60e+4	9.4	148
120.0	1.23e+4	1.3	148
126.0	2.04e+4	47.3	148
127.0	1.81e+4	11.6	148
128.0	2.53e+4	33.7	148
129.0	2.71e+4	22.7	148
130.0	2.63e+4	2.0	148
131.0	3.29e+4	9.5	148
132.0	3.47e+4	-0.7	148
134.0	4.80e+4	2.2	148
136.0	7.53e+4	19.4	148
137.0	8.29e+4	13.7	148
138.0	8.45e+4	0.4	148
139.0	1.25e+5	29.1	148
140.0	8.85e+4	-20.2	148
141.0	8.65e+4	-26.4	148
142.0	8.09e+4	-33.8	148
144.0	7.53e+4	-38.2	148
146.0	7.41e+4	-39.1	148
148.0	7.69e+4	-32.1	148
150.0	7.41e+4	-28.9	148
155.0	5.77e+4	-33.1	148
160.0	4.60e+4	-35.9	148
165.0	3.81e+4	-36.2	148
170.0	3.19e+4	-34.1	148
180.0	2.74e+4	-15.8	148
185.0	2.64e+4	-6.6	148
189.0	2.62e+4	-0.3	148
1254.0	7.14e+3	1.5	152
1487.0	5.98e+3	2.1	152
1740.0	4.77e+3	4.1	152
2013.0	3.49e+3	6.7	152
2307.0	2.54e+3	7.4	152
2621.0	1.90e+3	9.3	152
2984.0	1.38e+3	8.8	152
3313.0	1.06e+3	8.0	152

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
3691.0	8.16e+2	9.0	152
4012.0	6.55e+2	7.7	152
4508.0	4.76e+2	4.9	152
4949.0	3.77e+2	5.0	152
5411.0	2.97e+2	3.5	152
5895.0	2.35e+2	2.1	152
6400.0	1.88e+2	0.4	152
6926.0	4.28e+2	-2.2	152
7056.0	4.10e+2	-1.1	152
7473.0	4.85e+2	-0.2	152
7648.0	4.60e+2	1.2	152
8040.0	4.67e+2	1.9	152
8630.0	3.92e+2	1.8	152
9570.0	2.99e+2	0.8	152
9990.0	2.69e+2	1.1	152

Atomic Scattering Factors, f_1+if_2
63 - Europium (Eu)






63-Eu μ Coefficients
References
○ = 116
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Europium (Eu) — 63

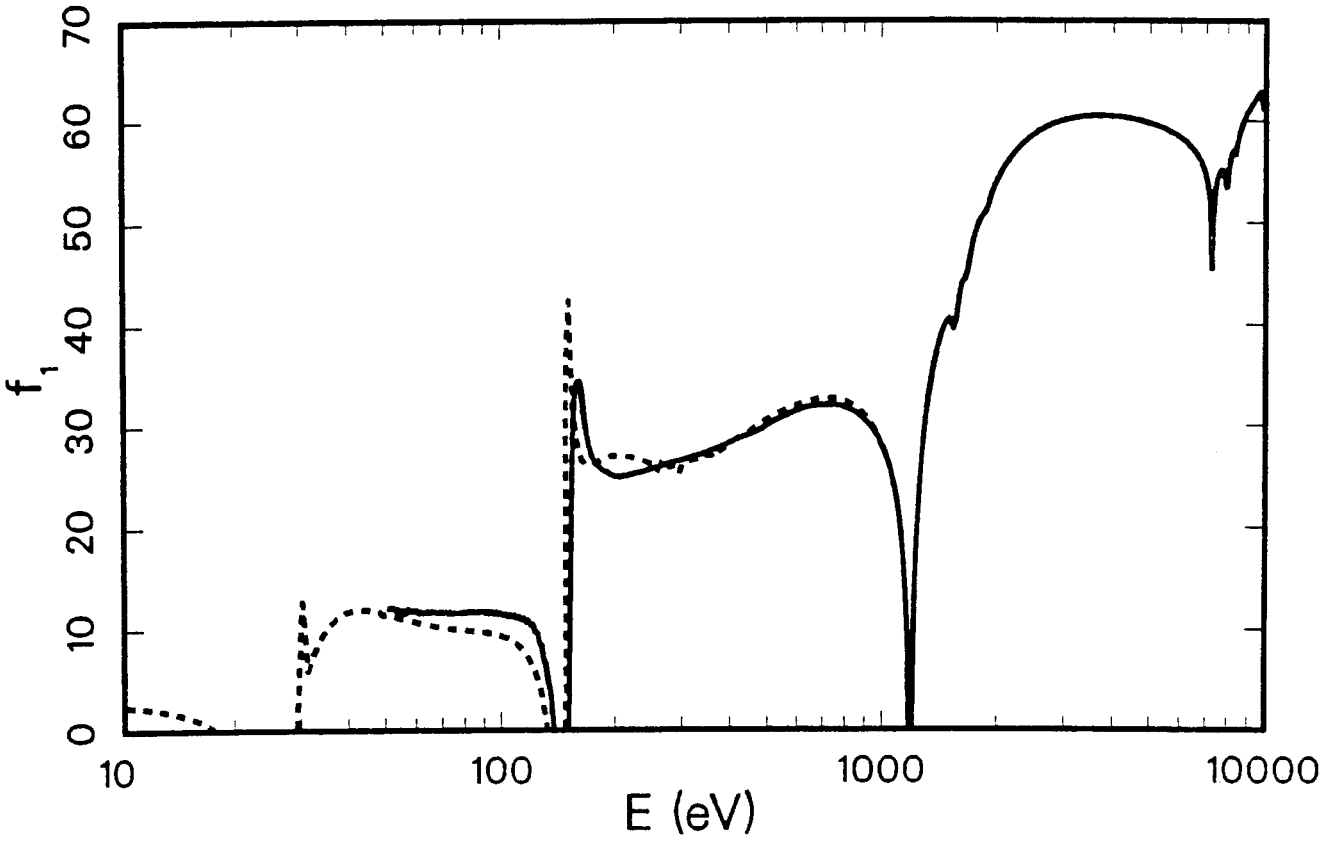
Atomic Weight = 151.96

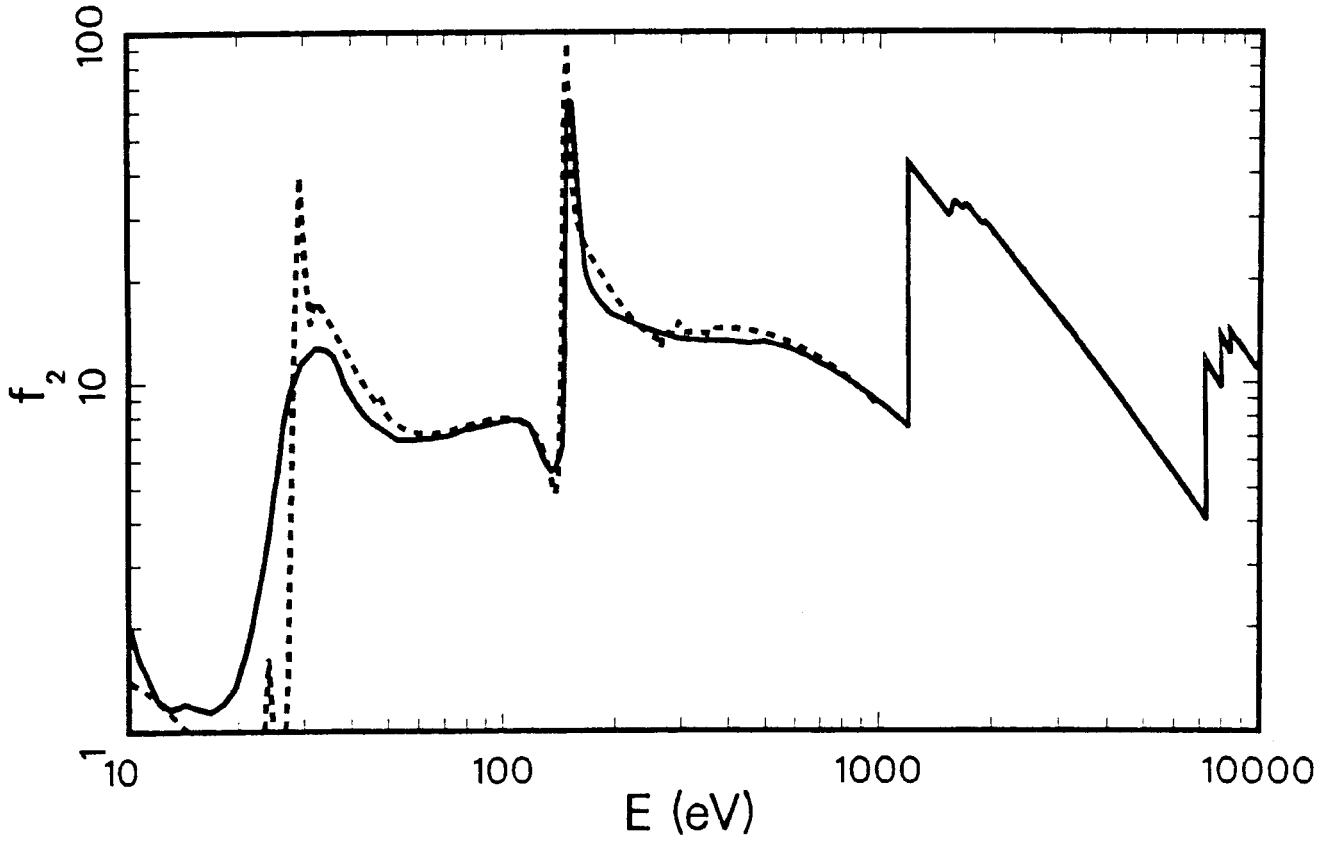
μ (barns/atom) = $\mu(cm^2/g) \times 252.34$

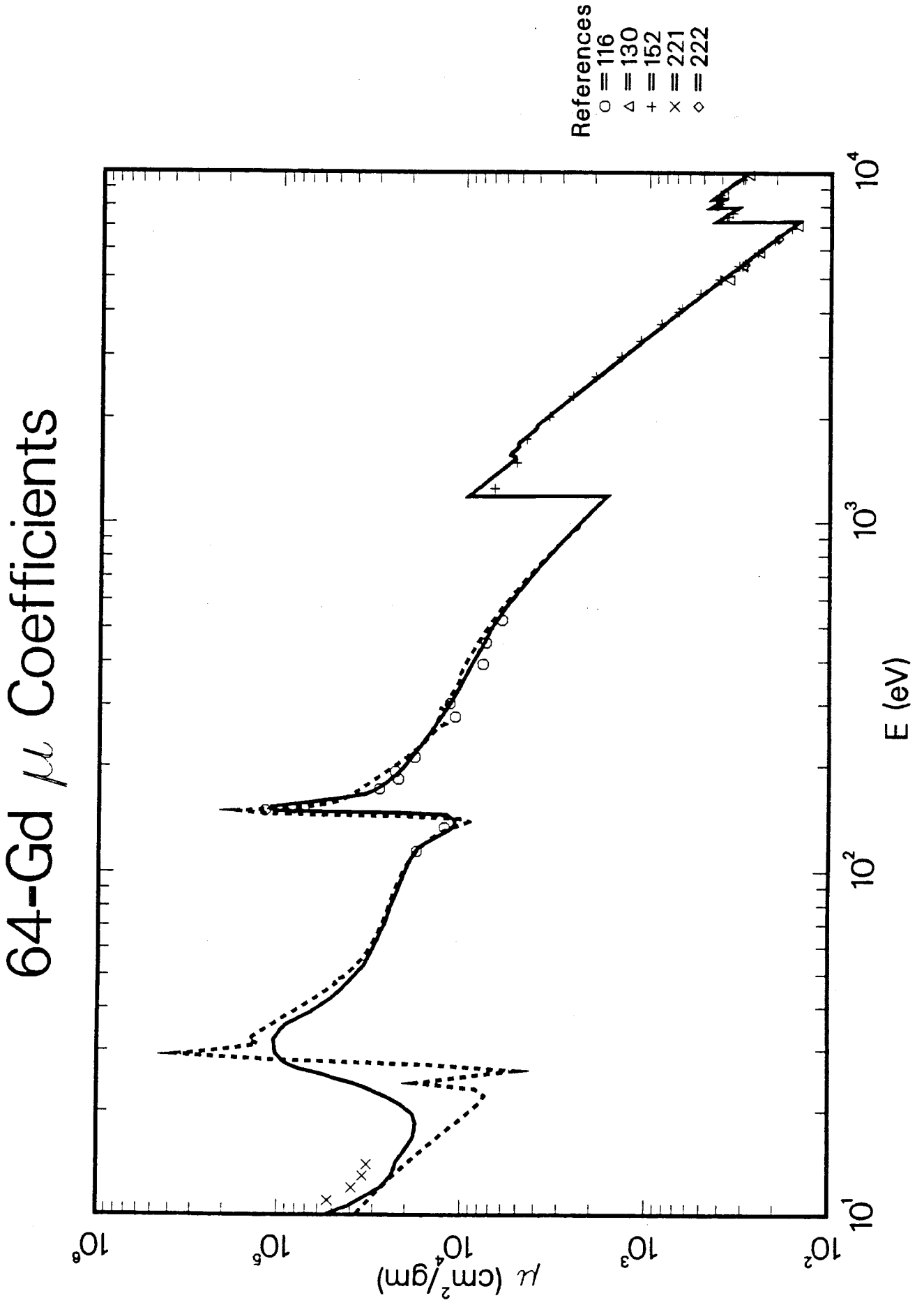
$E\mu(E) = 276.9\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	9.91e+3	-37.7	116
132.8	1.15e+4	-24.4	116
142.0	5.87e+4	-36.6	116
151.1	3.41e+4	-54.4	116
171.7	2.34e+4	-36.5	116
183.3	2.02e+4	-31.8	116
192.6	1.70e+4	-32.7	116
212.2	1.31e+4	-34.8	116
277.0	7.93e+3	-36.8	116
302.7	8.32e+3	-27.5	116
392.4	6.34e+3	-33.6	116
452.2	5.55e+3	-31.1	116
524.9	4.76e+3	-28.2	116

Atomic Scattering Factors, f_1+if_2
64 - Gadolinium (Gd)






64-Gd μ Coefficients
References
○ = 116
△ = 130
+ = 152
× = 221
◇ = 222
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Gadolinium (Gd) — 64

Atomic Weight = 157.25

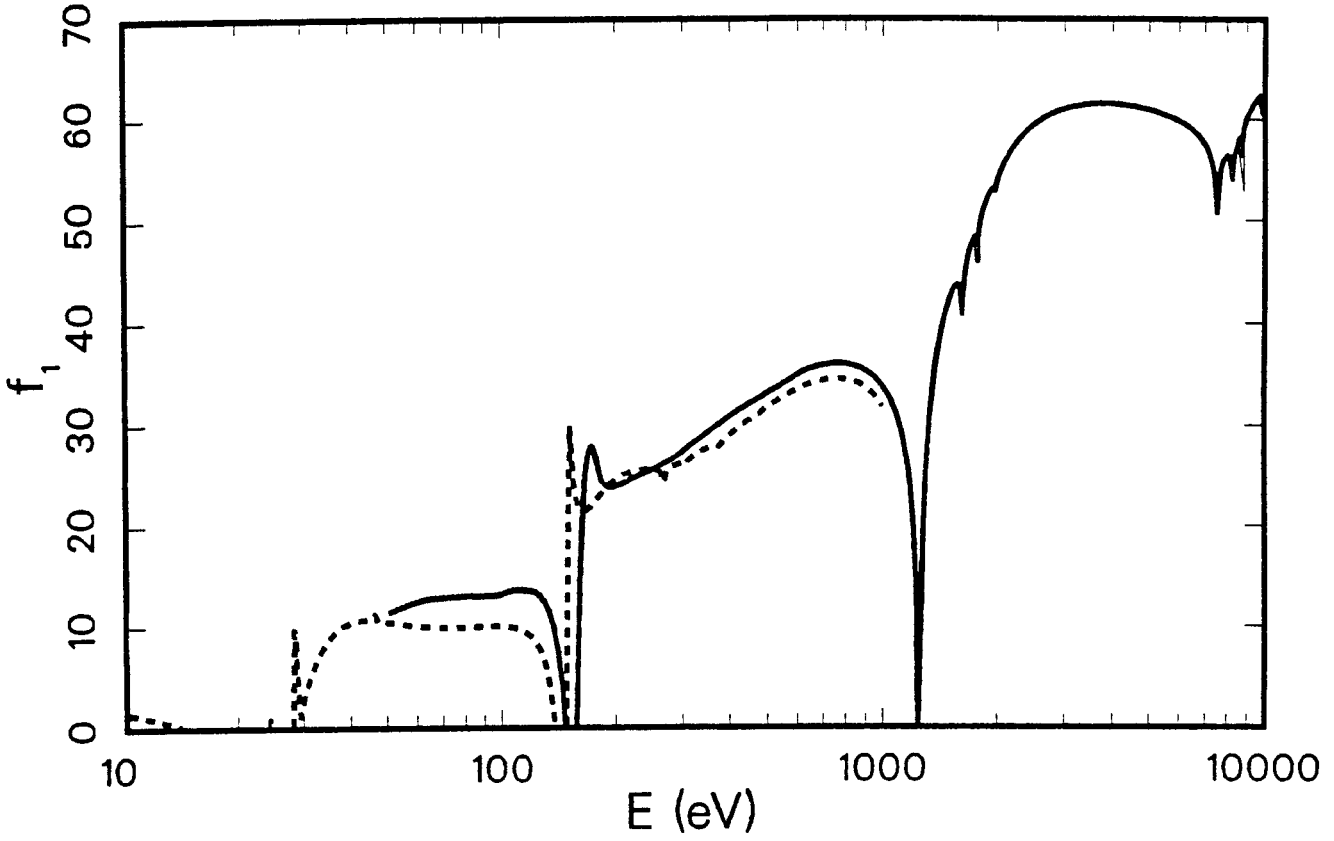
μ (barns/atom) = $\mu(cm^2/g) \times 261.12$

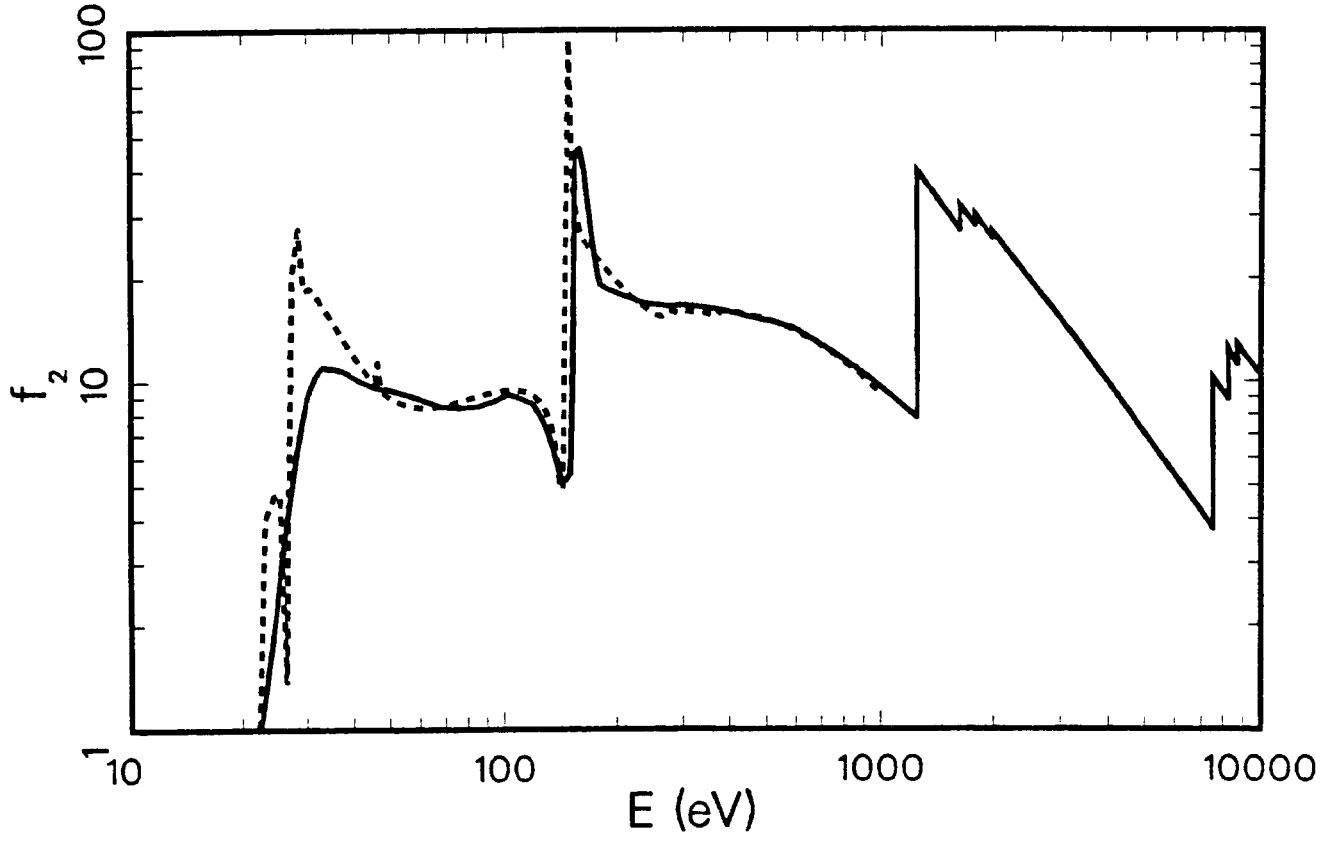
$E\mu(E) = 267.6\, f_2$ keV cm^2/g

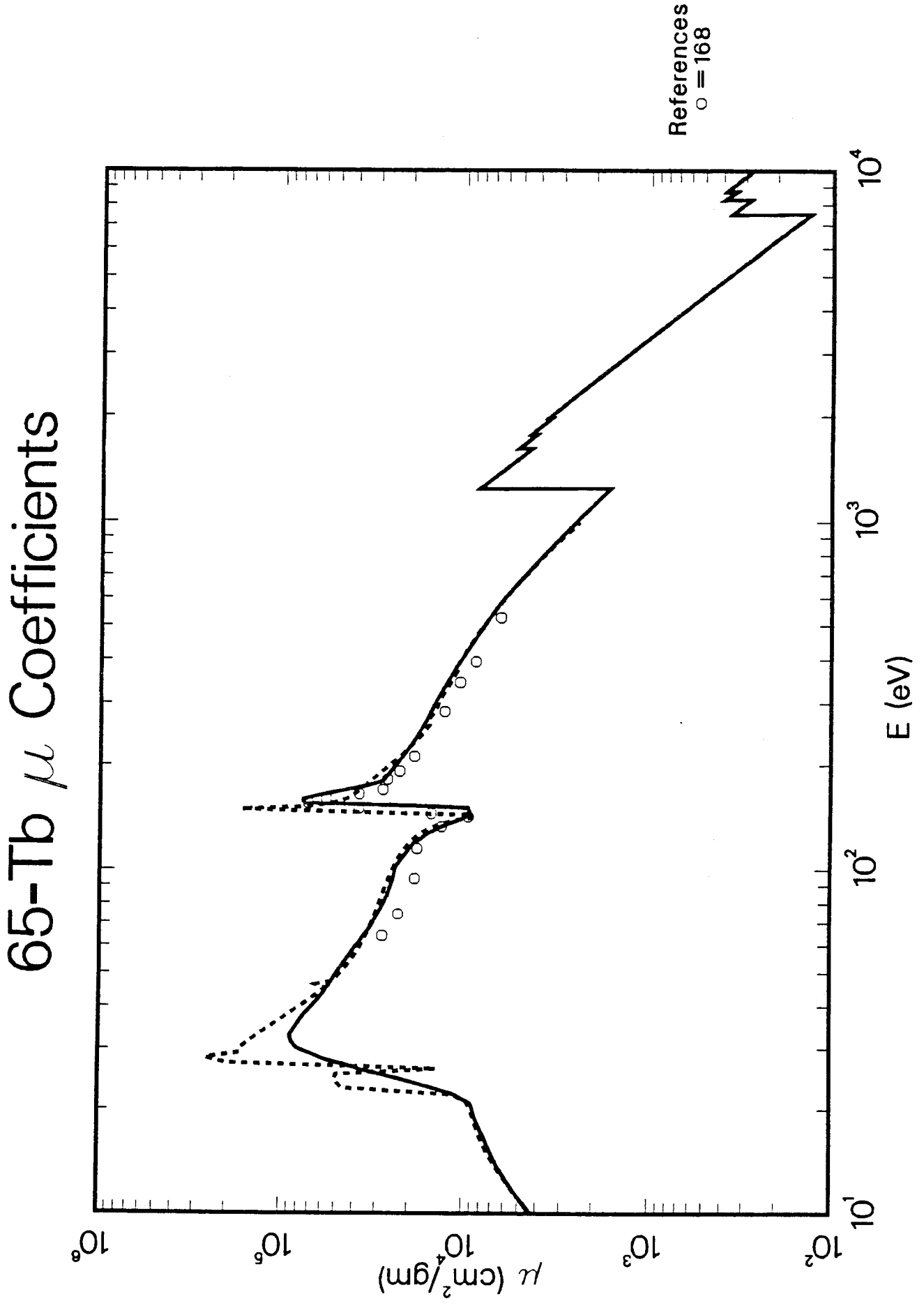
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.78e+4	-1.3	116
132.8	1.26e+4	9.8	116
149.2	1.20e+5	11.1	116
151.1	8.46e+4	-26.2	116
171.7	2.87e+4	-3.1	116
183.3	2.26e+4	-9.2	116
192.6	2.35e+4	5.7	116
212.2	1.84e+4	-4.1	116
277.0	1.11e+4	-16.2	116
302.7	1.18e+4	0.2	116
392.4	7.81e+3	-13.2	116
452.2	7.54e+3	-2.0	116
524.9	6.17e+3	-6.2	116
4951.0	3.63e+2	-8.5	130
5412.0	3.08e+2	-2.9	130
5895.0	2.49e+2	-2.5	130
7056.0	1.53e+2	-5.2	130
8634.0	3.94e+2	-5.3	130
9879.0	2.83e+2	-4.4	130
1254.0	6.86e+3	-18.4	152
1487.0	5.25e+3	-6.7	152
1740.0	4.63e+3	-3.9	152
2013.0	3.52e+3	-1.6	152
2307.0	2.61e+3	1.0	152
2621.0	1.95e+3	2.6	152
2984.0	1.42e+3	2.7	152
2985.0	1.43e+3	2.9	152
3313.0	1.11e+3	3.4	152
3314.0	1.11e+3	3.1	152
3691.0	8.58e+2	4.1	152
3692.0	8.52e+2	3.5	152
4012.0	6.87e+2	2.4	152
4089.0	6.57e+2	2.7	152
4508.0	5.21e+2	3.8	152
4512.0	5.20e+2	3.8	152
4949.0	3.98e+2	0.2	152
4953.0	4.08e+2	2.8	152
5411.0	3.11e+2	-2.0	152
5414.0	3.22e+2	1.6	152
5895.0	2.54e+2	-0.5	152
6400.0	2.04e+2	-1.7	152
6926.0	1.64e+2	-2.6	152
7473.0	3.67e+2	-6.0	152
7478.0	3.76e+2	-3.4	152
7648.0	3.50e+2	-4.2	152
8040.0	4.20e+2	-4.9	152
8040.0	4.29e+2	-2.9	152
8146.0	4.11e+2	-3.2	152
8630.0	4.08e+2	-2.0	152
8640.0	4.09e+2	-1.7	152

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
9570.0	3.08e+2	-4.1	152
9990.0	2.82e+2	-2.2	152
10.0	6.81e+4	22.3	221
11.0	5.32e+4	45.0	221
12.0	3.95e+4	43.9	221
13.0	3.42e+4	43.4	221
14.0	3.26e+4	44.2	221
5470.0	2.99e+2	-3.2	222
6470.0	1.95e+2	-3.1	222

Atomic Scattering Factors, f_1+if_2
65 - Terbium (Tb)






65-Tb μ Coefficients
References
○ = 168
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10⁻¹
10²
10³
10⁴
10⁵
10⁶

Terbium (Tb) — 65

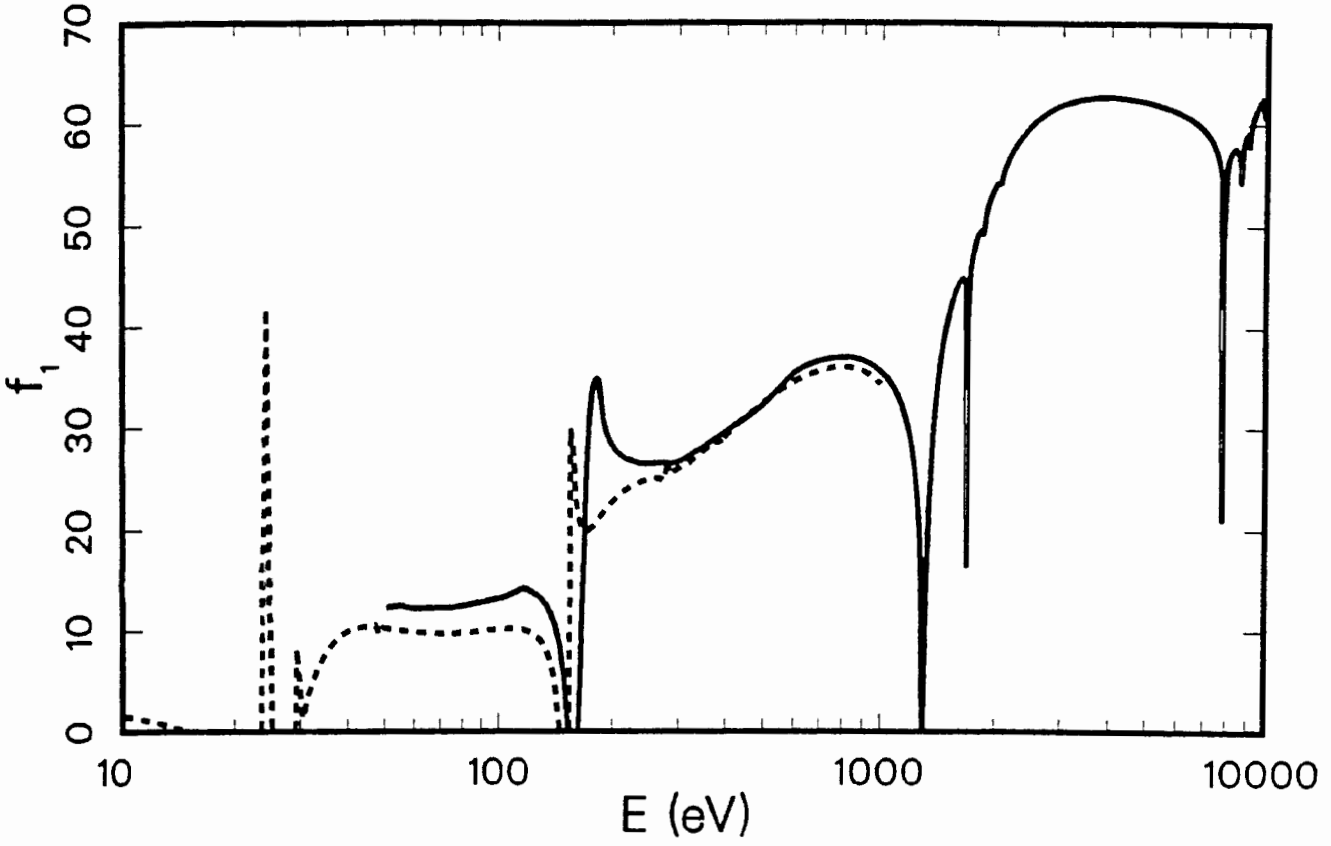
Atomic Weight = 158.92

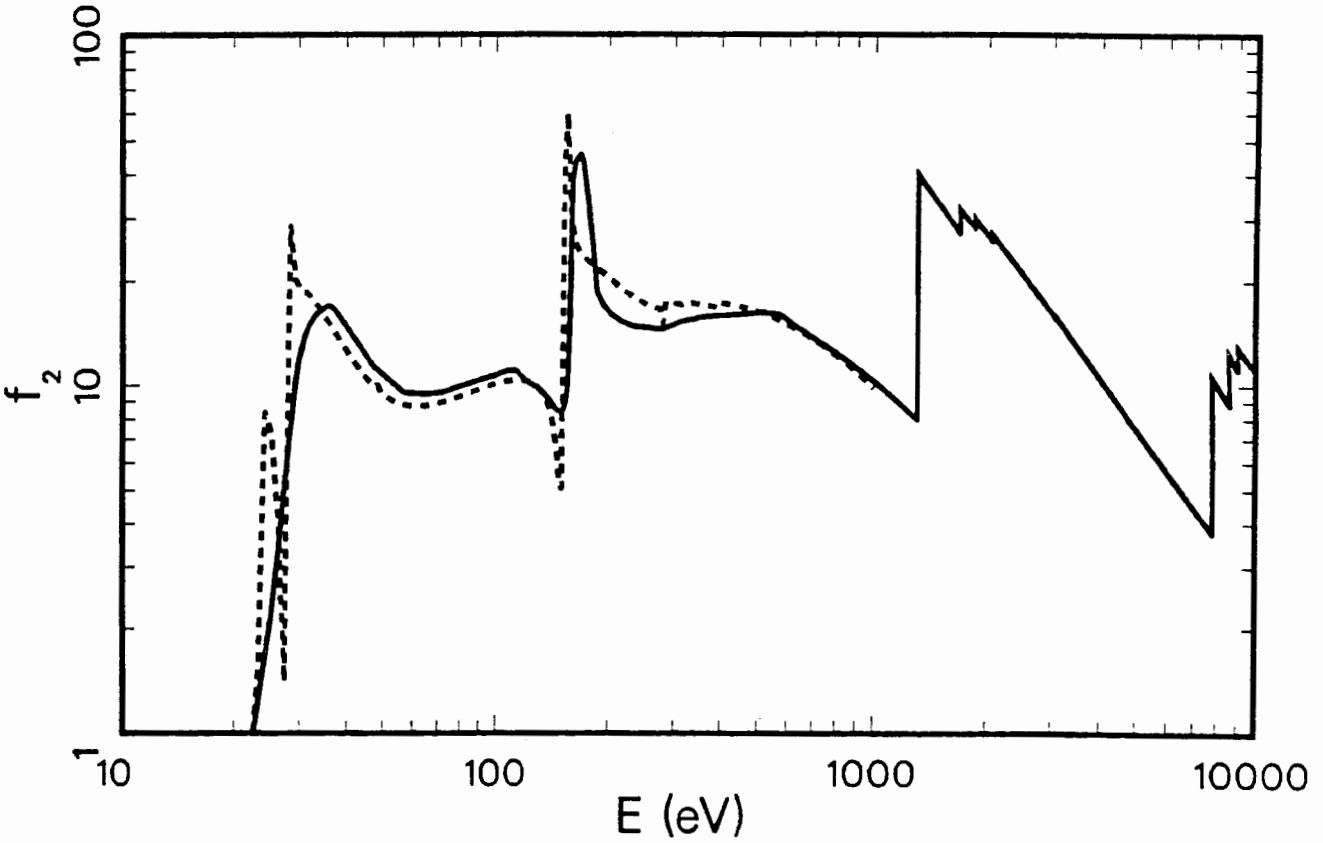
μ (barns/atom) = $\mu(cm^2/g) \times 263.90$

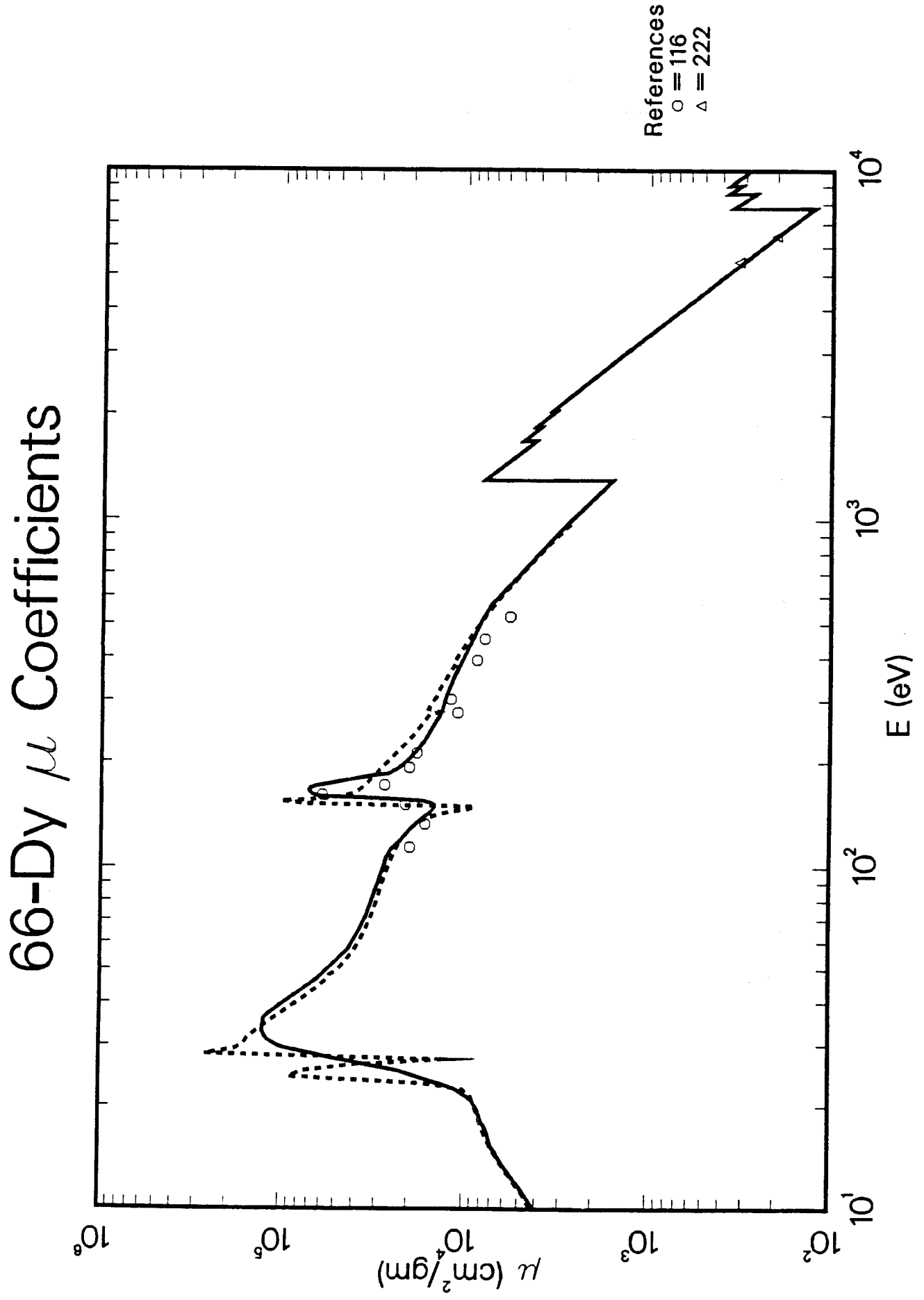
$E\mu(E) = 264.8\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
64.3	2.80e+4	-21.0	168
74.5	2.30e+4	-23.0	168
94.3	1.87e+4	-24.0	168
115.0	1.82e+4	-9.3	168
133.0	1.33e+4	-0.7	168
142.0	9.47e+3	-3.3	168
145.0	1.52e+4	61.7	168
150.0	3.79e+4	301.0	168
155.0	7.20e+4	-4.5	168
160.0	5.76e+4	-22.8	168
165.0	3.79e+4	-35.5	168
170.0	2.80e+4	-36.6	168
182.0	2.65e+4	-3.9	168
192.0	2.27e+4	-10.4	168
212.0	1.89e+4	-13.6	168
285.0	1.29e+4	-16.1	168
345.0	1.06e+4	-15.2	168
395.0	8.72e+3	-18.0	168
528.0	6.44e+3	-12.5	168

Atomic Scattering Factors, f_1+if_2
66 - Dysprosium (Dy)



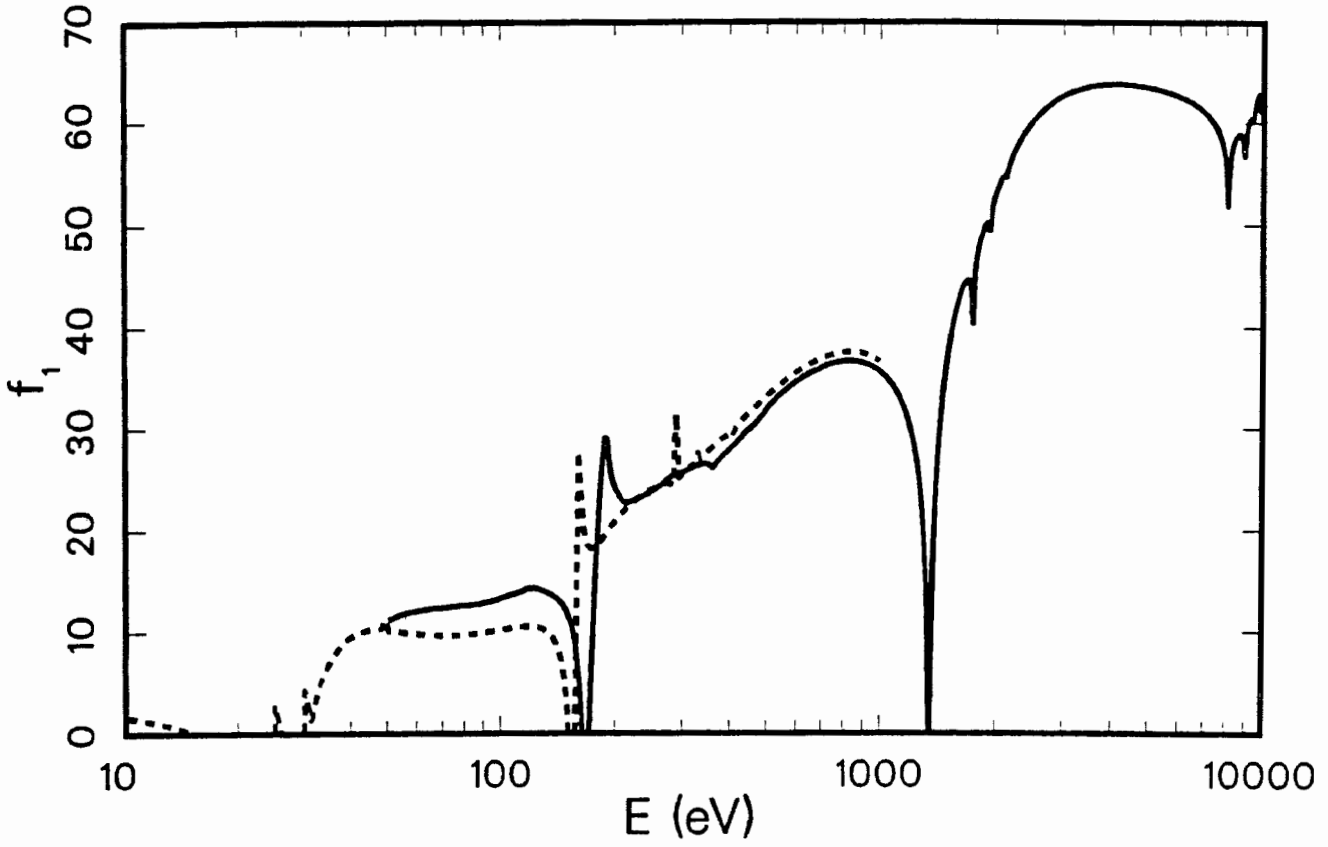


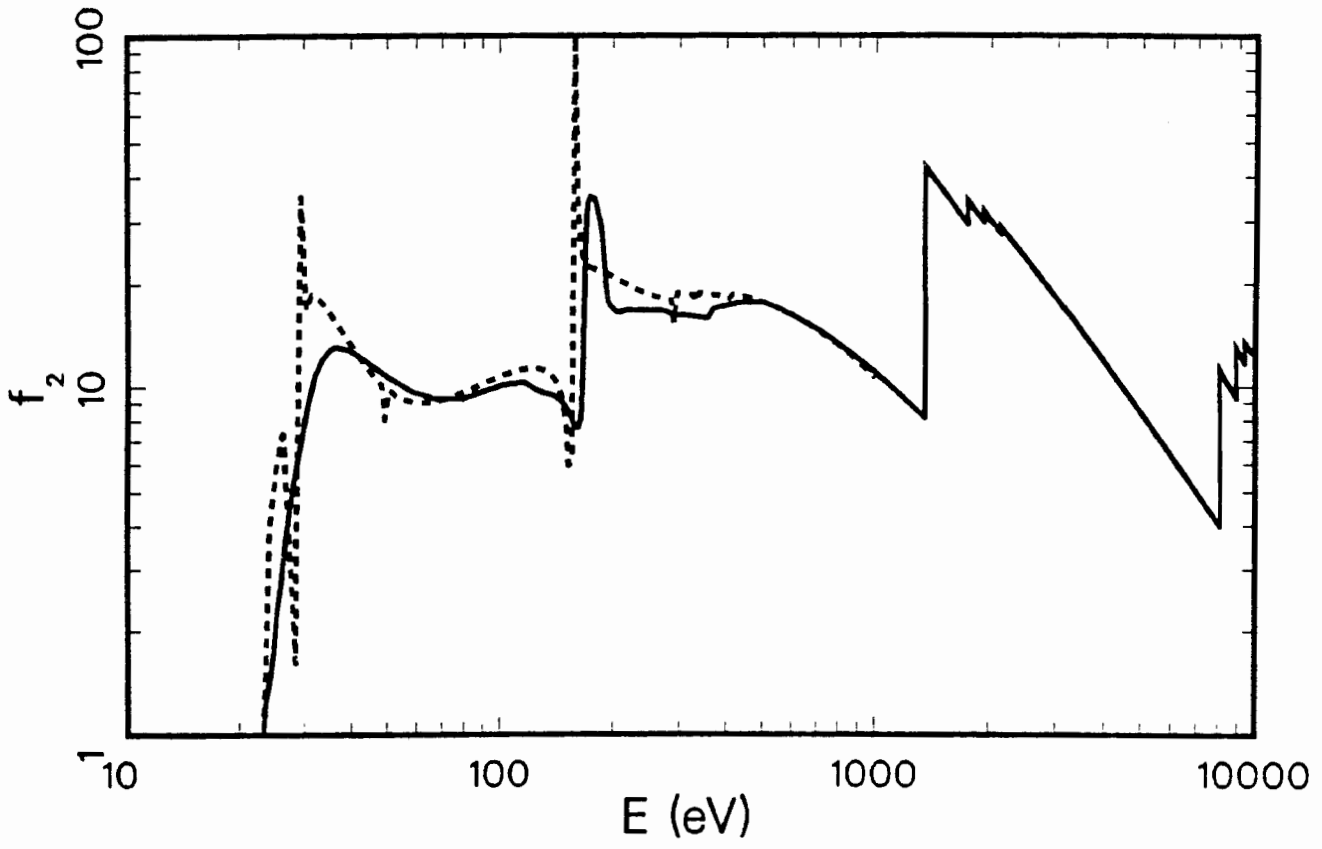

66-Dy μ Coefficients
References
○ = 116
△ = 222
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

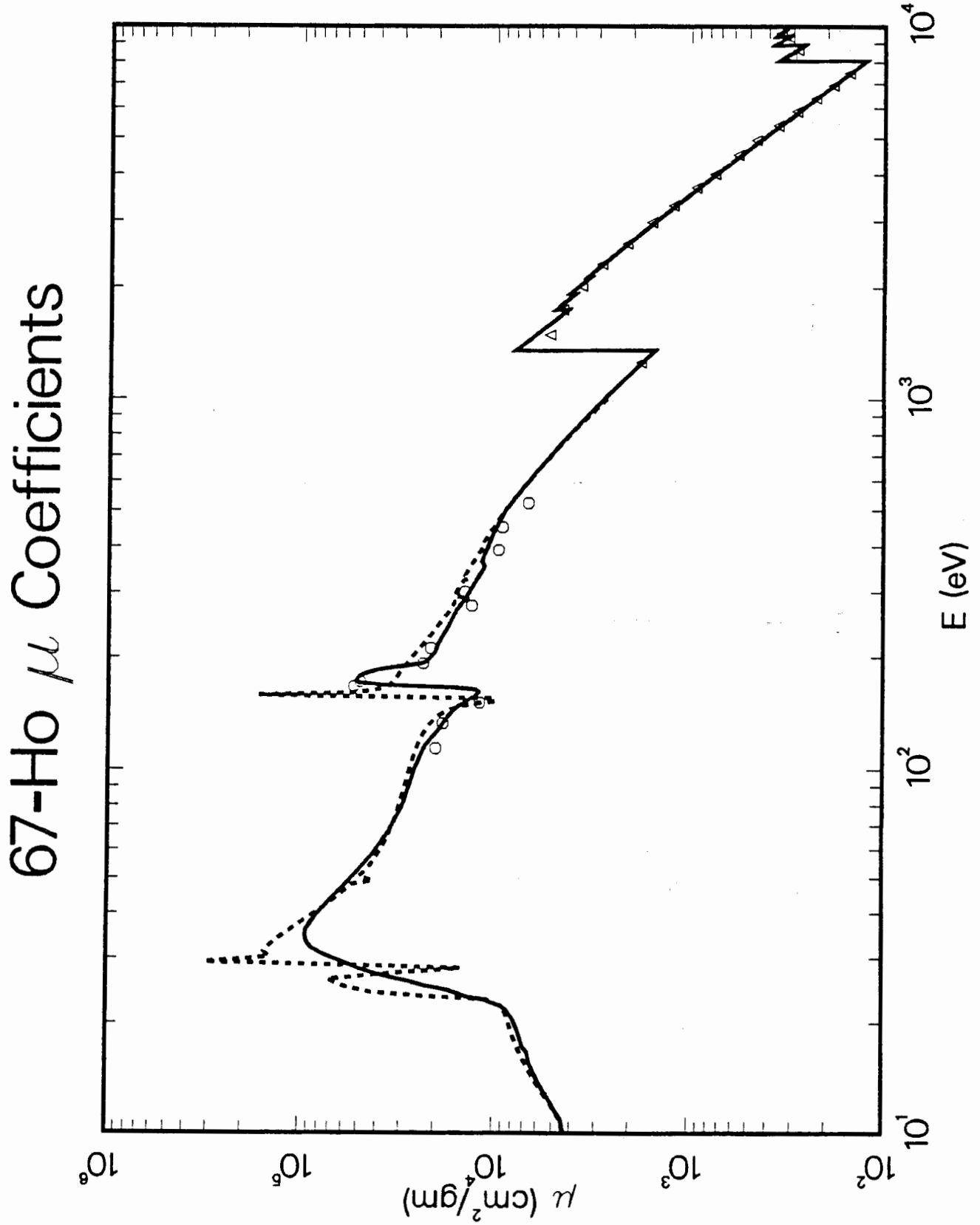
Dysprosium (Dy) — 66
Atomic Weight = 162.50
μ (barns/atom) = $\mu(cm^2/g) \times 269.84$
$E\mu(E) = 258.9\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.99e+4	-19.3	116
132.8	1.64e+4	-11.4	116
151.1	2.10e+4	42.1	116
161.0	6.00e+4	-10.7	116
171.7	2.74e+4	-55.6	116
192.6	2.00e+4	-12.7	116
212.2	1.83e+4	-2.9	116
277.0	1.10e+4	-18.7	116
302.7	1.19e+4	-7.1	116
392.4	8.67e+3	-16.9	116
452.2	7.86e+3	-14.1	116
524.9	5.74e+3	-27.9	116
5470.0	3.26e+2	6.0	222
6470.0	2.02e+2	0.8	222

Atomic Scattering Factors, f_1+if_2
67 - Holmium (Ho)



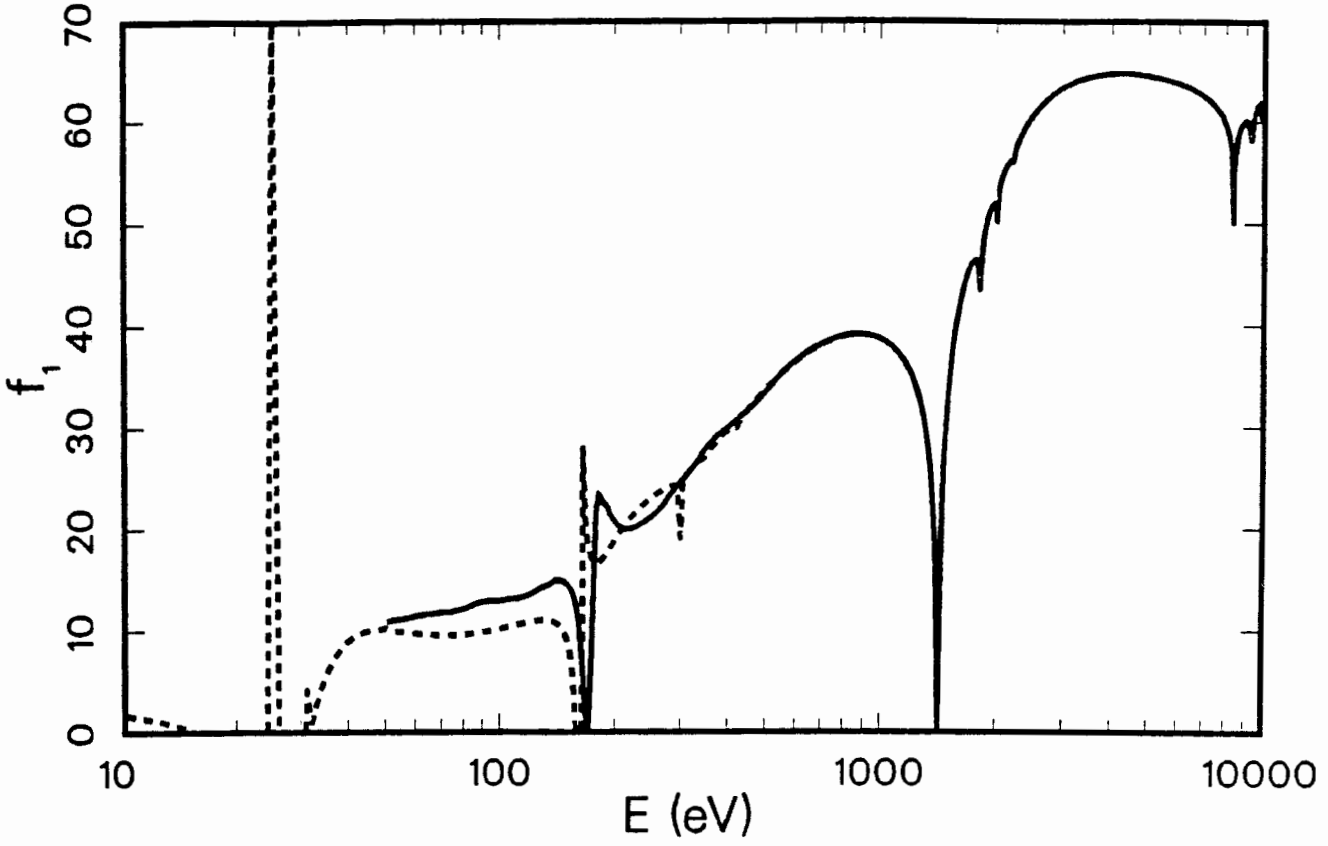


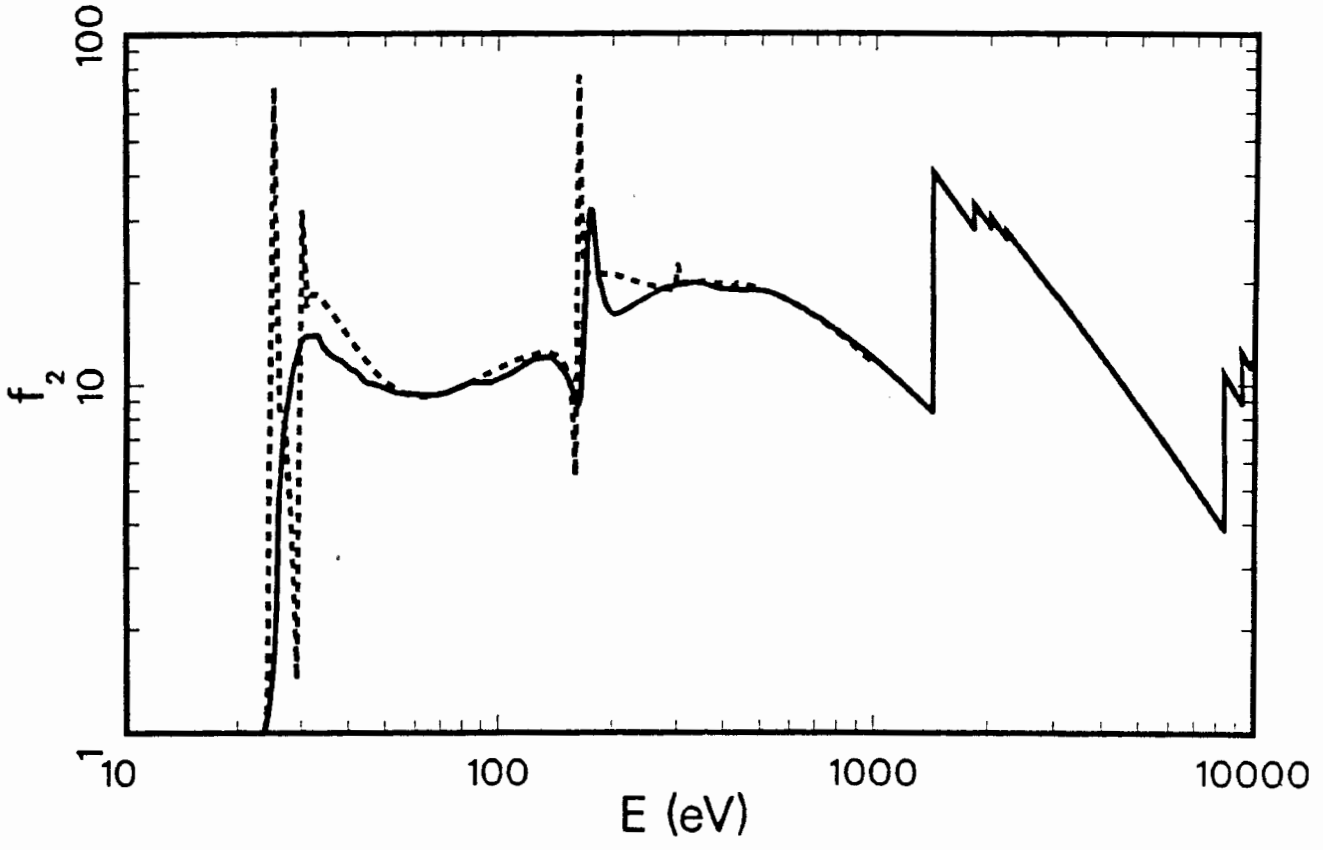

67-Ho μ Coefficients
References
○ = 116
△ = 152
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Holmium (Ho) — 67
Atomic Weight = 164.93
μ (barns/atom) = $\mu(cm^2/g) \times 273.88$
$E\mu(E) = 255.1\, f_2$ keV cm^2/g

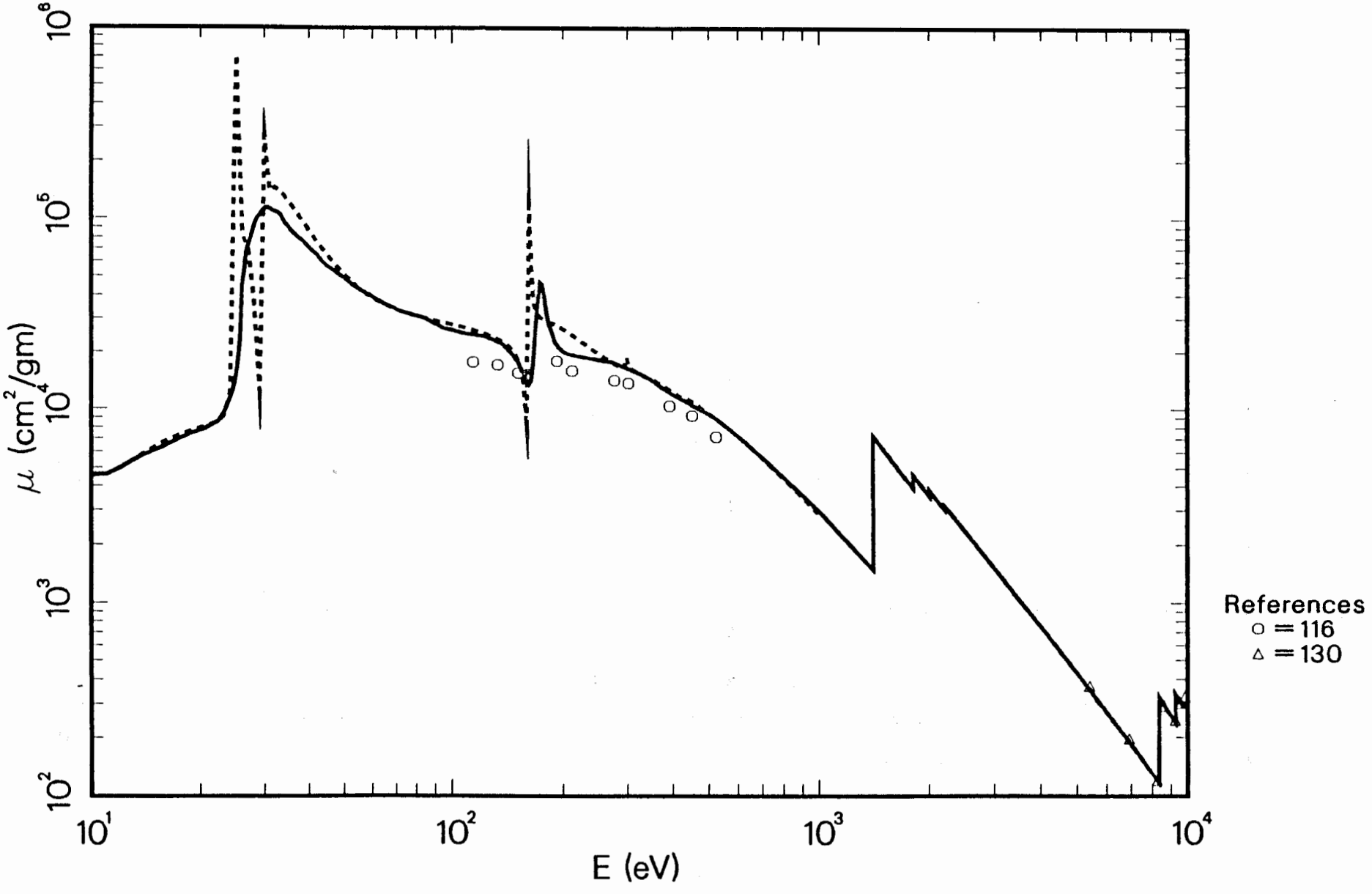
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	2.00e+4	-13.1	116
132.8	1.84e+4	0.2	116
151.1	1.19e+4	-17.5	116
167.0	5.33e+4	135.7	116
171.7	4.93e+4	-5.6	116
192.6	2.32e+4	-2.2	116
212.2	2.13e+4	6.9	116
277.0	1.32e+4	-12.9	116
302.7	1.43e+4	5.7	116
392.4	9.64e+3	-13.4	116
452.2	9.20e+3	-6.9	116
524.9	6.83e+3	-18.1	116
1254.0	1.81e+3	1.7	152
1487.0	5.37e+3	-15.3	152
1740.0	4.59e+3	2.5	152
2013.0	3.67e+3	-3.0	152
2307.0	2.89e+3	1.0	152
2621.0	2.14e+3	1.3	152
2984.0	1.60e+3	3.5	152
3313.0	1.24e+3	3.3	152
3691.0	9.45e+2	3.1	152
4012.0	7.58e+2	1.8	152
4508.0	5.75e+2	3.5	152
4949.0	4.63e+2	5.4	152
5411.0	3.59e+2	2.5	152
5895.0	2.90e+2	2.7	152
6400.0	2.31e+2	0.8	152
6926.0	1.88e+2	0.6	152
7473.0	1.55e+2	0.6	152
8265.0	3.13e+2	-5.4	152
8630.0	2.87e+2	-1.6	152
9340.0	3.18e+2	-1.8	152
9570.0	3.46e+2	-0.6	152
9990.0	3.17e+2	1.2	152

Atomic Scattering Factors, f_1+if_2
68 - Erbium (Er)





68-Er μ Coefficients



Erbium (Er) — 68

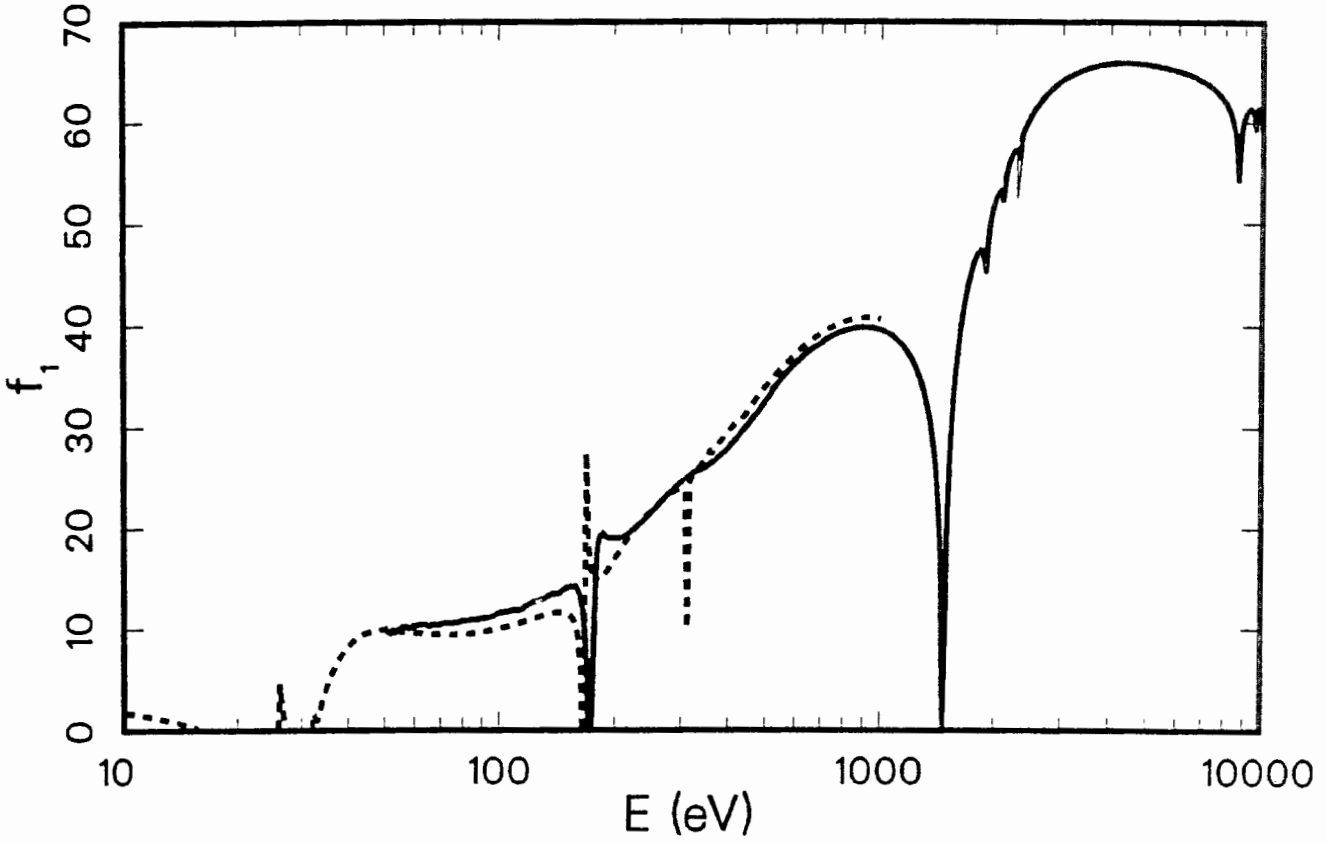
Atomic Weight = 167.26

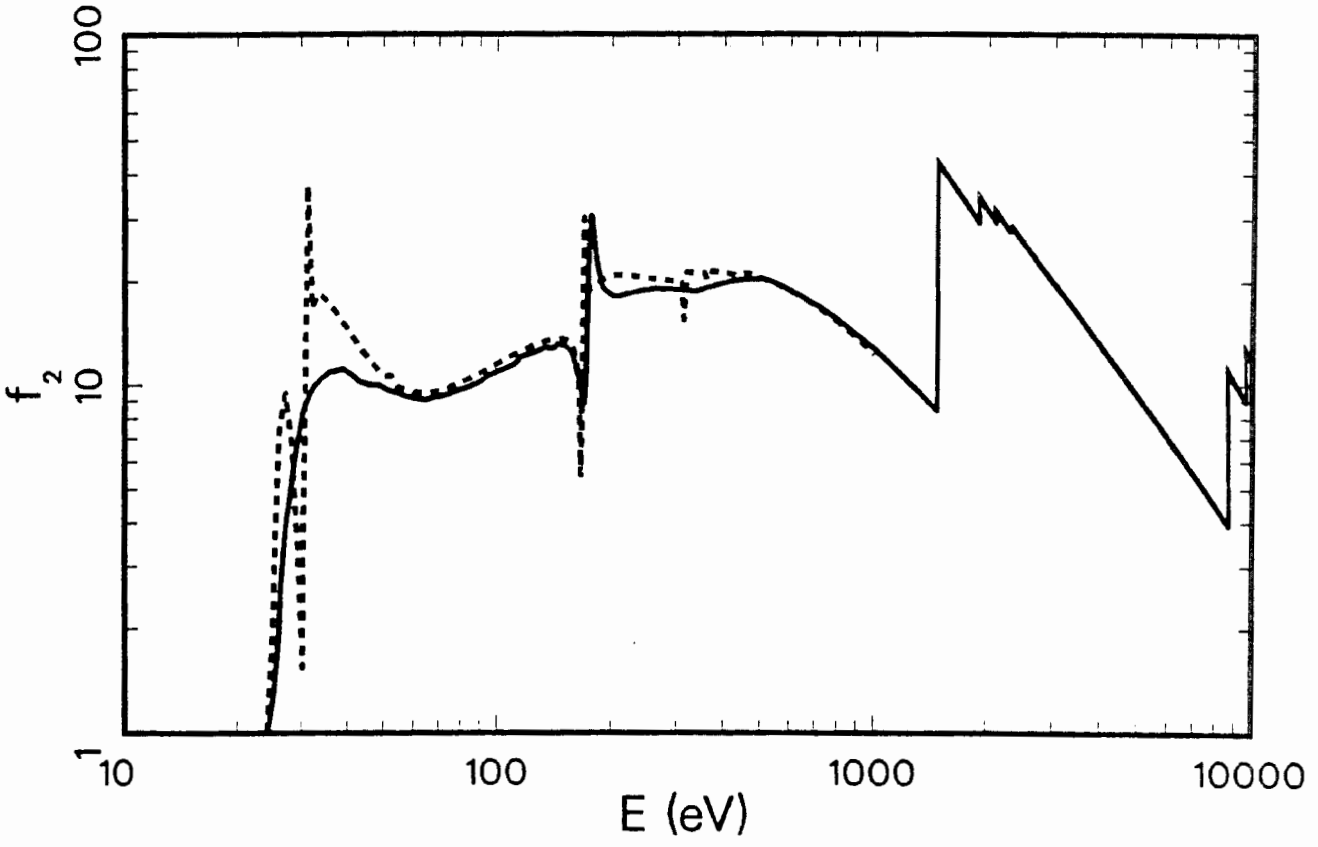
μ (barns/atom) = $\mu(cm^2/g) \times 277.75$

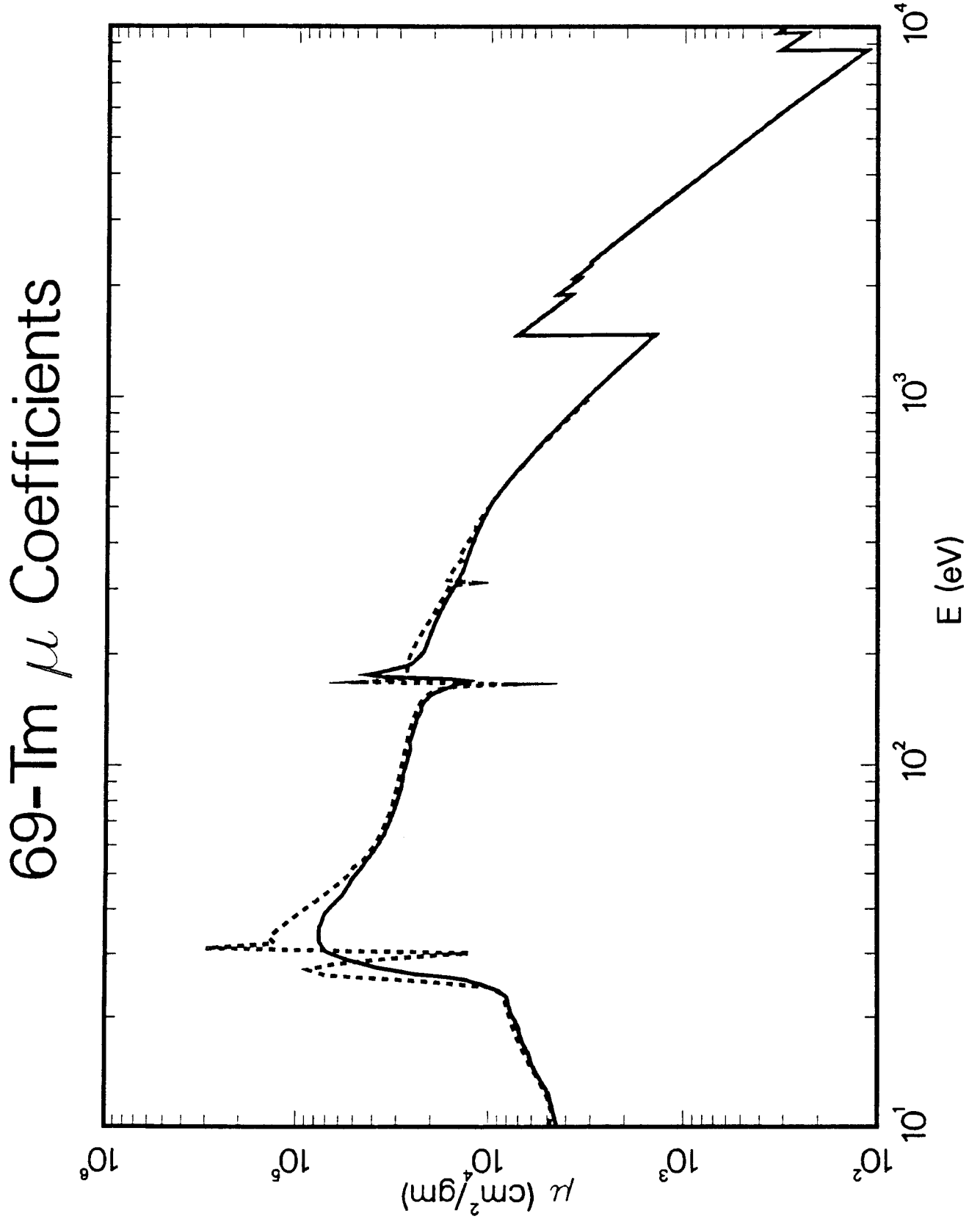
$E\mu(E) = 251.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	1.77e+4	-28.5	116
132.8	1.71e+4	-24.7	116
151.1	1.55e+4	-12.2	116
171.7	4.10e+4	0.6	116
192.6	1.79e+4	-18.5	116
212.2	1.59e+4	-17.6	116
277.0	1.41e+4	-19.3	116
302.7	1.37e+4	-16.0	116
392.4	1.04e+4	-15.0	116
452.2	9.25e+3	-12.1	116
524.9	7.16e+3	-19.5	116
5412.0	3.69e+2	4.3	130
6926.0	1.96e+2	3.9	130
8265.0	1.20e+2	0.6	130
8634.0	2.91e+2	-1.2	130
9245.0	2.47e+2	2.1	130
9574.0	3.02e+2	-1.2	130
9829.0	3.26e+2	5.3	130

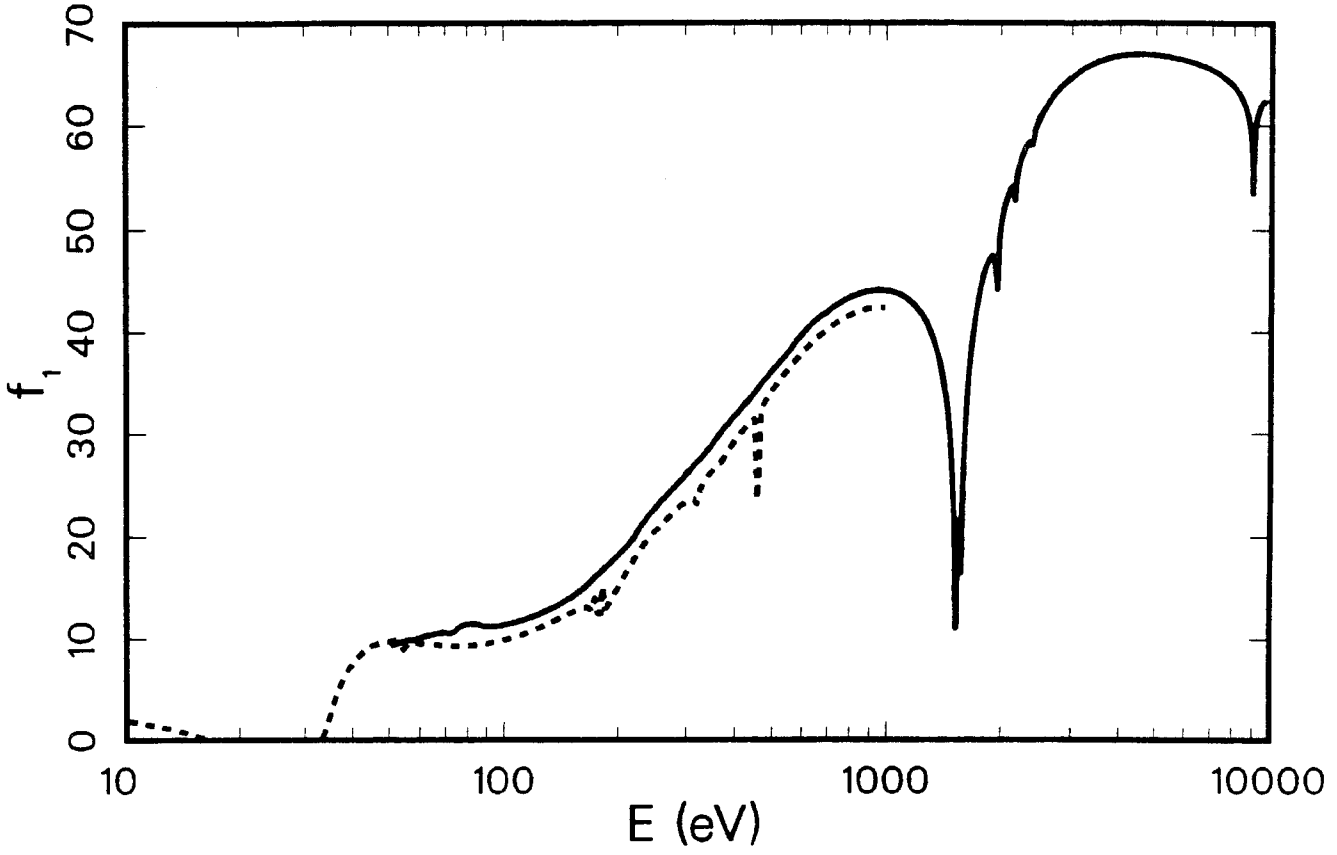
Atomic Scattering Factors, f_1+if_2
69 - Thulium (Tm)

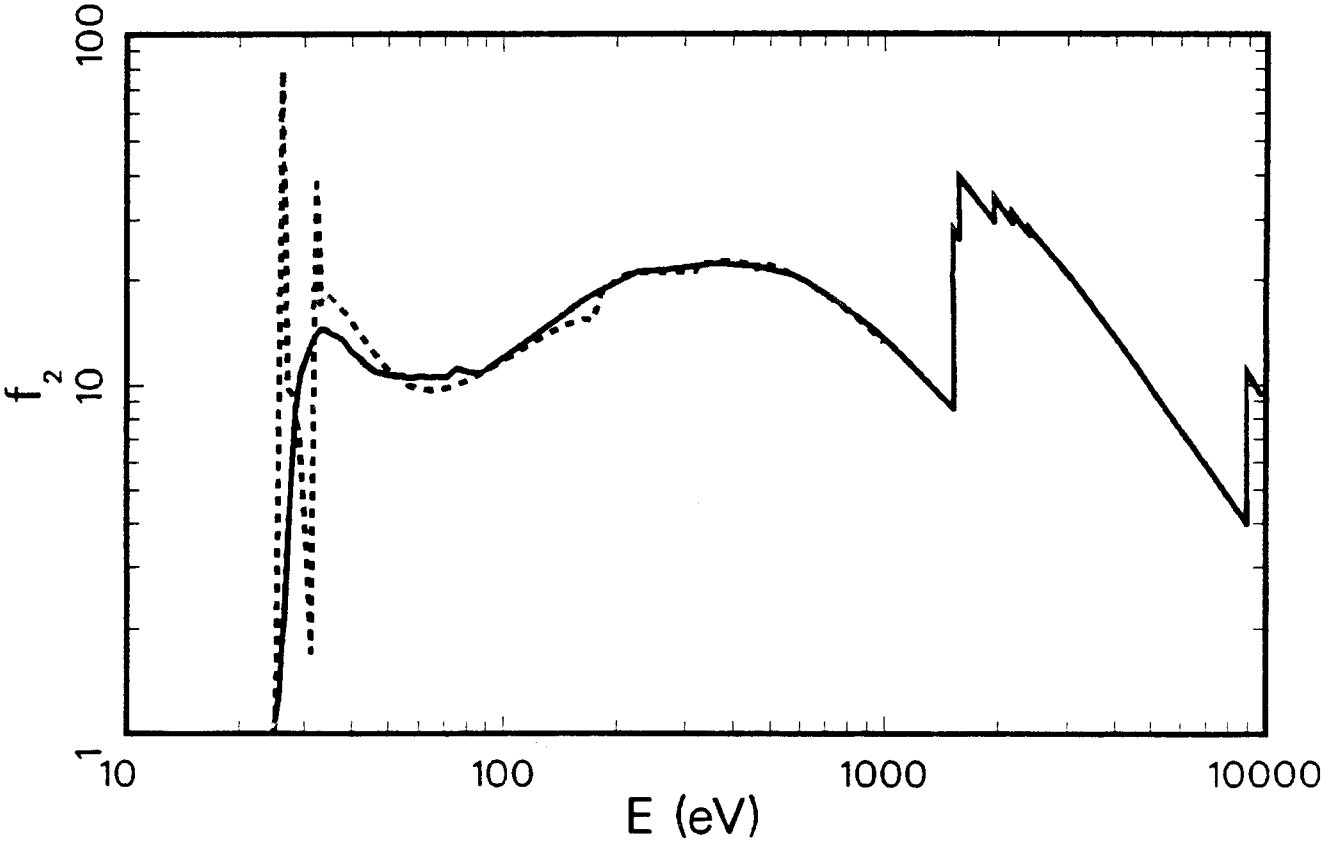


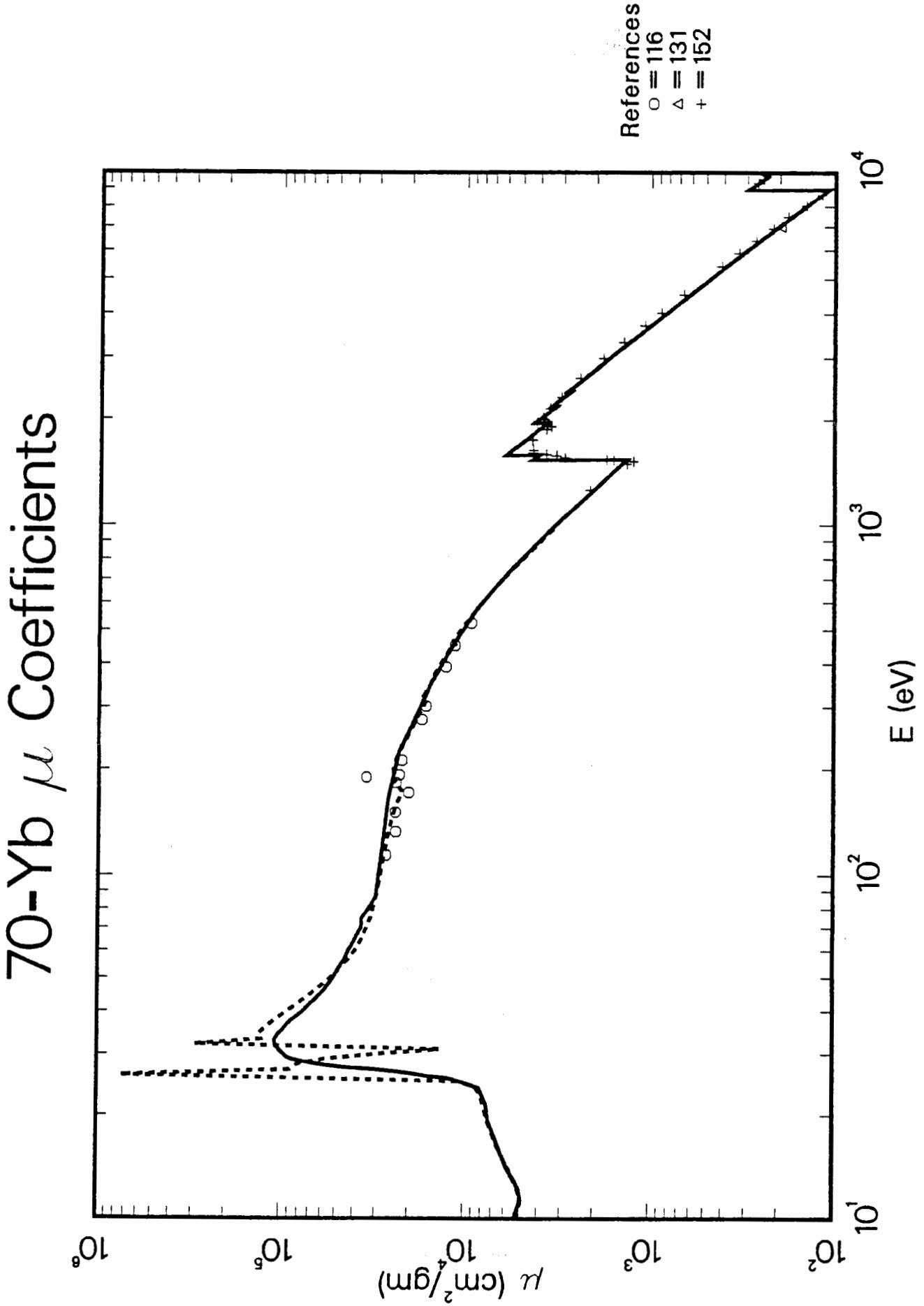



69-Tm μ Coefficients
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
70 - Ytterbium (Yb)






70-Yb μ Coefficients
References
○ = 116
△ = 131
+ = 152
μ (cm²/gm)
E (eV)
10⁸
10⁶
10⁴
10³
10²
10¹
10²
10³
10⁴

Ytterbium (Yb) — 70

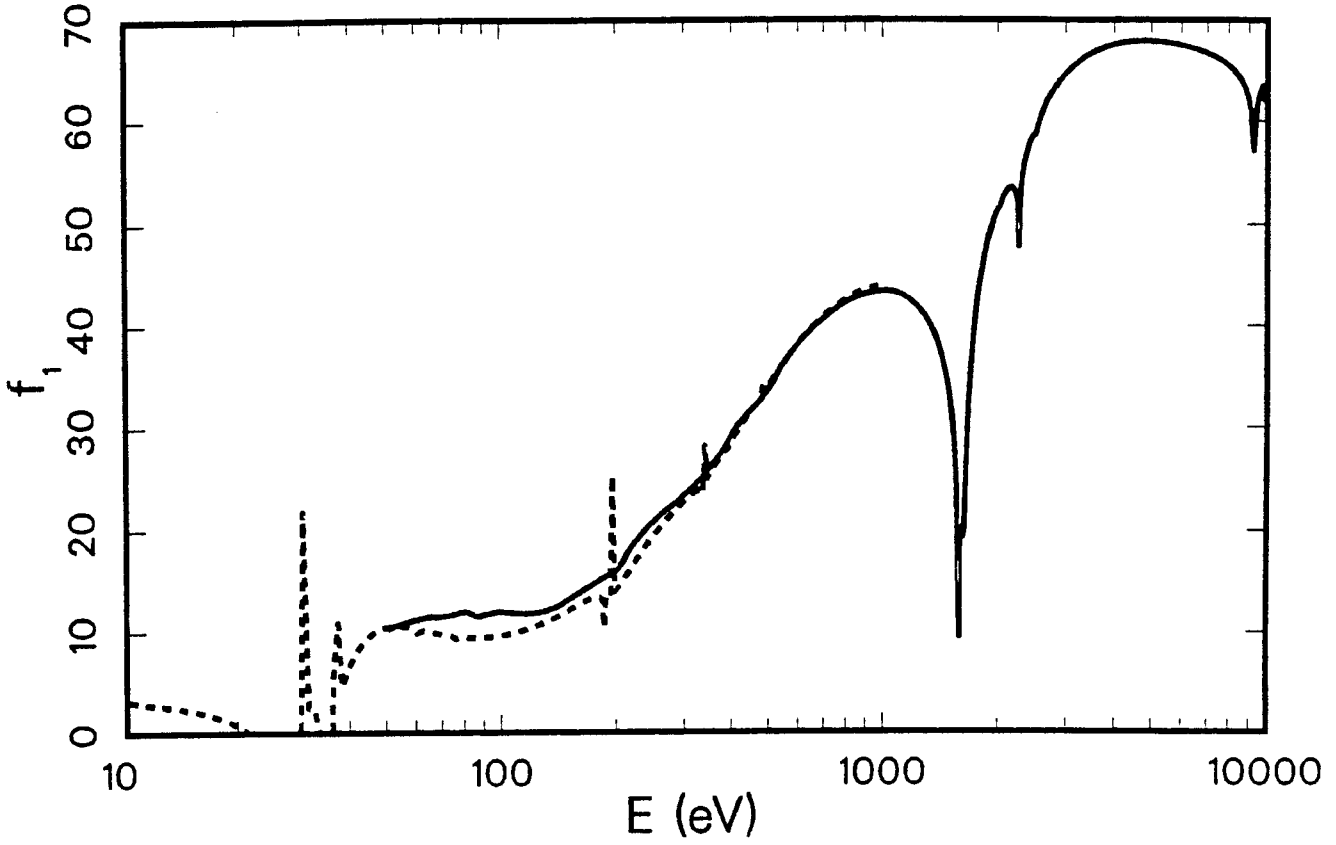
Atomic Weight = 173.04

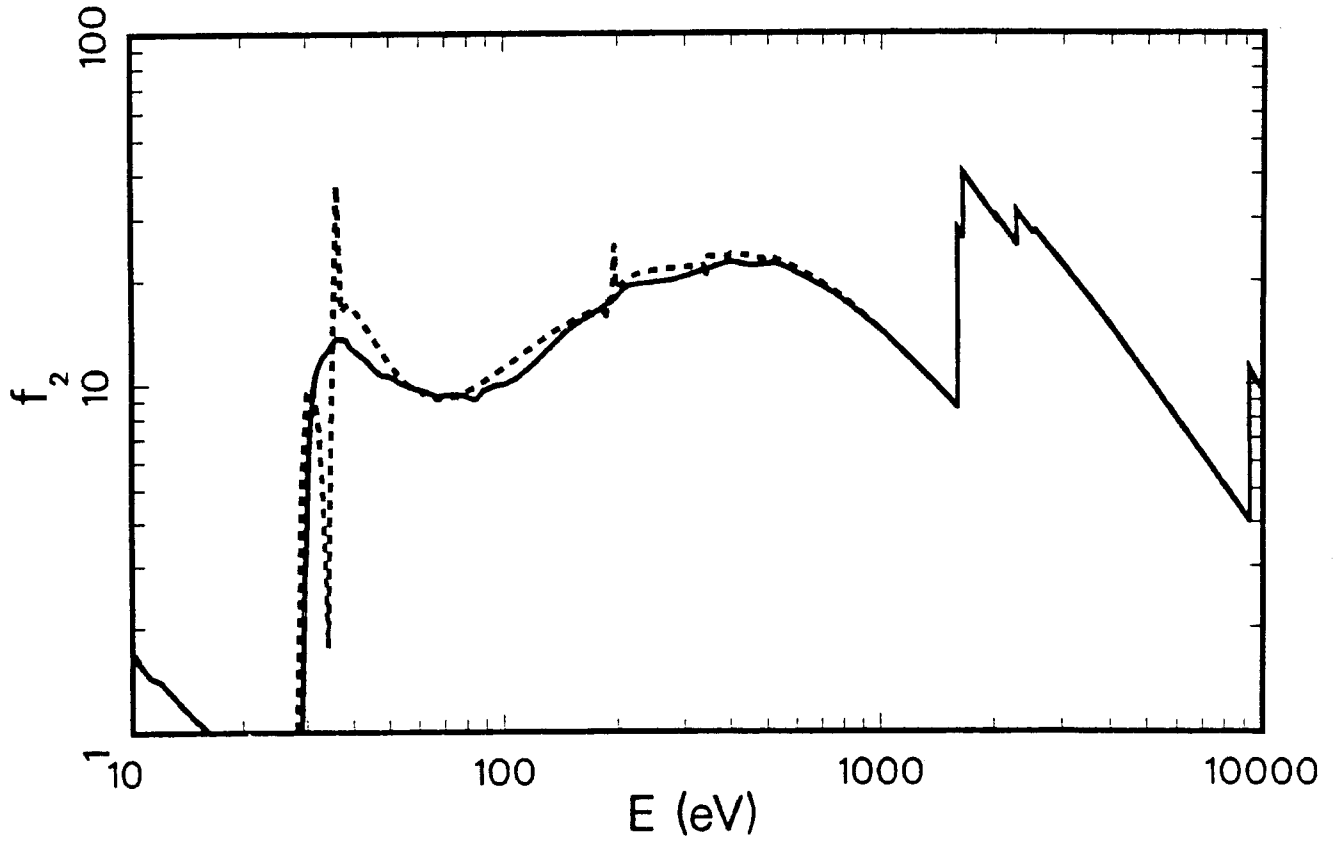
μ (barns/atom) = $\mu(cm^2/g) \times 287.34$

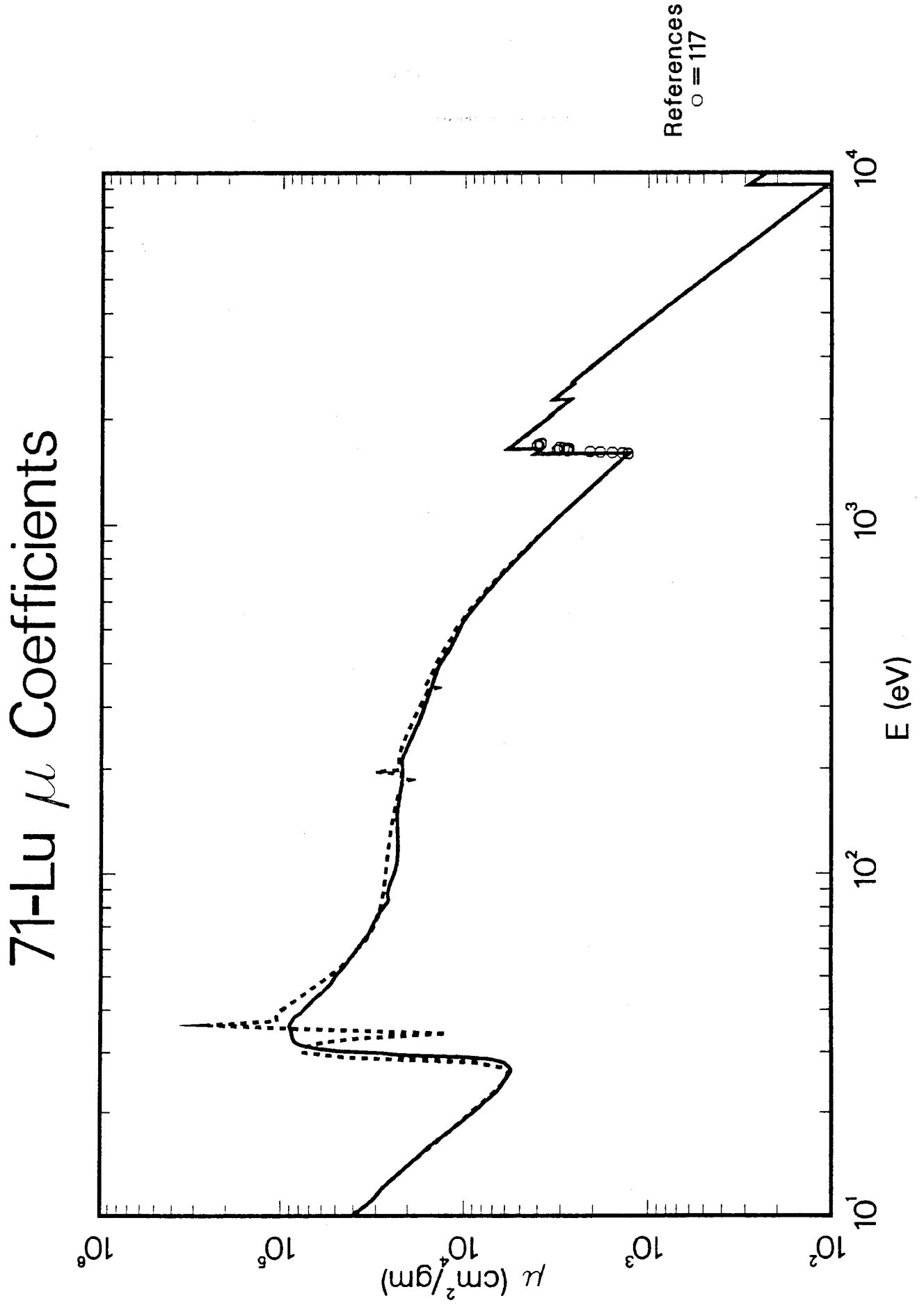
$E\mu(E) = 243.2\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
114.0	2.67e+4	-5.8	116
132.8	2.37e+4	-13.4	116
151.1	2.38e+4	-10.2	116
171.7	2.02e+4	-20.9	116
183.3	2.37e+4	-4.8	116
189.9	3.44e+4	40.6	116
192.6	2.27e+4	-6.9	116
212.2	2.21e+4	-5.4	116
277.0	1.72e+4	-9.0	116
302.7	1.64e+4	-6.5	116
392.4	1.28e+4	-7.0	116
452.2	1.15e+4	-2.8	116
524.9	9.33e+3	-4.7	116
7000.0	1.98e+2	-2.9	131
1254.0	2.16e+3	5.0	152
1487.0	1.36e+3	-5.8	152
1512.0	1.25e+3	-46.3	152
1519.0	1.60e+3	-44.5	152
1525.0	1.75e+3	-49.4	152
1548.0	2.95e+3	-31.2	152
1571.0	3.29e+3	-21.0	152
1584.0	3.72e+3	-20.3	152
1601.0	4.39e+3	-19.0	152
1627.0	4.39e+3	-22.4	152
1740.0	4.42e+3	-8.3	152
1865.0	3.72e+3	-9.1	152
1901.0	3.50e+3	-10.5	152
1925.0	3.70e+3	-8.9	152
1952.0	4.20e+3	-2.3	152
1993.0	3.82e+3	-6.3	152
2013.0	3.90e+3	-1.9	152
2141.0	3.57e+3	5.0	152
2307.0	3.09e+3	2.3	152
2621.0	2.46e+3	6.1	152
2984.0	1.82e+3	7.3	152
3313.0	1.41e+3	7.2	152
3691.0	1.09e+3	7.8	152
4012.0	8.85e+2	7.3	152
4508.0	6.65e+2	7.6	152
5411.0	4.13e+2	5.6	152
5895.0	3.33e+2	5.4	152
6400.0	2.70e+2	5.3	152
6926.0	2.17e+2	3.7	152
7473.0	1.81e+2	4.8	152
8040.0	1.44e+2	0.6	152
8630.0	1.18e+2	-0.4	152
9340.0	2.64e+2	0.6	152
9570.0	2.45e+2	0.3	152

Atomic Scattering Factors, f_1+if_2
71 - Lutetium (Lu)



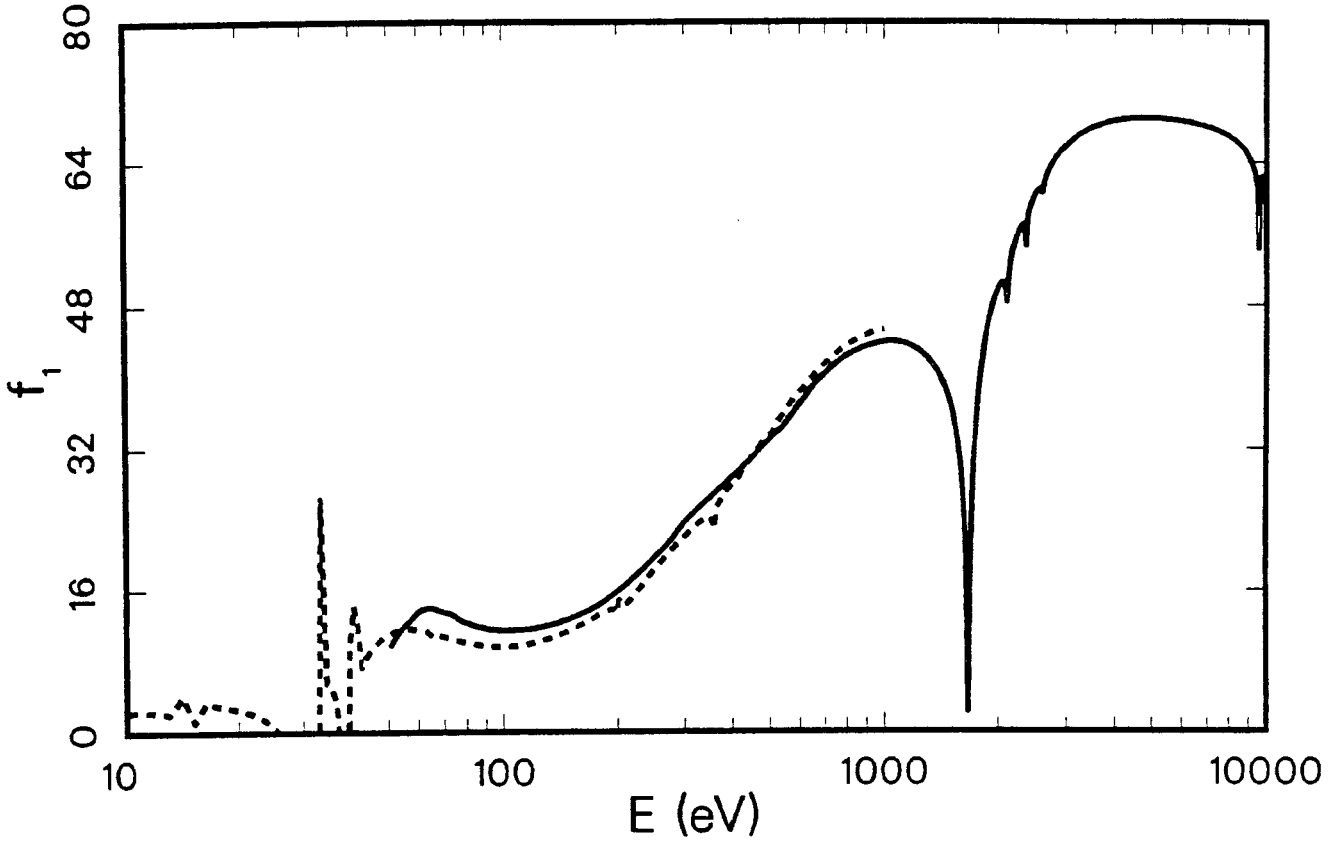


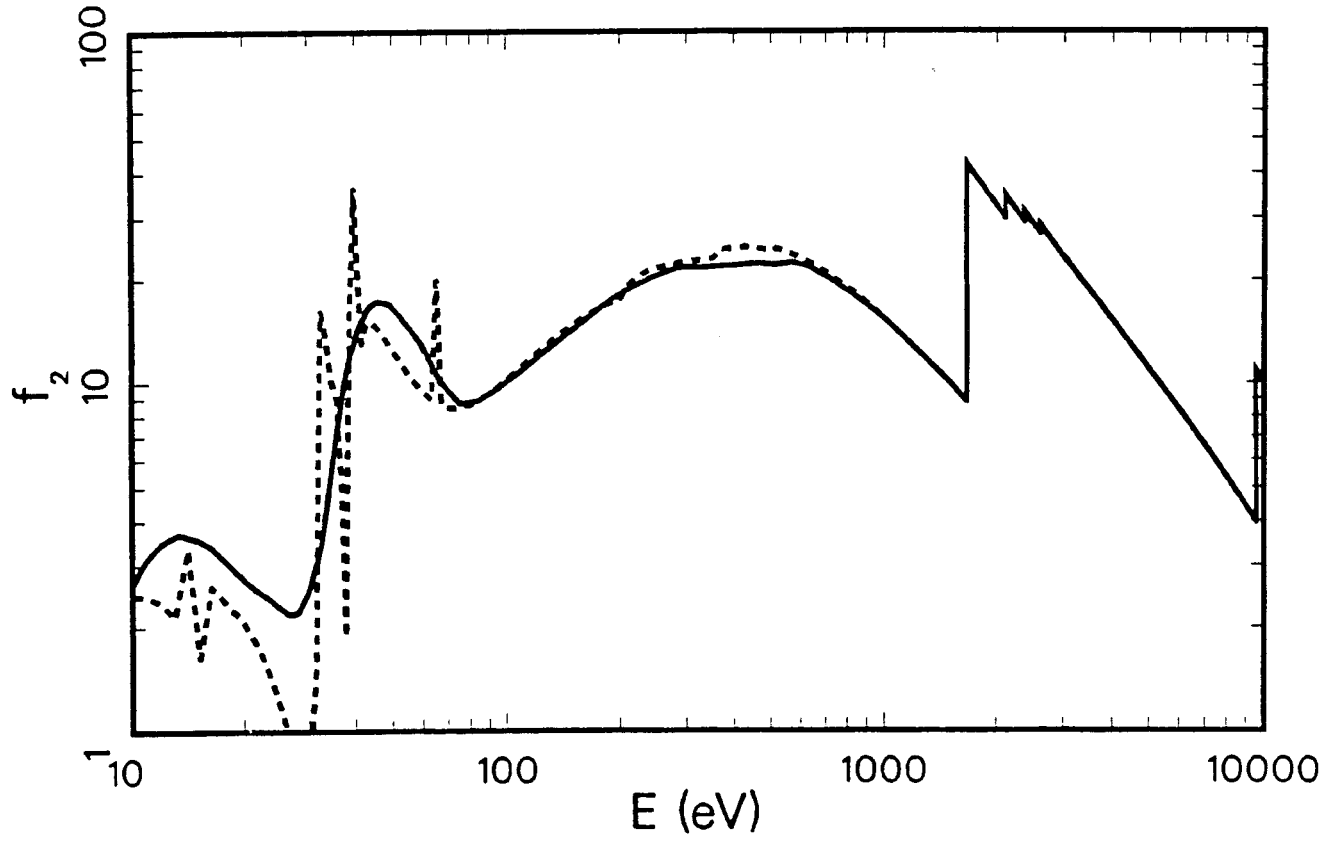

71-Lu μ Coefficients
References
○ = 117
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

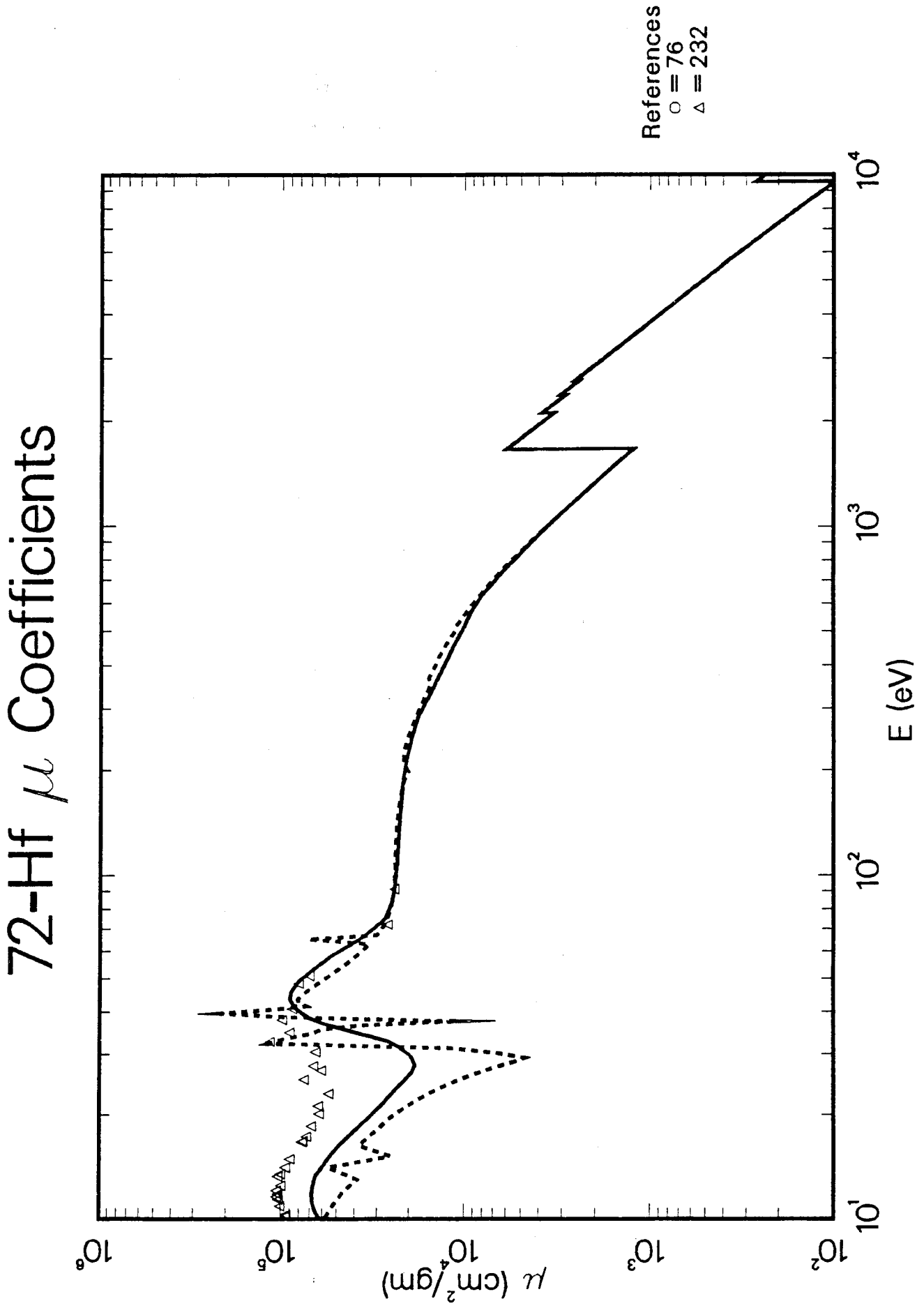
Lutetium (Lu) — 71
Atomic Weight = 174.97
μ (barns/atom) = $\mu(cm^2/g) \times 290.55$
$E\mu(E) = 240.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1587.0	1.30e+3	-40.2	117
1590.0	1.30e+3	-45.1	117
1595.0	1.40e+3	-48.8	117
1600.0	1.59e+3	-49.6	117
1605.0	1.85e+3	-49.2	117
1610.0	2.10e+3	-48.4	117
1620.0	2.79e+3	-30.3	117
1624.0	3.10e+3	-22.0	117
1626.0	3.19e+3	-19.5	117
1628.0	3.18e+3	-19.5	117
1635.0	2.75e+3	-29.6	117
1640.0	2.73e+3	-35.2	117
1645.0	2.79e+3	-45.8	117
1650.0	2.90e+3	-49.8	117
1655.0	3.07e+3	-46.5	117
1670.0	3.98e+3	-29.1	117
1675.0	4.10e+3	-26.4	117
1680.0	4.05e+3	-26.7	117
1685.0	4.05e+3	-26.2	117
1695.0	3.90e+3	-27.9	117
1700.0	3.88e+3	-27.7	117

Atomic Scattering Factors, f_1+if_2
72 - Hafnium (Hf)






72-Hf μ Coefficients
References
○ = 76
△ = 232
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

Hafnium (Hf) — 72

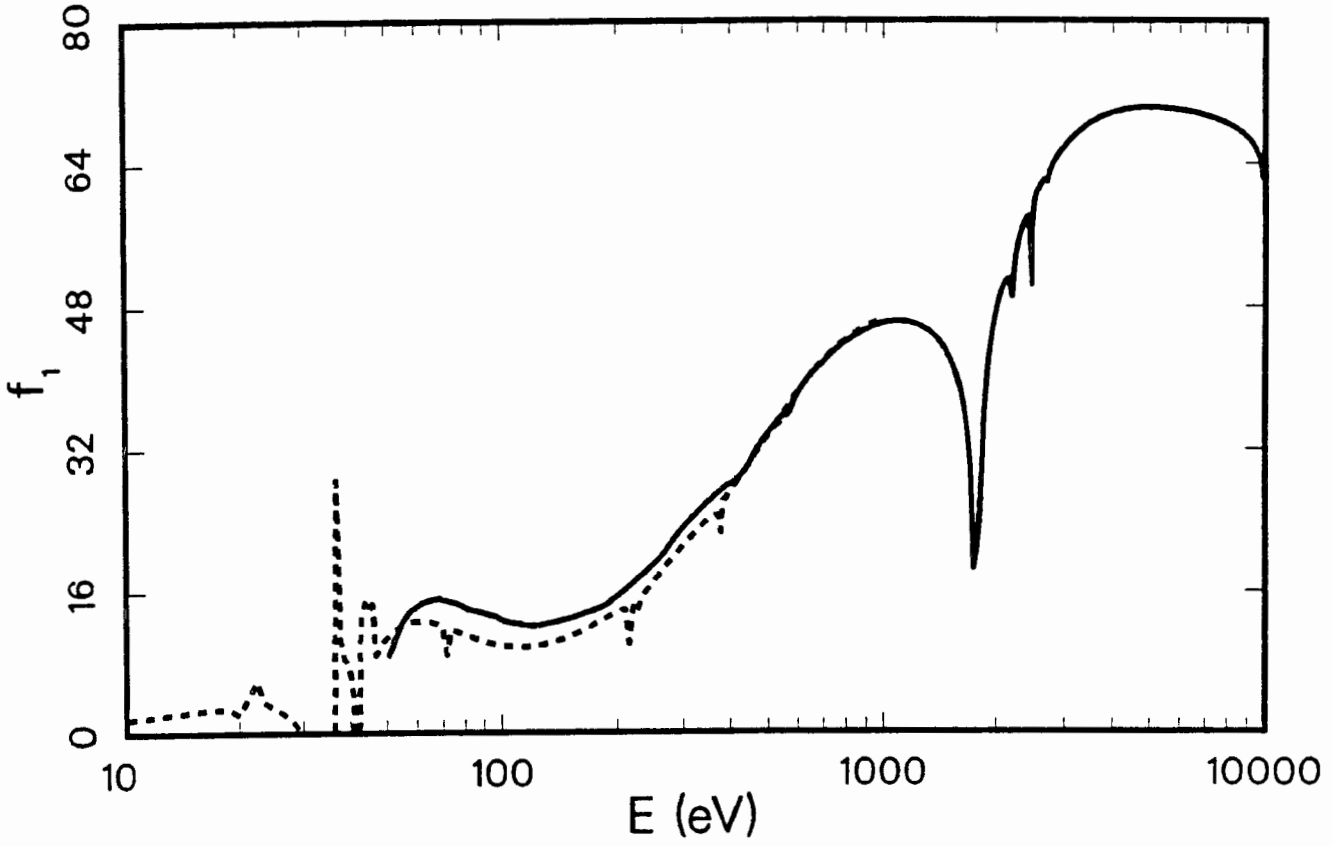
Atomic Weight = 178.49

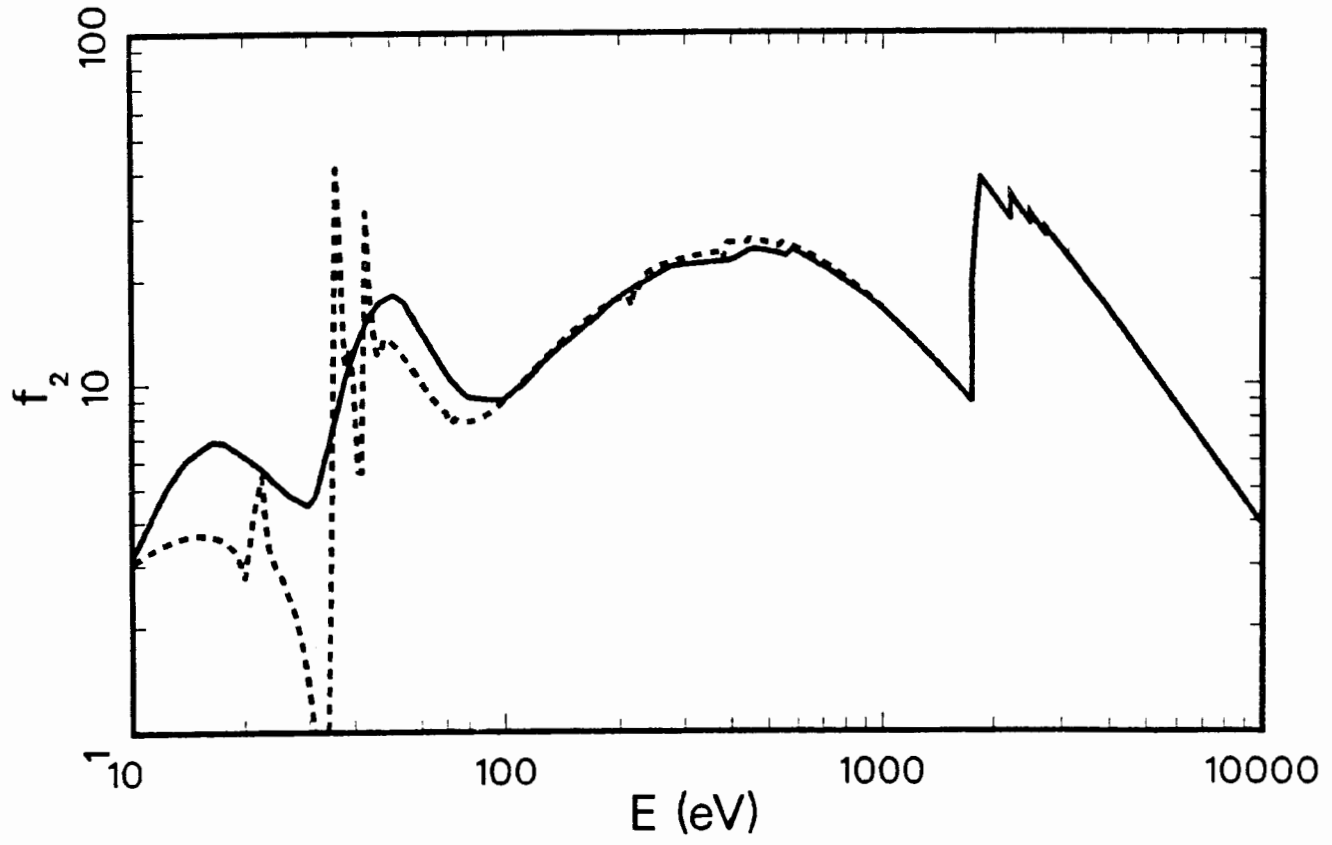
μ (barns/atom) = $\mu(cm^2/g) \times 296.39$

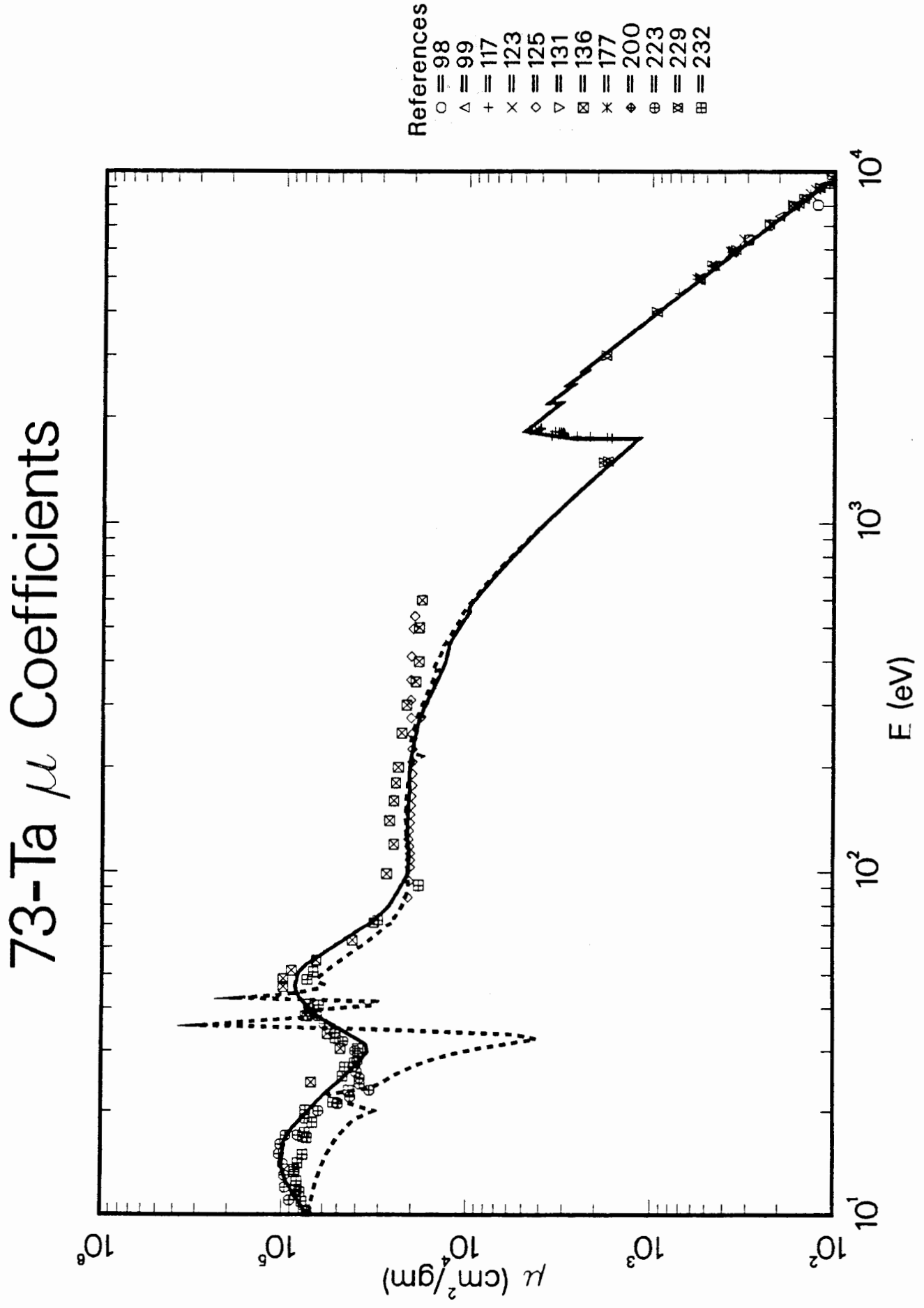
$E\mu(E) = 235.7\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8040.0	1.54e+1	-90.1	76
10.2	9.39e+4	48.5	232
10.3	9.43e+4	47.4	232
10.9	1.01e+5	51.5	232
11.4	1.03e+5	52.1	232
11.6	1.06e+5	55.7	232
11.8	1.04e+5	52.9	232
12.1	1.06e+5	55.9	232
12.5	9.99e+4	48.9	232
13.3	1.04e+5	59.3	232
13.5	1.01e+5	57.1	232
14.1	9.54e+4	58.0	232
14.9	9.02e+4	60.4	232
16.7	7.76e+4	67.0	232
16.8	7.66e+4	66.8	232
17.3	7.34e+4	69.4	232
18.5	6.90e+4	82.9	232
20.1	6.27e+4	96.8	232
21.2	6.34e+4	120.6	232
23.0	5.57e+4	122.8	232
25.3	7.58e+4	260.7	232
26.9	6.12e+4	221.0	232
27.7	6.75e+4	261.8	232
30.5	6.57e+4	214.6	232
32.7	1.15e+5	349.6	232
34.8	9.06e+4	128.7	232
37.9	9.89e+4	47.7	232
40.8	8.78e+4	5.3	232
48.4	8.08e+4	-2.1	232
51.0	7.07e+4	-5.1	232
72.3	2.65e+4	-11.0	232
91.5	2.42e+4	0.2	232

Atomic Scattering Factors, f_1+if_2
73 - Tantalum (Ta)






73-Ta μ Coefficients
References
○ = 98
△ = 99
+ = 117
× = 123
◇ = 125
▽ = 131
⊠ = 136
✳ = 177
◆ = 200
⊕ = 223
⊠ = 229
⊞ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Tantalum (Ta) — 73
Atomic Weight = 180.95
μ (barns/atom) = $\mu(cm^2/g) \times 300.48$
$E\mu(E) = 232.5\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6404.0	2.95e+2	3.8	98
7058.0	2.27e+2	2.7	98
8048.0	1.24e+2	-21.9	98
9442.0	1.05e+2	-0.4	98
4952.0	5.49e+2	0.7	99
5415.0	4.58e+2	5.3	99
5899.0	3.66e+2	4.6	99
6404.0	2.99e+2	5.3	99
7478.0	2.00e+2	4.7	99
8146.0	1.57e+2	2.4	99
9252.0	1.14e+2	3.6	99
9442.0	1.07e+2	2.2	99
9713.0	9.85e+1	1.0	99
1740.0	1.67e+3	7.3	117
1745.0	1.66e+3	-6.3	117
1750.0	1.77e+3	-12.3	117
1760.0	2.20e+3	-15.9	117
1765.0	2.58e+3	-13.3	117
1770.0	3.20e+3	-5.4	117
1773.0	3.50e+3	-2.4	117
1775.0	3.54e+3	-2.8	117
1780.0	3.27e+3	-13.8	117
1785.0	3.00e+3	-24.0	117
1800.0	3.04e+3	-31.6	117
1805.0	3.09e+3	-33.1	117
1810.0	3.15e+3	-34.5	117
1815.0	3.22e+3	-35.6	117
1820.0	3.40e+3	-31.5	117
1830.0	4.19e+3	-14.4	117
1833.0	4.60e+3	-5.7	117
1835.0	4.70e+3	-3.4	117
1838.0	4.60e+3	-5.0	117
1840.0	4.35e+3	-10.0	117
1845.0	4.10e+3	-14.6	117
1850.0	4.05e+3	-15.0	117
1855.0	4.04e+3	-14.7	117
1862.0	4.06e+3	-13.5	117
4512.0	7.18e+2	4.3	117
4953.0	5.69e+2	4.5	117
5414.0	4.54e+2	4.4	117
5898.0	3.64e+2	3.9	117
8640.0	1.36e+2	3.1	117
9023.0	1.20e+2	1.7	117
4952.0	5.49e+2	0.7	123
4953.0	5.69e+2	4.5	123
5414.0	4.54e+2	4.4	123
5898.0	3.64e+2	3.9	123
8640.0	1.36e+2	3.1	123
9023.0	1.20e+2	1.7	123
84.5	2.11e+4	-15.5	125

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
93.9	2.07e+4	-7.0	125
103.0	2.06e+4	-2.3	125
108.0	2.06e+4	-1.8	125
113.0	2.06e+4	-1.3	125
118.0	2.08e+4	-1.1	125
124.0	2.10e+4	-1.3	125
131.0	2.09e+4	-1.7	125
138.0	2.07e+4	-2.7	125
146.0	2.06e+4	-2.6	125
155.0	2.04e+4	-2.9	125
165.0	2.03e+4	-2.9	125
177.0	2.01e+4	-3.1	125
191.0	2.01e+4	-3.8	125
207.0	2.01e+4	-2.3	125
225.0	2.01e+4	0.9	125
248.0	2.02e+4	5.3	125
276.0	2.04e+4	11.0	125
310.0	2.05e+4	23.7	125
354.0	2.05e+4	39.2	125
413.0	2.04e+4	55.9	125
496.0	2.00e+4	77.1	125
539.0	1.96e+4	92.9	125
7058.0	2.27e+2	2.3	131
8000.0	1.62e+2	0.7	131
8047.0	1.69e+2	6.8	131
8398.0	1.43e+2	0.7	131
9000.0	1.19e+2	0.7	131
9500.0	1.03e+2	-0.5	131
24.3	6.99e+4	40.4	136
30.5	4.85e+4	38.3	136
33.7	5.70e+4	28.4	136
38.0	7.55e+4	16.7	136
41.1	7.31e+4	-4.2	136
46.2	9.94e+4	16.1	136
48.7	9.94e+4	18.1	136
51.5	9.01e+4	11.9	136
55.1	6.61e+4	-5.5	136
63.0	4.21e+4	-11.2	136
71.2	3.22e+4	-4.4	136
98.7	2.75e+4	29.8	136
120.0	2.53e+4	19.8	136
140.0	2.66e+4	25.2	136
160.0	2.53e+4	20.4	136
180.0	2.46e+4	18.4	136
200.0	2.40e+4	15.8	136
250.0	2.30e+4	19.9	136
300.0	2.16e+4	26.5	136
350.0	1.93e+4	29.7	136
400.0	1.86e+4	40.5	136
500.0	1.86e+4	66.6	136

Tantalum (Ta) — 73

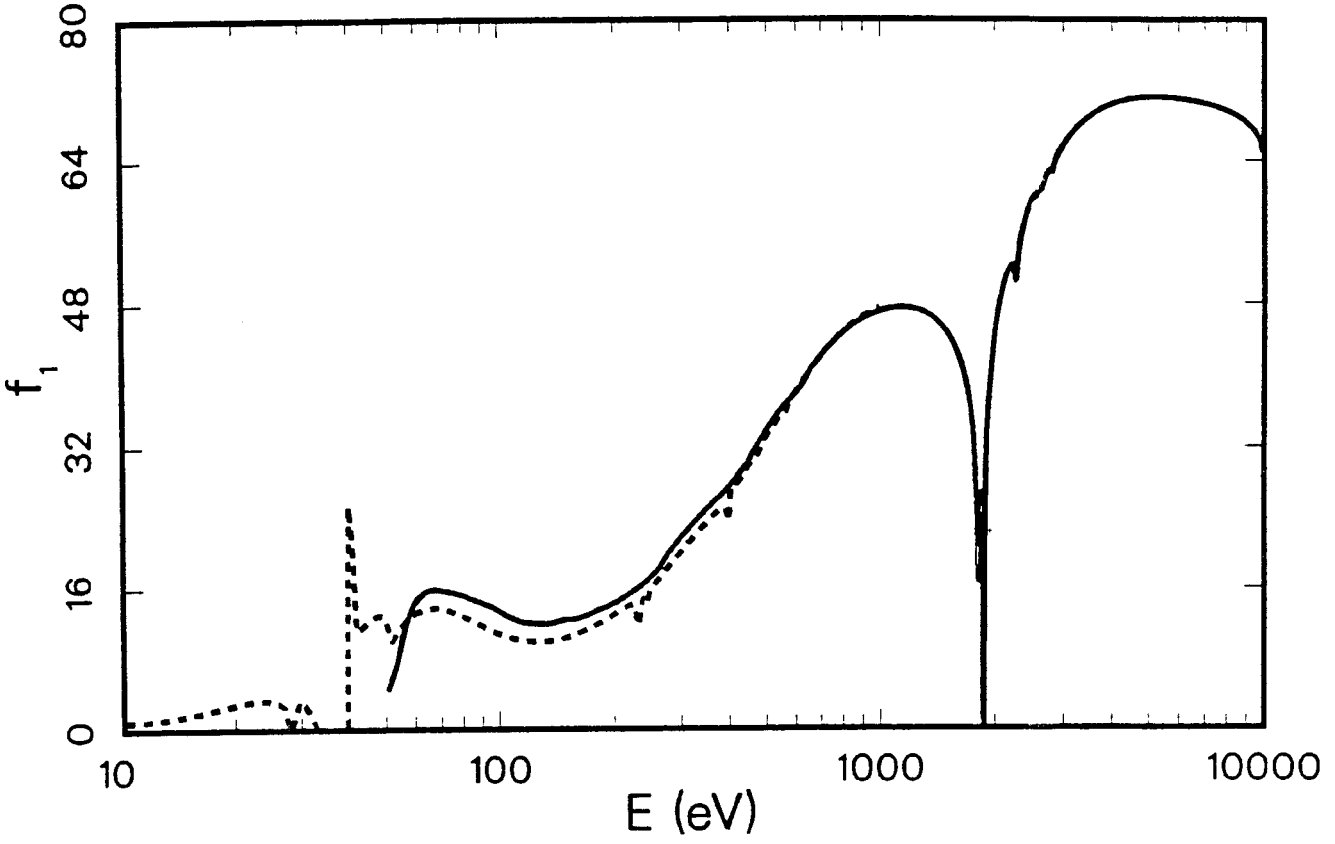
E(eV)	μ(cm^2/g)	% Error	Ref.
600.0	1.80e+4	94.8	136
5900.0	3.71e+2	6.1	177
6400.0	3.12e+2	9.7	177
7100.0	2.26e+2	3.7	177
8000.0	1.65e+2	2.9	177
8900.0	1.27e+2	4.3	177
277.0	1.81e+4	-1.3	200
10.0	8.37e+4	14.7	223
11.0	9.07e+4	10.5	223
12.0	9.60e+4	5.9	223
13.0	9.68e+4	-0.2	223
14.0	9.83e+4	-2.5	223
15.0	1.04e+5	3.9	223
16.0	1.02e+5	3.7	223
17.0	9.55e+4	2.2	223
17.0	8.20e+4	-12.2	223
19.0	7.54e+4	-4.4	223
20.0	6.35e+4	-12.0	223
21.0	5.00e+4	-24.6	223
22.0	4.30e+4	-29.7	223
23.0	3.37e+4	-39.9	223
24.0	3.81e+4	-25.5	223
25.0	3.82e+4	-19.1	223
26.0	3.97e+4	-9.2	223
27.0	4.12e+4	1.3	223
28.0	3.93e+4	2.2	223
29.0	3.90e+4	7.0	223
30.0	4.03e+4	15.5	223
32.0	4.69e+4	24.4	223
34.0	5.19e+4	13.6	223
36.0	5.93e+4	8.0	223
38.0	6.50e+4	0.4	223
40.0	7.08e+4	-2.3	223
1486.7	1.84e+3	10.2	229
1500.0	1.75e+3	7.0	229
3000.0	1.79e+3	-4.4	229
4000.0	9.49e+2	2.2	229
5000.0	5.52e+2	3.8	229
5414.7	4.71e+2	8.4	229
5946.7	3.60e+2	4.9	229
6000.0	3.46e+2	3.3	229
8000.0	1.66e+2	3.5	229
8397.6	1.47e+2	3.5	229
9000.0	1.21e+2	1.9	229
9500.0	1.04e+2	1.1	229
10.2	7.29e+4	-2.6	232
10.3	7.57e+4	0.0	232
10.9	7.80e+4	-3.8	232
11.4	8.37e+4	-2.4	232
11.6	8.02e+4	-8.3	232
11.8	8.31e+4	-6.7	232
12.1	8.34e+4	-8.8	232
12.5	8.27e+4	-12.6	232
13.3	8.53e+4	-13.4	232
13.5	8.56e+4	-13.8	232

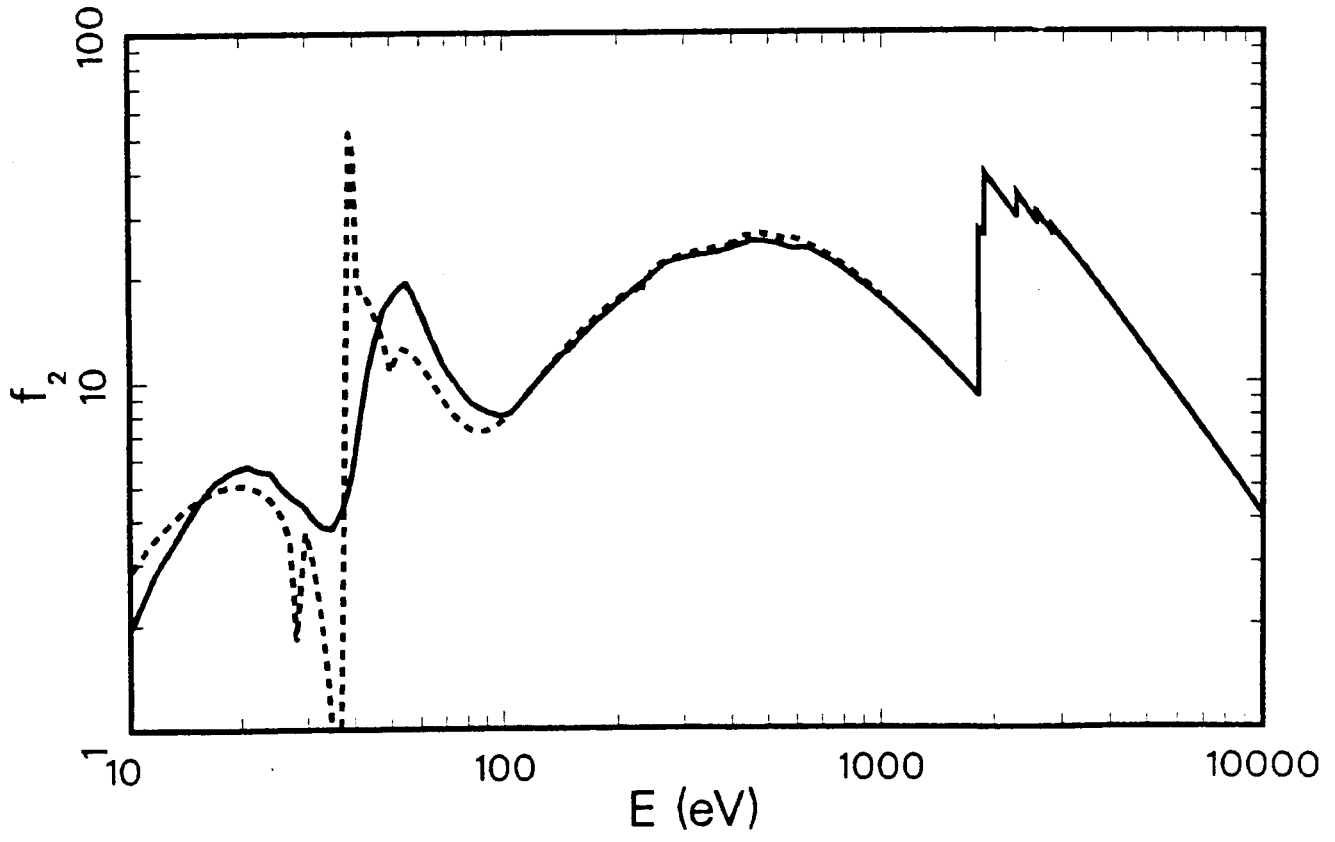
E(eV)	μ(cm^2/g)	% Error	Ref.
14.1	8.22e+4	-18.4	232
14.9	7.74e+4	-22.4	232
16.7	7.34e+4	-23.0	232
16.8	7.72e+4	-18.5	232
17.3	7.54e+4	-17.7	232
18.5	6.84e+4	-17.1	232
20.1	7.49e+4	4.7	232
21.2	5.26e+4	-19.3	232
23.0	4.35e+4	-22.4	232
25.3	4.72e+4	2.4	232
26.9	4.58e+4	11.9	232
27.7	4.06e+4	3.8	232
30.5	3.90e+4	11.1	232
32.7	5.17e+4	28.0	232
34.8	5.50e+4	11.6	232
37.9	7.36e+4	14.4	232
40.8	6.38e+4	-15.4	232
48.4	7.38e+4	-12.5	232
51.0	6.85e+4	-16.3	232
72.3	3.07e+4	-6.0	232
91.5	1.85e+4	-19.2	232

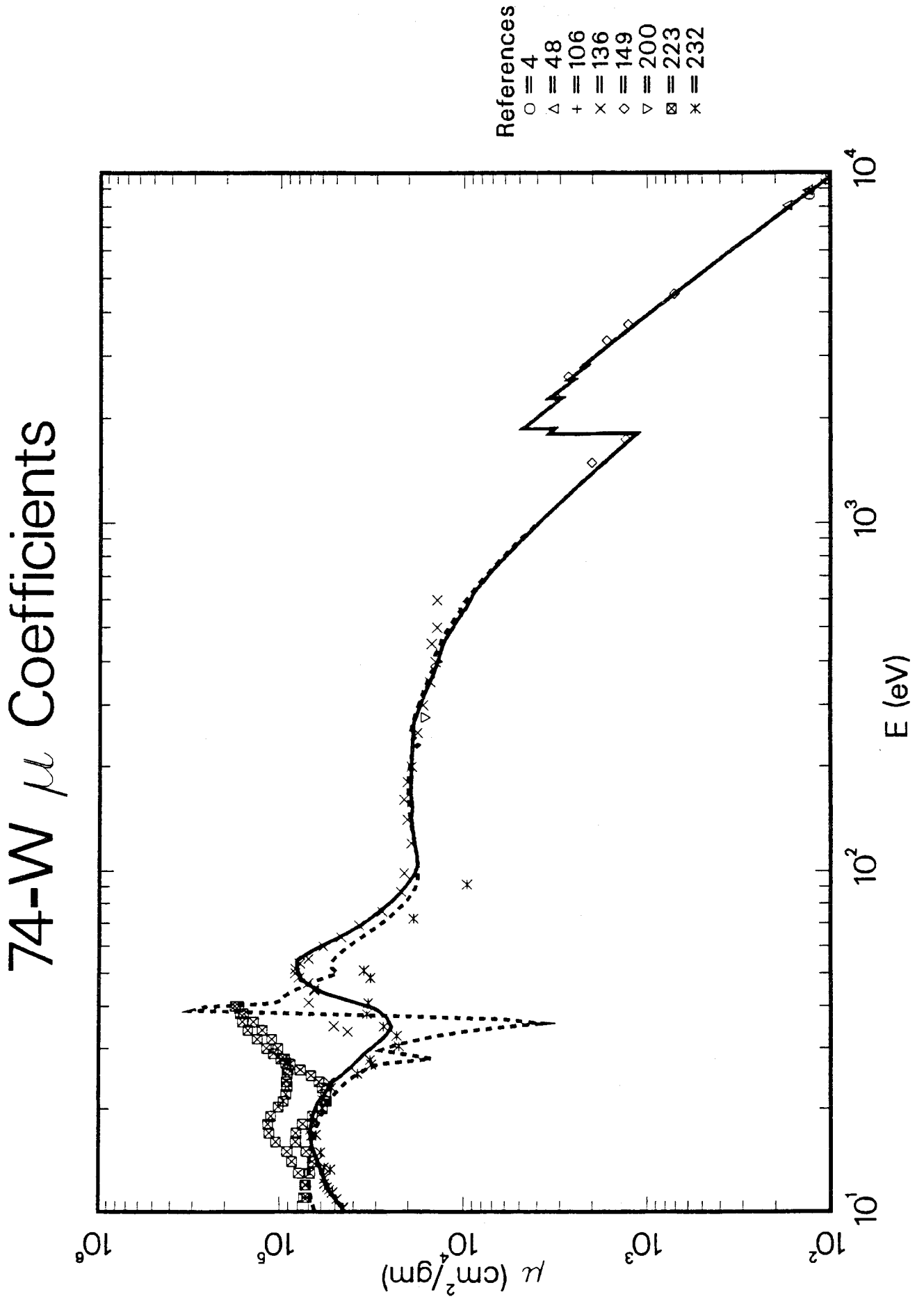
LAWRENCE BERKELEY LABORATORY
TECHNICAL INFORMATION DEPARTMENT
1 CYCLOTRON ROAD
BERKELEY, CALIFORNIA 94720

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price Code: A14

Atomic Scattering Factors, f_1+if_2
74 - Tungsten (W)






74-W μ Coefficients
References
○ = 4
△ = 48
+ = 106
× = 136
◇ = 149
▷ = 200
⊠ = 223
✳ = 232
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

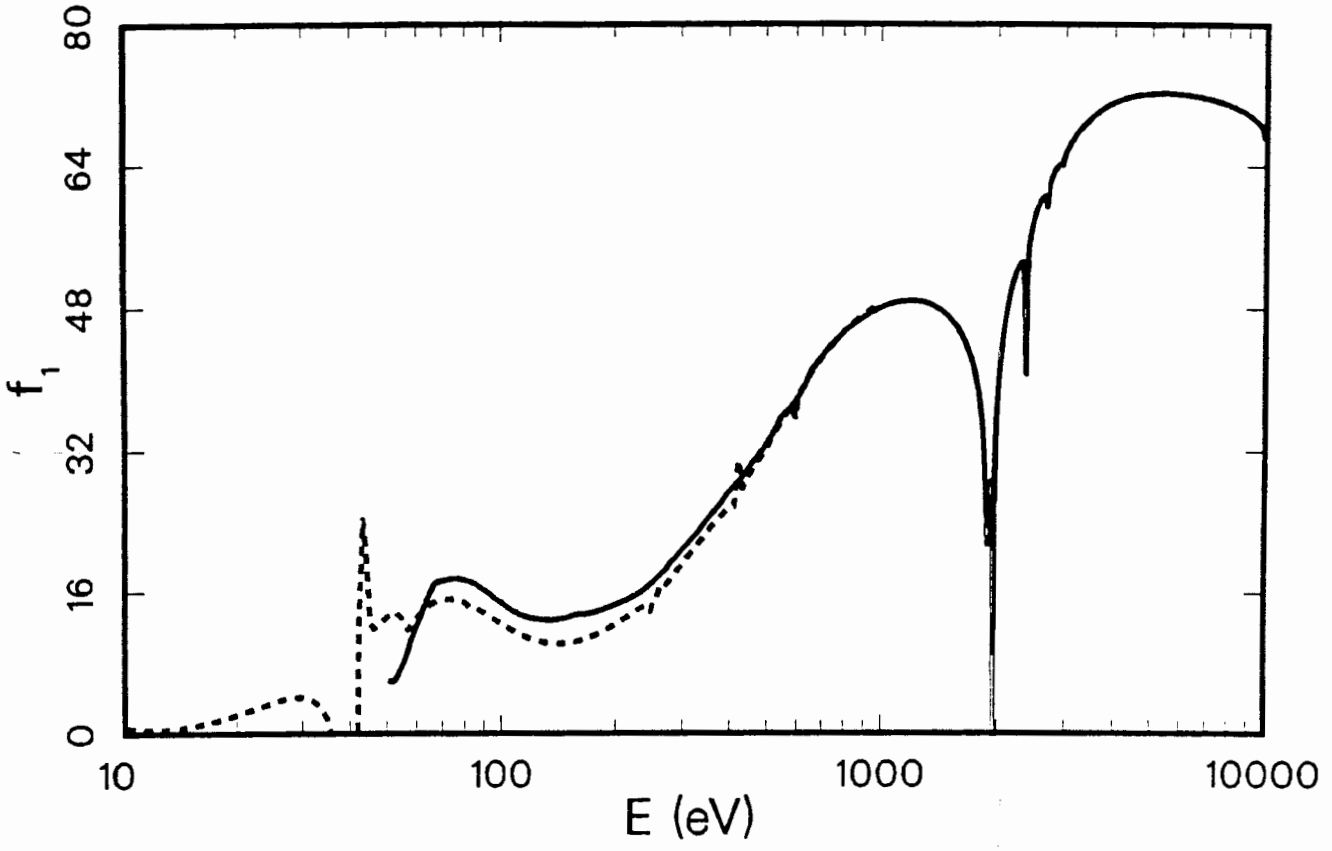
Tungsten (W) — 74
Atomic Weight = 183.85
μ (barns/atom) = $\mu(cm^2/g) \times 305.29$
$E\mu(E) = 228.9\, f_2$ keV cm^2/g

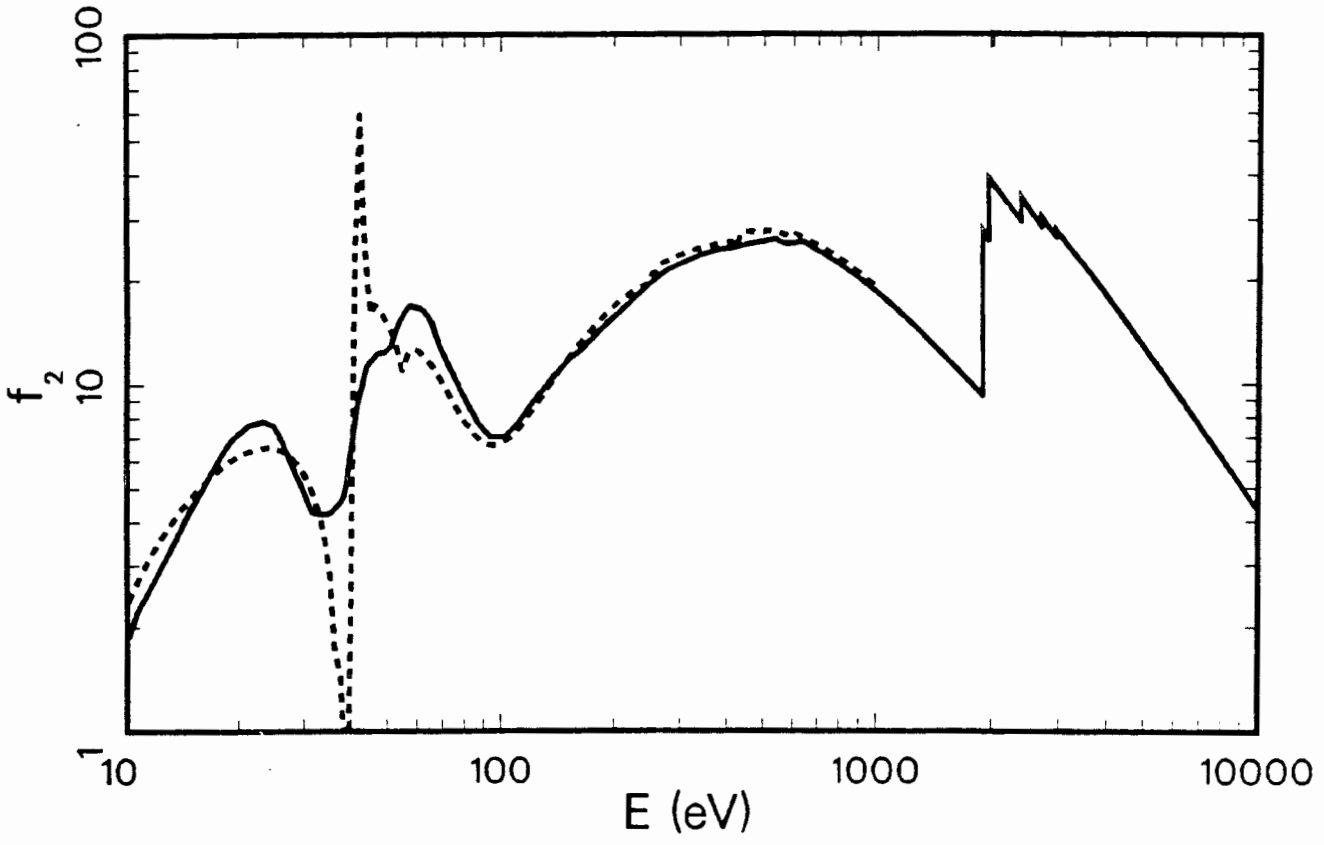
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8660.0	1.30e+2	-4.2	4
9590.0	1.05e+2	0.9	4
8047.0	1.72e+2	4.5	48
8904.0	1.33e+2	5.4	48
9885.0	9.91e+1	3.1	48
9000.0	1.25e+2	1.8	106
9500.0	1.05e+2	-1.5	106
10000.0	9.41e+1	1.0	106
23.9	5.42e+4	3.3	136
33.6	4.32e+4	67.5	136
34.9	5.13e+4	106.1	136
40.9	7.05e+4	80.7	136
44.4	6.55e+4	7.4	136
45.0	6.56e+4	2.4	136
46.8	7.09e+4	-2.7	136
48.6	7.92e+4	1.2	136
50.0	8.29e+4	4.1	136
51.5	8.29e+4	2.5	136
53.4	7.88e+4	-2.9	136
55.2	7.07e+4	-11.0	136
60.0	5.86e+4	-3.6	136
63.8	4.70e+4	-2.7	136
69.1	3.75e+4	1.9	136
75.7	2.79e+4	-4.2	136
86.8	2.20e+4	-0.3	136
98.6	2.11e+4	13.8	136
120.0	1.93e+4	4.0	136
140.0	2.03e+4	5.2	136
160.0	2.13e+4	10.1	136
180.0	2.03e+4	4.4	136
200.0	1.93e+4	-0.1	136
250.0	1.80e+4	-5.1	136
300.0	1.67e+4	-4.0	136
350.0	1.54e+4	0.0	136
400.0	1.44e+4	2.9	136
450.0	1.51e+4	15.7	136
500.0	1.41e+4	21.3	136
600.0	1.41e+4	51.4	136
1490.0	2.02e+3	15.6	149
1740.0	1.31e+3	5.3	149
2310.0	3.21e+3	-4.2	149
2620.0	2.72e+3	5.0	149
3320.0	1.67e+3	9.9	149
3690.0	1.28e+3	8.5	149
4510.0	7.14e+2	-0.1	149
277.0	1.62e+4	-12.0	200
10.0	5.93e+4	34.7	223
10.0	6.09e+4	38.2	223
11.0	7.39e+4	45.7	223
11.0	7.16e+4	41.2	223

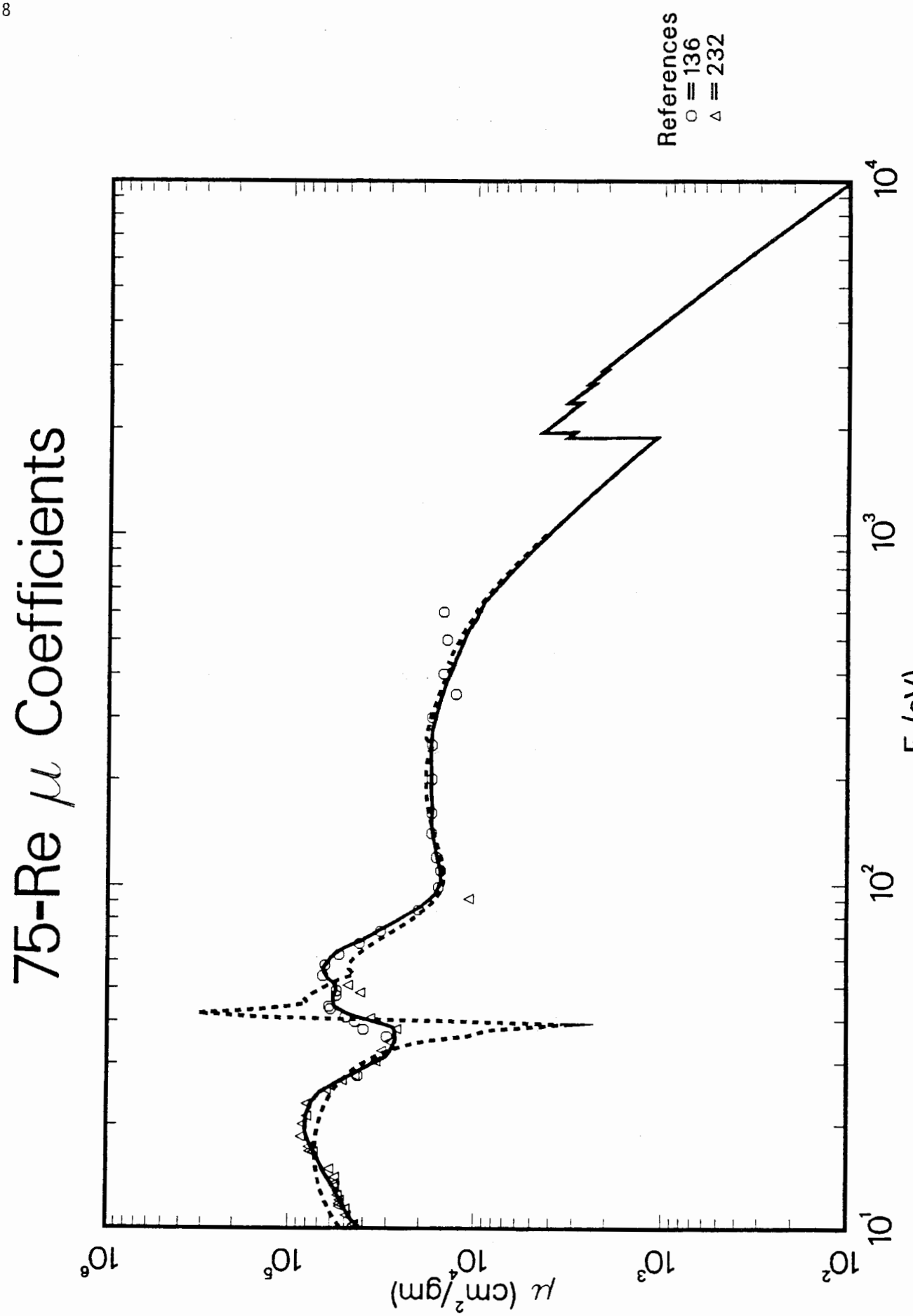
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
12.0	7.31e+4	30.4	223
12.0	7.25e+4	29.3	223
13.0	6.90e+4	16.1	223
13.0	7.92e+4	33.3	223
14.0	6.69e+4	6.8	223
14.0	8.60e+4	37.3	223
15.0	7.25e+4	10.1	223
15.0	9.14e+4	38.8	223
16.0	8.23e+4	21.1	223
16.0	1.05e+5	54.4	223
17.0	1.14e+5	65.2	223
17.0	8.21e+4	18.7	223
18.0	7.56e+4	11.2	223
18.0	1.16e+5	71.0	223
19.0	6.69e+4	-0.1	223
19.0	1.12e+5	67.1	223
20.0	5.88e+4	-9.0	223
20.2	1.02e+5	58.6	223
21.0	5.62e+4	-9.4	223
21.0	9.59e+4	54.6	223
22.0	5.66e+4	-2.2	223
22.0	9.24e+4	59.7	223
23.0	5.92e+4	8.1	223
23.2	9.14e+4	68.5	223
24.0	9.20e+4	77.0	223
24.0	6.18e+4	18.8	223
25.0	6.83e+4	45.6	223
25.2	9.13e+4	98.6	223
26.0	9.01e+4	109.6	223
26.0	7.78e+4	81.0	223
27.0	8.79e+4	121.1	223
27.2	9.29e+4	137.1	223
28.0	9.41e+4	153.1	223
28.0	9.85e+4	165.0	223
29.0	1.08e+5	209.2	223
30.0	1.02e+5	217.6	223
30.0	1.18e+5	266.4	223
32.0	1.33e+5	376.4	223
32.0	1.11e+5	298.0	223
34.0	1.50e+5	491.0	223
34.0	1.25e+5	392.5	223
36.0	1.61e+5	526.7	223
36.0	1.40e+5	445.6	223
38.0	1.66e+5	492.3	223
38.0	1.58e+5	463.8	223
40.0	1.76e+5	417.6	223
40.0	1.68e+5	392.9	223
10.2	4.57e+4	0.3	232
10.3	4.53e+4	-2.1	232
10.9	4.92e+4	-1.9	232

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
11.4	5.20e+4	-2.3	232
11.6	5.39e+4	-1.0	232
11.8	5.54e+4	0.0	232
12.1	5.73e+4	1.6	232
12.5	5.76e+4	-0.3	232
13.3	5.34e+4	-11.5	232
13.5	5.77e+4	-5.5	232
14.1	6.27e+4	-0.5	232
14.9	6.05e+4	-7.7	232
16.7	6.78e+4	-1.8	232
16.8	6.40e+4	-7.5	232
17.3	6.95e+4	1.0	232
18.5	6.54e+4	-3.1	232
20.1	5.93e+4	-8.0	232
21.2	5.88e+4	-3.9	232
23.0	5.27e+4	-3.9	232
25.3	3.80e+4	-16.4	232
26.9	3.19e+4	-20.3	232
27.7	3.24e+4	-14.4	232
30.5	2.26e+4	-27.0	232
32.7	2.32e+4	-13.2	232
34.8	2.74e+4	10.2	232
37.9	3.39e+4	21.8	232
40.8	3.34e+4	-13.1	232
48.4	3.25e+4	-58.4	232
51.0	3.54e+4	-56.1	232
72.3	1.88e+4	-42.5	232
91.5	9.61e+3	-52.9	232

Atomic Scattering Factors, f_1+if_2
75 - Rhenium (Re)






75-Re μ Coefficients
References
○ = 136
△ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Rhenium (Re) — 75

Atomic Weight = 186.21

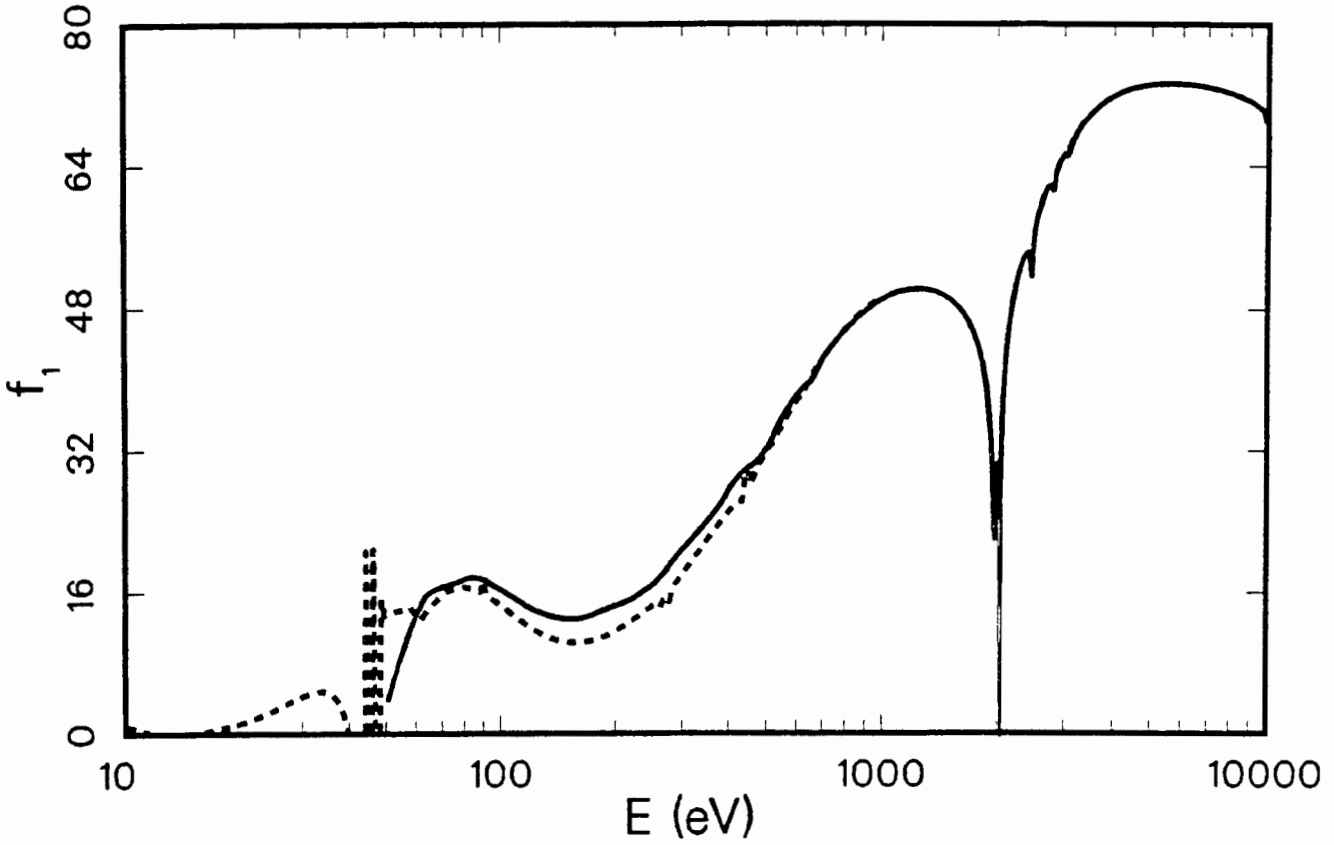
μ (barns/atom) = $\mu(cm^2/g) \times 309.21$

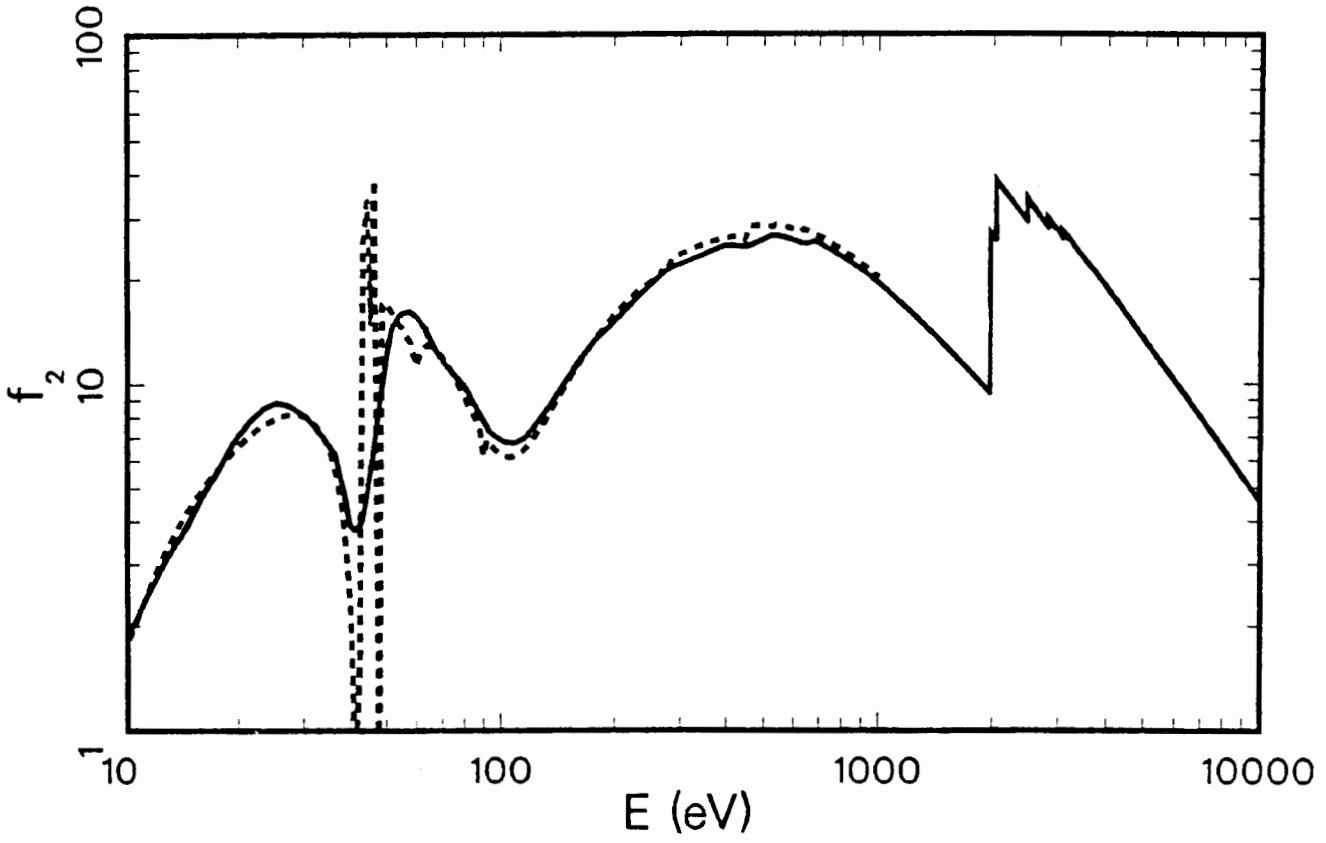
$E\mu(E) = 226.0\, f_2$ keV cm^2/g

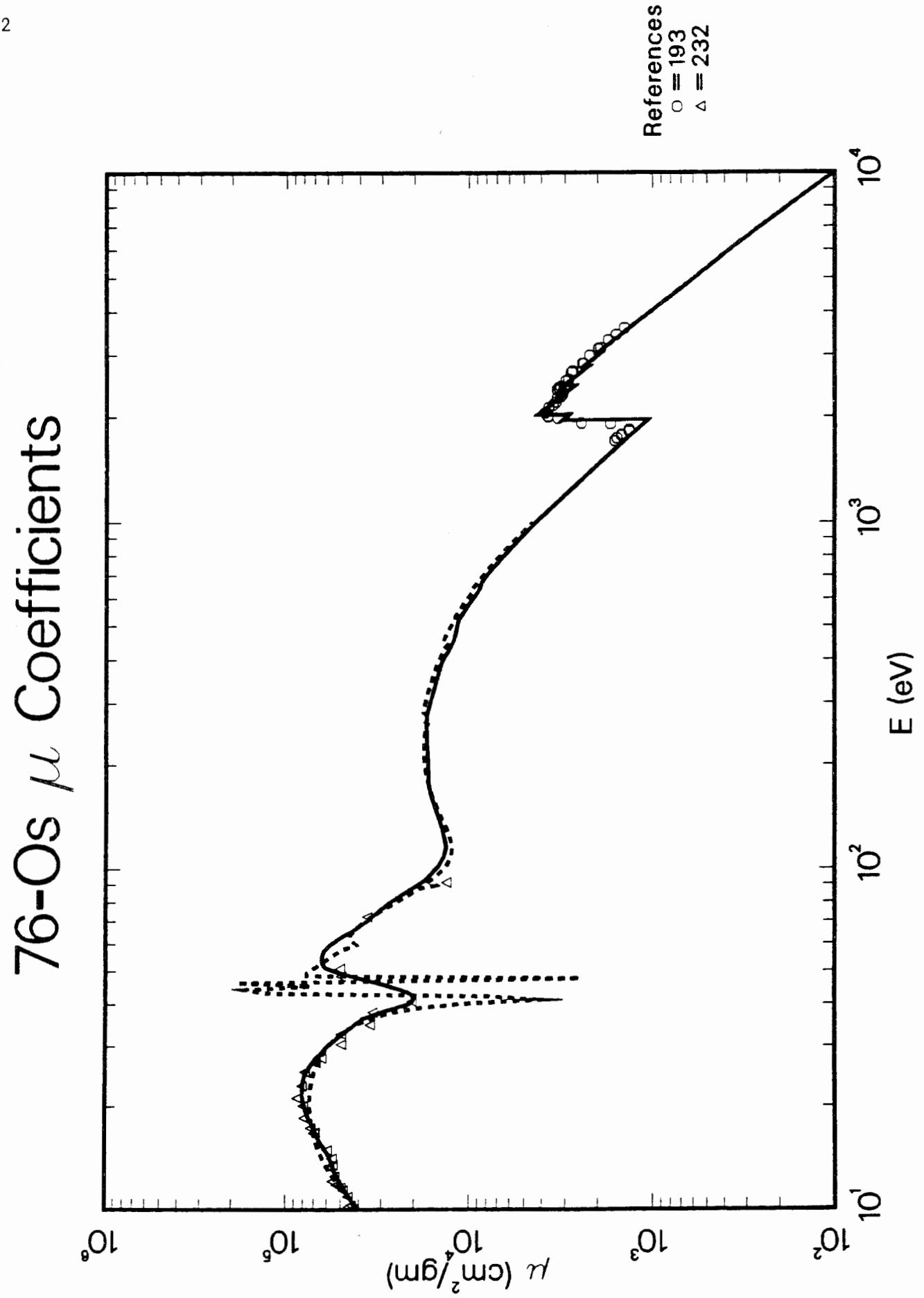
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
27.7	4.31e+4	-10.7	136
36.0	3.02e+4	10.8	136
37.8	4.03e+4	46.2	136
39.9	4.49e+4	25.9	136
41.1	5.03e+4	16.3	136
43.4	6.07e+4	10.6	136
44.2	6.16e+4	6.5	136
47.5	5.65e+4	-3.4	136
49.1	5.63e+4	-0.8	136
54.3	6.67e+4	4.4	136
58.3	6.50e+4	0.2	136
62.6	5.49e+4	-5.8	136
67.5	4.26e+4	-6.3	136
73.2	3.28e+4	-3.9	136
84.7	2.06e+4	-4.4	136
98.8	1.60e+4	-0.4	136
110.0	1.55e+4	-0.6	136
120.0	1.65e+4	1.1	136
140.0	1.75e+4	1.1	136
160.0	1.75e+4	0.2	136
200.0	1.75e+4	-0.9	136
250.0	1.75e+4	-1.3	136
300.0	1.75e+4	4.4	136
350.0	1.29e+4	-15.9	136
400.0	1.52e+4	9.1	136
500.0	1.46e+4	24.4	136
600.0	1.52e+4	57.9	136
10.2	4.54e+4	6.0	232
10.3	4.49e+4	2.8	232
10.9	4.92e+4	2.5	232
11.4	4.99e+4	-0.4	232
11.6	5.37e+4	5.6	232
11.8	5.40e+4	4.3	232
12.1	5.36e+4	0.9	232
12.5	5.51e+4	0.5	232
13.3	5.66e+4	-3.1	232
13.5	5.78e+4	-2.5	232
14.1	5.71e+4	-8.5	232
14.9	6.12e+4	-7.6	232
16.7	7.40e+4	1.2	232
16.8	7.76e+4	5.4	232
17.3	7.80e+4	3.2	232
18.5	8.64e+4	8.4	232
20.1	8.41e+4	3.5	232
21.2	8.02e+4	-0.7	232
23.0	8.03e+4	5.1	232
25.3	6.37e+4	-2.6	232
26.9	5.26e+4	-2.0	232
27.7	4.49e+4	-7.0	232
30.5	3.45e+4	0.4	232

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
32.7	3.22e+4	10.5	232
34.8	2.94e+4	7.2	232
37.9	2.69e+4	-2.8	232
40.8	3.70e+4	-10.2	232
48.4	4.23e+4	-26.7	232
51.0	4.90e+4	-14.1	232
91.5	1.09e+4	-39.0	232

Atomic Scattering Factors, f_1+if_2
76 - Osmium (Os)





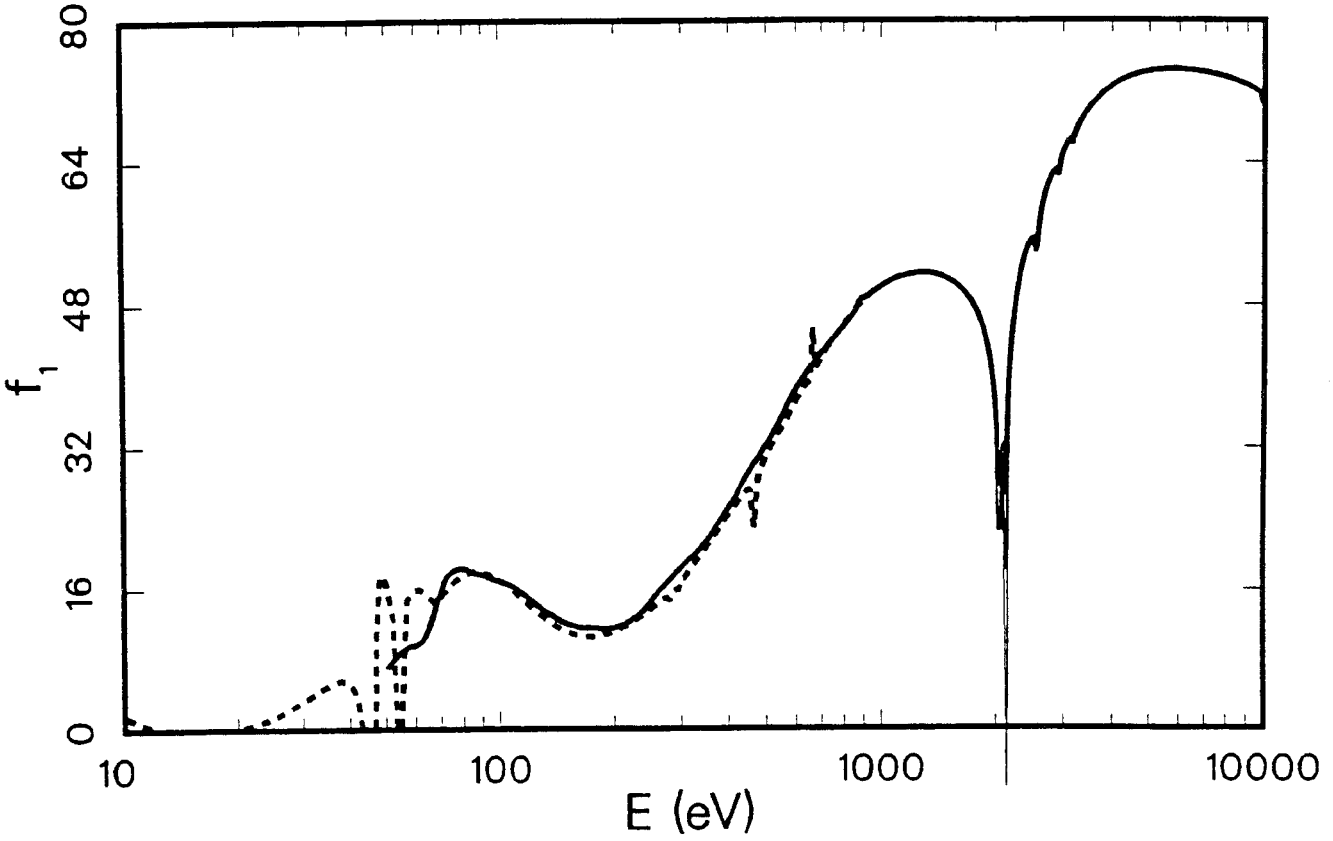

76-Os μ Coefficients
References
○ = 193
△ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

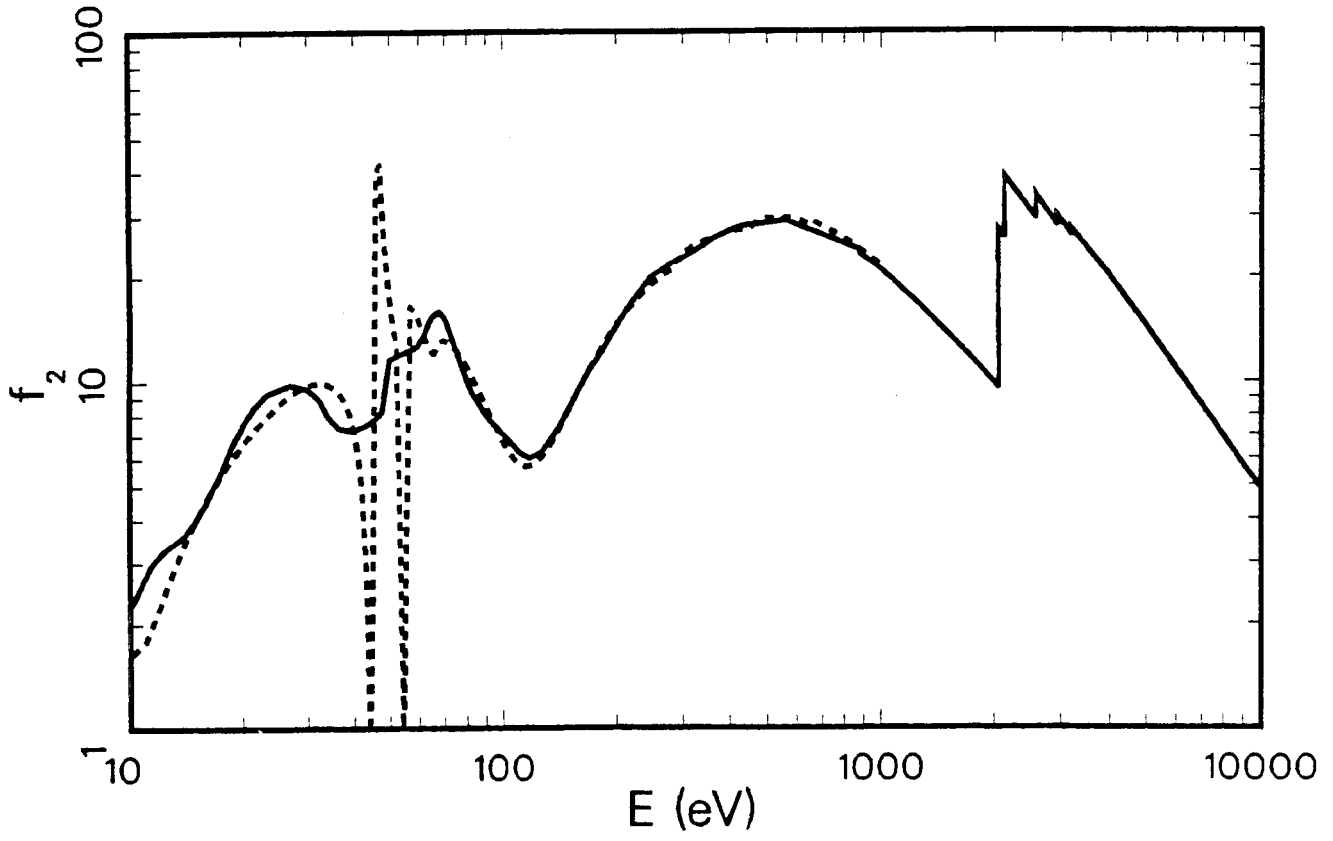
Osmium (Os) — 76
Atomic Weight = 190.20
μ (barns/atom) = $\mu(cm^2/g) \times 315.84$
$E\mu(E) = 221.2 f_2$ keV cm^2/g

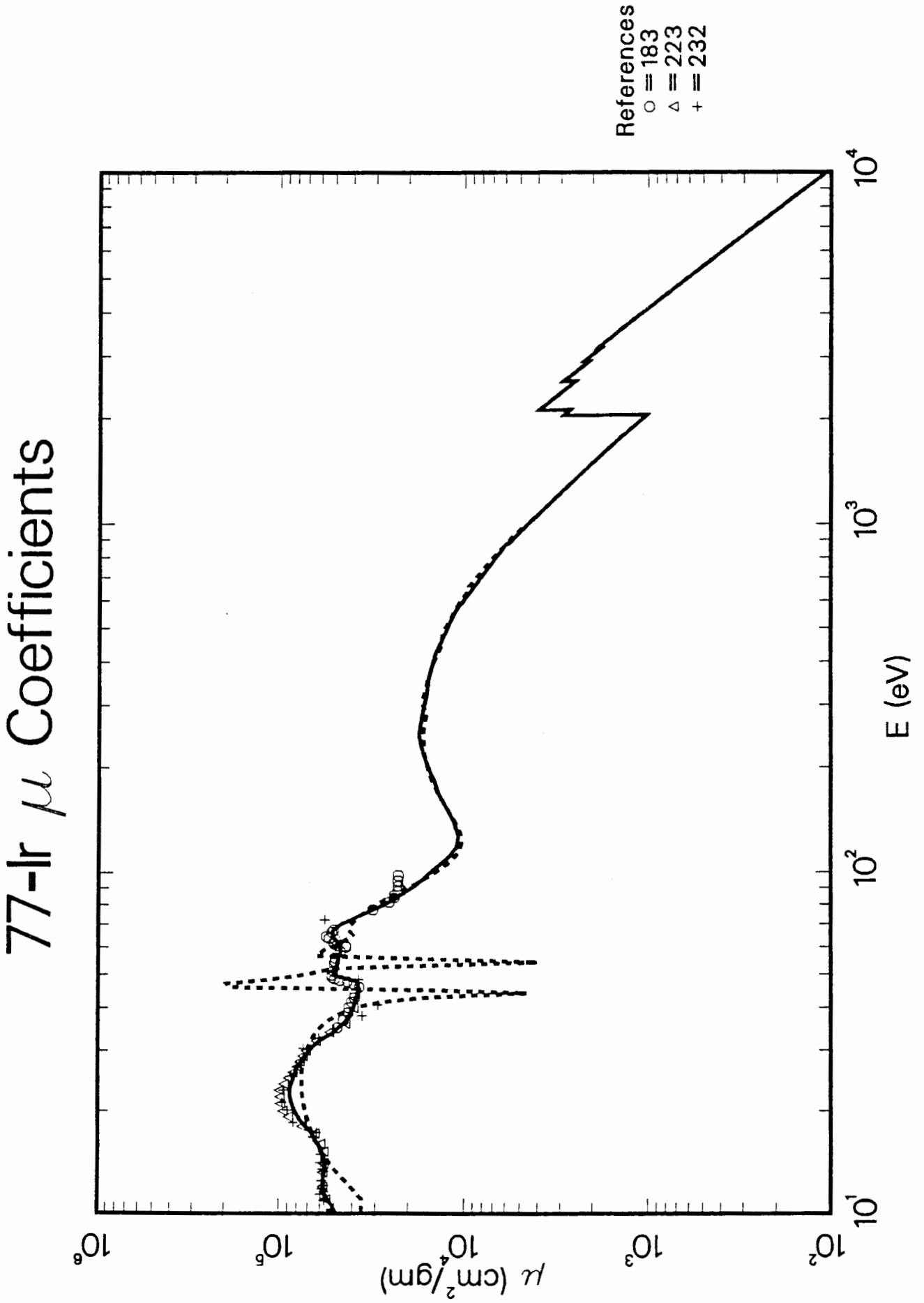
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
1710.0	1.61e+3	13.1	193
1740.0	1.56e+3	13.9	193
1770.0	1.48e+3	12.0	193
1780.0	1.48e+3	12.9	193
1820.0	1.34e+3	7.8	193
1840.0	1.34e+3	10.4	193
1910.0	1.70e+3	51.9	193
1920.0	2.45e+3	121.1	193
1980.0	3.26e+3	68.4	193
2000.0	3.70e+3	26.0	193
2010.0	3.72e+3	27.9	193
2050.0	3.84e+3	-3.0	193
2120.0	3.67e+3	-2.4	193
2160.0	3.48e+3	-3.2	193
2200.0	3.36e+3	-2.3	193
2260.0	3.29e+3	2.0	193
2290.0	3.15e+3	0.9	193
2310.0	3.11e+3	1.6	193
2340.0	3.07e+3	3.5	193
2390.0	3.30e+3	16.7	193
2420.0	3.23e+3	17.7	193
2440.0	3.16e+3	11.8	193
2530.0	2.97e+3	4.2	193
2560.0	2.87e+3	3.5	193
2680.0	2.77e+3	12.4	193
2700.0	2.74e+3	13.0	193
2837.0	2.37e+3	4.2	193
2840.0	2.42e+3	6.4	193
2990.0	2.20e+3	10.1	193
3130.0	1.98e+3	5.8	193
3150.0	1.92e+3	4.3	193
3320.0	1.74e+3	7.1	193
3440.0	1.58e+3	6.0	193
3600.0	1.42e+3	6.5	193
10.2	4.53e+4	7.1	232
10.3	4.42e+4	3.6	232
10.9	4.59e+4	1.1	232
11.4	4.87e+4	1.6	232
11.6	5.02e+4	2.8	232
11.8	5.29e+4	6.6	232
12.1	5.58e+4	9.7	232
12.5	5.41e+4	2.6	232
13.3	5.80e+4	4.4	232
13.5	5.55e+4	-1.0	232
14.1	5.60e+4	-2.9	232
14.9	5.96e+4	-2.5	232
16.7	6.99e+4	2.1	232
16.8	6.94e+4	0.8	232
17.3	7.27e+4	3.2	232
18.5	7.93e+4	6.1	232

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
20.1	8.02e+4	1.5	232
21.2	8.66e+4	7.1	232
23.0	8.16e+4	0.9	232
25.3	7.84e+4	1.7	232
26.9	6.88e+4	-3.5	232
27.7	6.40e+4	-6.5	232
30.5	5.02e+4	-13.5	232
32.7	5.01e+4	1.4	232
34.8	3.49e+4	-17.8	232
37.9	3.36e+4	11.1	232
40.8	2.05e+4	-0.1	232
48.4	5.01e+4	14.4	232
51.0	5.10e+4	-14.4	232
72.3	3.60e+4	5.8	232
91.5	1.33e+4	-26.5	232

Atomic Scattering Factors, f_1+if_2
77 - Iridium (Ir)






77-Ir μ Coefficients
References
○ = 183
△ = 223
+ = 232
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10²
10³
10⁴
10⁵
10⁶

Iridium (Ir) — 77

Atomic Weight = 192.22

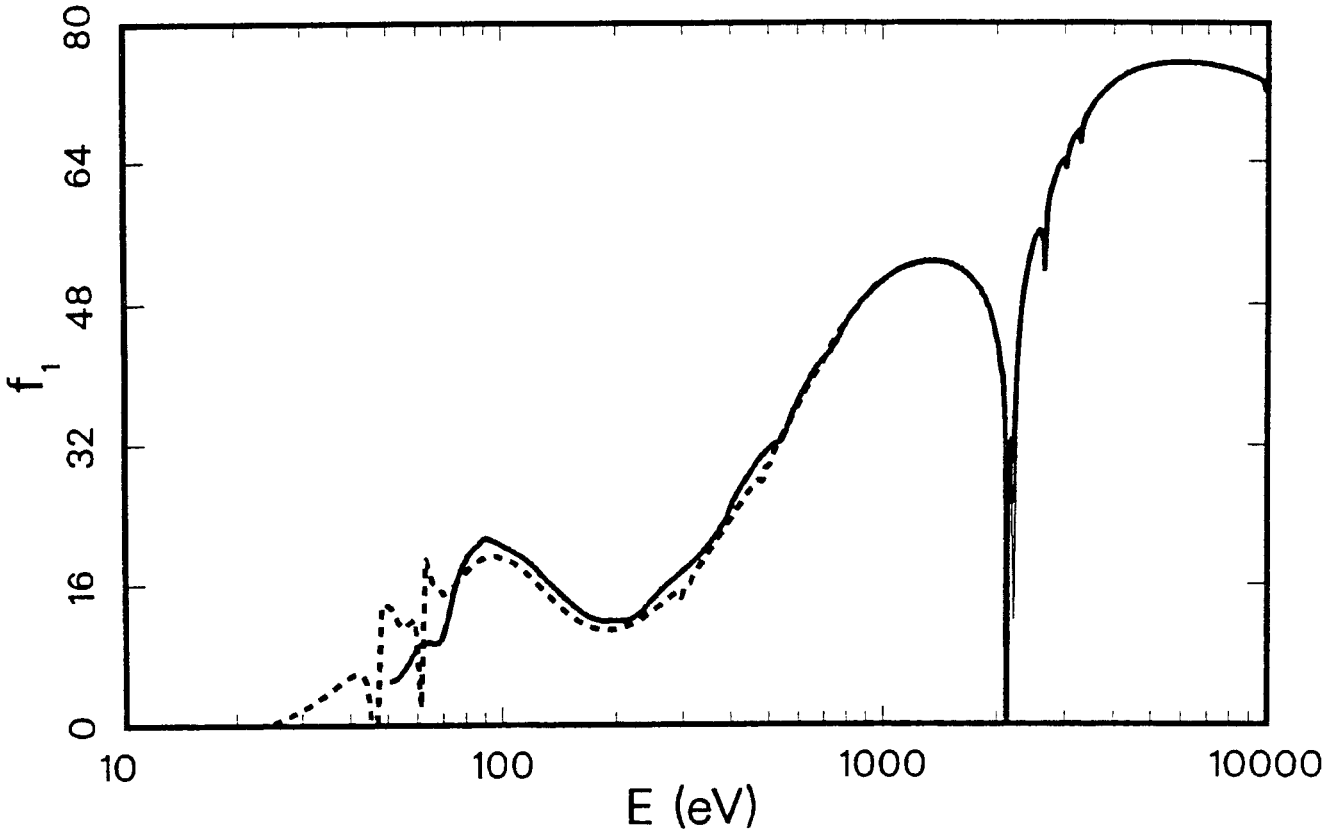
μ (barns/atom) = $\mu(cm^2/g) \times 319.19$

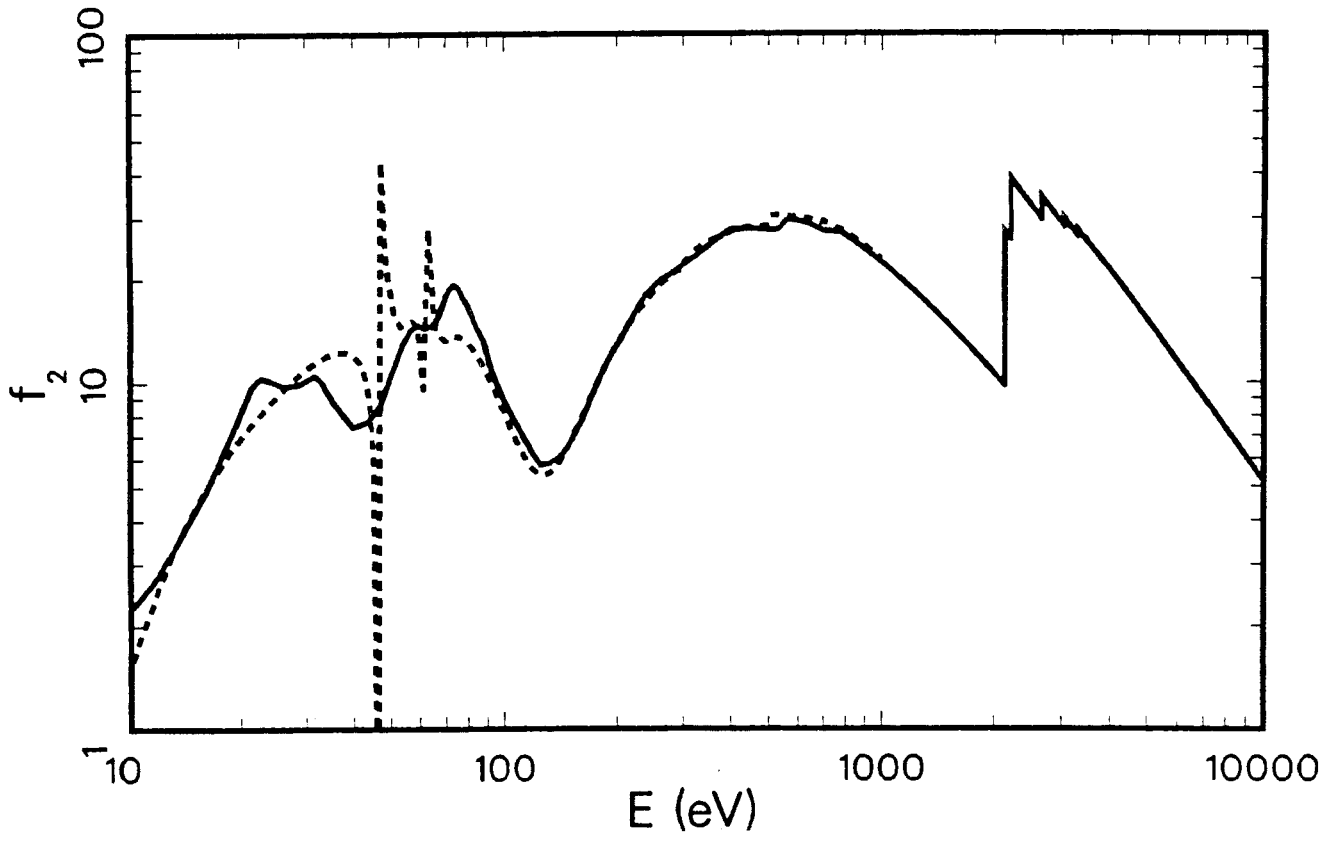
$E\mu(E) = 218.9\, f_2$ keV cm^2/g

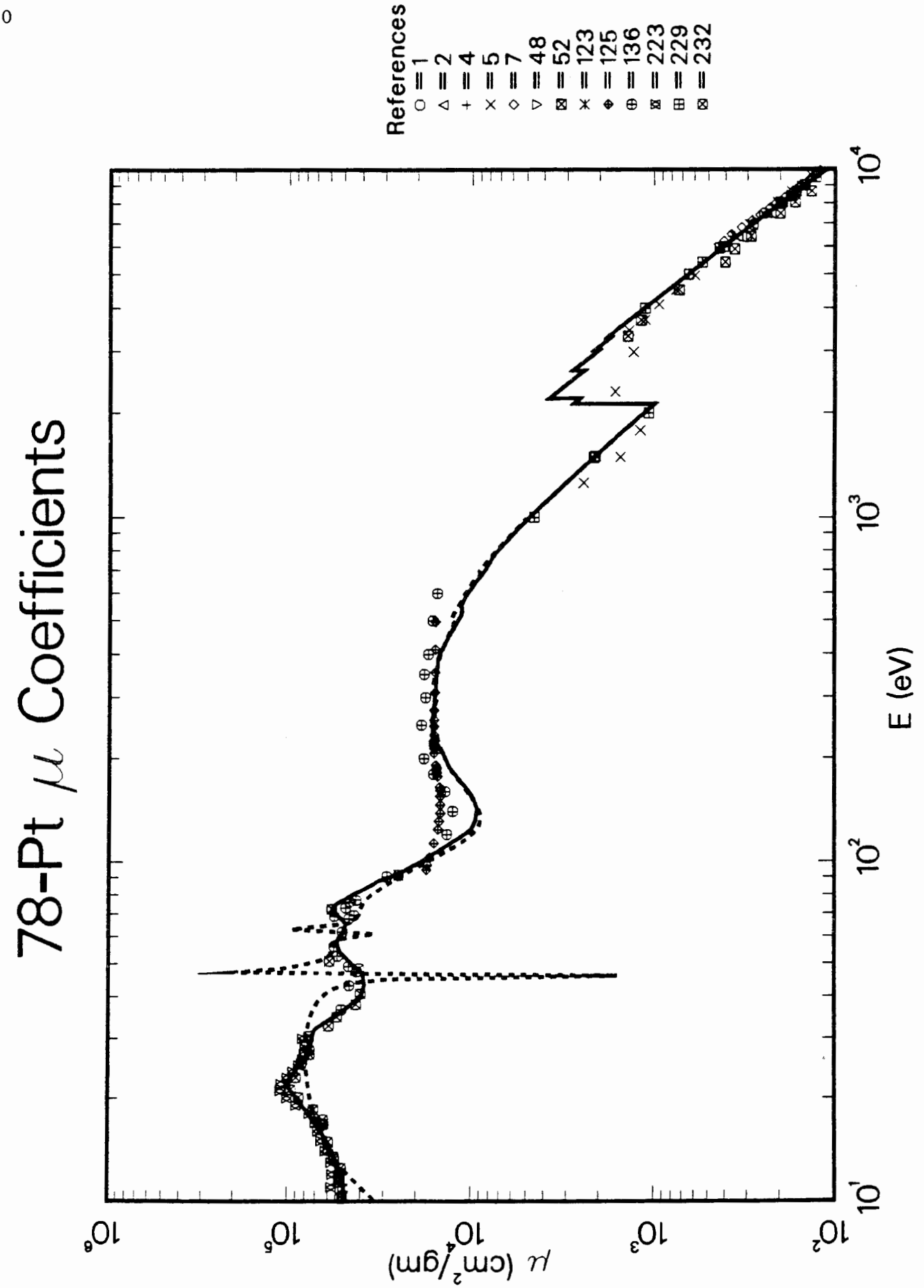
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
35.0	4.86e+4	1.4	183
36.8	4.49e+4	3.1	183
38.7	4.22e+4	3.0	183
40.1	4.20e+4	6.2	183
41.7	4.06e+4	4.6	183
42.8	3.90e+4	2.0	183
43.7	3.89e+4	2.6	183
45.9	3.68e+4	-1.8	183
47.0	3.93e+4	4.7	183
47.7	4.28e+4	13.7	183
48.2	4.71e+4	17.1	183
48.6	5.04e+4	18.1	183
49.2	5.21e+4	11.6	183
49.9	5.23e+4	3.0	183
51.3	5.12e+4	2.4	183
54.0	5.07e+4	4.0	183
54.8	5.02e+4	3.9	183
56.0	5.00e+4	4.6	183
58.5	4.69e+4	0.1	183
60.2	4.36e+4	-7.6	183
60.6	4.39e+4	-7.4	183
60.8	4.85e+4	2.1	183
61.4	5.06e+4	5.7	183
62.0	5.11e+4	5.8	183
63.4	4.99e+4	-0.2	183
63.9	5.40e+4	6.7	183
64.6	5.58e+4	8.2	183
66.6	5.22e+4	0.8	183
67.6	5.09e+4	-0.8	183
77.5	3.12e+4	-0.1	183
81.5	2.55e+4	0.2	183
84.0	2.39e+4	2.3	183
85.5	2.39e+4	7.3	183
88.0	2.29e+4	11.0	183
91.3	2.27e+4	21.9	183
94.6	2.28e+4	32.5	183
98.1	2.27e+4	42.6	183
11.0	5.60e+4	2.5	223
12.0	5.84e+4	1.0	223
13.2	5.83e+4	1.9	223
14.0	5.74e+4	1.6	223
15.2	5.75e+4	-2.2	223
16.0	5.98e+4	-2.7	223
17.2	6.43e+4	-4.1	223
18.0	7.54e+4	5.1	223
19.2	8.91e+4	13.3	223
20.0	9.55e+4	16.3	223
21.0	9.84e+4	15.8	223
22.0	9.91e+4	14.4	223
23.0	9.95e+4	14.0	223

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
24.0	9.41e+4	10.1	223
25.0	8.90e+4	6.6	223
26.0	8.43e+4	3.4	223
27.0	8.03e+4	1.0	223
28.0	7.69e+4	1.3	223
29.0	7.45e+4	2.4	223
30.0	7.16e+4	3.5	223
32.0	6.34e+4	3.7	223
34.0	5.36e+4	5.1	223
36.0	4.38e+4	-2.9	223
40.0	3.96e+4	0.0	223
10.2	5.19e+4	4.0	232
10.3	5.21e+4	3.2	232
10.9	5.71e+4	5.7	232
11.4	5.97e+4	5.0	232
11.6	5.71e+4	-0.1	232
11.8	5.86e+4	2.0	232
12.1	5.72e+4	-1.4	232
12.5	5.87e+4	1.6	232
13.3	5.70e+4	-0.2	232
13.5	5.79e+4	1.8	232
14.1	5.94e+4	4.8	232
14.9	5.92e+4	1.9	232
16.7	6.43e+4	-0.7	232
16.8	6.56e+4	0.7	232
17.3	6.26e+4	-7.4	232
18.5	8.32e+4	10.9	232
20.1	8.94e+4	8.2	232
21.2	9.55e+4	11.7	232
23.0	9.44e+4	8.2	232
25.3	8.59e+4	3.6	232
26.9	8.03e+4	0.5	232
27.7	7.65e+4	-0.7	232
30.5	7.35e+4	9.6	232
32.7	6.08e+4	5.8	232
34.8	5.06e+4	4.2	232
37.9	3.55e+4	-15.5	232
40.8	2.92e+4	-25.5	232
48.4	3.70e+4	-10.6	232
51.0	5.19e+4	3.5	232
72.3	5.70e+4	37.6	232
91.5	2.19e+4	18.3	232

Atomic Scattering Factors, f_1+if_2
78 - Platinum (Pt)






78-Pt μ Coefficients
References
○ = 1
△ = 2
+ = 4
× = 5
◇ = 7
▽ = 48
⊠ = 52
✳ = 123
◆ = 125
⊕ = 136
⊠ = 223
⊞ = 229
⊠ = 232
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

Platinum (Pt) — 78

Atomic Weight = 195.09

μ (barns/atom) = $\mu(cm^2/g) \times 323.96$

$E\mu(E) = 215.7\, f_2$ keV cm^2/g

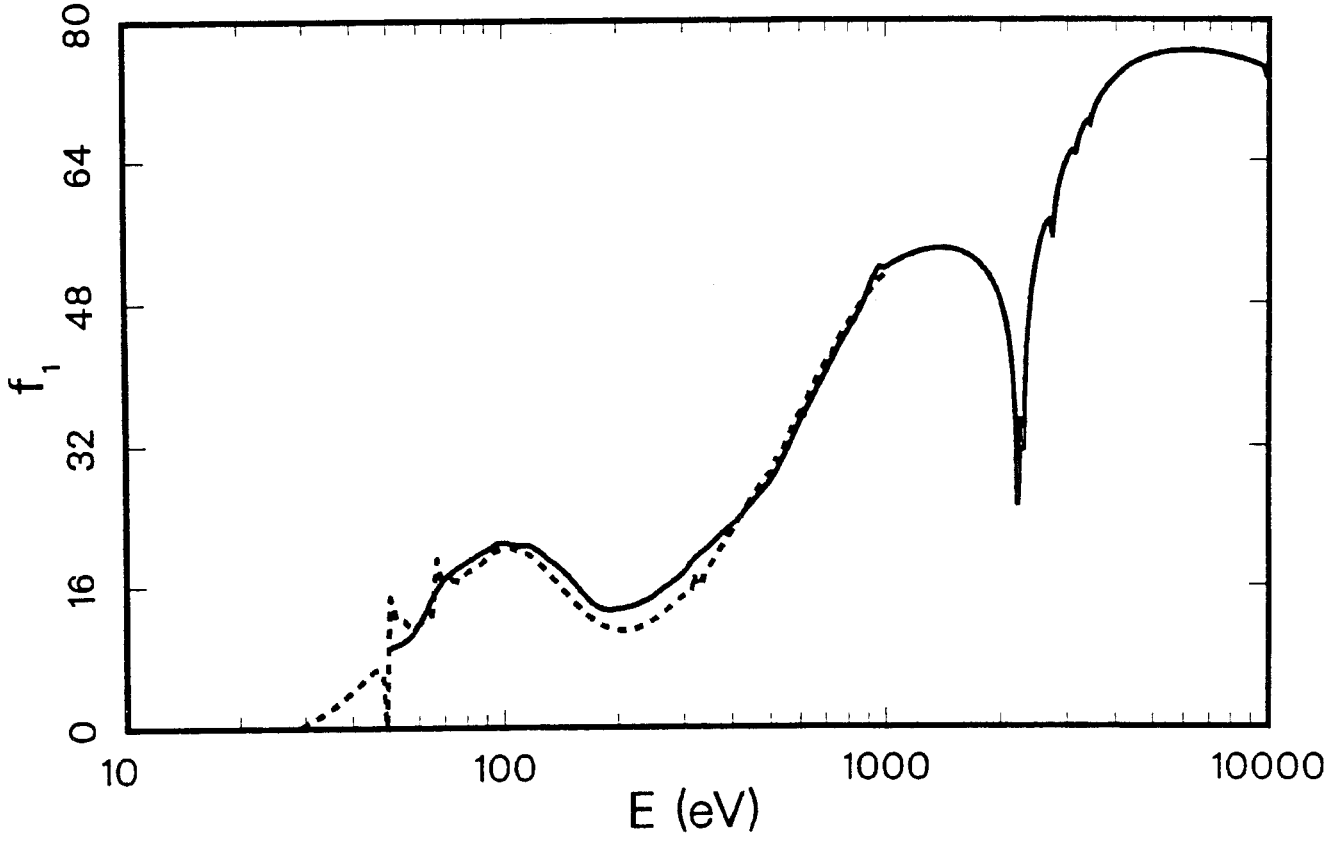
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6400.0	3.03e+2	-12.9	1
6930.0	2.78e+2	-2.1	1
7470.0	2.43e+2	3.4	1
8040.0	1.99e+2	2.3	1
8630.0	1.65e+2	1.9	1
6400.0	3.40e+2	-2.4	2
6930.0	2.81e+2	-1.2	2
7480.0	2.36e+2	0.9	2
8050.0	1.94e+2	0.1	2
8640.0	1.62e+2	0.5	2
6410.0	3.65e+2	5.2	4
7040.0	2.80e+2	2.5	4
8070.0	1.99e+2	3.3	4
8660.0	1.71e+2	6.4	4
8930.0	1.55e+2	4.4	4
9590.0	1.31e+2	6.0	4
1256.0	2.44e+3	-20.0	5
1490.0	1.53e+3	-28.5	5
1780.0	1.19e+3	-18.7	5
2300.0	1.64e+3	-51.7	5
2990.0	1.29e+3	-37.6	5
3450.0	1.37e+3	-15.3	5
3700.0	1.12e+3	-18.1	5
4100.0	9.39e+2	-11.7	5
4520.0	7.56e+2	-9.6	5
4960.0	5.96e+2	-10.1	5
6410.0	3.51e+2	1.1	5
6940.0	2.91e+2	2.7	5
7480.0	2.28e+2	-2.6	5
8050.0	2.06e+2	6.3	5
8650.0	1.73e+2	7.3	5
8920.0	1.52e+2	2.1	5
9590.0	1.35e+2	9.3	5
6210.0	4.07e+2	8.3	7
6510.0	3.70e+2	10.9	7
6810.0	3.25e+2	9.3	7
7130.0	2.83e+2	7.0	7
7400.0	2.55e+2	6.1	7
7750.0	2.26e+2	5.7	7
7910.0	2.14e+2	5.7	7
7990.0	2.10e+2	6.2	7
8060.0	1.96e+2	1.6	7
8290.0	1.89e+2	5.3	7
8380.0	1.71e+2	-2.4	7
8580.0	1.71e+2	3.7	7
8920.0	1.57e+2	5.4	7
9320.0	1.38e+2	3.8	7
9720.0	1.23e+2	3.3	7
8047.0	1.98e+2	2.3	48
8904.0	1.51e+2	1.1	48

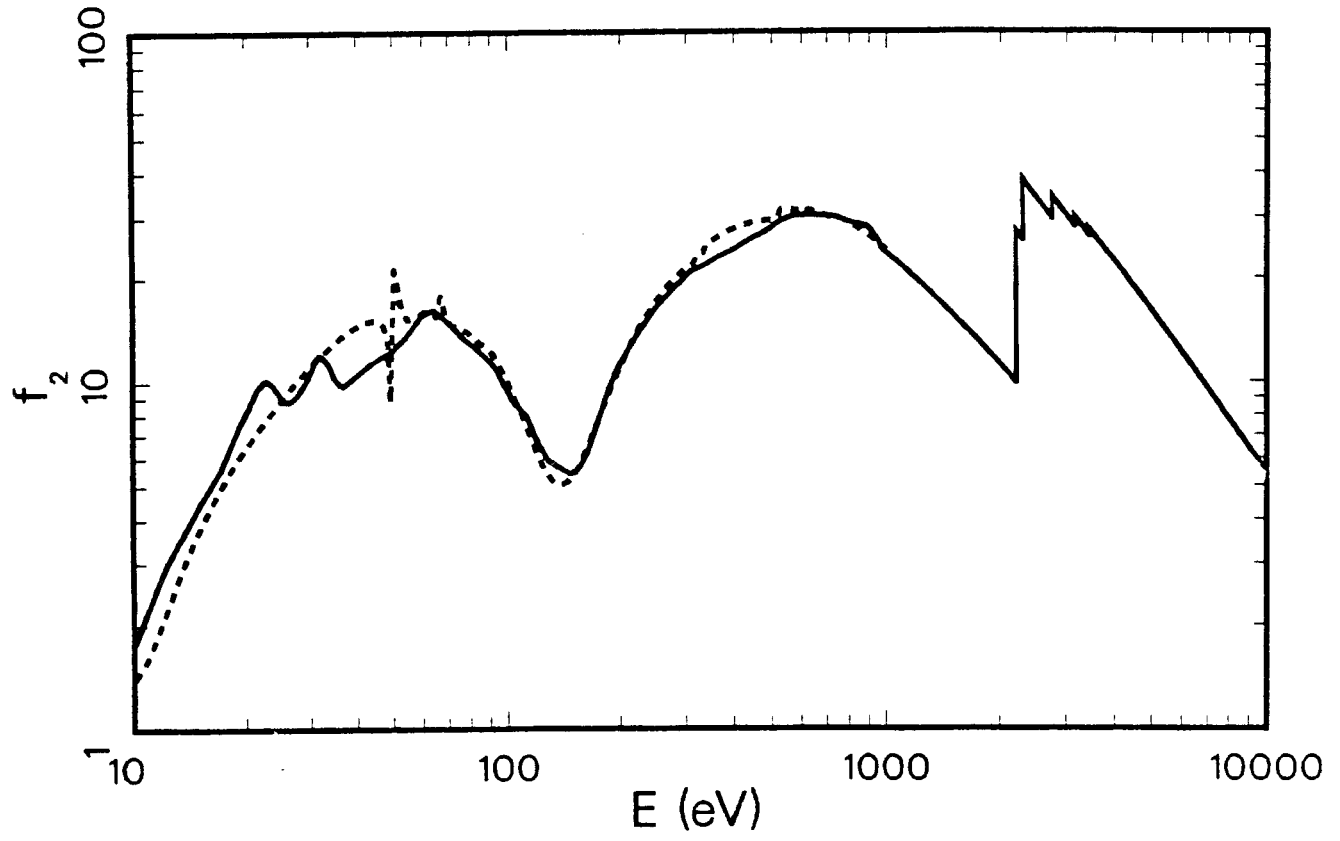
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
9885.0	1.15e+2	0.9	48
3318.0	1.39e+3	-21.9	52
3697.0	1.18e+3	-14.0	52
4516.0	7.27e+2	-13.2	52
5420.0	4.00e+2	-24.6	52
5904.0	3.55e+2	-17.0	52
6409.0	2.87e+2	-17.3	52
7484.0	1.99e+2	-14.8	52
8053.0	1.65e+2	-14.6	52
8644.0	1.35e+2	-16.6	52
5898.0	4.39e+2	2.3	123
6404.0	3.54e+2	1.7	123
8040.0	1.95e+2	0.5	123
9023.0	1.46e+2	0.9	123
94.8	1.76e+4	-23.4	125
97.8	1.74e+4	-15.3	125
103.0	1.69e+4	-2.4	125
113.0	1.60e+4	22.3	125
124.0	1.52e+4	51.3	125
131.0	1.50e+4	56.6	125
138.0	1.48e+4	57.2	125
146.0	1.48e+4	56.0	125
155.0	1.48e+4	48.4	125
161.0	1.48e+4	41.9	125
165.0	1.49e+4	38.0	125
177.0	1.53e+4	27.0	125
182.0	1.54e+4	22.8	125
185.0	1.56e+4	21.2	125
188.0	1.55e+4	17.8	125
191.0	1.56e+4	17.0	125
207.0	1.60e+4	11.6	125
214.0	1.60e+4	7.8	125
218.0	1.61e+4	6.3	125
221.0	1.61e+4	4.8	125
225.0	1.61e+4	3.1	125
234.0	1.60e+4	-0.2	125
248.0	1.60e+4	-2.0	125
258.0	1.60e+4	-2.3	125
276.0	1.60e+4	-0.7	125
310.0	1.58e+4	0.2	125
354.0	1.58e+4	2.3	125
413.0	1.58e+4	8.9	125
496.0	1.57e+4	30.4	125
36.6	5.10e+4	3.5	136
43.2	4.62e+4	20.4	136
47.5	4.21e+4	4.7	136
49.2	4.66e+4	7.9	136
52.8	5.35e+4	7.8	136
56.3	5.61e+4	4.6	136
62.0	5.04e+4	0.7	136

E(eV)	μ(cm^2/g)	% Error	Ref.
67.9	4.65e+4	-9.0	136
69.1	5.58e+4	4.8	136
69.4	4.36e+4	-19.0	136
73.0	4.84e+4	-14.3	136
76.1	4.60e+4	-11.9	136
77.1	4.27e+4	-15.0	136
90.6	2.91e+4	4.6	136
120.0	1.36e+4	23.6	136
140.0	1.27e+4	35.0	136
160.0	1.39e+4	34.3	136
180.0	1.61e+4	30.0	136
200.0	1.82e+4	31.3	136
250.0	1.88e+4	15.1	136
300.0	1.79e+4	12.9	136
350.0	1.82e+4	17.7	136
400.0	1.73e+4	15.5	136
500.0	1.64e+4	36.9	136
600.0	1.54e+4	46.6	136
11.0	5.73e+4	16.6	223
12.0	5.68e+4	11.4	223
13.0	5.73e+4	6.4	223
14.0	6.17e+4	7.3	223
15.0	6.47e+4	5.6	223
16.0	6.74e+4	4.0	223
17.0	6.92e+4	-1.4	223
18.0	7.50e+4	-1.2	223
19.0	8.91e+4	8.8	223
20.0	1.00e+5	13.9	223
21.0	1.09e+5	15.0	223
22.0	1.08e+5	10.2	223
23.0	1.00e+5	4.0	223
24.0	9.32e+4	2.5	223
25.0	8.64e+4	0.8	223
26.0	8.25e+4	1.9	223
27.0	8.06e+4	2.9	223
28.0	7.96e+4	4.8	223
29.0	7.97e+4	7.8	223
30.0	8.24e+4	12.9	223
1000.0	4.53e+3	-5.6	229
1486.7	2.15e+3	0.1	229
1500.0	2.11e+3	-0.1	229
2000.0	1.07e+3	-5.6	229
4000.0	1.12e+3	-1.0	229
5000.0	6.45e+2	-0.8	229
5414.7	5.41e+2	1.7	229
5946.7	4.30e+2	2.5	229
6000.0	4.10e+2	-0.1	229
8000.0	1.98e+2	0.4	229
8397.6	1.73e+2	-0.3	229
9000.0	1.46e+2	0.3	229
9500.0	1.27e+2	0.4	229
9961.5	1.13e+2	1.0	229
10000.0	1.11e+2	0.4	229
10.2	4.98e+4	2.7	232
10.3	5.09e+4	4.9	232

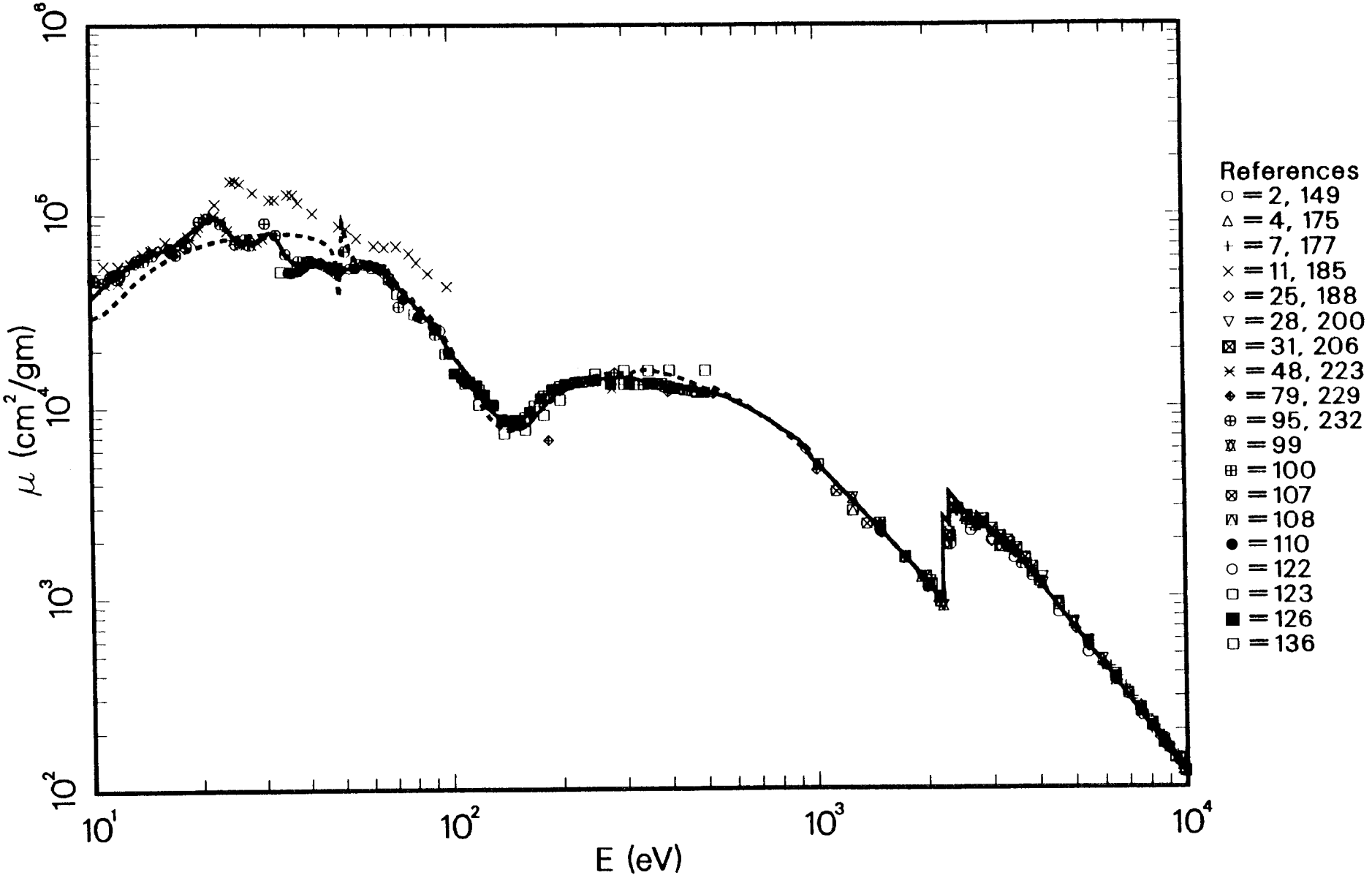
E(eV)	μ(cm^2/g)	% Error	Ref.
10.9	4.91e+4	0.2	232
11.4	5.18e+4	4.5	232
11.6	5.14e+4	3.0	232
11.8	5.18e+4	2.7	232
12.1	5.14e+4	0.2	232
12.5	5.08e+4	-3.1	232
13.3	5.50e+4	0.4	232
13.5	5.54e+4	-0.3	232
14.1	5.92e+4	2.3	232
14.9	5.95e+4	-2.1	232
16.7	6.40e+4	-6.6	232
16.8	6.28e+4	-9.1	232
17.3	6.33e+4	-12.1	232
18.5	7.12e+4	-9.8	232
20.1	8.63e+4	-2.9	232
21.2	9.57e+4	-0.9	232
23.0	8.94e+4	-7.2	232
25.3	8.40e+4	-0.4	232
26.9	7.55e+4	-3.9	232
27.7	7.53e+4	-1.7	232
30.5	7.62e+4	5.0	232
32.7	5.96e+4	-10.9	232
34.8	5.38e+4	-3.9	232
37.9	4.24e+4	-6.6	232
40.8	4.02e+4	1.5	232
48.4	4.08e+4	-2.4	232
51.0	5.92e+4	27.5	232
72.3	5.76e+4	1.8	232
91.5	2.50e+4	-5.4	232

Atomic Scattering Factors, f_1+if_2
79 - Gold (Au)





79-Au μ Coefficients



Gold (Au) — 79

Atomic Weight = 196.97

μ (barns/atom) = $\mu(cm^2/g) \times 327.08$

$E\mu(E) = 213.6\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5410.0	5.07e+2	-9.6	2
6400.0	3.67e+2	0.3	2
6930.0	3.06e+2	2.5	2
7480.0	2.53e+2	3.1	2
8050.0	2.10e+2	3.3	2
8640.0	1.78e+2	5.1	2
7490.0	2.65e+2	8.4	4
8070.0	2.10e+2	4.0	4
8660.0	1.79e+2	6.2	4
9590.0	1.37e+2	5.7	4
6210.0	4.27e+2	8.0	7
6510.0	3.78e+2	7.8	7
6810.0	3.37e+2	8.1	7
7130.0	2.94e+2	6.1	7
7470.0	2.65e+2	7.6	7
7820.0	2.35e+2	7.6	7
8190.0	2.08e+2	7.2	7
8380.0	1.95e+2	6.6	7
8580.0	1.85e+2	7.2	7
8980.0	1.65e+2	7.4	7
9410.0	1.47e+2	8.1	7
9850.0	1.27e+2	5.0	7
277.0	1.25e+4	-12.3	11
5423.0	5.41e+2	-2.9	25
6479.0	3.57e+2	0.6	25
7487.0	2.35e+2	-4.0	25
8650.0	1.67e+2	-1.2	25
1487.0	2.45e+3	8.7	28
2042.0	1.21e+3	6.4	28
2395.0	2.91e+3	-8.5	28
2622.0	2.55e+3	-0.4	28
2821.0	2.45e+3	-1.2	28
2984.0	1.91e+3	-11.8	28
3151.0	2.05e+3	1.5	28
3691.0	1.47e+3	2.2	28
4090.0	1.25e+3	11.3	28
4510.0	9.25e+2	4.6	28
4952.0	7.20e+2	2.8	28
5414.0	5.85e+2	4.5	28
6403.0	3.87e+2	5.9	28
7477.0	2.59e+2	5.4	28
8047.0	2.16e+2	6.2	28
8650.0	1.69e+2	-0.2	31
9273.0	1.41e+2	0.0	31
9500.0	1.42e+2	6.8	31
9894.0	1.20e+2	0.1	31
10000.0	1.22e+2	4.8	31
8904.0	1.60e+2	1.9	48
9885.0	1.22e+2	1.5	48
109.7	1.35e+4	-14.7	79

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
185.0	6.74e+3	-37.3	79
282.0	1.52e+4	6.6	79
395.0	1.20e+4	-7.6	79
525.0	1.17e+4	-1.0	79
8048.0	2.06e+2	1.3	95
8048.0	2.06e+2	1.3	95
8904.0	1.60e+2	1.9	95
9885.0	1.22e+2	1.5	95
10000.0	1.26e+2	8.2	95
1254.0	3.33e+3	4.0	99
1487.0	2.30e+3	2.1	99
1739.0	1.61e+3	-0.1	99
1922.0	1.26e+3	-2.6	99
2136.0	9.89e+2	-3.9	99
2166.0	9.46e+2	-5.1	99
2205.0	8.93e+2	-45.9	99
2257.0	1.86e+3	-25.5	99
2293.0	2.05e+3	-31.0	99
2422.0	2.91e+3	-6.0	99
2526.0	2.61e+3	-6.8	99
2558.0	2.52e+3	-7.2	99
2697.0	2.33e+3	-2.7	99
2838.0	2.39e+3	-2.2	99
2985.0	2.15e+3	-0.7	99
3134.0	1.81e+3	-9.4	99
3151.0	1.97e+3	-2.6	99
3171.0	1.96e+3	-1.3	99
3337.0	1.82e+3	3.5	99
3444.0	1.73e+3	2.8	99
3605.0	1.56e+3	2.7	99
3843.0	1.33e+3	2.2	99
4089.0	1.16e+3	3.2	99
4510.0	9.30e+2	5.2	99
4949.0	7.36e+2	4.9	99
5414.0	5.80e+2	3.7	99
5898.0	4.65e+2	3.2	99
6404.0	3.76e+2	3.0	99
6930.0	3.08e+2	3.2	99
7478.0	2.54e+2	3.4	99
8040.0	2.10e+2	3.0	99
8640.0	1.76e+2	3.8	99
9710.0	1.29e+2	2.9	99
105.0	1.51e+4	-13.3	100
110.0	1.41e+4	-10.2	100
120.0	1.25e+4	6.2	100
130.0	1.04e+4	8.7	100
140.0	8.53e+3	0.9	100
145.0	8.50e+3	6.2	100
150.0	8.59e+3	10.4	100
155.0	8.59e+3	10.4	100

Gold (Au) — 79

E(eV)	μ(cm^2/g)	% Error	Ref.
160.0	8.90e+3	11.1	100
170.0	1.02e+4	14.4	100
180.0	1.16e+4	13.5	100
190.0	1.24e+4	10.3	100
200.0	1.29e+4	7.1	100
210.0	1.32e+4	5.0	100
220.0	1.35e+4	3.4	100
230.0	1.36e+4	1.4	100
240.0	1.38e+4	0.0	100
250.0	1.39e+4	-1.5	100
300.0	1.32e+4	-8.2	100
310.0	1.32e+4	-8.2	100
320.0	1.32e+4	-6.9	100
330.0	1.32e+4	-5.3	100
340.0	1.32e+4	-3.9	100
350.0	1.34e+4	-2.2	100
360.0	1.33e+4	-2.0	100
370.0	1.31e+4	-1.8	100
380.0	1.33e+4	0.8	100
390.0	1.29e+4	-1.3	100
400.0	1.27e+4	-1.6	100
420.0	1.25e+4	-2.2	100
440.0	1.23e+4	-2.4	100
460.0	1.21e+4	-1.6	100
475.0	1.20e+4	-1.4	100
1130.0	3.61e+3	-8.6	107
1370.0	2.42e+3	-9.5	107
1012.0	4.98e+3	1.3	108
1254.0	2.85e+3	-11.0	108
1487.0	2.43e+3	8.0	108
35.5	5.10e+4	-15.6	110
36.3	5.05e+4	-12.5	110
37.9	5.17e+4	-8.4	110
39.4	5.43e+4	-3.4	110
41.5	5.69e+4	1.6	110
43.7	5.70e+4	2.7	110
46.4	5.45e+4	0.5	110
49.6	5.21e+4	-1.8	110
54.8	5.33e+4	-0.9	110
59.6	5.51e+4	-1.1	110
64.1	5.31e+4	-1.2	110
69.2	4.55e+4	-2.1	110
74.9	3.70e+4	-5.5	110
82.2	2.99e+4	-8.4	110
91.8	2.59e+4	-0.3	110
99.8	1.91e+4	-5.1	110
35.7	5.11e+4	-14.5	122
38.5	5.27e+4	-6.5	122
39.4	5.52e+4	-1.8	122
40.5	5.70e+4	1.5	122
41.7	5.73e+4	2.3	122
43.7	5.65e+4	1.8	122
44.9	5.51e+4	0.2	122
46.4	5.35e+4	-1.5	122
48.0	5.26e+4	-2.1	122

E(eV)	μ(cm^2/g)	% Error	Ref.
49.9	5.24e+4	-1.2	122
52.7	5.32e+4	-0.1	122
54.4	5.48e+4	2.1	122
57.7	5.57e+4	1.1	122
60.3	5.53e+4	-0.2	122
62.6	5.42e+4	-0.9	122
64.4	5.25e+4	-1.5	122
65.9	5.06e+4	-0.9	122
68.2	4.76e+4	-0.5	122
70.5	4.36e+4	-2.6	122
74.3	3.84e+4	-3.6	122
84.0	2.96e+4	-5.5	122
90.6	2.65e+4	-0.5	122
94.3	2.53e+4	5.5	122
99.5	1.97e+4	-2.8	122
1487.0	2.33e+3	3.4	123
1740.0	1.60e+3	-1.2	123
2014.0	1.13e+3	-3.8	123
2166.0	9.36e+2	-6.1	123
2257.0	1.87e+3	-24.9	123
2308.0	2.07e+3	-40.3	123
2622.0	2.42e+3	-5.4	123
2816.0	2.42e+3	-2.7	123
3314.0	1.80e+3	0.8	123
3692.0	1.47e+3	2.3	123
4012.0	1.19e+3	1.3	123
4512.0	8.99e+2	1.8	123
6404.0	3.77e+2	3.3	123
8040.0	2.09e+2	2.4	123
8640.0	1.75e+2	3.0	123
103.0	1.51e+4	-17.0	126
108.0	1.45e+4	-11.4	126
113.0	1.38e+4	-5.7	126
118.0	1.31e+4	4.6	126
124.0	1.18e+4	10.3	126
131.0	1.03e+4	9.2	126
138.0	8.71e+3	0.7	126
146.0	8.50e+3	7.4	126
155.0	8.59e+3	10.4	126
165.0	9.51e+3	14.0	126
177.0	1.12e+4	14.2	126
191.0	1.25e+4	9.8	126
207.0	1.32e+4	6.1	126
225.0	1.36e+4	2.4	126
248.0	1.39e+4	-0.6	126
276.0	1.32e+4	-7.3	126
310.0	1.33e+4	-7.6	126
354.0	1.34e+4	-1.6	126
413.0	1.26e+4	-2.0	126
496.0	1.20e+4	-0.3	126
33.8	5.13e+4	-27.1	136
37.7	5.35e+4	-5.2	136
40.1	5.75e+4	2.4	136
48.0	5.29e+4	-1.5	136
55.2	5.60e+4	3.7	136

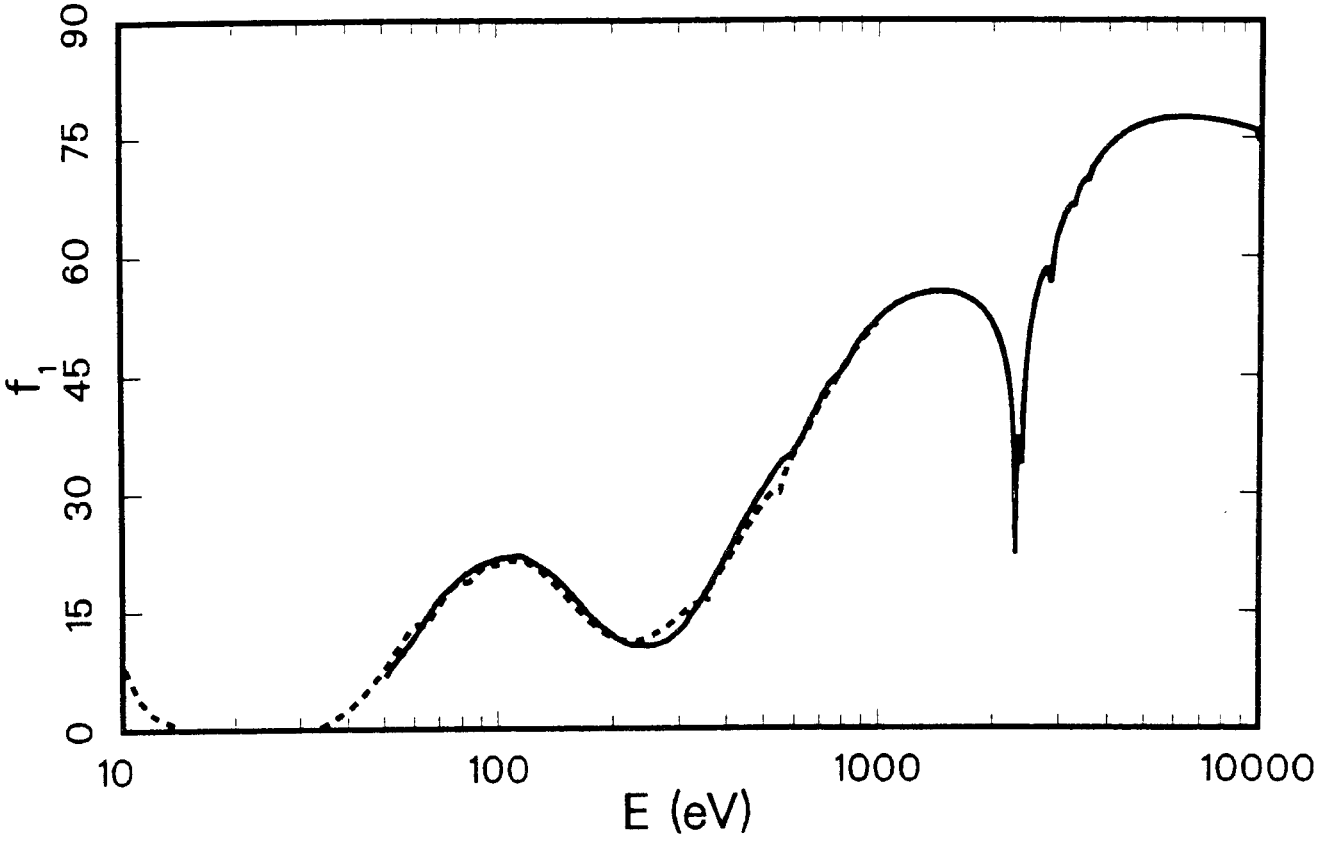
Gold (Au) — 79

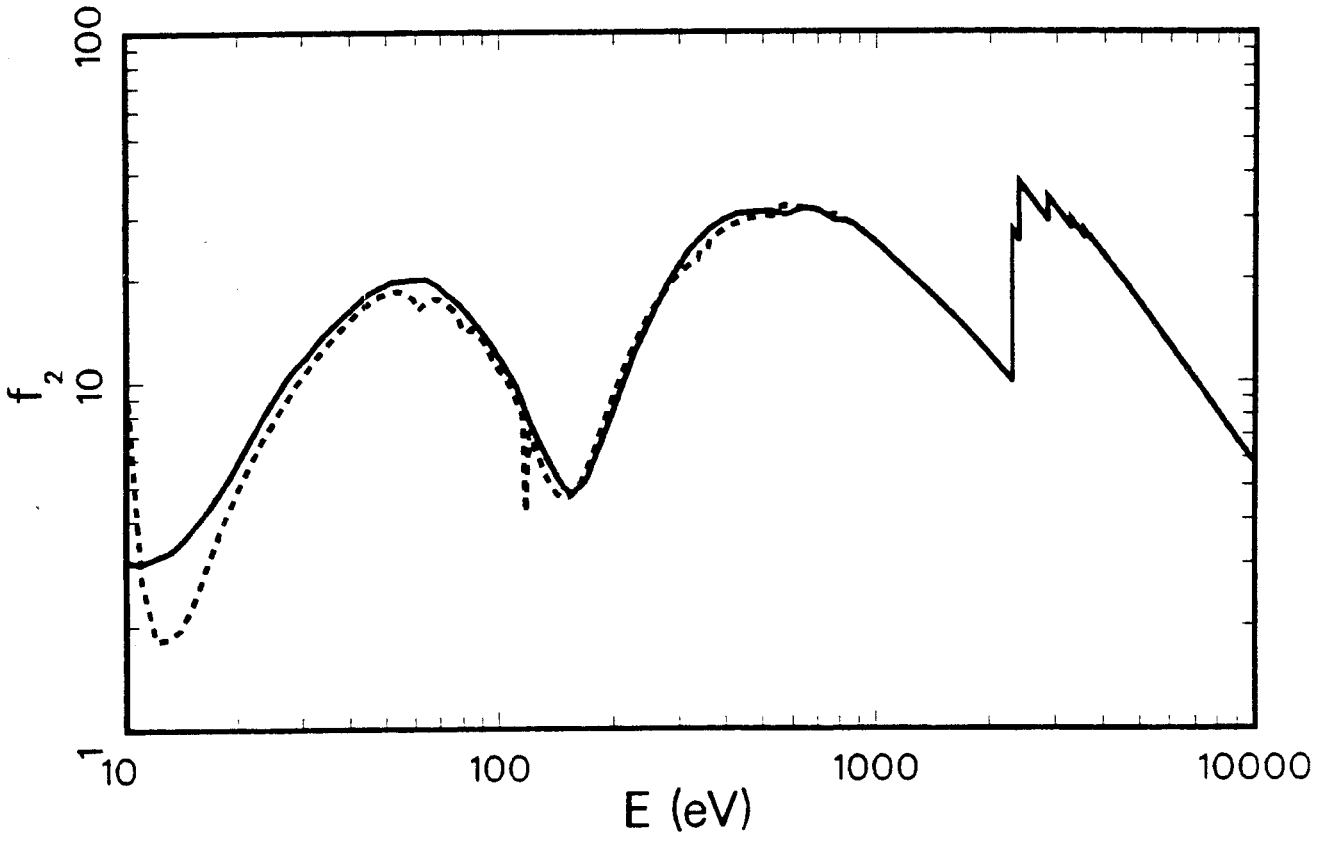
E(eV)	μ(cm^2/g)	% Error	Ref.
61.4	5.37e+4	-2.5	136
68.1	4.68e+4	-2.4	136
71.7	3.95e+4	-8.4	136
80.0	3.08e+4	-10.3	136
91.7	2.57e+4	-1.0	136
97.5	1.93e+4	-10.9	136
110.0	1.35e+4	-14.3	136
120.0	1.04e+4	-11.7	136
140.0	7.34e+3	-13.2	136
160.0	7.64e+3	-4.6	136
180.0	9.17e+3	-9.9	136
200.0	1.10e+4	-8.6	136
250.0	1.50e+4	6.5	136
300.0	1.56e+4	8.4	136
350.0	1.56e+4	14.1	136
400.0	1.56e+4	20.3	136
500.0	1.56e+4	29.9	136
1490.0	2.22e+3	-1.0	149
1740.0	1.59e+3	-1.5	149
2010.0	1.16e+3	-1.7	149
2310.0	1.88e+3	-45.6	149
2620.0	2.22e+3	-13.4	149
2990.0	1.97e+3	-8.5	149
3150.0	1.82e+3	-9.9	149
3440.0	1.59e+3	-5.8	149
3600.0	1.47e+3	-3.8	149
3840.0	1.28e+3	-2.5	149
4510.0	8.29e+2	-6.2	149
5410.0	5.73e+2	2.2	149
6400.0	3.60e+2	-1.6	175
7472.0	2.48e+2	0.8	175
8041.0	2.08e+2	2.0	175
9713.0	1.22e+2	-2.8	175
3300.0	1.76e+3	-2.6	177
4800.0	7.83e+2	3.4	177
5900.0	4.27e+2	-5.0	177
6400.0	3.67e+2	0.4	177
7100.0	2.85e+2	1.6	177
8000.0	1.99e+2	-3.6	177
8900.0	1.57e+2	-0.2	177
10.9	5.48e+4	27.4	185
12.0	5.46e+4	8.7	185
14.8	6.55e+4	5.3	185
16.2	7.25e+4	8.7	185
18.7	7.69e+4	-3.4	185
19.8	8.22e+4	-4.8	185
22.2	1.14e+5	18.6	185
24.5	1.50e+5	86.7	185
25.2	1.51e+5	103.3	185
26.0	1.47e+5	102.7	185
28.2	1.31e+5	83.0	185
31.4	1.20e+5	47.9	185
32.5	1.21e+5	56.0	185
35.2	1.29e+5	109.5	185
36.5	1.28e+5	124.1	185

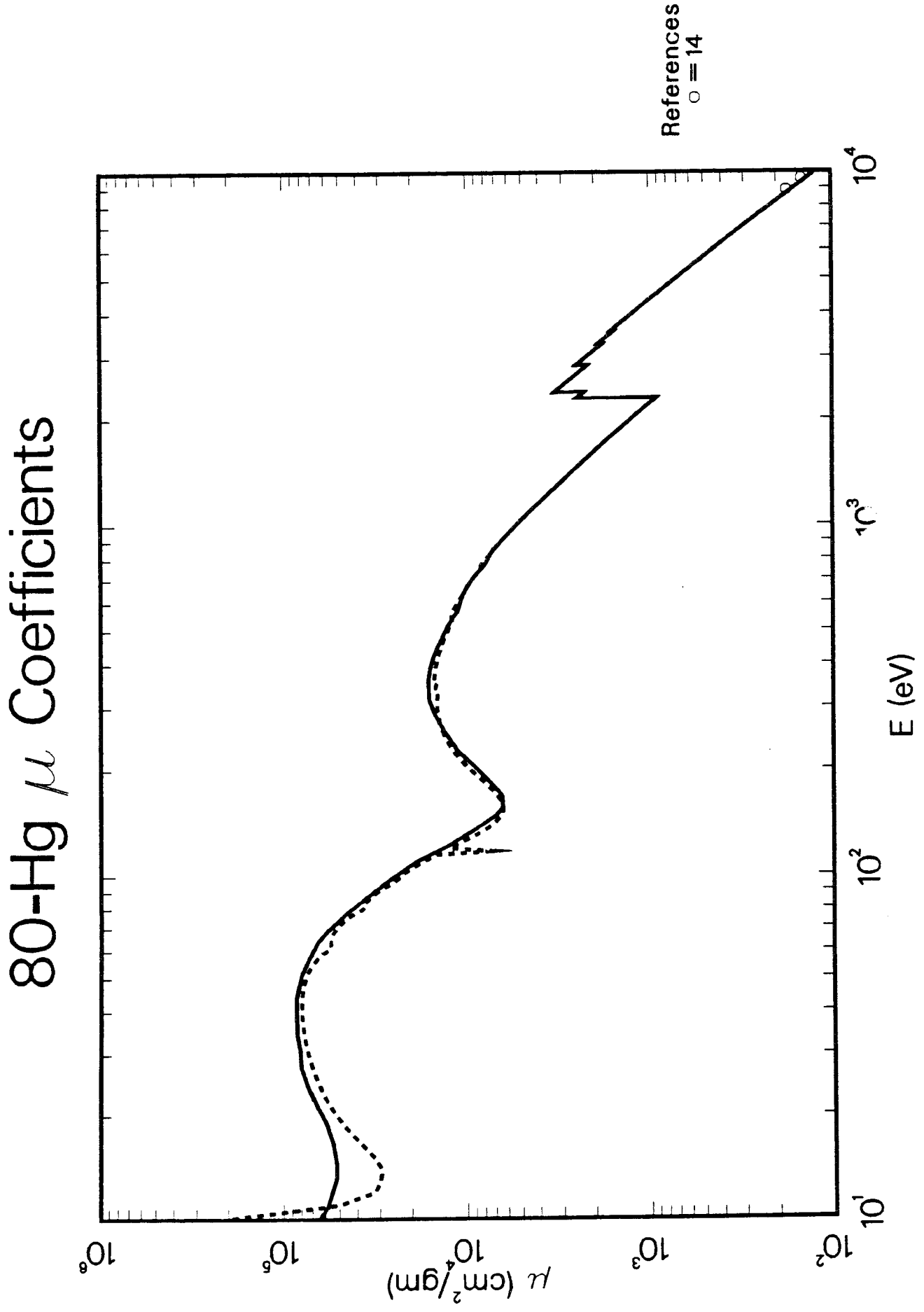
E(eV)	μ(cm^2/g)	% Error	Ref.
37.8	1.16e+5	105.9	185
41.5	1.02e+5	82.7	185
49.3	8.75e+4	64.5	185
51.6	8.51e+4	59.9	185
55.1	7.57e+4	40.3	185
61.7	6.93e+4	26.0	185
66.0	6.83e+4	34.0	185
71.4	6.88e+4	58.1	185
77.4	6.33e+4	73.0	185
81.5	5.71e+4	71.9	185
87.6	5.00e+4	74.5	185
98.7	4.27e+4	105.2	185
934.0	5.96e+3	-0.8	188
277.0	1.38e+4	-3.2	200
1980.0	1.27e+3	4.8	206
2050.0	1.17e+3	3.5	206
2160.0	1.01e+3	0.5	206
2260.0	2.06e+3	-17.0	206
2288.0	2.17e+3	-22.4	206
2340.0	2.79e+3	-17.0	206
2420.0	2.89e+3	-6.9	206
2560.0	2.68e+3	-1.3	206
2840.0	2.55e+3	4.5	206
2995.0	2.27e+3	5.7	206
3150.0	2.07e+3	2.4	206
3290.0	1.96e+3	7.9	206
3330.0	1.90e+3	7.5	206
3480.0	1.79e+3	8.1	206
3670.0	1.59e+3	9.0	206
3840.0	1.42e+3	8.6	206
10.0	4.20e+4	13.3	223
11.0	4.39e+4	0.5	223
12.0	4.47e+4	-10.9	223
13.0	5.60e+4	2.2	223
14.0	6.32e+4	7.6	223
15.0	6.62e+4	5.1	223
16.0	6.64e+4	0.5	223
17.0	6.79e+4	-1.9	223
18.0	7.00e+4	-7.1	223
19.0	7.48e+4	-8.2	223
20.0	8.72e+4	-0.2	223
21.0	9.71e+4	4.6	223
22.0	9.94e+4	3.5	223
23.0	9.30e+4	-0.1	223
24.0	8.32e+4	-2.1	223
25.0	7.48e+4	-1.4	223
26.0	7.10e+4	-1.8	223
27.0	7.09e+4	-0.2	223
28.0	7.06e+4	-1.2	223
29.0	7.31e+4	-0.3	223
30.0	7.56e+4	-0.9	223
1000.0	4.65e+3	-7.5	229
1486.7	2.21e+3	-2.0	229
1500.0	2.15e+3	-3.0	229
2000.0	1.11e+3	-6.8	229

E(eV)	μ(cm^2/g)	% Error	Ref.
4000.0	1.16e+3	-1.9	229
5000.0	6.73e+2	-1.6	229
5414.7	5.57e+2	-0.4	229
5946.7	4.41e+2	-0.1	229
6000.0	4.28e+2	-0.8	229
8000.0	2.08e+2	0.7	229
8397.6	1.82e+2	-0.4	229
9000.0	1.53e+2	0.0	229
9500.0	1.33e+2	0.2	229
9961.5	1.18e+2	0.7	229
10000.0	1.17e+2	0.1	229
10.2	4.66e+4	21.4	232
10.3	4.58e+4	17.2	232
10.9	4.52e+4	5.1	232
11.4	4.83e+4	4.3	232
11.6	4.94e+4	3.5	232
11.8	5.00e+4	2.0	232
12.1	4.84e+4	-4.7	232
12.5	5.24e+4	-0.8	232
13.3	5.67e+4	1.5	232
13.5	5.88e+4	3.7	232
14.1	5.84e+4	-1.4	232
14.9	6.23e+4	-0.4	232
16.7	6.72e+4	-1.5	232
16.8	6.49e+4	-5.4	232
17.3	6.27e+4	-11.3	232
18.5	6.90e+4	-12.1	232
20.1	9.30e+4	5.7	232
21.2	9.65e+4	2.8	232
23.0	9.05e+4	-2.8	232
25.3	7.16e+4	-3.6	232
26.9	7.50e+4	5.7	232
27.7	7.01e+4	-1.7	232
30.5	9.11e+4	16.3	232
32.7	7.91e+4	3.7	232
34.8	6.33e+4	0.7	232
37.9	5.83e+4	3.4	232
40.8	5.85e+4	4.3	232
48.4	5.08e+4	-5.1	232
51.0	6.51e+4	22.5	232
72.3	3.38e+4	-20.1	232
91.5	2.41e+4	-7.6	232

Atomic Scattering Factors, f_1+if_2
80 - Mercury (Hg)



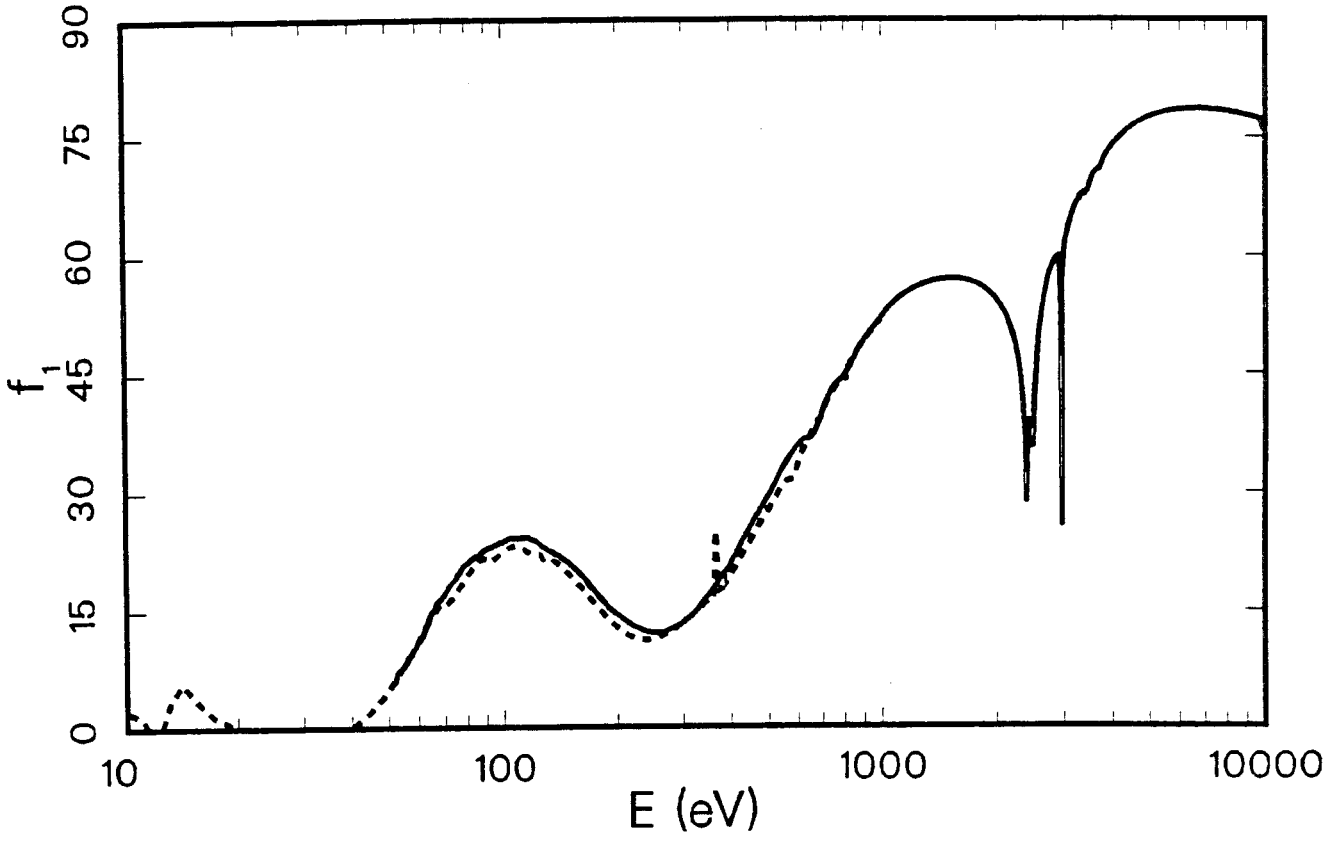


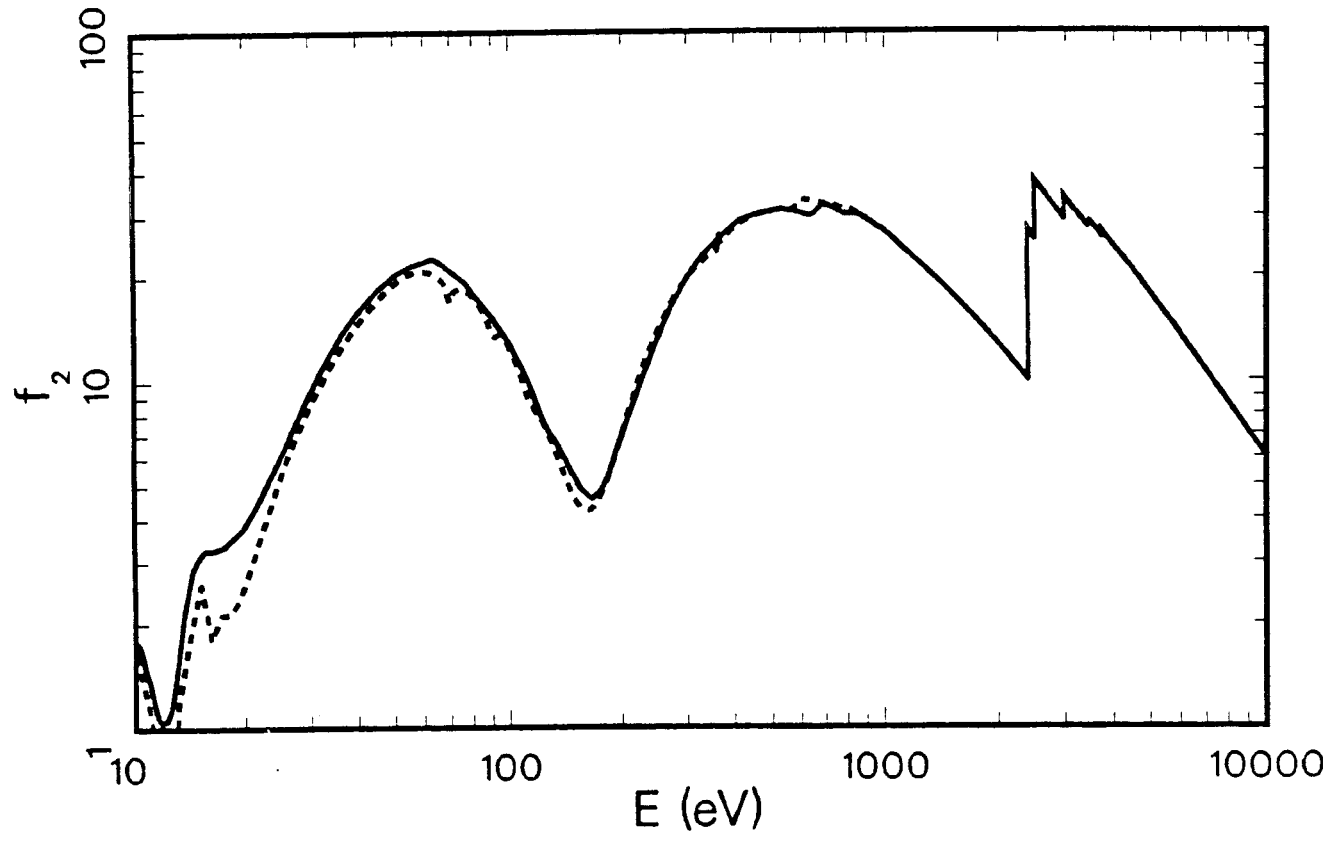

80-Hg μ Coefficients
References
○ = 14
μ (cm²/gm)
E (eV)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

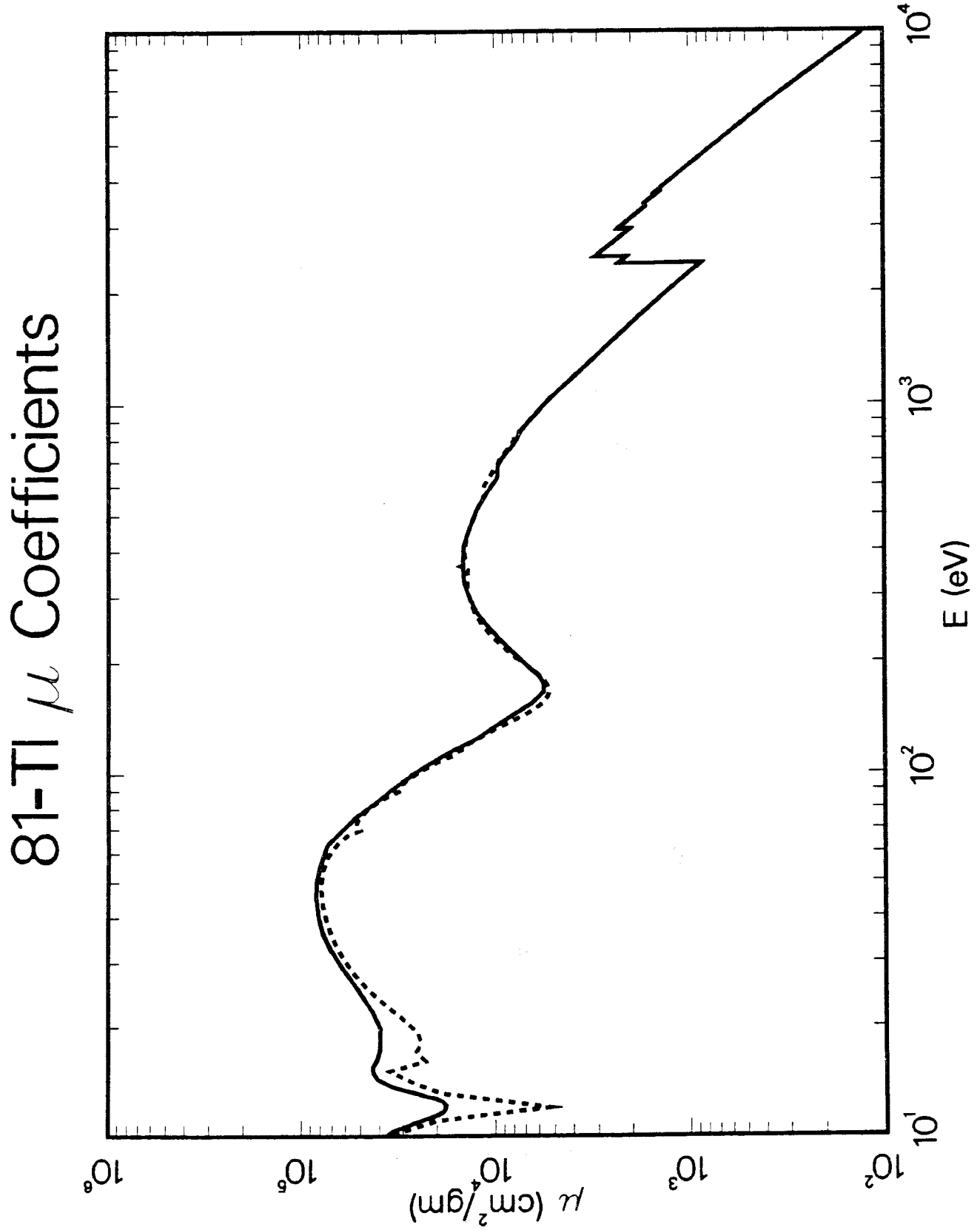
Mercury (Hg) — 80
Atomic Weight = 200.59
μ (barns/atom) = $\mu(cm^2/g) \times 333.09$
$E\mu(E) = 209.8\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
8860.0	1.75e+2	6.7	14
9540.0	1.45e+2	6.9	14

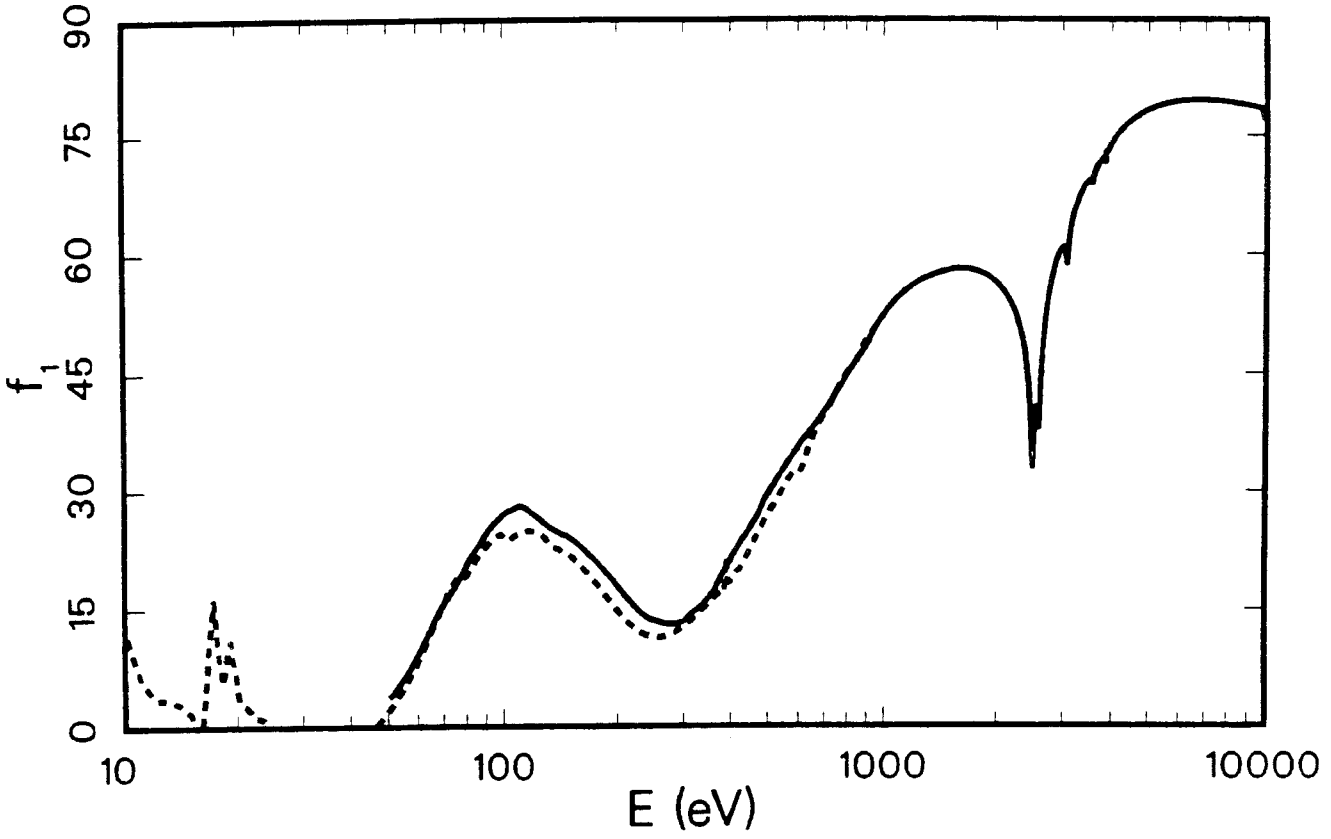
Atomic Scattering Factors, f_1+if_2
81 - Thallium (Tl)

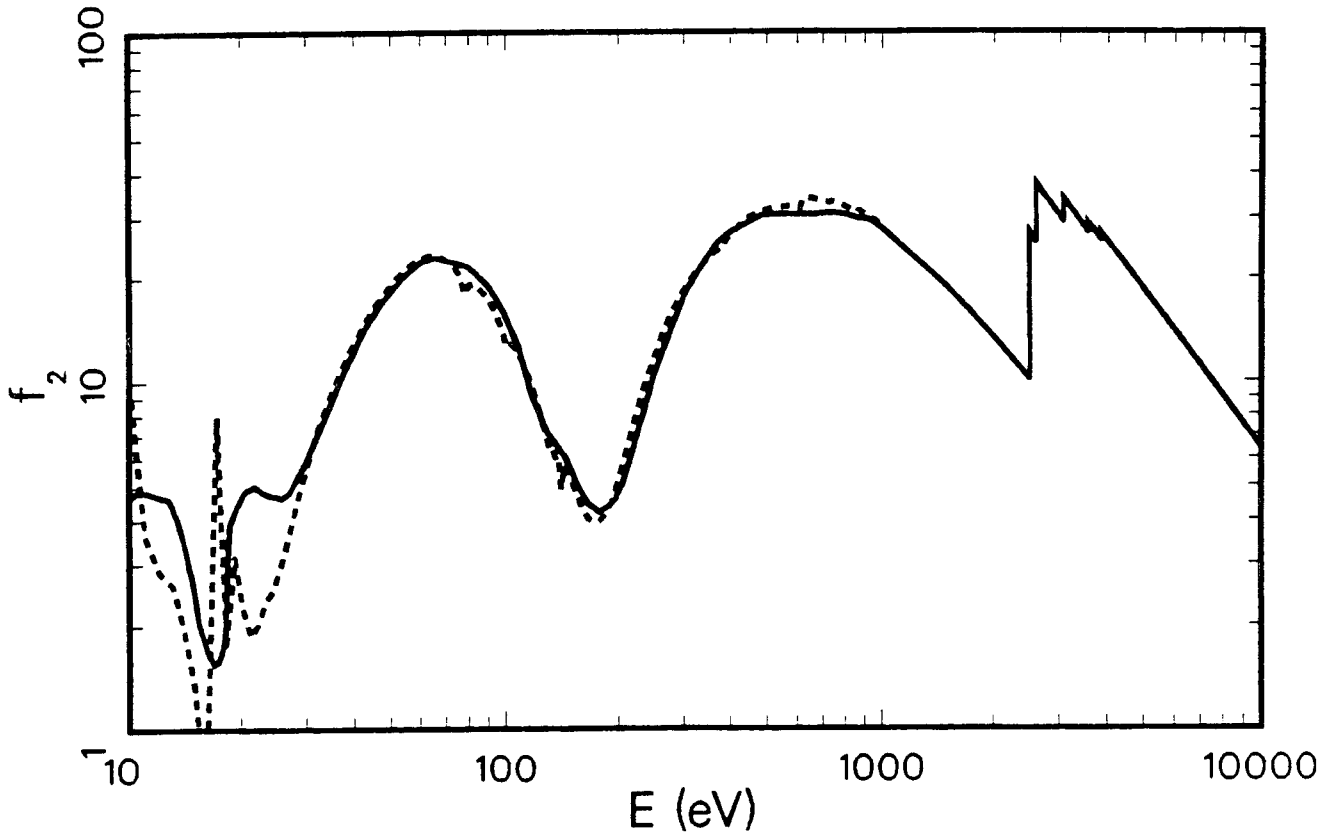


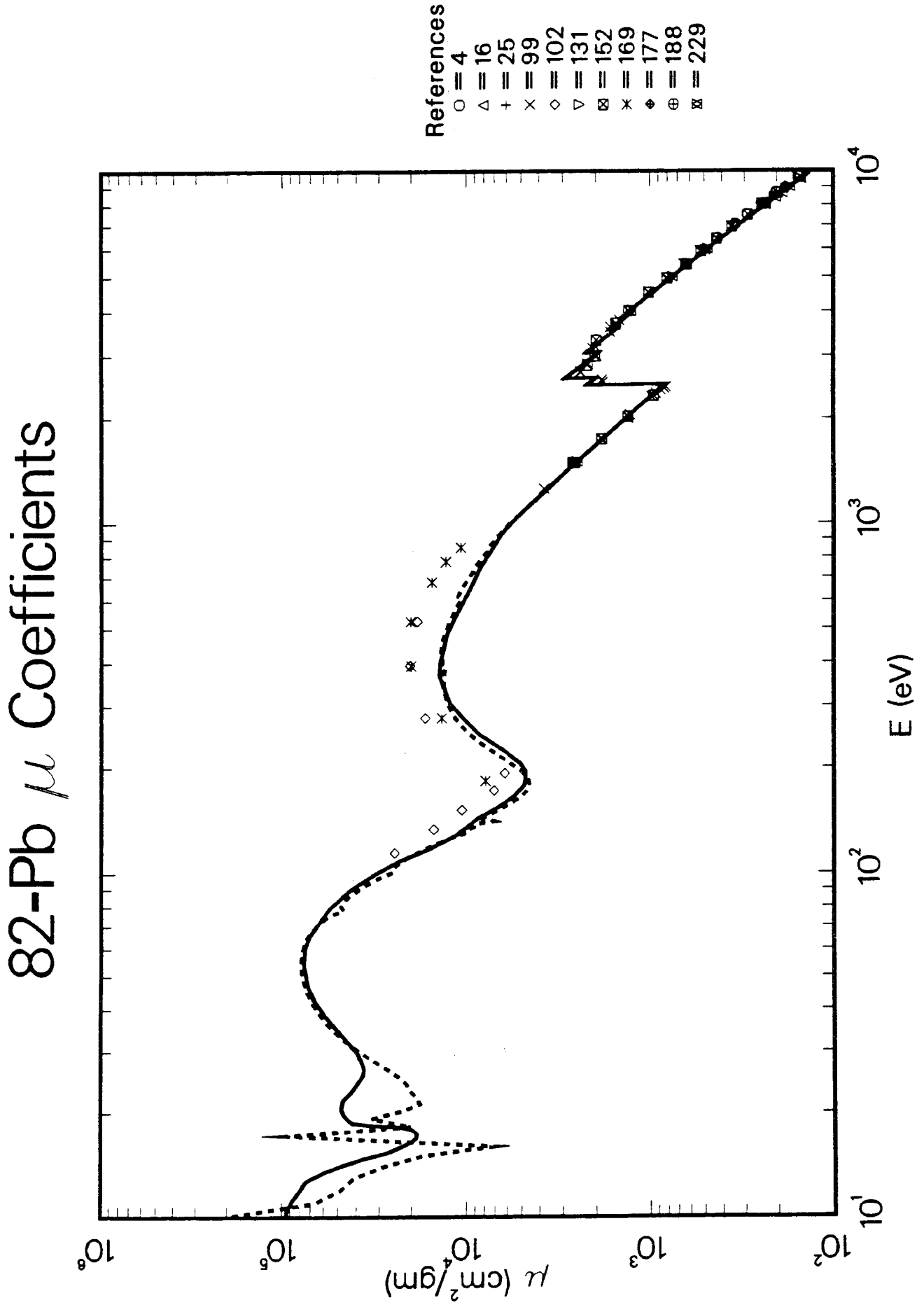



81-Tl μ Coefficients
μ (cm²/gm)
10⁸
10⁶
10⁴
10³
10²
10¹
10²
10³
10⁴
E (eV)

Atomic Scattering Factors, f_1+if_2
82 - Lead (Pb)






82-Pb μ Coefficients
References
○ = 4
△ = 16
+ = 25
× = 99
◇ = 102
▽ = 131
⊠ = 152
✳ = 169
◆ = 177
⊕ = 188
⊠ = 229
μ (cm²/gm)
E (eV)
10⁸
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴

Lead (Pb) — 82

Atomic Weight = 207.20

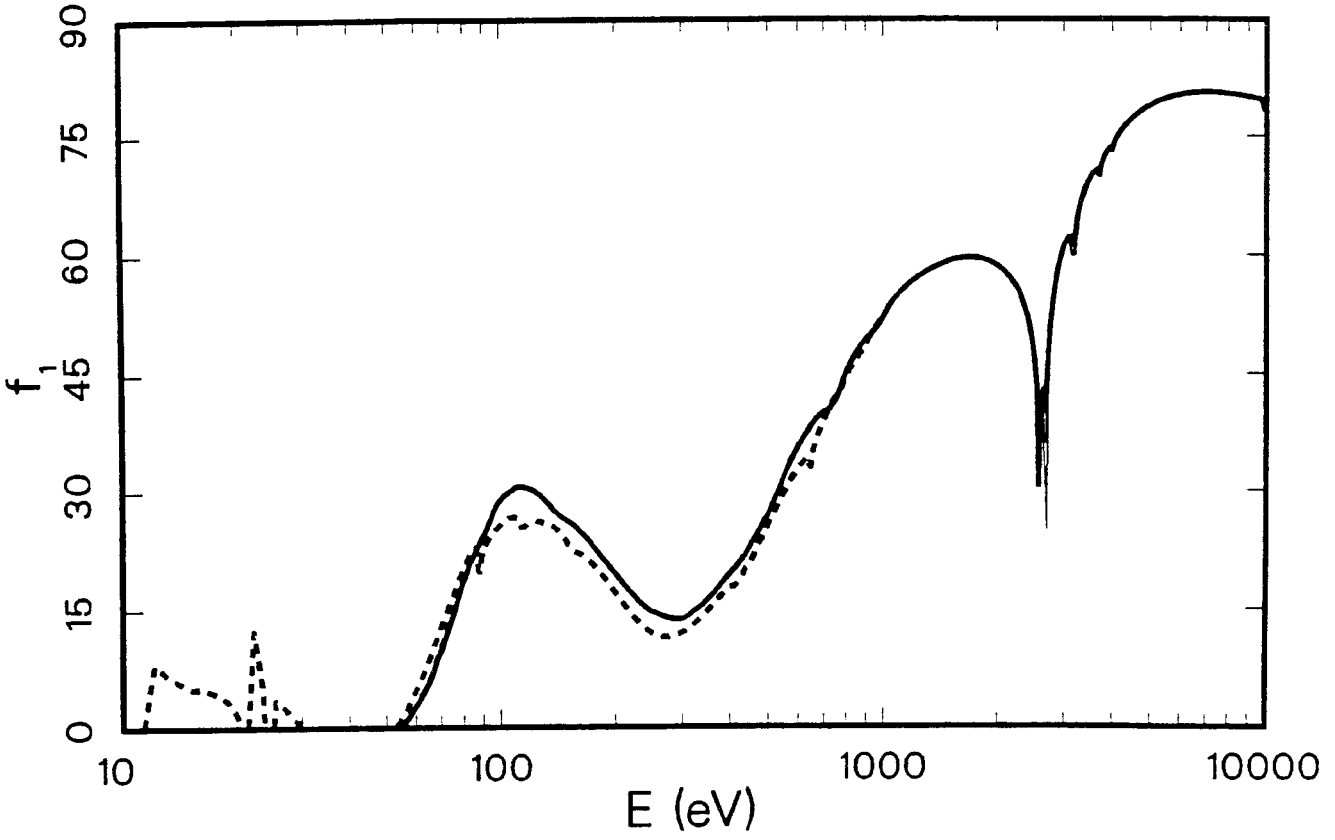
μ (barns/atom) = $\mu(cm^2/g) \times 344.07$

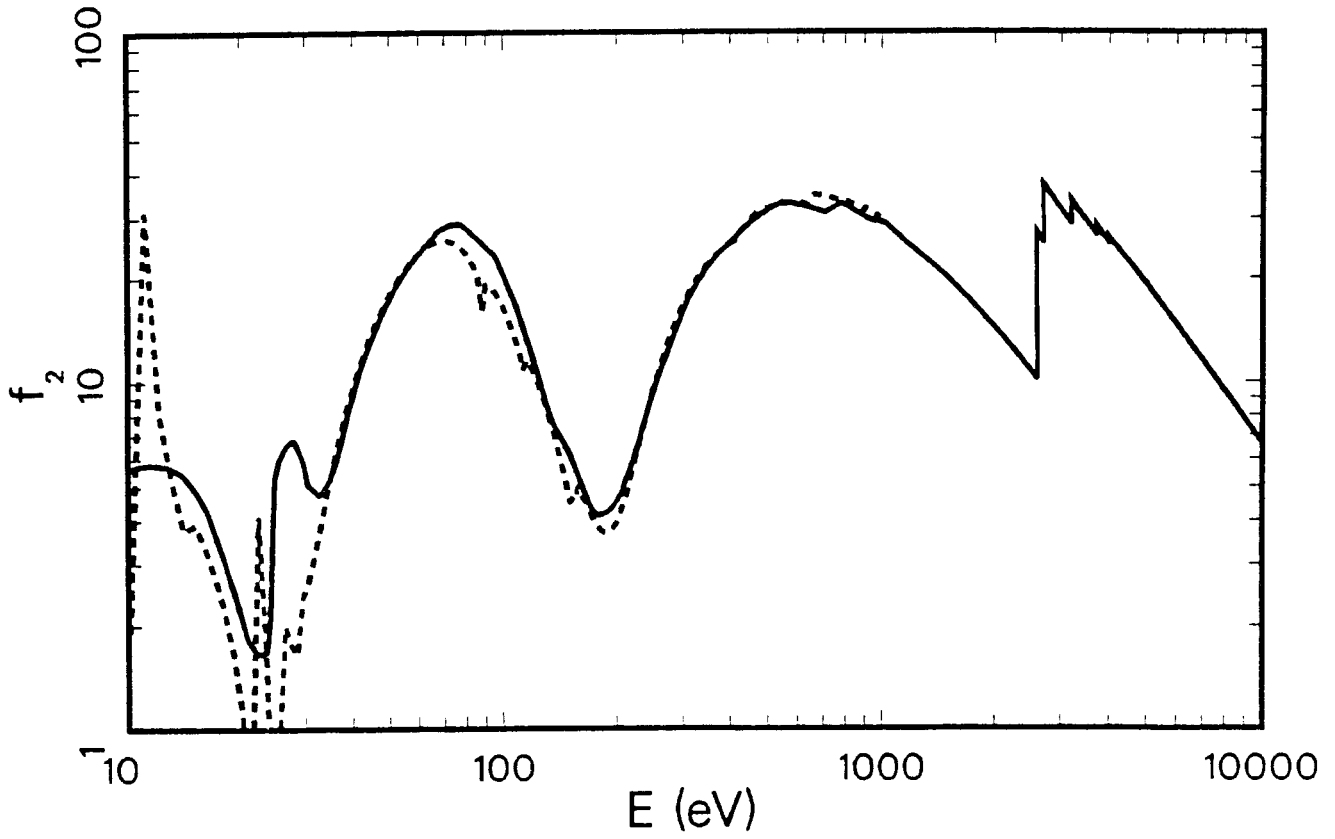
$E\mu(E) = 203.1\, f_2$ keV cm^2/g

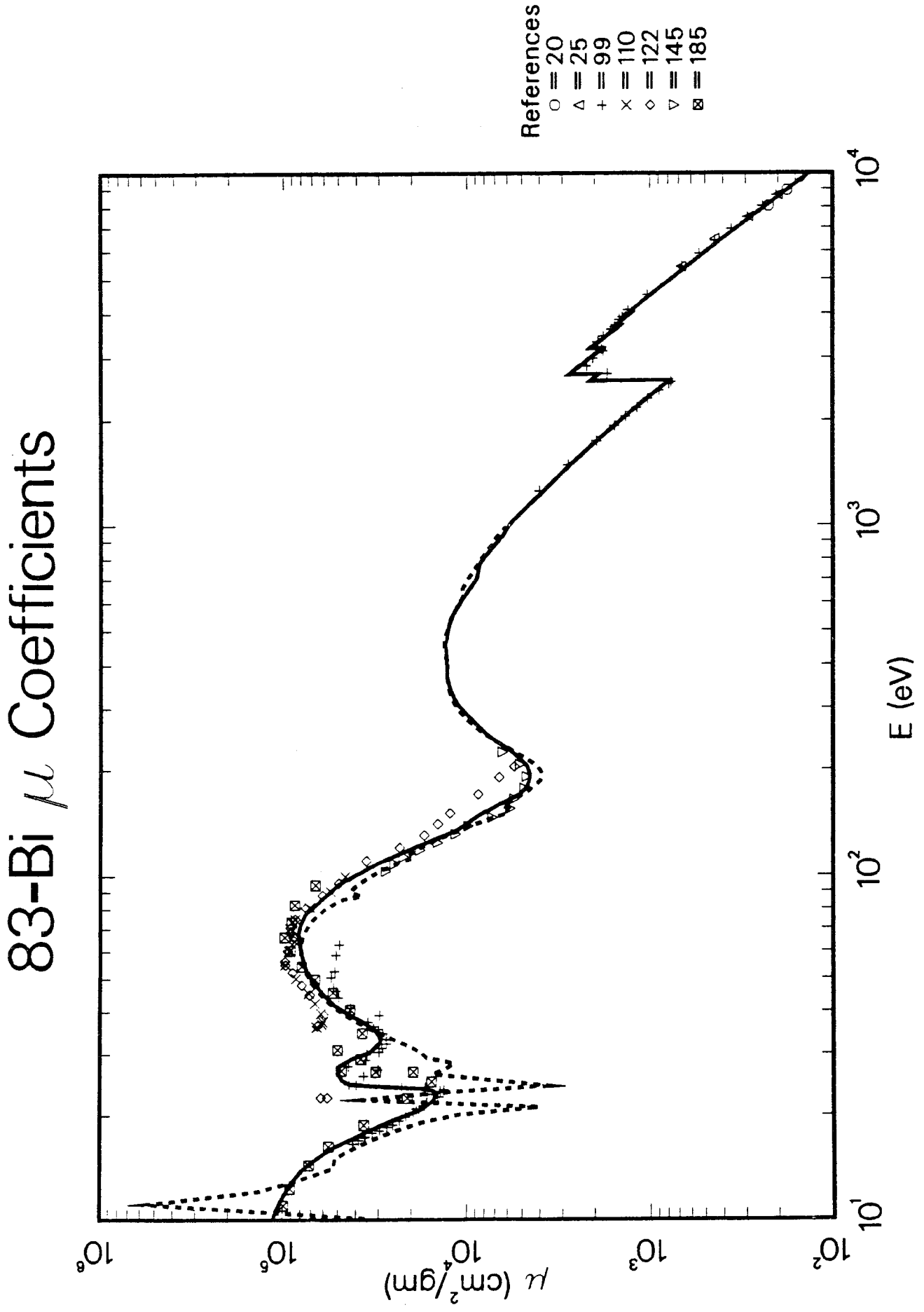
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
6410.0	4.20e+2	4.5	4
7040.0	3.35e+2	5.7	4
7490.0	2.90e+2	7.1	4
8070.0	2.30e+2	2.7	4
8660.0	2.02e+2	8.0	4
8930.0	1.80e+2	4.1	4
9590.0	1.54e+2	6.9	4
8650.0	1.87e+2	-0.2	16
6479.0	4.16e+2	6.4	25
8058.0	2.42e+2	7.7	25
8650.0	2.00e+2	6.5	25
1254.0	3.77e+3	4.8	99
1487.0	2.64e+3	3.2	99
1739.0	1.87e+3	1.8	99
2043.0	1.29e+3	0.0	99
2293.0	9.82e+2	-1.3	99
2346.0	9.24e+2	-2.1	99
2395.0	8.68e+2	-3.6	99
2422.0	8.38e+2	-4.4	99
2443.0	8.19e+2	-4.7	99
2526.0	1.83e+3	-13.9	99
2558.0	1.85e+3	-10.2	99
2684.0	2.42e+3	-9.2	99
2697.0	2.41e+3	-8.5	99
2838.0	2.21e+3	-5.0	99
2985.0	1.98e+3	-3.7	99
3134.0	2.07e+3	-2.2	99
3171.0	2.00e+3	-2.8	99
3488.0	1.66e+3	1.9	99
3605.0	1.66e+3	4.4	99
3663.0	1.56e+3	1.7	99
3768.0	1.48e+3	3.3	99
4510.0	1.02e+3	5.7	99
4949.0	8.12e+2	5.7	99
5414.0	6.47e+2	5.3	99
5898.0	5.26e+2	6.1	99
6930.0	3.55e+2	7.6	99
114.0	2.47e+4	36.6	102
132.8	1.50e+4	44.4	102
151.1	1.06e+4	47.7	102
171.7	7.06e+3	38.2	102
192.6	6.16e+3	30.2	102
277.0	1.67e+4	61.0	102
392.4	2.03e+4	46.0	102
524.9	1.85e+4	57.1	102
7058.0	3.30e+2	4.8	131
8000.0	2.34e+2	2.4	131
8398.0	2.07e+2	2.2	131
9000.0	1.73e+2	1.9	131
9500.0	1.51e+2	2.2	131

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
9962.0	1.32e+2	1.2	131
10000.0	1.31e+2	1.2	131
1487.0	2.65e+3	3.5	152
1740.0	1.86e+3	1.5	152
2013.0	1.33e+3	-0.3	152
2307.0	9.56e+2	-2.5	152
2815.0	2.22e+3	-6.2	152
2984.0	2.02e+3	-1.6	152
3313.0	1.99e+3	7.5	152
3691.0	1.55e+3	2.9	152
4012.0	1.32e+3	2.6	152
4508.0	1.02e+3	5.0	152
4949.0	8.03e+2	4.5	152
5411.0	6.34e+2	3.0	152
5895.0	5.21e+2	4.9	152
6400.0	4.26e+2	5.7	152
6926.0	3.51e+2	6.1	152
7473.0	2.87e+2	5.3	152
8040.0	2.40e+2	6.3	152
8630.0	1.99e+2	5.4	152
9570.0	1.50e+2	3.7	152
9990.0	1.33e+2	2.7	152
183.0	7.86e+3	65.1	169
277.0	1.36e+4	30.6	169
392.0	2.00e+4	44.1	169
525.0	2.01e+4	71.0	169
679.0	1.54e+4	68.4	169
776.0	1.29e+4	61.1	169
852.0	1.07e+4	50.0	169
8000.0	2.33e+2	1.9	177
8900.0	1.80e+2	3.5	177
1486.0	2.65e+3	3.4	188
1486.7	2.59e+3	1.3	229
1500.0	2.52e+3	0.2	229
2000.0	1.33e+3	-1.9	229
4000.0	1.27e+3	-1.7	229
5000.0	7.49e+2	0.0	229
5414.7	6.22e+2	1.3	229
5946.7	4.93e+2	1.6	229
6000.0	4.80e+2	1.0	229
8000.0	2.31e+2	0.9	229
8397.6	2.03e+2	0.6	229
9000.0	1.70e+2	0.4	229
9500.0	1.48e+2	0.6	229
9961.5	1.31e+2	0.5	229
10000.0	1.30e+2	0.2	229

Atomic Scattering Factors, f_1+if_2
83 - Bismuth (Bi)






83-Bi μ Coefficients
References
○ = 20
△ = 25
+ = 99
× = 110
◇ = 122
▽ = 145
⊠ = 185
μ (cm²/gm)
E (eV)
10¹
10²
10³
10⁴
10⁵
10⁶

Bismuth (Bi) — 83
Atomic Weight = 208.98
μ (barns/atom) = μ(cm^2/g) × 347.03
Eμ(E) = 201.4 f_2 keV cm^2/g

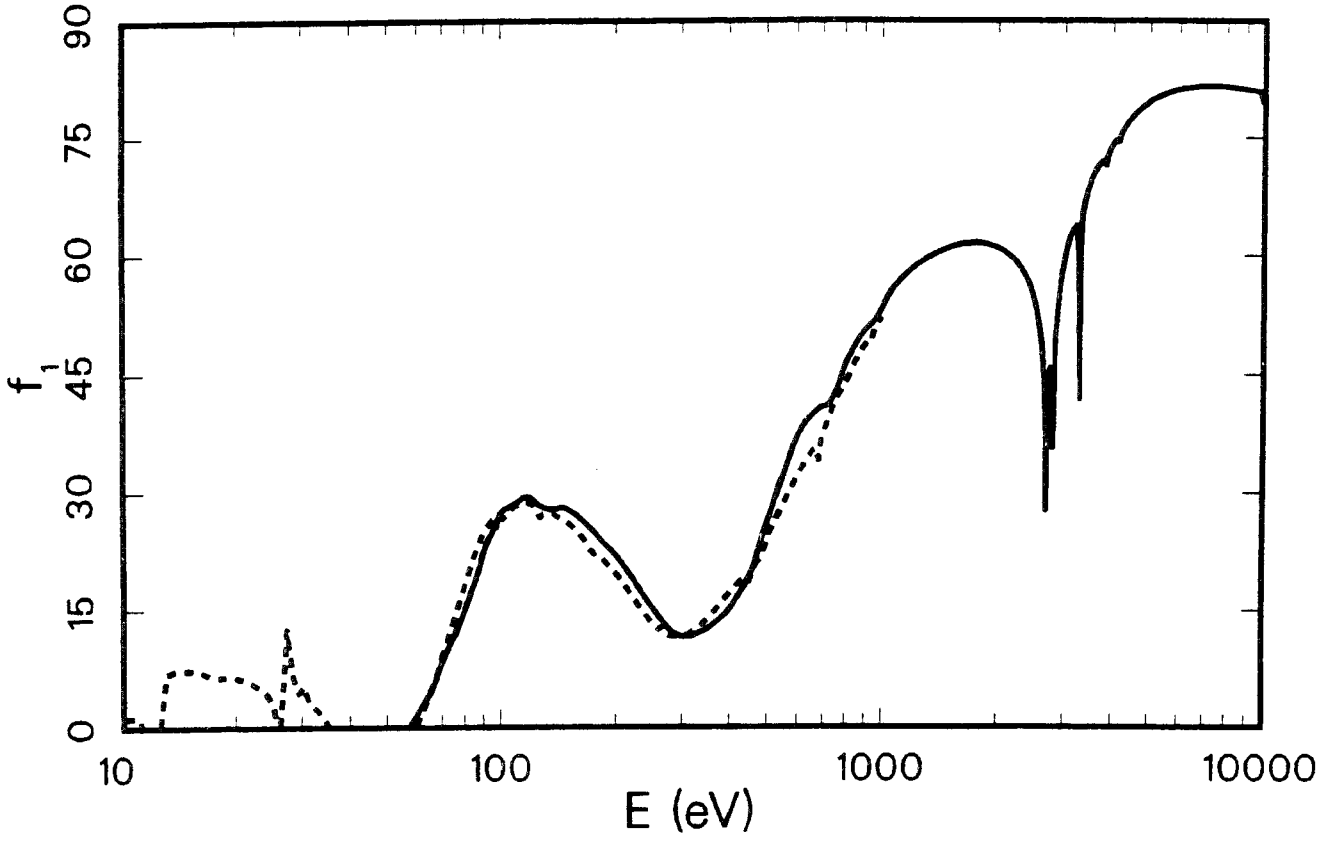
E(eV)	μ(cm^2/g)	% Error	Ref.
8048.0	2.25e+2	-3.3	20
8930.0	1.77e+2	-0.4	20
9713.0	1.50e+2	4.5	20
5423.0	6.81e+2	7.6	25
6479.0	4.43e+2	9.5	25
7487.0	2.88e+2	2.8	25
8650.0	1.99e+2	3.1	25
16.6	4.14e+4	-13.7	99
17.0	3.86e+4	-11.2	99
17.3	3.58e+4	-11.6	99
17.4	3.52e+4	-10.8	99
17.8	3.25e+4	-9.8	99
18.1	2.95e+4	-12.1	99
18.5	2.70e+4	-11.9	99
18.8	2.51e+4	-12.2	99
19.3	2.31e+4	-9.4	99
19.8	2.13e+4	-5.0	99
20.4	1.94e+4	0.0	99
20.8	1.81e+4	2.2	99
20.9	1.87e+4	7.2	99
21.3	1.70e+4	2.3	99
21.7	1.65e+4	4.8	99
22.6	1.43e+4	-3.3	99
23.0	1.62e+4	11.2	99
23.3	1.34e+4	-7.5	99
23.5	1.39e+4	-6.6	99
23.8	1.33e+4	-14.5	99
24.1	1.67e+4	-29.7	99
24.1	2.25e+4	-5.6	99
24.5	3.96e+4	-7.5	99
24.6	4.35e+4	0.2	99
24.6	4.34e+4	0.2	99
26.0	3.61e+4	-26.3	99
27.1	3.02e+4	-39.2	99
27.7	4.36e+4	-11.6	99
28.9	3.51e+4	-18.5	99
30.0	3.48e+4	-3.4	99
30.5	2.99e+4	-9.9	99
31.3	2.85e+4	-9.7	99
32.2	2.69e+4	-9.7	99
33.2	2.71e+4	-7.5	99
34.6	2.84e+4	-6.3	99
35.5	3.01e+4	-5.3	99
36.2	3.18e+4	-4.6	99
37.4	3.43e+4	-6.8	99
39.1	2.95e+4	-31.7	99
41.1	4.28e+4	-14.1	99
44.1	4.96e+4	-14.3	99
46.1	5.09e+4	-18.2	99
47.1	5.29e+4	-17.8	99

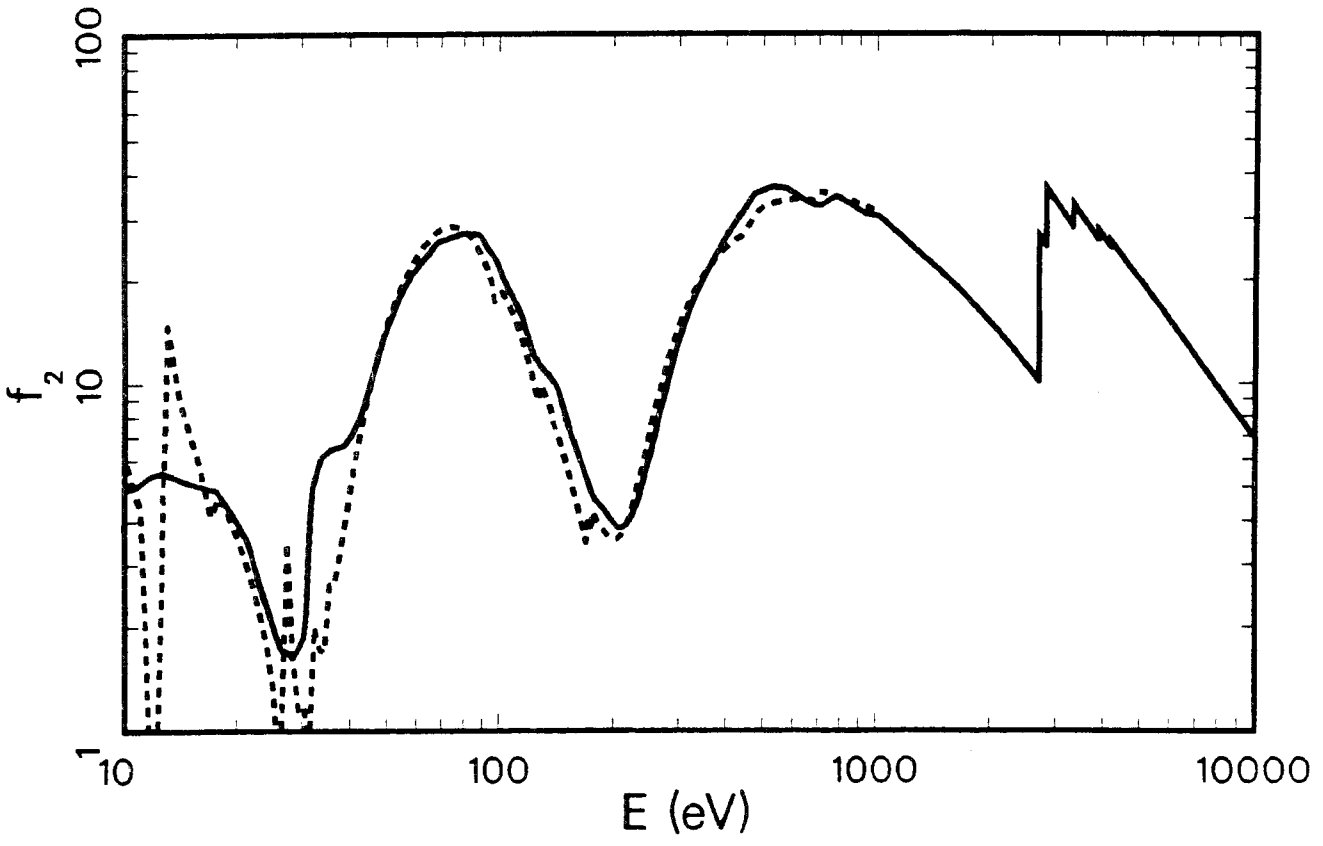
E(eV)	μ(cm^2/g)	% Error	Ref.
50.5	5.45e+4	-22.8	99
52.6	5.22e+4	-29.0	99
58.6	5.13e+4	-34.7	99
62.9	4.93e+4	-38.9	99
1254.0	4.01e+3	5.6	99
1487.0	2.79e+3	2.9	99
1739.0	1.96e+3	0.3	99
1922.0	1.57e+3	-0.1	99
2043.0	1.36e+3	-1.0	99
2166.0	1.19e+3	-1.2	99
2293.0	1.03e+3	-1.9	99
2422.0	8.96e+2	-3.1	99
2526.0	7.95e+2	-4.9	99
2558.0	7.73e+2	-4.7	99
2697.0	1.70e+3	-38.0	99
2838.0	2.21e+3	-8.8	99
2985.0	2.04e+3	-4.4	99
3134.0	1.80e+3	-4.8	99
3171.0	1.84e+3	-7.4	99
3316.0	1.93e+3	0.9	99
3444.0	1.80e+3	3.3	99
3605.0	1.62e+3	4.7	99
3663.0	1.56e+3	4.5	99
3843.0	1.47e+3	4.7	99
3905.0	1.41e+3	4.5	99
4089.0	1.31e+3	4.6	99
4510.0	1.03e+3	4.1	99
5414.0	6.72e+2	5.8	99
5898.0	5.39e+2	5.1	99
6404.0	4.41e+2	5.8	99
6930.0	3.58e+2	5.0	99
7478.0	2.94e+2	4.7	99
8040.0	2.43e+2	4.2	99
8640.0	2.04e+2	5.2	99
36.1	6.51e+4	96.4	110
36.7	6.09e+4	76.2	110
37.3	5.99e+4	64.6	110
39.5	6.18e+4	39.0	110
42.3	6.66e+4	24.5	110
45.3	7.19e+4	18.5	110
50.0	8.48e+4	21.4	110
55.0	9.69e+4	27.5	110
60.3	9.27e+4	16.6	110
64.3	8.63e+4	6.4	110
70.1	9.09e+4	12.5	110
74.6	8.57e+4	10.6	110
81.0	7.17e+4	4.7	110
90.1	5.49e+4	-0.2	110
99.6	4.58e+4	10.5	110
22.5	5.69e+4	283.2	122

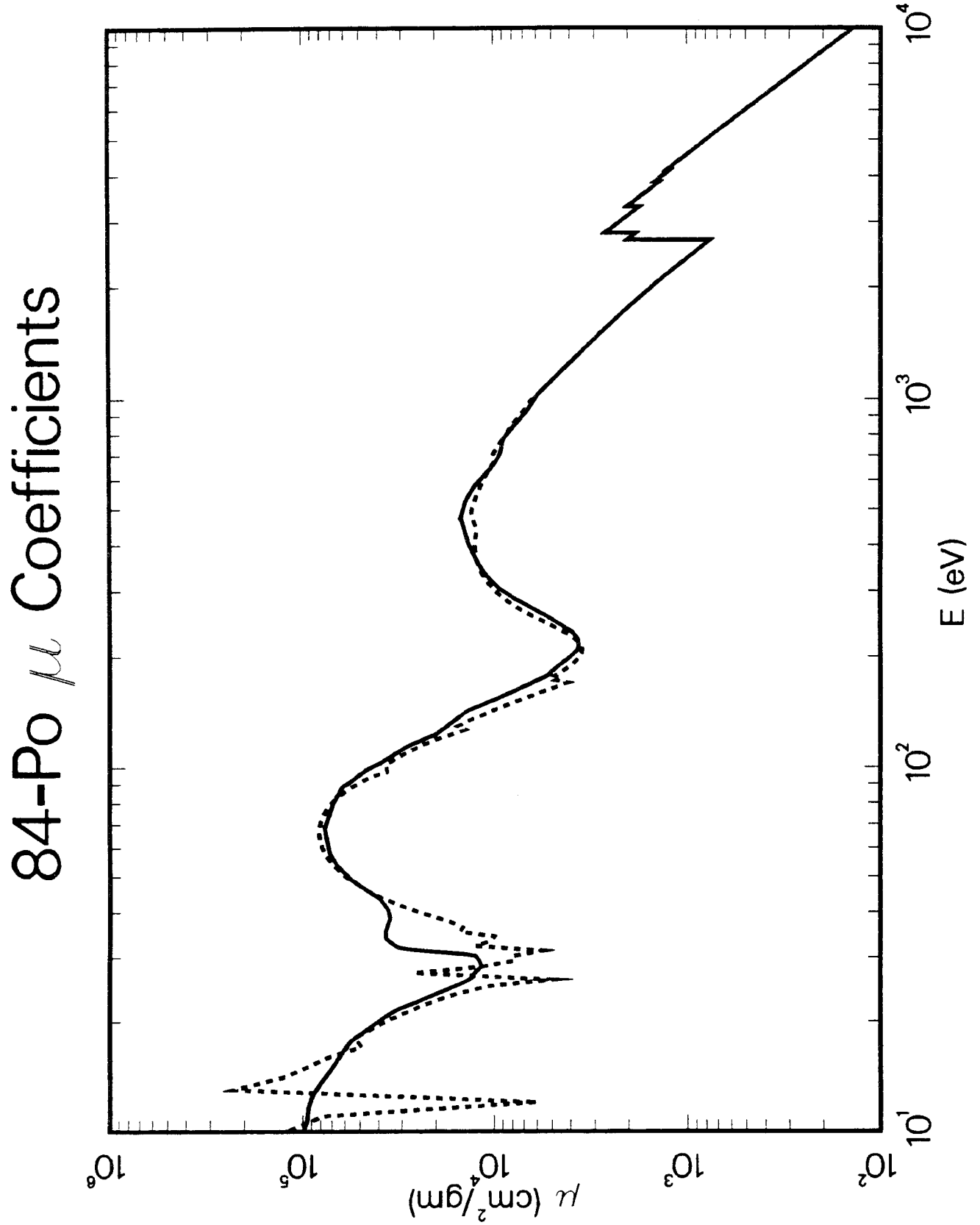
E(eV)	μ(cm^2/g)	% Error	Ref.
22.5	6.20e+4	317.5	122
36.4	6.46e+4	90.9	122
39.1	5.90e+4	36.8	122
44.9	7.15e+4	19.5	122
47.9	7.88e+4	19.2	122
52.1	8.85e+4	21.5	122
54.9	9.68e+4	27.5	122
56.1	9.73e+4	26.7	122
60.3	9.42e+4	18.5	122
64.6	8.69e+4	7.1	122
66.2	8.75e+4	7.0	122
68.5	9.06e+4	11.0	122
70.4	9.11e+4	12.9	122
74.7	8.55e+4	10.5	122
80.7	7.48e+4	8.5	122
87.9	6.10e+4	5.3	122
95.3	4.95e+4	1.8	122
110.0	3.49e+4	22.9	122
120.0	2.31e+4	19.8	122
130.0	1.70e+4	28.6	122
140.0	1.44e+4	42.4	122
150.0	1.24e+4	50.8	122
170.0	8.64e+3	67.7	122
190.0	6.63e+3	47.1	122
204.0	5.48e+3	17.8	122
103.0	2.74e+4	-25.3	145
108.0	2.45e+4	-20.4	145
113.0	2.19e+4	-13.0	145
118.0	1.79e+4	-14.1	145
124.0	1.44e+4	-12.7	145
131.0	1.15e+4	-9.6	145
138.0	9.80e+3	-7.1	145
146.0	7.20e+3	-19.6	145
155.0	5.76e+3	-20.7	145
165.0	5.48e+3	-5.0	145
177.0	4.81e+3	1.8	145
191.0	4.70e+3	4.3	145
207.0	5.10e+3	6.9	145
225.0	6.34e+3	12.9	145
11.0	9.93e+4	-6.0	185
12.3	9.10e+4	-3.3	185
14.4	7.19e+4	-1.1	185
16.3	5.63e+4	8.8	185
18.8	3.60e+4	26.0	185
22.4	2.09e+4	39.7	185
25.0	1.55e+4	-66.3	185
26.7	3.11e+4	-37.7	185
26.7	1.94e+4	-61.0	185
26.9	4.78e+4	-3.9	185
29.1	3.74e+4	-10.8	185
30.9	5.01e+4	54.6	185
34.6	3.65e+4	20.3	185
40.6	4.28e+4	-10.9	185
45.5	5.34e+4	-12.6	185
49.7	6.71e+4	-3.3	185

E(eV)	μ(cm^2/g)	% Error	Ref.
54.3	7.89e+4	4.7	185
60.4	9.12e+4	14.7	185
66.2	9.77e+4	19.5	185
73.3	8.95e+4	13.6	185
82.4	8.60e+4	30.1	185
94.2	6.68e+4	33.3	185

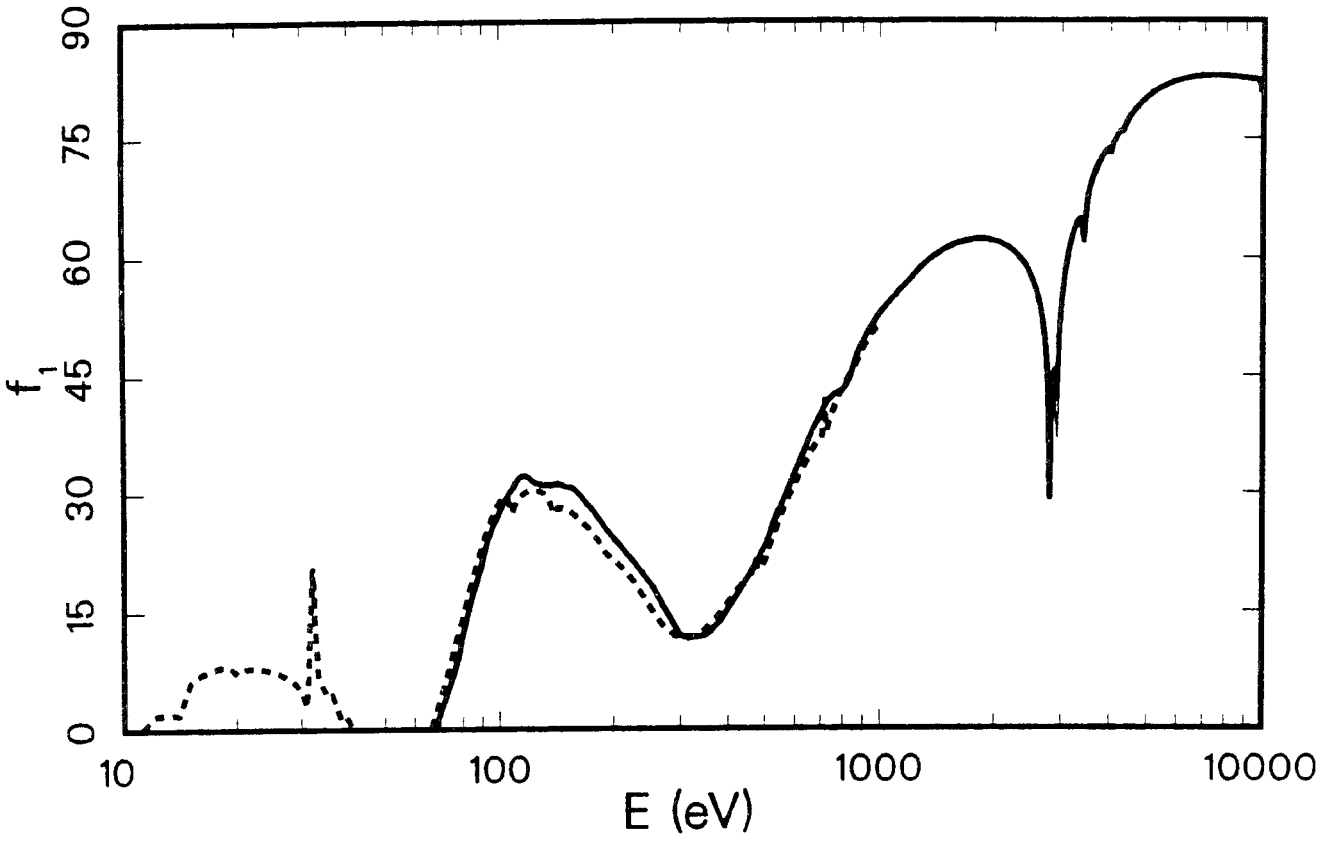
Atomic Scattering Factors, f_1+if_2
84 - Polonium (Po)

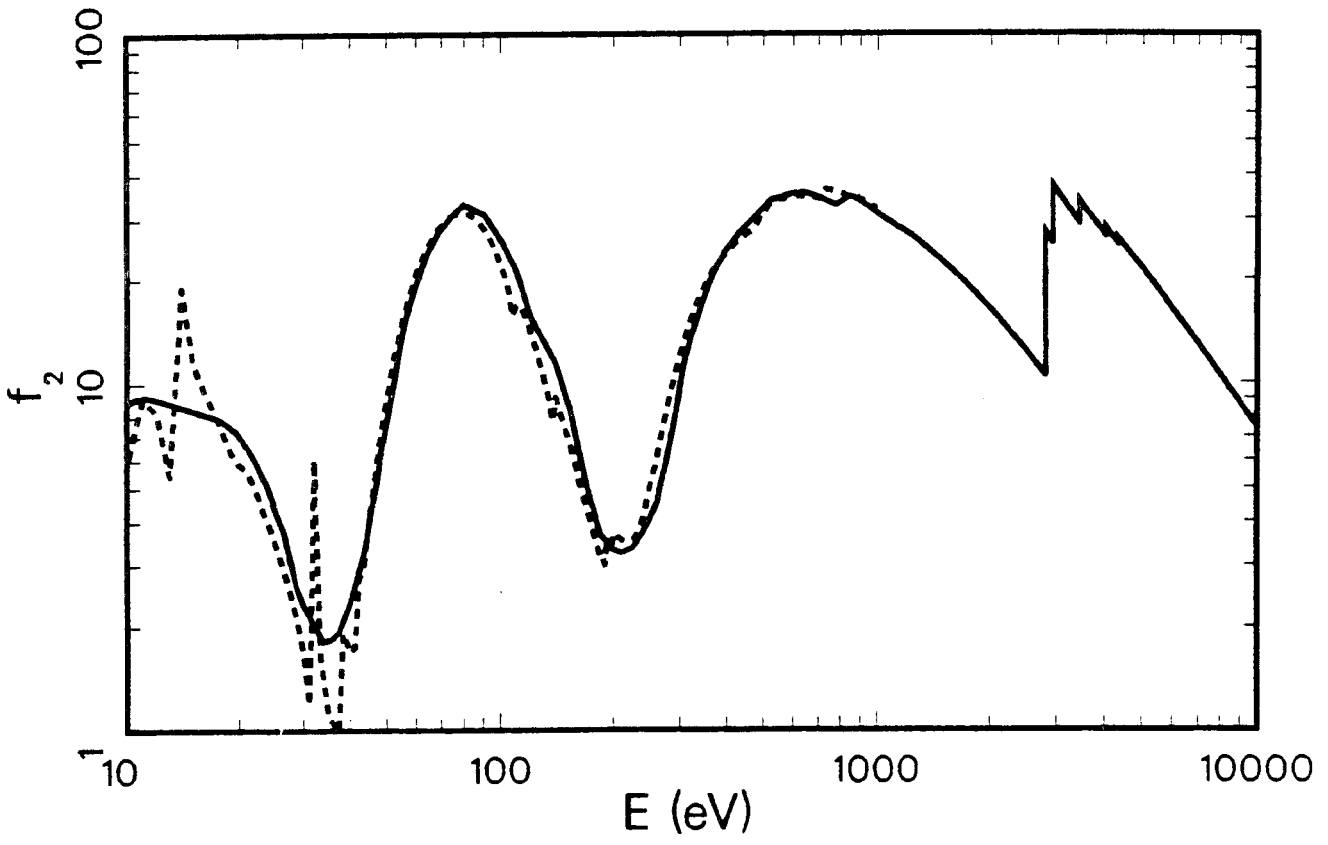


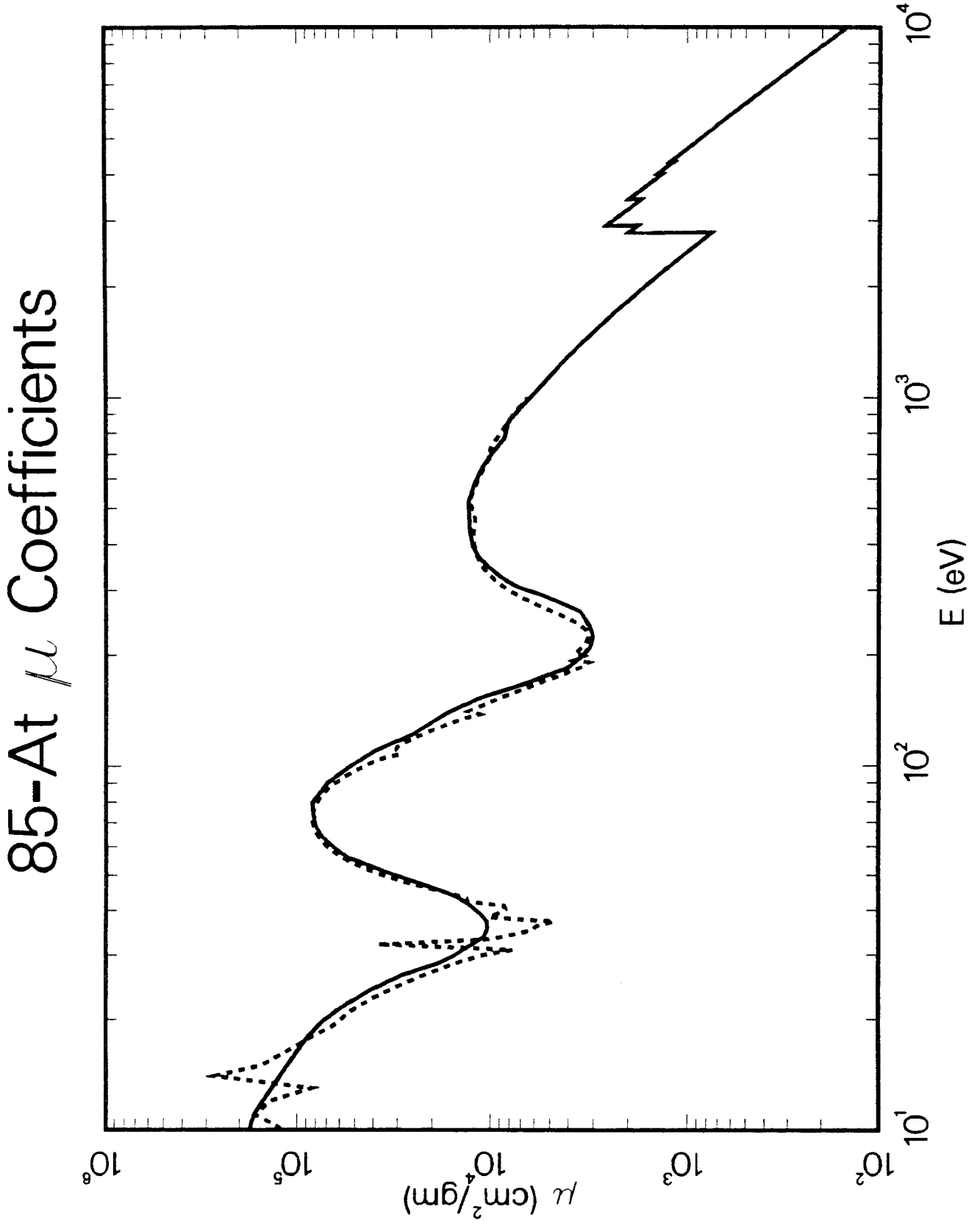



84-Po μ Coefficients
μ (cm²/gm)
10²
10³
10⁴
10⁵
10⁶
E (eV)
10¹
10²
10³
10⁴

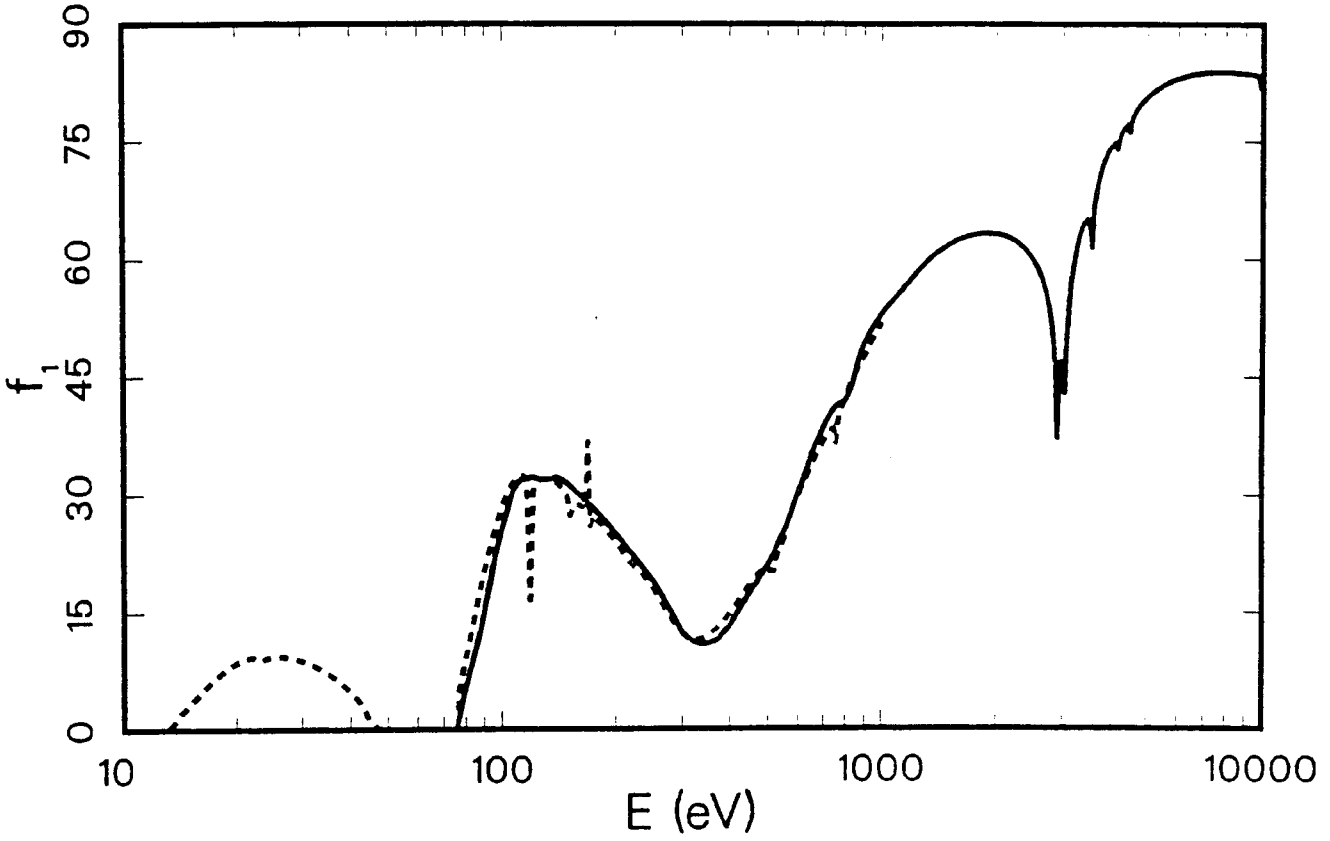
Atomic Scattering Factors, f_1+if_2
85 - Astatine (At)

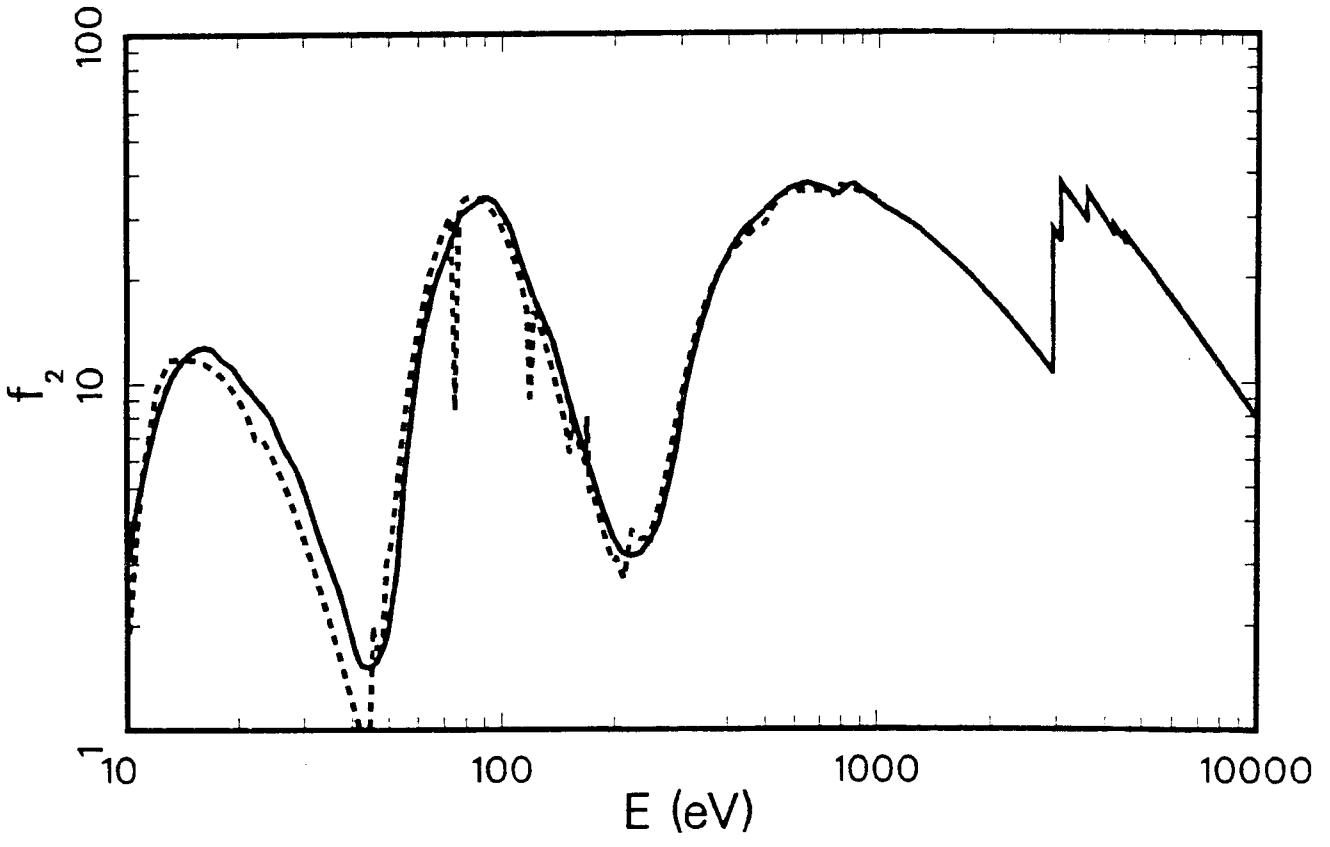


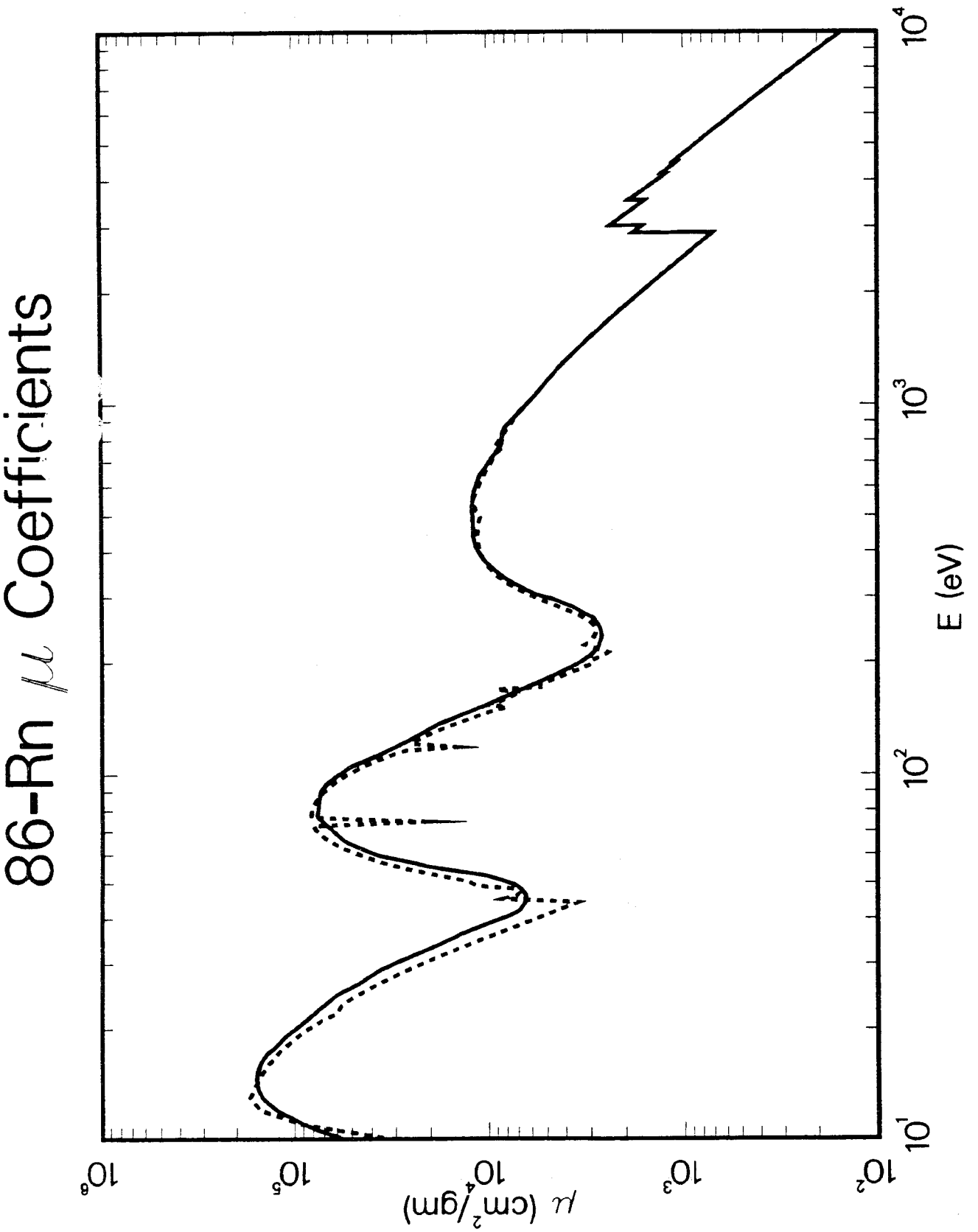



85-At μ Coefficients
μ (cm²/gm)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴
E (eV)

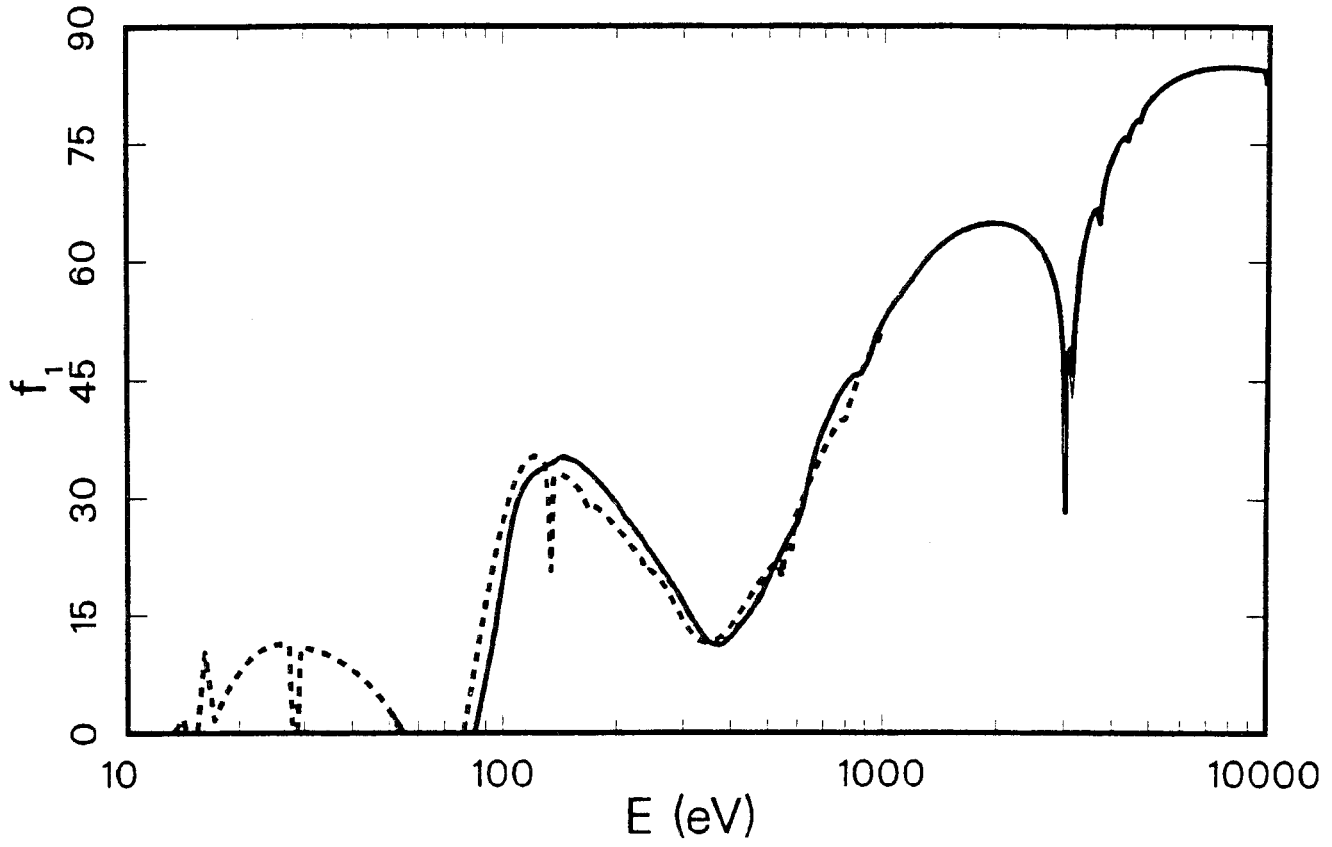
Atomic Scattering Factors, f_1+if_2
86 - Radon (Rn)

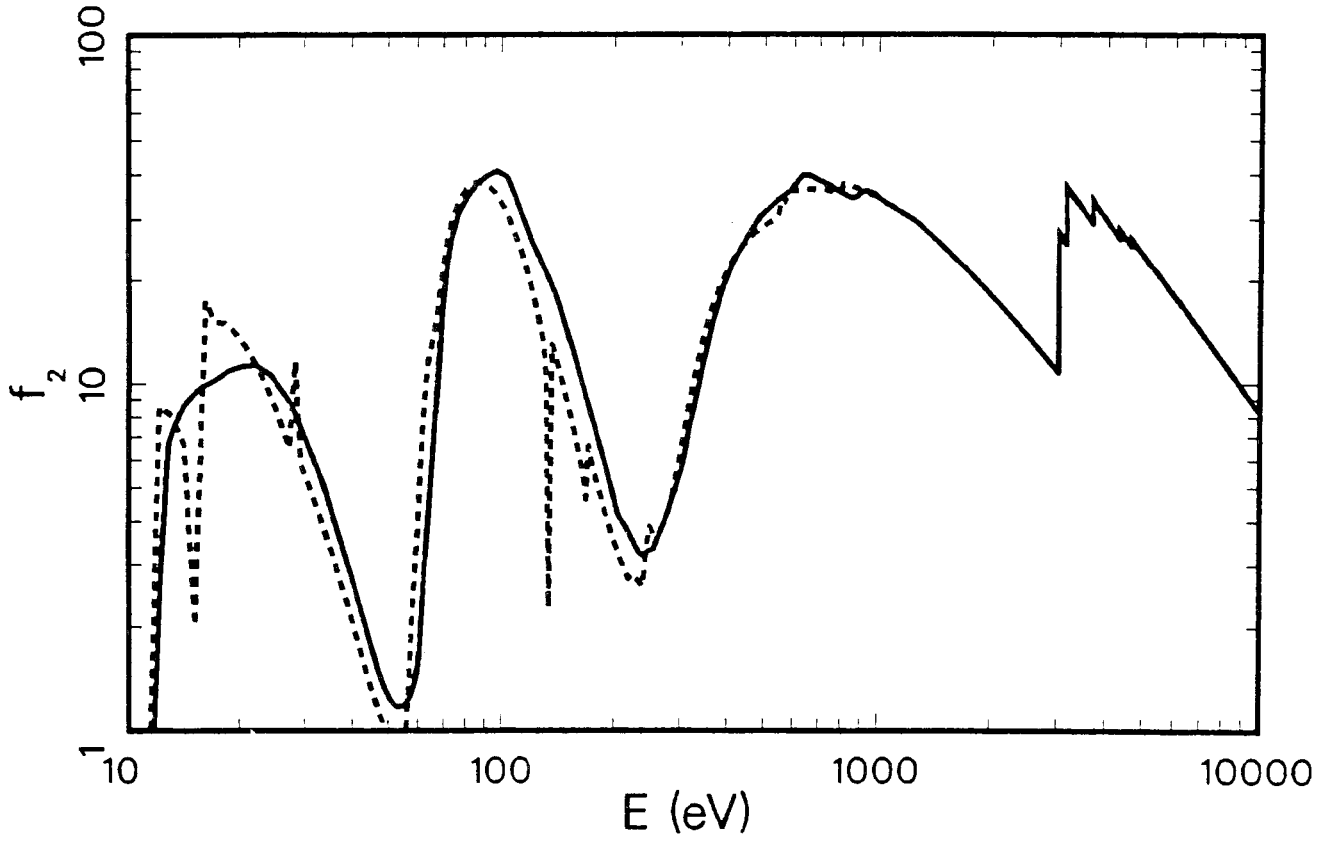


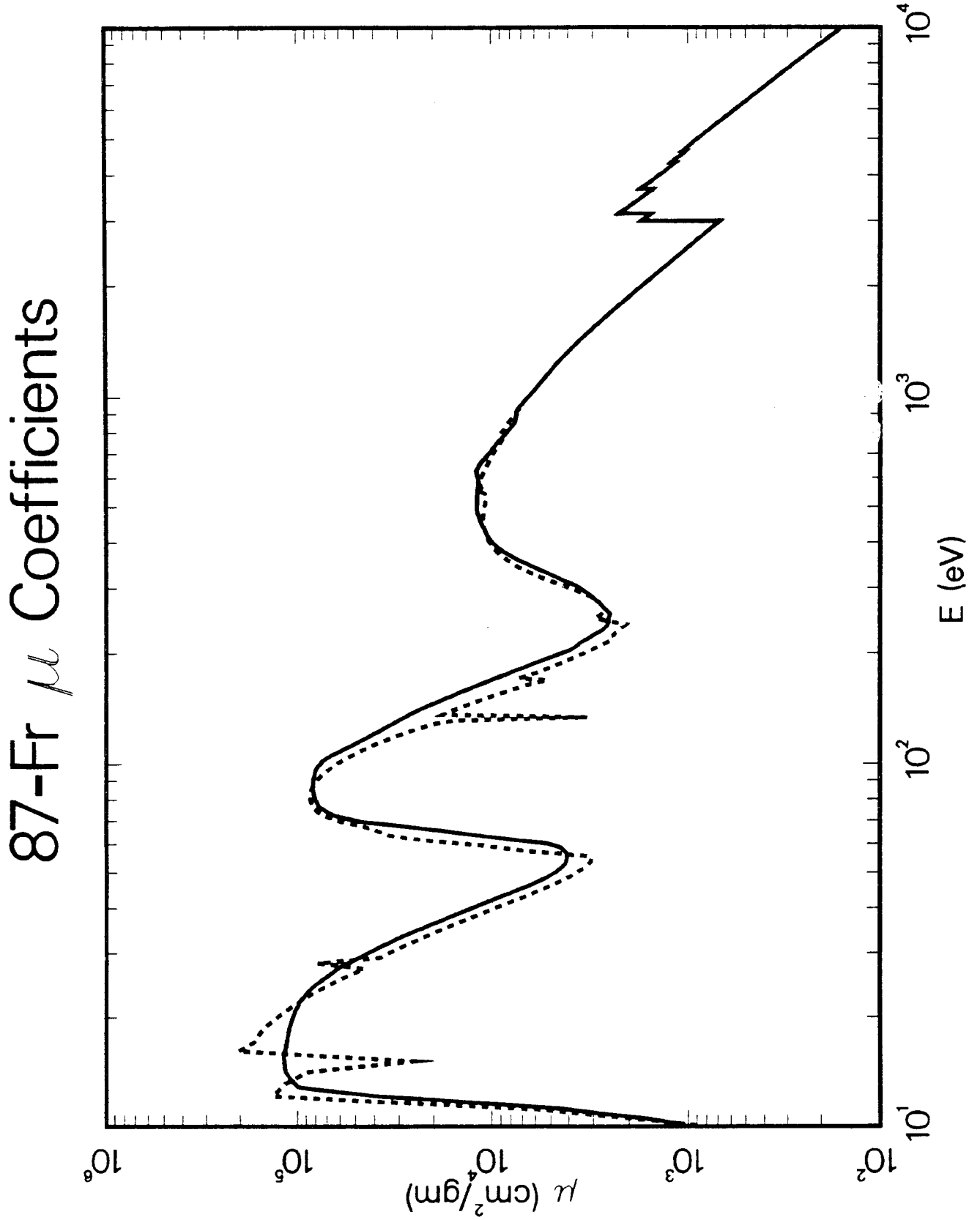



86-Rn μ Coefficients
μ (cm²/gm)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴
E (eV)

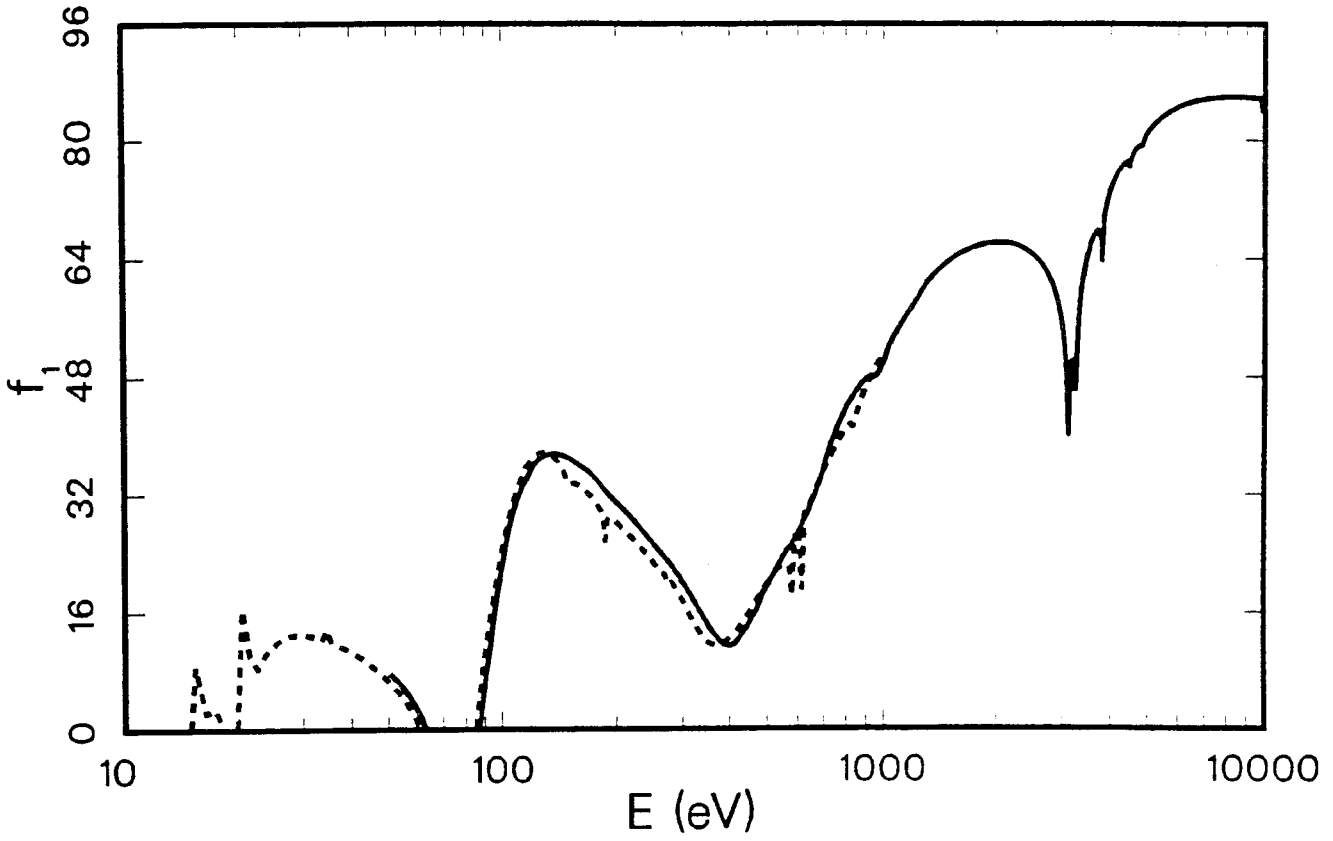
Atomic Scattering Factors, f_1+if_2
87 - Francium (Fr)

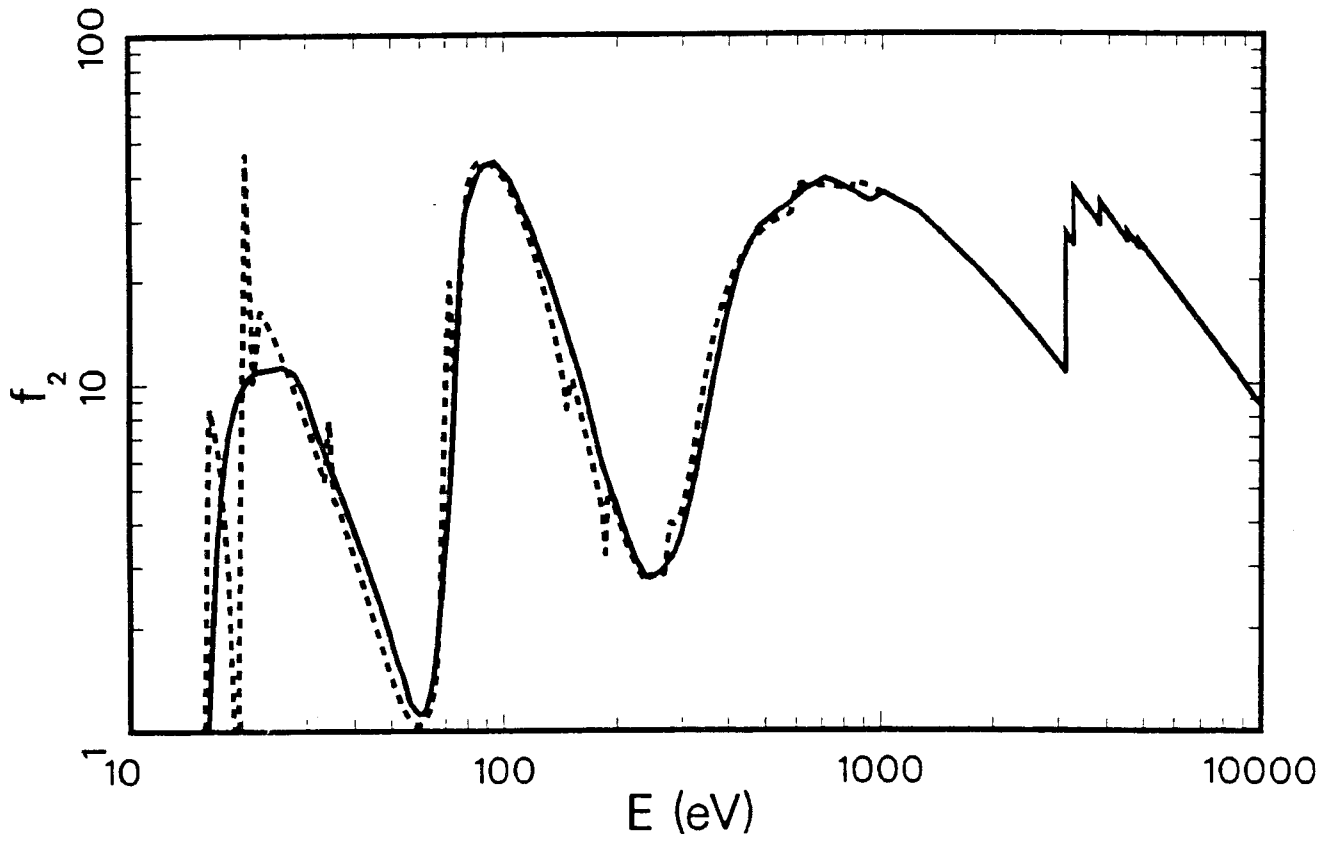


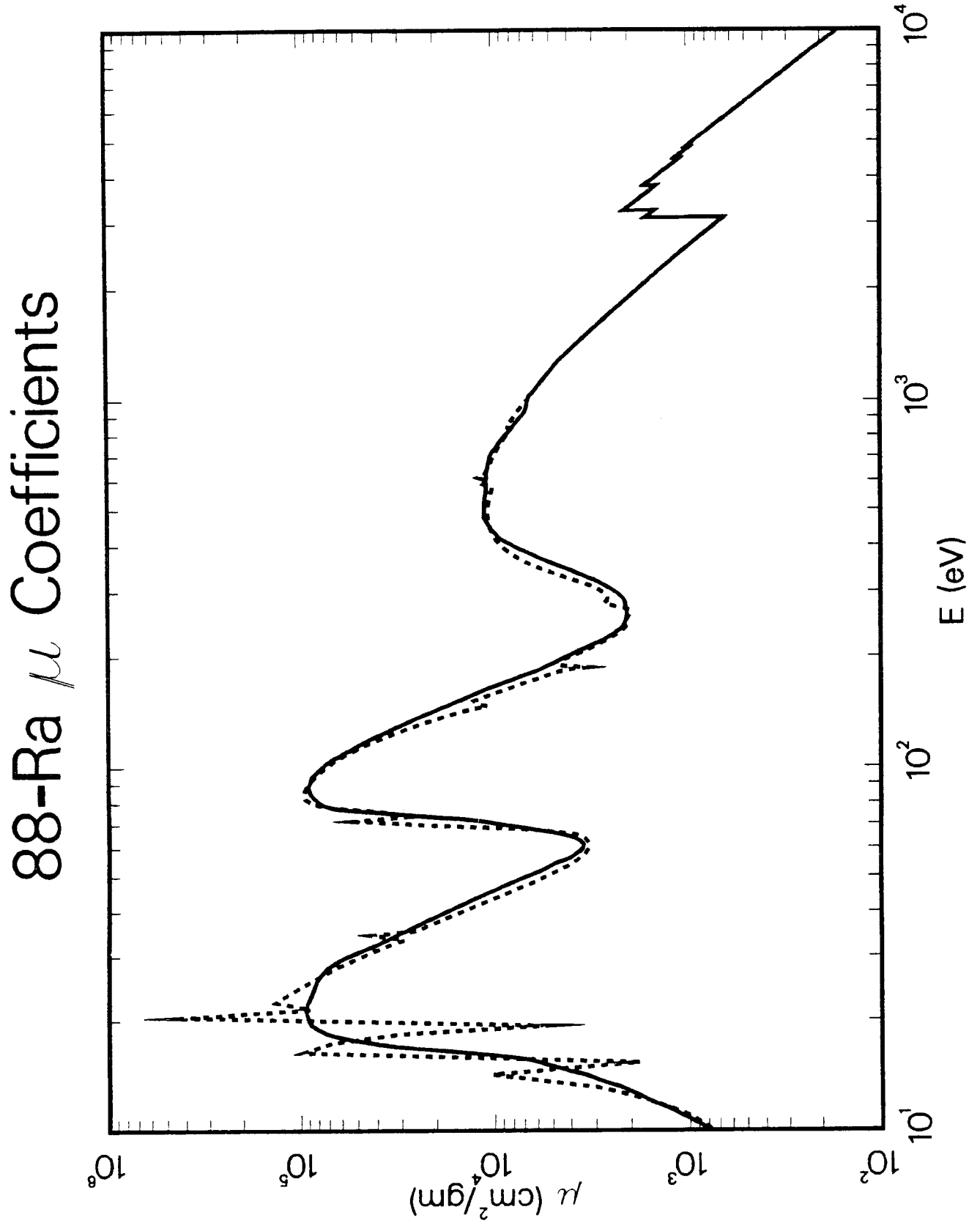



87-Fr μ Coefficients
μ (cm²/gm)
10⁶
10⁵
10⁴
10³
10²
10¹
10²
10³
10⁴
E (eV)

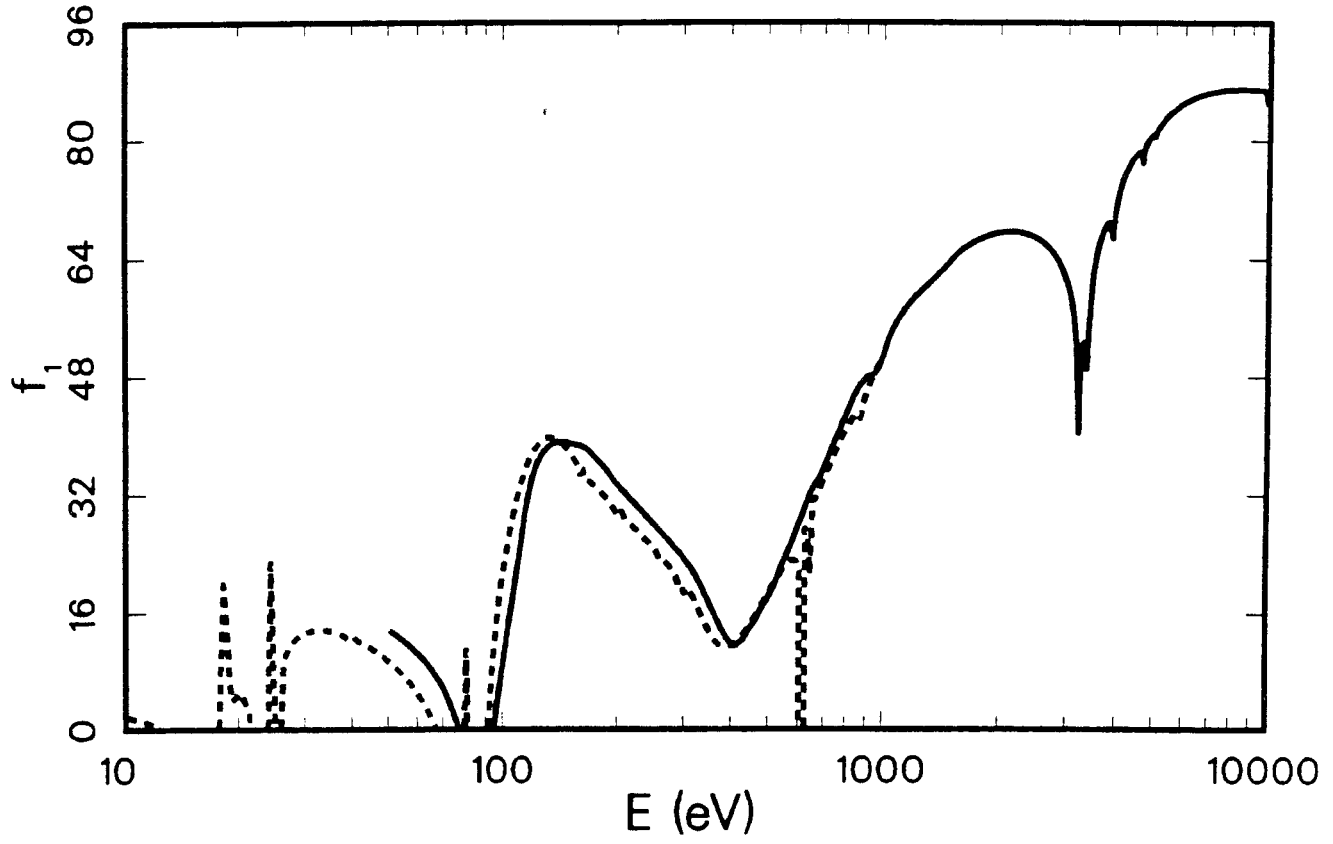
Atomic Scattering Factors, f_1+if_2
88 - Radium (Ra)

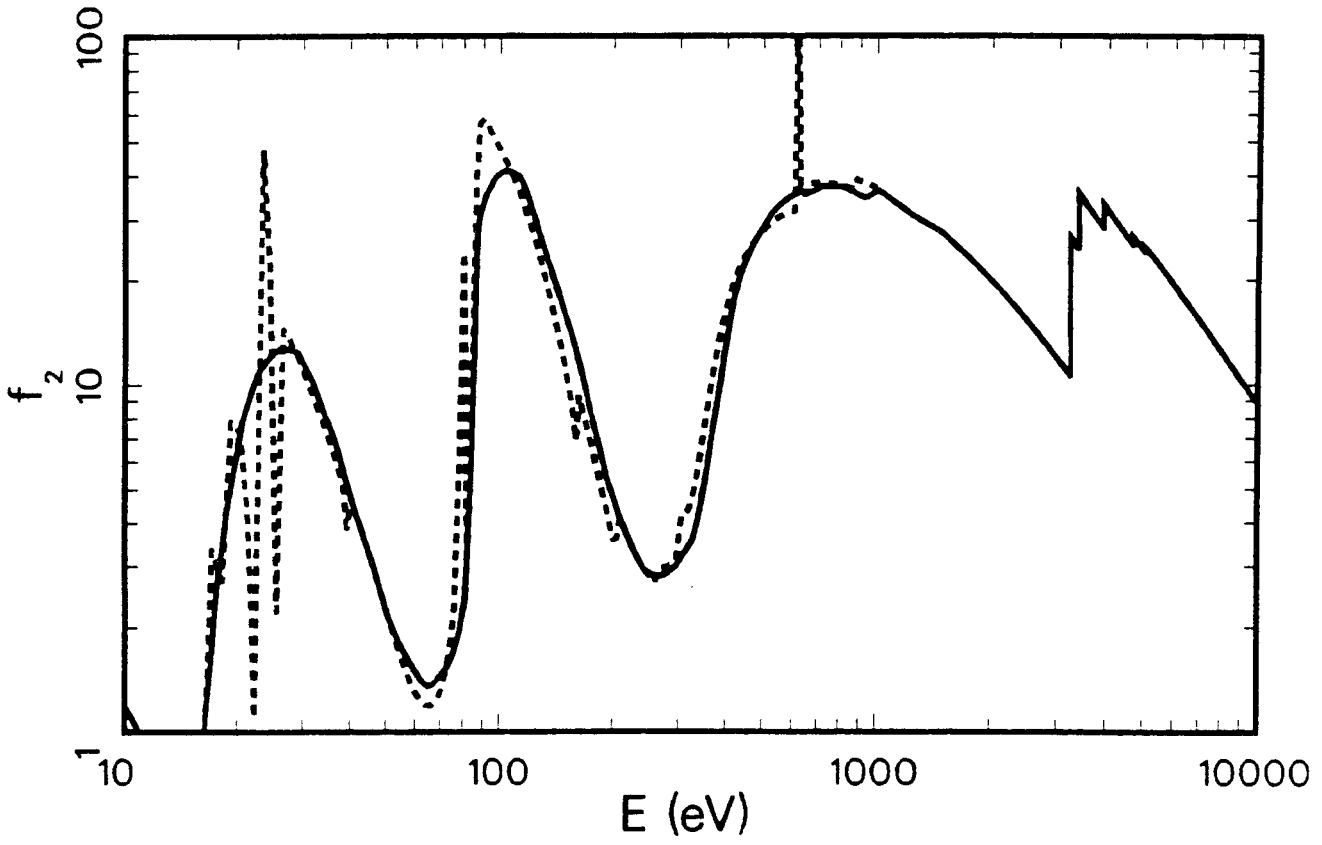


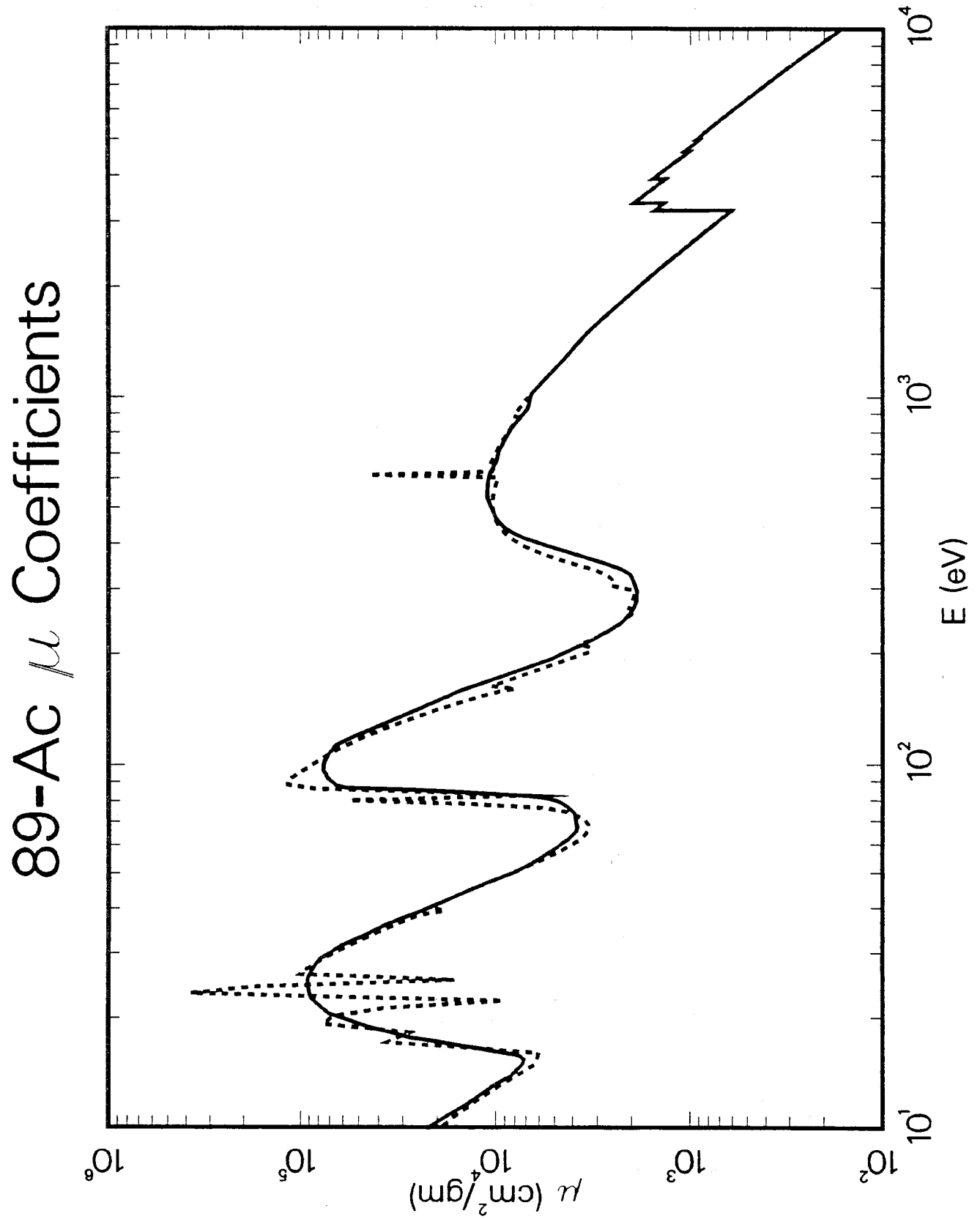



88-Ra μ Coefficients
μ (cm²/gm)
10⁸
10⁵
10⁴
10³
10²
10⁴
10³
10²
10¹
E (eV)

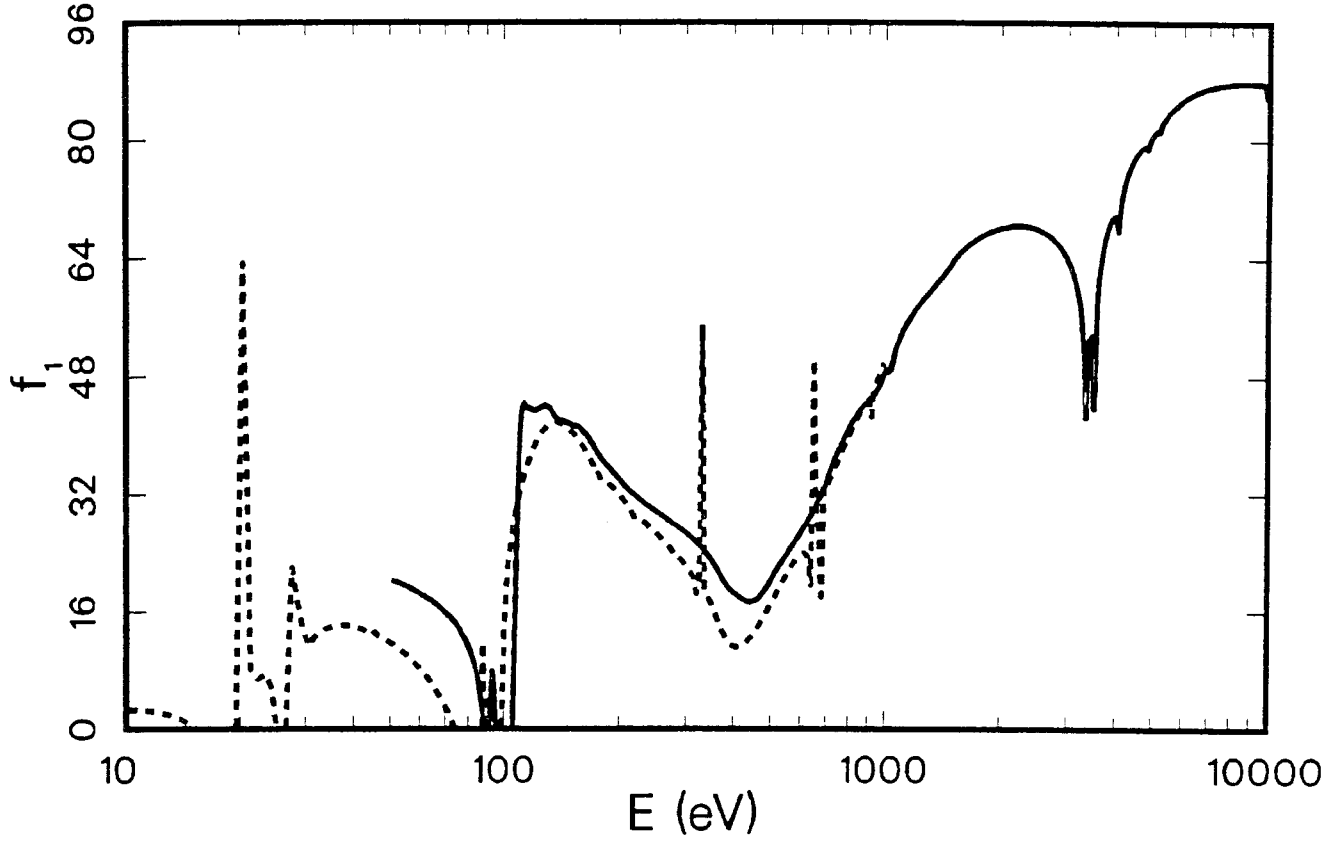
Atomic Scattering Factors, f_1+if_2
89 - Actinium (Ac)

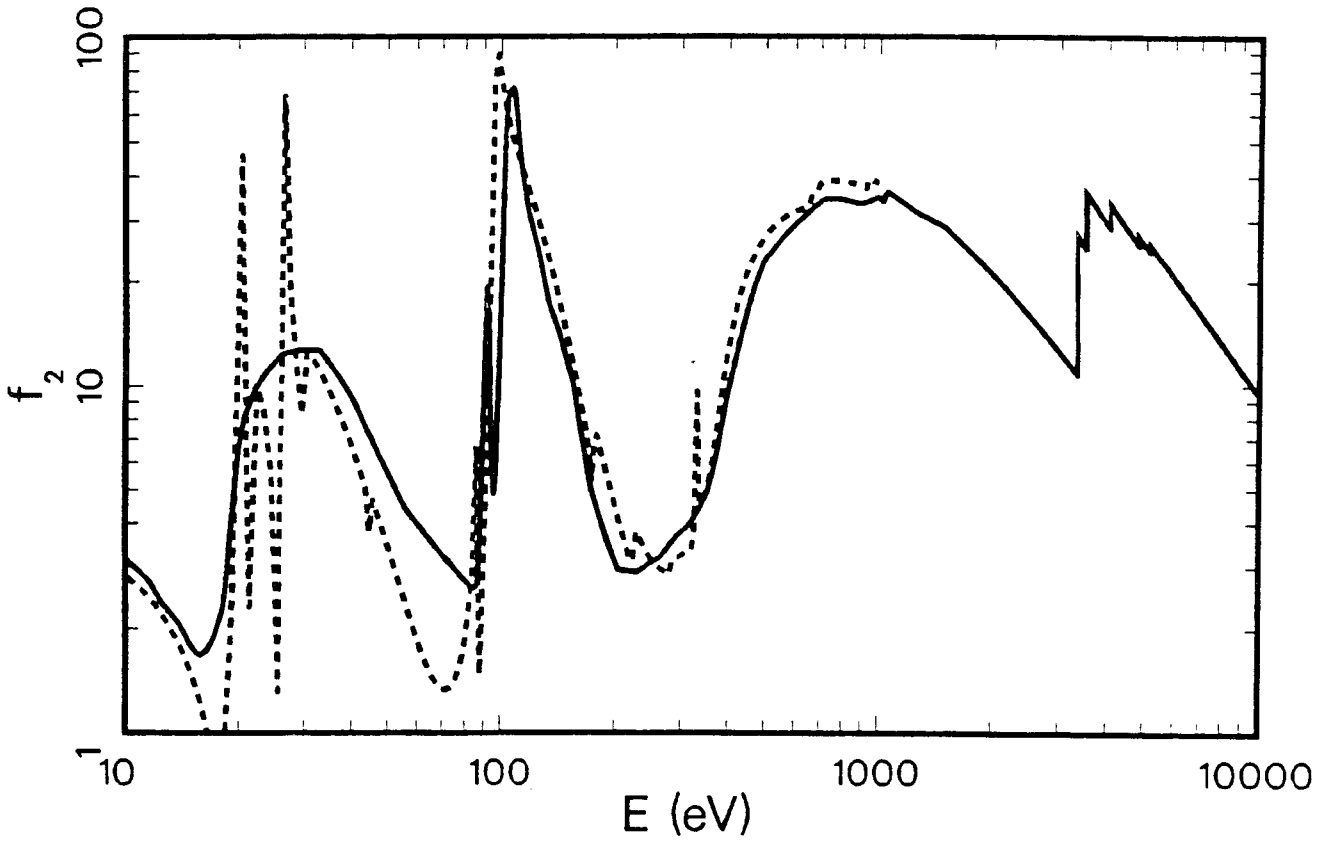


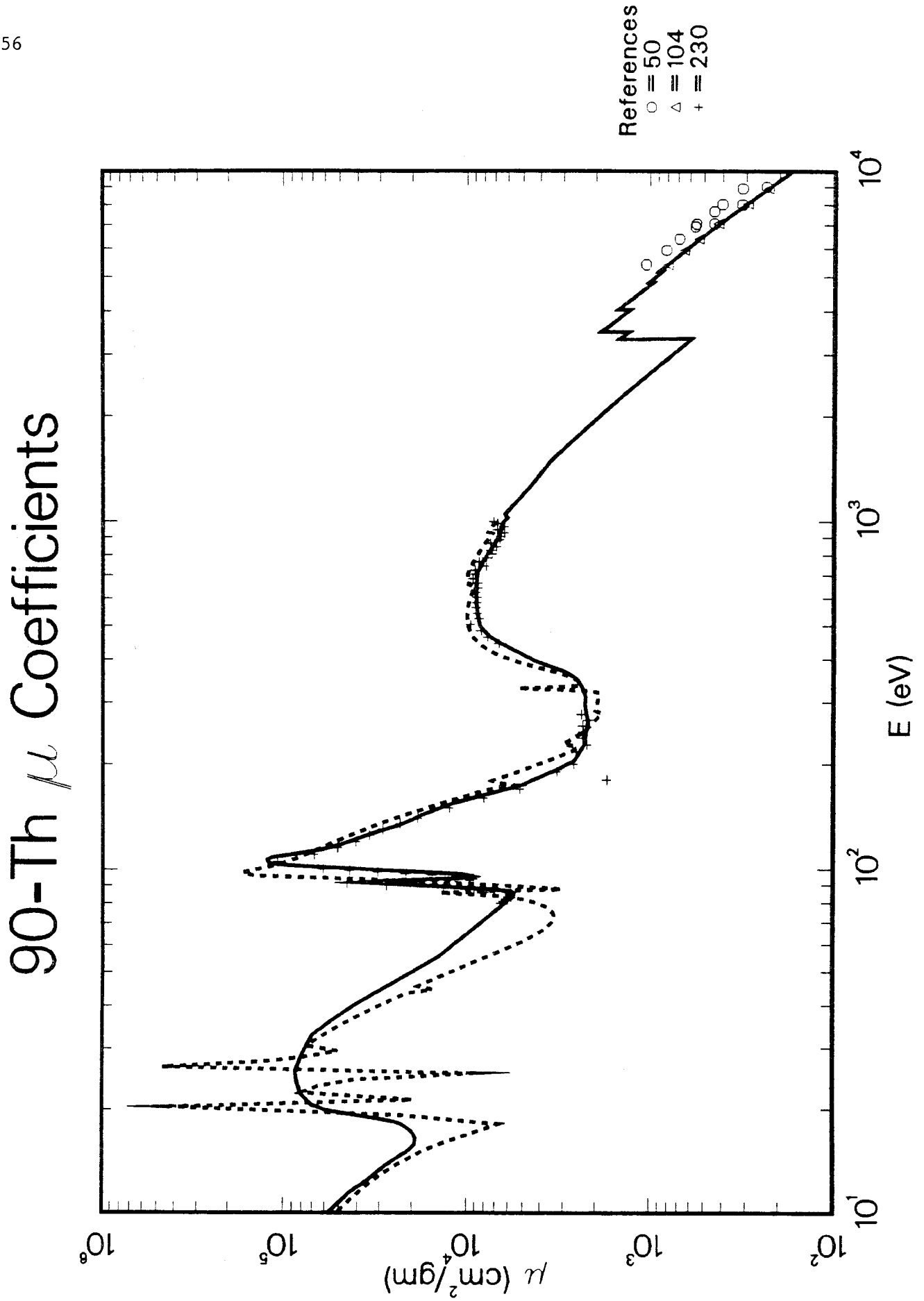



89-Ac μ Coefficients
μ (cm²/gm)
10²
10³
10⁴
10⁵
10⁶
E (eV)
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
90 - Thorium (Th)






90-Th μ Coefficients
References
○ = 50
△ = 104
+ = 230
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Thorium (Th) — 90

Atomic Weight = 232.04

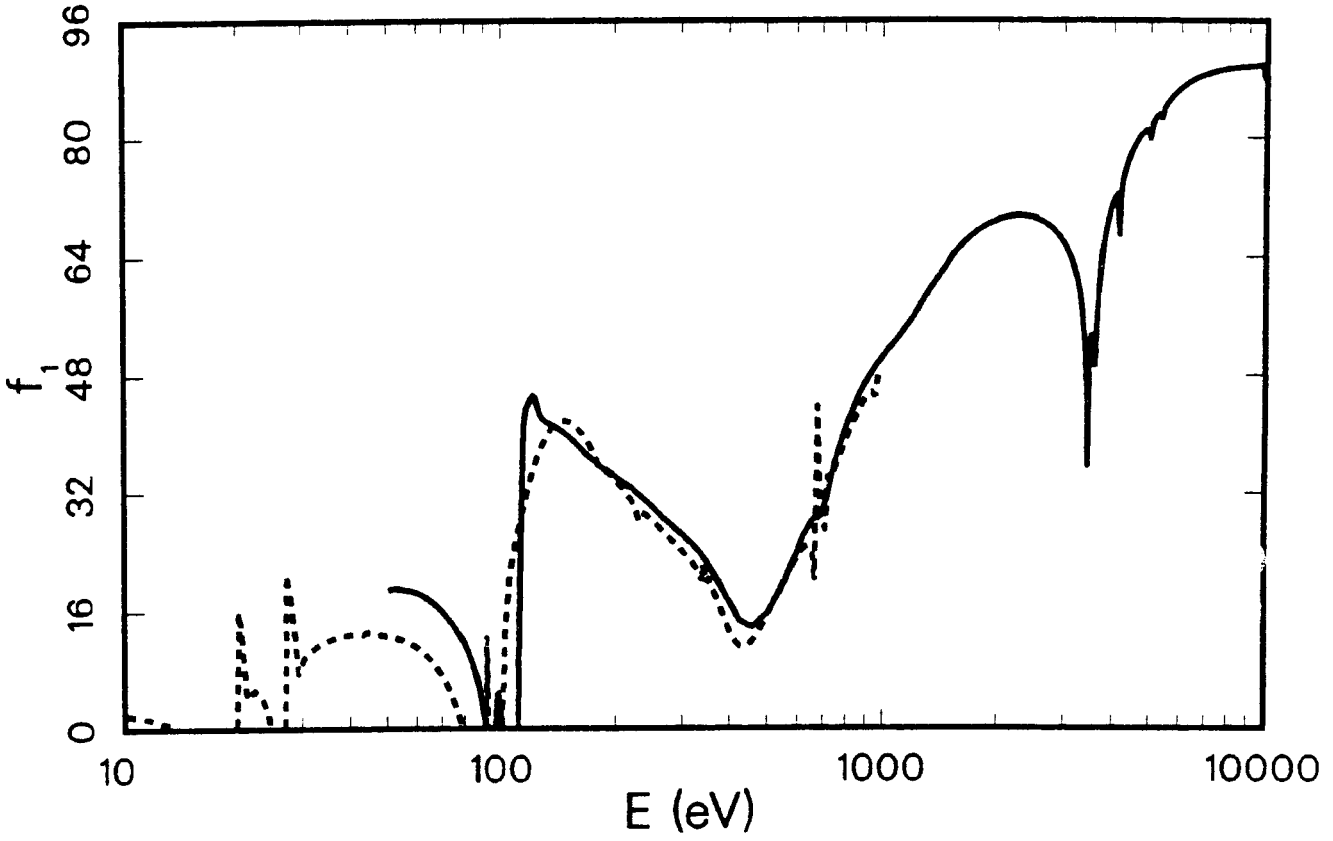
μ (barns/atom) = $\mu(cm^2/g) \times 385.31$

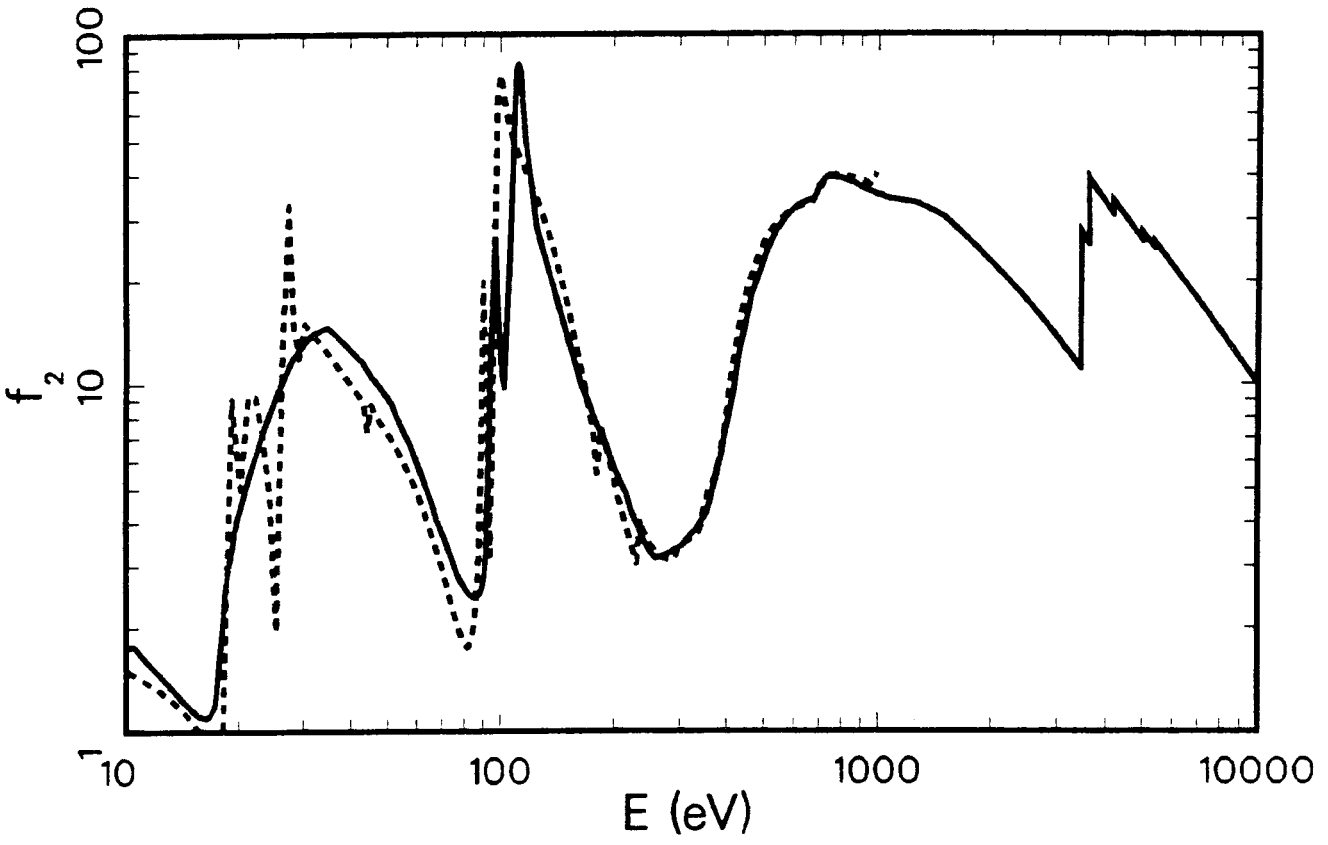
$E\mu(E) = 181.3 f_2$ keV cm^2/g

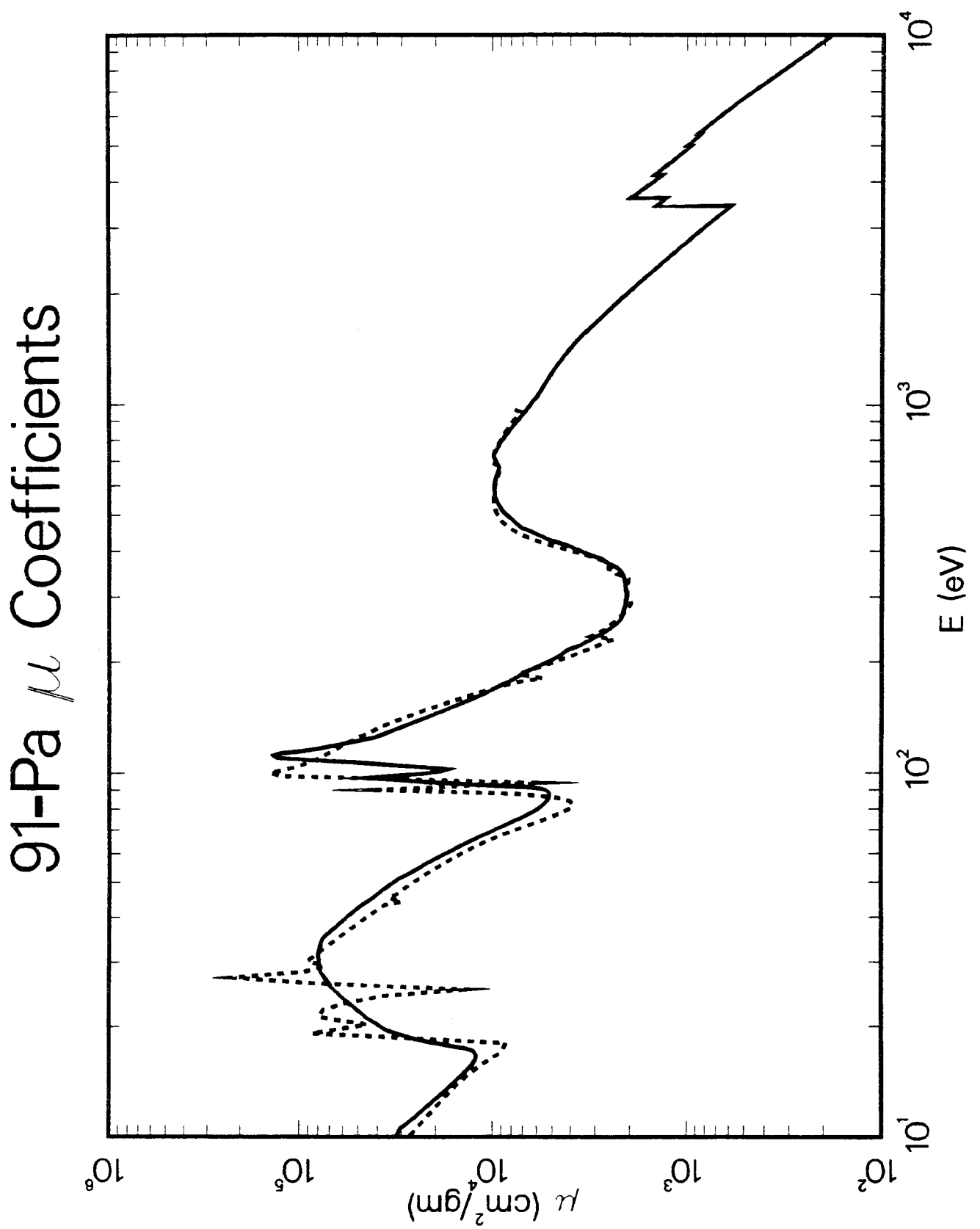
E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5411.0	1.05e+3	30.9	50
5946.0	8.12e+2	27.6	50
6399.0	6.90e+2	30.2	50
6925.0	5.62e+2	29.3	50
7057.0	5.53e+2	33.4	50
7058.0	4.43e+2	6.9	50
7649.0	4.44e+2	31.4	50
8000.0	3.16e+2	4.7	50
8023.0	4.01e+2	34.1	50
8904.0	3.14e+2	37.1	50
9000.0	2.34e+2	5.2	50
9962.0	1.78e+2	3.6	50
5400.0	7.97e+2	-1.3	104
5940.0	6.44e+2	0.8	104
6400.0	5.37e+2	1.4	104
7060.0	4.22e+2	1.9	104
8040.0	2.95e+2	-0.8	104
8900.0	2.28e+2	-0.6	104
80.0	6.48e+3	4.6	230
81.0	6.31e+3	4.3	230
82.0	6.00e+3	1.8	230
83.0	5.77e+3	1.5	230
84.0	5.77e+3	2.9	230
85.0	5.78e+3	4.2	230
86.0	8.01e+3	42.9	230
87.0	7.04e+3	15.3	230
88.0	9.07e+3	14.8	230
89.0	1.35e+4	9.5	230
90.0	2.77e+4	45.2	230
91.0	4.57e+4	55.2	230
92.0	1.93e+4	-56.8	230
93.0	9.57e+3	-59.5	230
94.0	9.14e+3	-27.2	230
95.0	1.16e+4	24.7	230
96.0	1.55e+4	69.7	230
97.0	2.16e+4	92.7	230
98.0	3.09e+4	84.0	230
99.0	4.42e+4	76.5	230
100.0	6.14e+4	64.9	230
105.0	1.07e+5	-10.8	230
110.0	6.86e+4	-26.5	230
115.0	5.12e+4	-12.1	230
120.0	4.07e+4	-8.3	230
125.0	3.44e+4	-3.9	230
130.0	2.89e+4	2.5	230
135.0	2.33e+4	3.1	230
140.0	1.86e+4	-4.4	230
150.0	1.25e+4	-11.1	230
160.0	8.04e+3	-14.2	230
170.0	5.18e+3	-14.0	230

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
180.0	1.72e+3	-60.9	230
190.0	3.24e+3	-6.6	230
200.0	2.62e+3	-7.4	230
217.0	2.55e+3	4.8	230
227.0	2.22e+3	-3.8	230
237.0	2.35e+3	3.7	230
247.0	2.34e+3	4.4	230
257.0	2.35e+3	6.3	230
267.0	2.20e+3	-0.2	230
277.0	2.39e+3	7.0	230
444.0	6.69e+3	2.6	230
464.0	7.70e+3	4.0	230
484.0	8.40e+3	4.2	230
504.0	9.58e+3	12.3	230
524.0	8.54e+3	-1.3	230
544.0	8.76e+3	-0.2	230
564.0	8.92e+3	0.9	230
584.0	8.79e+3	-0.9	230
604.0	8.82e+3	-0.9	230
624.0	8.93e+3	0.4	230
644.0	8.72e+3	-1.8	230
664.0	8.69e+3	-2.0	230
684.0	9.33e+3	5.5	230
704.0	8.97e+3	1.8	230
724.0	9.05e+3	4.7	230
744.0	7.86e+3	-6.6	230
764.0	8.61e+3	5.2	230
784.0	7.81e+3	-1.9	230
804.0	7.30e+3	-5.7	230
824.0	7.45e+3	-0.6	230
844.0	6.92e+3	-4.8	230
864.0	7.46e+3	5.6	230
884.0	6.67e+3	-3.2	230
904.0	6.55e+3	-2.9	230
924.0	6.29e+3	-5.3	230
944.0	6.83e+3	4.1	230
964.0	6.30e+3	-2.9	230
984.0	6.87e+3	7.1	230
994.0	7.15e+3	12.1	230

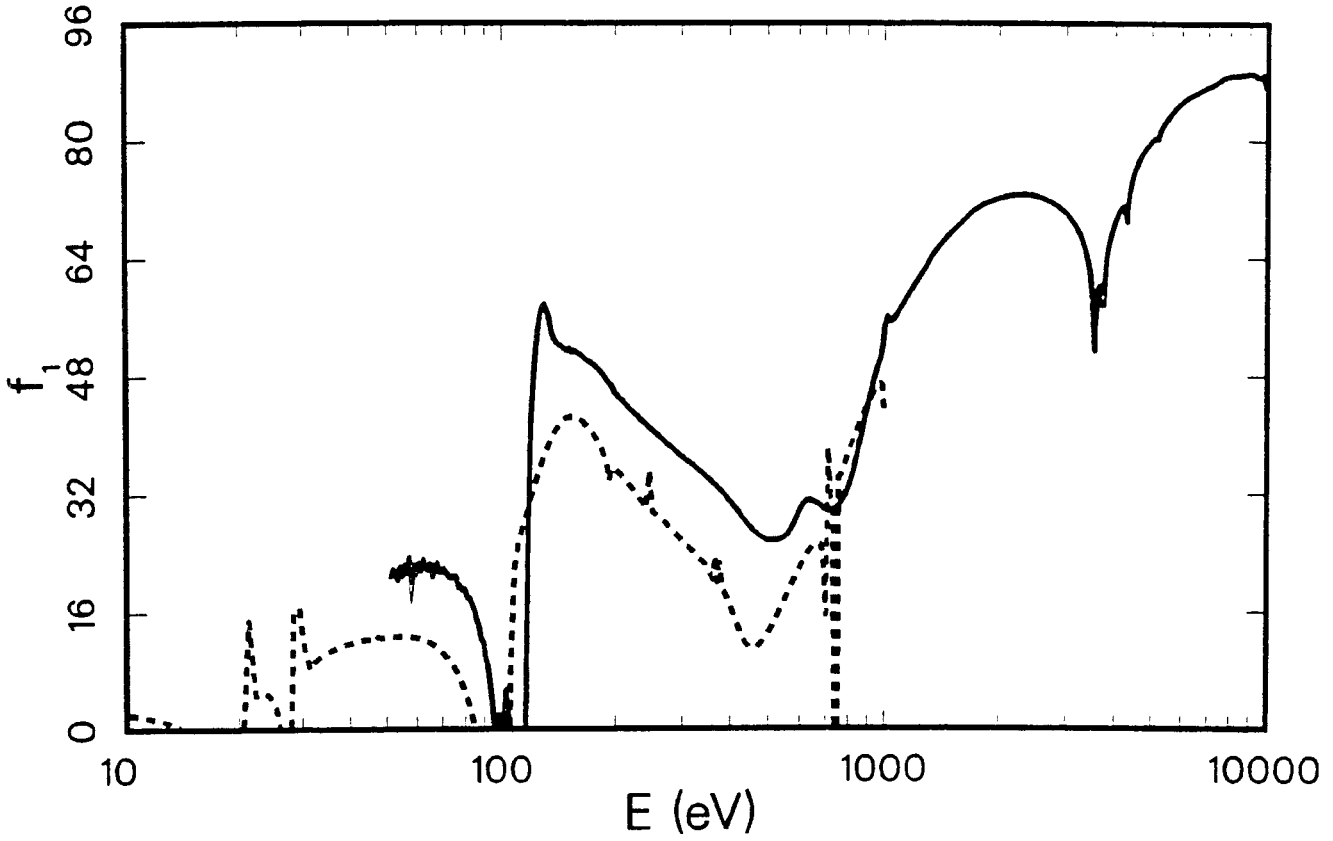
Atomic Scattering Factors, f_1+if_2
91 - Protactinium (Pa)

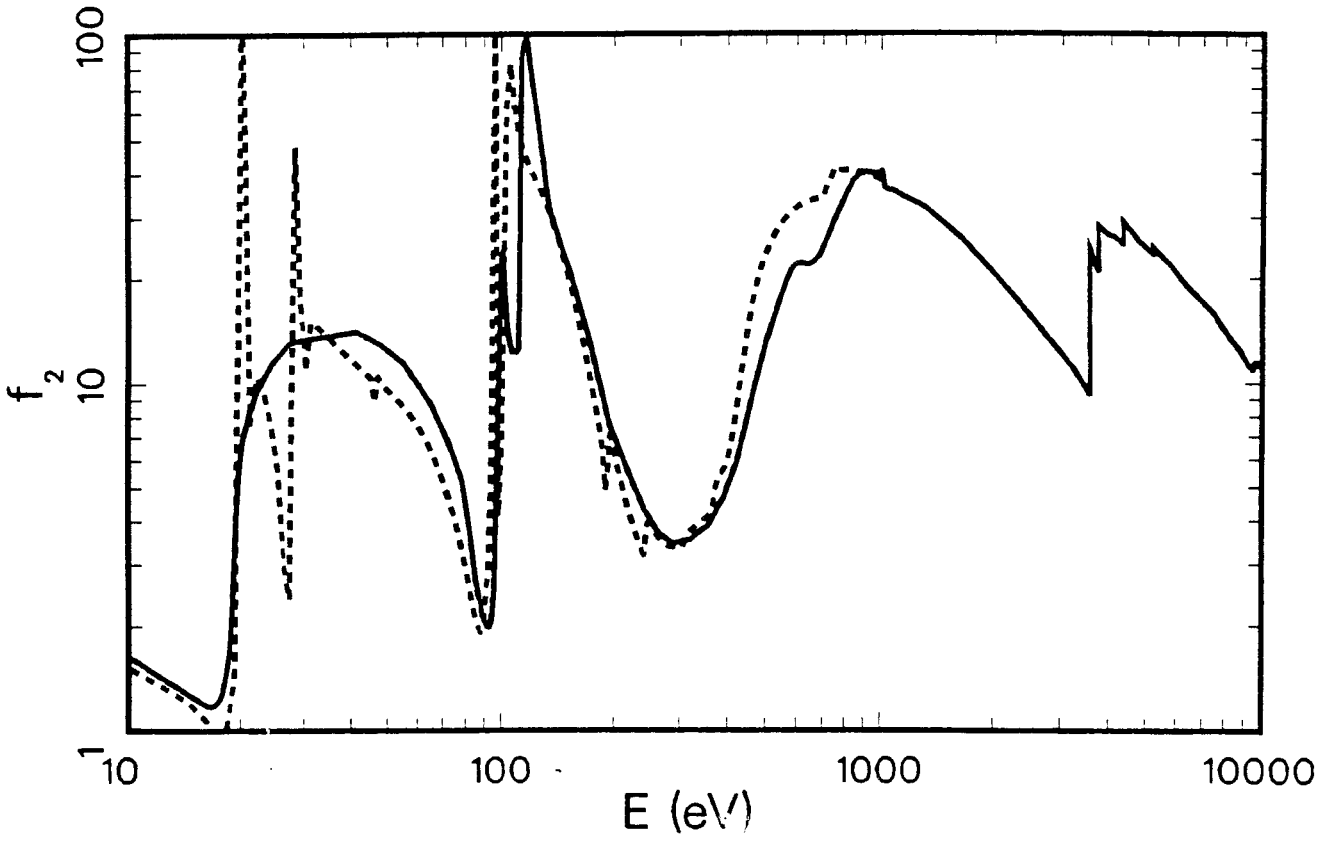


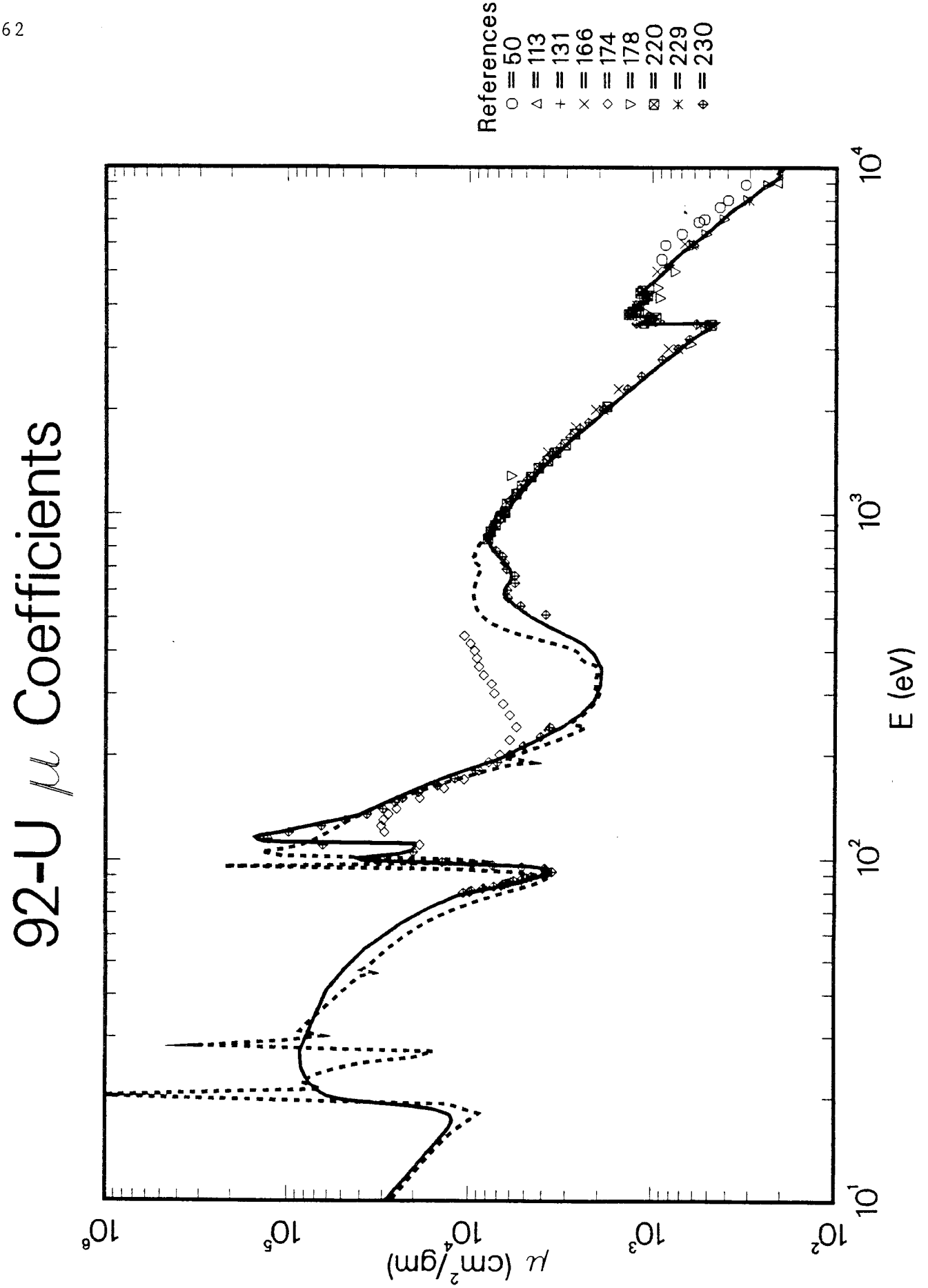



91-Pa μ Coefficients
μ (cm²/gm)
10²
10³
10⁴
10⁵
10⁶
E (eV)
10¹
10²
10³
10⁴

Atomic Scattering Factors, f_1+if_2
92 - Uranium (U)






92-U μ Coefficients
References
○ = 50
△ = 113
+ = 131
× = 166
◇ = 174
▽ = 178
⊠ = 220
✳ = 229
⊕ = 230
μ (cm²/gm)
E (eV)
10²
10³
10⁴
10⁵
10⁶
10¹
10²
10³
10⁴

Uranium (U) — 92

Atomic Weight = 238.03

μ (barns/atom) = $\mu(cm^2/g) \times 395.26$

$E\mu(E) = 176.8\, f_2$ keV cm^2/g

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
5411.0	8.94e+2	16.8	50
5946.0	8.54e+2	37.7	50
6399.0	6.98e+2	33.6	50
6925.0	5.68e+2	28.5	50
7057.0	5.32e+2	25.2	50
7649.0	4.41e+2	24.7	50
8023.0	3.96e+2	27.5	50
8904.0	3.17e+2	32.3	50
9000.0	2.14e+2	-8.0	113
9959.0	1.84e+2	-6.1	131
10000.0	1.81e+2	-6.7	131
1500.0	3.80e+3	14.1	166
1775.0	2.69e+3	14.1	166
2000.0	2.09e+3	15.6	166
2293.0	1.55e+3	16.3	166
3000.0	8.25e+2	15.5	166
3520.0	5.57e+2	16.9	166
4000.0	1.23e+3	4.8	166
5000.0	9.49e+2	9.4	166
6000.0	6.73e+2	10.9	166
9961.0	1.89e+2	-3.5	166
10000.0	6.71e+3	3360.3	166
110.0	1.87e+4	-5.9	174
120.0	2.96e+4	-73.2	174
125.0	3.09e+4	-60.6	174
130.0	3.01e+4	-44.9	174
135.0	2.81e+4	-30.5	174
140.0	2.53e+4	-26.9	174
150.0	1.87e+4	-27.6	174
160.0	1.37e+4	-28.9	174
170.0	1.06e+4	-26.4	174
180.0	8.85e+3	-16.6	174
190.0	7.84e+3	-0.4	174
200.0	6.83e+3	10.0	174
220.0	6.07e+3	39.1	174
240.0	5.57e+3	74.4	174
260.0	6.07e+3	138.7	174
280.0	6.58e+3	198.3	174
300.0	7.34e+3	259.6	174
320.0	7.59e+3	289.4	174
340.0	8.35e+3	331.9	174
360.0	8.85e+3	354.3	174
380.0	9.11e+3	341.9	174
400.0	9.36e+3	320.5	174
420.0	9.87e+3	300.0	174
442.0	1.06e+4	257.7	174
1282.0	5.92e+3	32.8	178
3100.0	6.25e+2	-5.7	178
3400.0	5.25e+2	0.4	178
3600.0	9.16e+2	-19.0	178

E(eV)	$\mu(cm^2/g)$	% Error	Ref.
3800.0	1.07e+3	-17.5	178
4200.0	9.06e+2	-16.6	178
4500.0	9.29e+2	-14.3	178
5000.0	7.54e+2	-13.1	178
5940.0	6.02e+2	-3.1	178
6400.0	5.19e+2	-0.7	178
7060.0	4.14e+2	-2.4	178
8040.0	3.08e+2	-0.3	178
8900.0	2.39e+2	-0.5	178
10000.0	1.80e+2	-7.2	178
844.0	7.98e+3	-1.0	220
884.0	7.70e+3	-4.2	220
925.0	7.27e+3	-5.4	220
975.0	6.80e+3	-6.3	220
1006.0	6.47e+3	-9.1	220
1066.0	6.29e+3	6.1	220
1137.0	5.64e+3	5.0	220
1200.0	5.23e+3	6.0	220
1270.0	4.68e+3	3.5	220
1350.0	4.26e+3	4.6	220
1420.0	3.81e+3	3.0	220
1500.0	3.46e+3	3.9	220
1580.0	3.05e+3	1.3	220
1700.0	2.72e+3	4.7	220
2040.0	1.80e+3	4.2	220
3520.0	4.90e+2	2.9	220
3569.0	1.12e+3	-4.7	220
3623.0	1.04e+3	-5.5	220
3692.0	9.60e+2	-6.8	220
3765.0	1.36e+3	15.1	220
3840.0	1.30e+3	2.6	220
3918.0	1.24e+3	1.8	220
4000.0	1.20e+3	1.5	220
4161.0	1.12e+3	1.2	220
4270.0	1.07e+3	-3.1	220
4340.0	1.18e+3	5.4	220
4410.0	1.14e+3	0.9	220
9961.0	1.82e+2	-6.8	220
1486.7	3.54e+3	4.5	229
1500.0	3.46e+3	3.9	229
2000.0	1.90e+3	5.2	229
3000.0	7.33e+2	2.6	229
5946.7	6.17e+2	-0.4	229
6000.0	6.06e+2	-0.2	229
8000.0	3.03e+2	-3.3	229
9961.5	1.83e+2	-6.8	229
10000.0	1.81e+2	-6.8	229
80.0	1.07e+4	6.7	230
80.6	9.90e+3	5.1	230
81.2	9.68e+3	9.5	230

E(eV)	μ(cm^2/g)	% Error	Ref.
82.1	8.41e+3	4.4	230
82.7	8.33e+3	10.9	230
83.3	7.33e+3	4.5	230
83.9	6.71e+3	2.4	230
84.5	6.64e+3	8.5	230
84.8	6.41e+3	8.5	230
85.4	6.15e+3	11.2	230
86.0	5.96e+3	13.5	230
86.6	5.73e+3	13.9	230
87.3	5.20e+3	8.8	230
88.1	4.87e+3	7.9	230
89.0	4.62e+3	9.1	230
90.2	3.90e+3	-3.0	230
91.1	3.77e+3	-3.3	230
92.0	3.57e+3	-6.9	230
92.9	3.85e+3	1.8	230
94.1	3.90e+3	-0.7	230
95.0	5.18e+3	28.3	230
96.2	7.44e+3	6.4	230
97.1	9.58e+3	-14.7	230
98.0	1.40e+4	-22.1	230
98.9	2.09e+4	-27.1	230
99.8	3.09e+4	-32.0	230
100.0	3.32e+4	-34.1	230
105.0	2.04e+4	-8.7	230
110.0	6.40e+4	221.3	230
115.0	1.28e+5	-12.8	230
120.0	9.86e+4	-10.7	230
125.0	6.50e+4	-17.0	230
130.0	4.86e+4	-11.0	230
135.0	3.69e+4	-8.7	230
140.0	3.02e+4	-12.7	230
146.0	2.58e+4	-11.0	230
150.0	2.34e+4	-9.5	230
156.0	1.90e+4	-12.3	230
163.0	1.48e+4	-15.7	230
171.0	1.19e+4	-15.3	230
180.0	9.21e+3	-13.3	230
190.0	7.03e+3	-10.7	230
200.0	6.06e+3	-2.4	230
212.0	5.11e+3	2.1	230
225.0	4.12e+3	2.6	230
236.0	3.72e+3	9.9	230
240.0	3.66e+3	14.7	230
510.0	3.88e+3	-20.6	230
540.0	5.34e+3	-5.6	230
570.0	6.24e+3	-1.3	230
600.0	6.26e+3	-3.4	230
630.0	5.72e+3	-6.9	230
660.0	5.74e+3	-4.2	230
690.0	6.34e+3	4.1	230
720.0	6.48e+3	-0.3	230
750.0	6.66e+3	-4.2	230
780.0	7.20e+3	-2.3	230
844.0	7.98e+3	-1.0	230

E(eV)	μ(cm^2/g)	% Error	Ref.
854.0	7.96e+3	-1.2	230
864.0	7.85e+3	-2.4	230
874.0	7.70e+3	-4.2	230
884.0	7.70e+3	-4.1	230
904.0	7.46e+3	-5.2	230
935.0	7.14e+3	-5.9	230
965.0	6.84e+3	-6.3	230
995.0	6.53e+3	-8.9	230
1006.0	6.47e+3	-9.1	230
1046.0	6.39e+3	5.5	230
1086.0	6.08e+3	5.5	230
1107.0	5.91e+3	5.5	230
1147.0	5.60e+3	5.7	230
1178.0	5.32e+3	4.6	230
1210.0	5.08e+3	4.3	230
1250.0	4.89e+3	5.6	230
1280.0	4.59e+3	2.8	230
1340.0	4.24e+3	2.6	230
1400.0	4.00e+3	5.3	230
1470.0	3.61e+3	4.3	230
1557.0	3.26e+3	5.1	230
1660.0	2.88e+3	5.3	230
1760.0	2.55e+3	6.2	230
1835.0	2.29e+3	4.6	230
2000.0	1.90e+3	5.2	230
2293.0	1.38e+3	3.6	230
2500.0	1.16e+3	6.0	230
2800.0	8.87e+2	5.9	230
3000.0	7.33e+2	2.7	230
3200.0	6.36e+2	3.2	230
3500.0	5.00e+2	3.5	230
3538.0	5.86e+2	18.7	230
3547.0	1.24e+3	62.0	230
3574.0	1.07e+3	-7.9	230
3613.0	1.02e+3	-8.0	230
3662.0	9.97e+2	-5.6	230
3713.0	1.06e+3	4.6	230
3765.0	1.37e+3	15.1	230
3818.0	1.33e+3	3.8	230
3907.0	1.25e+3	2.2	230
4025.0	1.18e+3	0.7	230
4180.0	1.09e+3	-0.8	230
4300.0	1.09e+3	-2.0	230
4400.0	1.16e+3	2.1	230

Bibliography

1. Barkla, C. G., and Sadler, C. A., Philos. Mag. **14**, 408–422 (1907).
2. Barkla, C. G., and Sadler, C. A., Philos. Mag. **17**, 736–760 (1909).
3. Whiddington, R., Proc. R. Soc. Lond. **85**, 323–331 (1911).
4. Allen, S. J. M., Phys. Rev. **28**, 907–922 (1926).
5. Jonsson, E., Ph. D. Dissertation (University of Uppsala, Sweden, 1928).
6. Kurtz, H., Ann. Phys. **85**, 529–551 (1928).
7. Backhurst, I., Philos. Mag. **7**, 353–373 (1929).
8. Colvert, W. W., Phys. Rev. **36**, 1619–1624 (1930).
9. Woernle, B., Ann. Phys. (Leipzig) **5**, 475–506 (1930).
10. Coster, D., and Veldkamp, J., Z. Phys. **70**, 306–316 (1931).
11. Dershem, E., and Schein, M., Phys. Rev. **37**, 1238–1245 (1931).
12. Kustner, H., Z. Phys. **70**, 468–491 (1931).
13. Spencer, R. G., Phys. Rev. **39**, 178 (1932); see also: Phys. Rev. **38**, 1932–1937 (1931).
14. Uber, F. M., Phys. Rev. **38**, 217–224 (1931).
15. Crowther, J. A., and Orton, L. H. H., Philos. Mag. **13**, 505–523 (1932).
16. Kustner, H., Z. Phys. **77**, 52–59 (1932).
17. Martin, L. H., and Lang, K. C., Proc. R. Soc. Lond. A **137**, 199–216 (1932).
18. Messner, R. H., Z. Phys. **85**, 727–740 (1933).
19. Allen, S. J. M., Phys. Rev. **45**, 122–123 (1934).
20. Carr, L. H., Phys. Rev. **46**, 92–95 (1934).
21. Grosskurth, K., Ann. Phys. (Leipzig) **20**, 197–232 (1934).
22. White, T. N., Phys. Rev. **46**, 865–867 (1934).
23. Bandopadhyaya, G.B., and Maitra, A. T., Philos. Mag. **21**, 869–880 (1936).
24. Biermann, H. H., Ann. Phys. **26**, 740–760 (1936).
25. Schulz, K., Ann. Phys. **27**, 1–14 (1936).
26. Callisen, F. I., Z. Phys. **107**, 15–43 (1937).
27. Hill, R. D., Proc. R. Soc. Lond. A **161**, 284–294 (1937).
28. Andrews, C. L., Phys. Rev. **54**, 994–999 (1938).

29. Hansen, H., Ann. Phys. **35**, 524–546 (1939).

30. Wrede, W., Ann. Physik (Leipzig) **36**, 681–695 (1939).

31. Laubert, S., Ann. Phys. (Leipzig) **40**, 553–578 (1941).

32. Tomboulian, D. H., Pell, E. M., Phys. Rev. **83**, 1196–1201 (1951).

33. Hubbell, J., (unpublished work, 1953, obtained from Ref. 233).

34. Lee, P., and Weissler, G. L., Proc. R. Soc. Lond. A **219**, 71–76 (1953).

35. Townsend, J. R., Phys. Rev. **92**, 556–560 (1953) .

36. Johnston, R. W., and Tomboulian, D. H., Phys. Rev. **94**, 1585–1589 (1954).

37. Chipman, D. R., J. Appl. Phys. **26**, 1387 (1955).

38. Lee, P., and Weissler, G. L., Phys. Rev. **99**, 540–542 (1955).

39. Woodruff, R. W., and Givens, M. P., Phys. Rev. **97**, 52–54 (1955).

40. Tomboulian, D. H., and Bedo, D. E., Phys. Rev. **104**, 590–597 (1956).

41. Baurmann, E., and Ulmer, K., Z. Naturforsch. **12A**, 670–671 (1957).

42. Olmer, P., and Champier, G., C. R. Acad. Sci. **245**, 542–543 (1957).

43. Tomboulian, D. H., Bedo, D. E., and Neupert, W. M., J. Phys. Chem. Solids **3**, 282–302 (1957).

44. Batterman, B. W., Rev. Sci. Instrum. **29**,1132 (1958).

45. Ergun, S., and Tiensuu, V., J. Appl. Phys. **29**, 946–949 (1958).

46. Axelrod, N. N., and Givens, M. P., Phys. Rev. **115**, 97 (1959).

47. Batterman, B. W., Phys. Rev. **115**, 81–86 (1959).

48. Deslattes, R. D., Ph. D. Dissertation (John Hopkins Univ., Baltimore, MD 1959); AFOSR-TN-58-784 (1958).

49. Hopkins, J. I., J. Appl. Phys. **30**, 185–187 (1959).

50. Roof, R. B., Jr., Phys. Rev. **113**, 820–825 (1959).

51. Ditchburn, R. W., Proc. Phys. Soc. **75**, 461–462 (1960).

52. Ehrenfried, C. E., and Dodds, D. E., AFSWC-TN-59-33, **56** (1960).

53. Ganeev, A. S., and Izrailev, I. M., Sov. Phys. Tech. Phys. **5**, 1016–1017 (1960).

54. Matin, P., Ph. D. Thesis (Vanderbilt Univ., Nashville, TN 1960).

55. Pery-Thorne, A. and Garton, W. R. S., Proc. Phys. Soc. **76**, 833–843 (1960).

56. Baker, D. J., Bedo, D. E., and Tomboulian, D. H., Phys. Rev. **124**, 1471–1476 (1961).

57. Bonse, U., Z. Phys. **161**, 310–329 (1961).

58. Nordfors, B., Ark. Fys. **20**, 1–23 (1961).

59. Sweeny, W. R., Seal, R. T., and Birks, L. S., Spectrochim. Acta **17**,364–365 (1961).

60. Baker, D. J., Jr., and Tomboulian, D. H., Phys. Rev. **128**, 677–680, (1962).

61. Batterman, B. W., Phys. Rev. **126**, 1461–1469 (1962).

62. Buckman, W. G., Ph. D. Thesis (Vanderbilt Univ., Nashville, TN 1962).

63. Dyer, G. R., Ph. D. Thesis (Emory Univ., Atlanta, GA 1962).

64. Noreland, E., Ark. Fys. **23**, 273–281 (1962).

65. Schnopper, H. W., Ph. D. Thesis (Cornell Univ., Ithaca, NY 1962).

66. Vodar, B., J. Quant. Spectrosc. Radiat. Transfer. **2**, 393–412 (1962).

67. Kroger, H. and Tomboulian, D. H., Phys. Rev. **130**, 152–154 (1963).

68. Lukirskii, A. P., and Zimkina, T. M., Bull. Acad. Sci. USSR, Phys. Ser. **27**, 817–820 (1963).

69. Sorum, H., Phys. Norv. **1**, 157–164 (1963).

70. Alexander, R. W., Ederer, D. L., and Tomboulian, D. H. Bull. Am. Phys. Soc. (Ser. 2) **9**, 626 (1964).

71. Batterman, B. W., Phys. Rev. **133**, 1759–1764 (1964).

72. Cole, M., Woodhouse, J. B., and Hughes, G. D., Technical Report, U. S. Dept. of Army, E. R. O. Contract DA-91-591-EUC 3094 (1964).

73. Cooke, B. A., and Stewardson, E. A., Br. J. Appl. Phys. **15**, 1315–1319 (1964).

74. Ederer, D. L., Phys. Rev. Lett. **13**, 760–762 (1964).

75. Ederer, D. L., and Tomboulian, D. H., Phys. Rev. **133**, A1525–1532 (1964).

76. Karev, V. N., Zavod. Lab. **30**, 548–551 (1964).

77. Lefeld-Sosnowska, M., Phys. Status Solidi **7**, 449–462 (1964).

78. Lukirskii, A. P., Brytov, I. A., and Zimkina, T. M., Opt. Spectrosc. **17**, 234–237 (1964).

79. Lukirskii, A. P., Savinov, E. P., Ershov, O. A., and Shepelev, Y. F., Opt. Spectrosc. (USSR) **16**, 168–172 (1964).

80. Ogier, W. T., Lucas, G. J., and Park, R. J., Appl. Phys. Lett. **5**, 146–147 (1964).

81. Rustgi, O. P., J. Opt. Soc. Am. **54**, 464–466 (1964).

82. Rustgi, O. P., Fisher, E. I. and Fuller, C. H., J. Opt. Soc. Am. **54** 745–746 (1964).

83. Samson, J. A., J. Opt. Soc. Am. **54**, 420–421 (1964).

84. Samson, J. A., J. Opt. Soc. Am. **54**, 876–877 (1964).

85. Samson, J. A., J. Opt. Soc. Am. **54**, 1491 (1964).

86. Cooper, M. J., Acta Crystallogr. **18**, 813 (1965).

87. Duncumb, P., and Melford, D. A., Proc. 4th Int. Congr. X-Ray Optics and Microanalysis, Paris (1965).

88. Lowry, J. F., Tomboulian, D. H., and Ederer, D. L., Phys. Rev. **137**, A1054–1057 (1965).

89. Matsunga, F. M., Jackson, R. S., and Watanabe, K., J. Quant. Spectrosc. Radiat. Transfer **5**, 329–333 (1965).

90. Merlini, A., and Pace, S., Nuovo Cimento, (Ser. 10) **35**, 377–390 (1965).

91. Prevo, C. T., and Cate, J. L., UCRL-14680, Hazards Control Quarterly Rep., No. **23**, 1–7 (1965).

92. Samson, J. A., J. Opt. Soc. Am. **55**, 935–937 (1965).

93. Watanabe, T., Phys. Rev., **137**, A1380–1382 (1965).

94. Weissmantel, C., and Wunschmann, M., Z. Chem. **5**, 191–193 (1965).

95. Bearden, A. J., J. Appl. Phys. **37**, 1681–1692 (1966).

96. Codling, K., Madden, R. P., Hunter, W. R., and Angel, D. W., J. Opt. Soc. Am. **56**, 189–192 (1966).

97. Gableske, R., and Moring, M., Z. Angew. Phys. **21**, 246–249 (1966).

98. Heinrich, K. F. J., *The Electron Microprobe* (Wiley, New York 1966) p. 296–377.

99. Hunter, W. R., *Optical Properties and Electronic Structures of Metal and Alloys*, ed. F. Abels (North Holland, Amsterdam, 1966) p. 136.

100. Jaegle, P., and Missoni, G., C. R. Acad. Sci., Ser. B **262**, 71–74 (1966).

101. Lukirskii, A. P., Brytov, I. A., and Griborskii, S. A., Opt. Spectrosc. **20**, 203–204 (1966).

102. Lukirskii, A. P., Zimkina, T. M., and Gribovskii, S. A., Sov. Phys. Solid State **8**, 1525–1526 (1966).

103. Baldwin, T. O., Young, F. W., Jr., and Merlini, A., Phys. Rev. **163**, 591–598 (1967).

104. Bezdenezhnykh, G. V., Zapysov, A. L., Israilev, I. M., and Saprykin, V. N., Opt. Spectrosc. **23**, 533 (1967).

105. Carter, R. W., Rohrer, R. H., Carlton, W. R., and Dyer, G. R., Health Physics **13**, 593–599 (1967).

106. DelGrande, N. K., Stinner, R. J., and Oliver, A. J., (Unpublished work, 1967, obtained from Ref. 233).

107. Ershov, O. A., Opt. Spectrosc. **22**, 252–255 (1967).

108. Ershov, O. A., Brytov, I. A., and Lukirskii, A. P., Opt. Spectrosk. **22**,127–134 (1967).

109. Fomichev, V. A., and Lukirskii, A. P., Opt. Spectrosc. **22**, 432–434 (1967).

110. Haensel, R., Kunz, C. and Sonntag, B., Phys. Lett., **25A**, 205–206 (1967).

111. Henke, B. L., Elgin, R. L., Lent, R. E., and Ledingham, R. B., Norelco Reporter **14**, 112–131 (1967).

112. Hudson, R. D., and Carter, V. L., J. Opt. Soc. Am. **57**, 651–654 (1967).

113. Perkin, J. L., and Douglas, A. C., Proc. Phys. Soc., Lond. **92**, 618–621 (1967).

114. Singer, S., J. Appl. Phys. **38**, 2897–2898 (1967).

115. Zhukova, I. I., Fomichev, V. A., and Zimkina, T. M., Bull. Acad. Si. USSR, Phys. Ser. **31**, 967–971 (1967).

116. Zimkina, T. M., Fomichev, V. A., Gribovskii, S. A., and Zhukova, Sov. Phys. - Solid State **9**, 1128–1130 (1967).

117. Combley, F. H., Stewardson, E. A., and Wilson, J. E., J. Phys. B **1**, 120–127 (1968).

118. Deslattes, R. D., Phys. Rev. Lett. **20**, 483–485 (1968).

119. Ekstig, B., Ark. Fys. **37**, 107–116 (1968).

120. Fomichev, V. A., and Zhukova, I. I., Opt. Spectrosc. (USSR) **24**, 147–148 (1968).

121. Fomichev, V. A., and Zhukova, I. I., Opt. Spectrosk. **24**, 284–286 (1968) 122. Haensel, R., Kunz, C., Sasaki, T., and Sonntag, B., Appl. Optics **7**, 301–306 (1968).

123. Hon, P. K., and Heinrich, K. F. J., (unpublished work, 1968, obtained from Ref. 233).

124. Hudson, R. D. and Carter, V. L., J. Opt. Soc. Am. **58**, 430–431 (1968).

125. Jaegle, P., Combet-Farnoux, F., Dhez, P., Cremonese, M., and Onori, G., Phys. Lett. **26A**, 364–365 (1968).

126. Jarvinien, M., Merisalo, M., and Inkinen, O., Phys. Rev. **178**, 1108–1110 (1968).

127. Kohlhaas, E., and Scheiding, F., Proc. 5th Int. Congr. X-Ray Optics and Microanalysis, Tübingen, W. Germany (1968).

128. Weisweiler, W., Proc. 5th Int. Congr. X-Ray Optics and Microanalysis, Tübingen, W. Germany (1968).

129. Alexandropoulos, N. G., Rev. Sci. Instrum. **40**, 952–954 (1969).

130. Dalton, J. L., and Goldak, J., Can. Spectrosc. **14**, 171–173 (1969).

131. Del Grande, N. K., Mallet, J. H., and Oliver, A. J., (Unpublished data and also data listed in Lawrence Livermore National Laboratory, Livermore, CA, UCRL-50174, 1969).

132. Del Grande, N. K., Stinner, R. J.,and Oliver, A. J., (Unpublished data and also data from Lawrence Livermore National Laboratory, Livermore, CA, UCRL-50174, 1969).

133. Efimov, O., and Persson, E., Sov. Phys. Solid State **10**, 1756–1758 (1969).

134. Grimvall, G., and Persson, E., Acta. Crystallogr., Sect. A **25** Part 3, 417–422 (1969).

135. Haensel, R., Sonntag, B., Kunz, C., and Sasaki, T., J. Appl. Phys. **40**, 3046–3047 (1969).

136. Haensel, R., Radler, K., Sonntag, B., and Kunz, C., Solid State Commun. **7**, 1495–1497

(1969).

137. Haensel, R., Keitel, G., Schreiber, P., and Kunz, C., Phys. Rev. **188**, 1375–1380 (1969).

138. Senemaud, G., J. Phys. (Paris) **30**, 811–818 (1969).

139. Sonntag, B., Haensel, R., and Kunz, C., Solid State Commun. **7**, 597 (1969) See also: Sonntag, B., Ph. D. Thesis (Univ. of Hamburg, Hamburg, W. Germany 1969).

140. Wuilleumier, F., Ph. D. Thesis (Lab. Chim. Phys., Paris 1969).

141. Brown, F. C., Gahwiller, C.,Fujita H., Kunz, A. B., Scheifley, W., and Carrera, N., Phys. Rev. B **2**, 2126–2138 (1970).

142. Cardona, M., Gudat, W., Sonntag, B., and Yu, P. Y., DESY F41-70/6 (1970).

143. Denne,D. R., J. Phys. D **3**, 1392–1398 (1970).

144. Denne, D. R., J. Phys. D **3**, 1405–1406 (1970).

145. Dhez, P. and Jaegle, P., CNRS Colloq. No. 196 (1970).

146. Gahwiller C., and Brown, F. C., Phys. Rev. B **2**, 1918–1925 (1970).

147. Haensel, R., Keitel, G., Sonntag, B., Kunz, C., and Schreiber, P., Phys. Stat. Sol. A **2**, 85–90 (1970).

148. Haensel, R., Rabe, P., and Sonntag, B., Solid State Commun. **8**, 1845–1848 (1970).

149. Lublin, P., Cuko, P., and Jaworowski, R. J., *Advances in X-ray Analysis* (Plenum Press, New York, 1970) **13**, p. 632–638.

150. McCrary, J. H., Looney, L. D., and Atwater, H. F., J. Appl. Phys. **41**, 3570–3572 (1970).

151. McCrary, J. H., Looney, L. D., Constanten, C. P., and Atwater, H. F., Phys. Rev. A **2**, 2489–2497 (1970).

152. Ortner, B., Ebel, H., and Lihl, F., Mikrokim. Acta, Suppl. IV, 270–279 (1970).

153. Bennett, S. W., Tellinghuisen, J. B., and Phillips, L. F., J. Physical Chem., **75**, 719–721 (1971).

154. Del Grande, N. K., and Oliver, A. J., Bull. Am. Phys. Soc. (Ser. 2) **16**, 545 (1971).

155. De Reilac, L., and Damany-Astoin, N., J. Phys. C **4**, 32–36 (1971).

156. Ghezzi, C., Merlini, A., and Pace, S., Phys. Rev. B **4**, 1833–1842 (1971).

157. Ottewell, D., Wilson, J. E., and Larrad, A. J., J. Phys. E **4**, 740–742 (1971).

158. Brown, F. C., and O. P. Rustgi, Phys. Rev. Lett. **28**, 497–500 (1972).

159. Kyser, D. F., *Proc. 6th Int. Conf. on X-Ray Optics and Microanalysis* (Univ. of Tokyo Press, Tokyo, Japan 1972) p. 147–156.

160. McClintock, J. E., Levine, A., and Rappaport, S., Rev. Sci. Instr. **43**, 902–905 (1972).

161. Starr, W. L., and Loewenstein, M., J. Geophys. Res. **77**, 4790–4796 (1972).

162. Watson, W. S., J. Phys. B **5**, 2292–2303 (1972).

163. Wolff, H. W., Radler, K., Sonntag, B., and Haensel, R., Z. Physik **257**, 353–368 (1972).

164. Carlson, R. W., Judge, D. L., Ogawa, M., and Lee, L. C., App. Opt. **12**, 409–412 (1973).

165. Comes, F. J., Nielson, U., and Schwarz, W. H. E., J. Chem. Phys. **58**, 2230–2237 (1973).

166. Del Grande, N. K., and Oliver, A. J., Bull. Am. Phys. Soc. **18**, 635 (1973).

167. Giardina, M. D., And Merlini, A., Z. Naturforsch. **28A**, 360–1365 (1973).

168. Gribovskii, S. A. and Zimkina, T. M., Sov. Phys. Sol. Stat. **15**, 217–218 (1973).

169. Henke, B. L., and Ebisu, E. S., *Advances in X-ray Analysis* (Plenum Press, New York, 1973) **17**, p. 150–213.

170. Hildebrandt, G., Stephenson, J. D., and Wagenfield, H., Z. Naturforsch. **28A**, 588–600 (1973).

171. Hribar, M., Kodre, A., Moljk, A., and Pahor, J., Fizika **5**, 171–177 (1973).

172. Millar, R. H. (unpublished work, 1973, obtained from Ref. 233).

173. Sonntag, B., Tuomi, T., and Zimmerer, G., Phys. Stat. Sol. (b) **58**, 101–110 (1973).

174. Cukier,M., Dhez, P., Wuilleumier, F., and Jaegle, P., Phys. Lett. A **48**, 307–308 (1974).

175. Mantler, M., X-Ray Spectrometry **3**, 90–98 (1974).

176. Millar, R.H., and Greening, J. R., J. Phys. B **7**, 2332–2344 (1974).

177. Parthasaradhi, K., and Hansen, H. H., Phys. Rev. A **10**, 563–568 (1974).

178. Rao-Sahib, T. S., and Wittry, D. B., J. Appl. Phys. **45**, 5060–5068 (1974).

179. Rabe, P., Radler, K., Wolff, H. W., Proc. of 4th Inter. Conf. on VUV Rad. Phys., Hamburg, W. Germany, 1974, p. 247–249.

180. Singman, L., J. Appl. Phys. **45**, 1885–1887 (1974).

181. Wehenkel, C., and Gauthe, B., Phys. Lett. **47A**, 253–254 (1974).

182. Calvert, L. D., Killean, R. C. G., and Mathieson, A., Acta Crystallogr. A **31**, 855–856 (1975).

183. Cukier, M., Dhez, P., Jaegle, P., and Farnoux, F. C., Phys. Lett. **51A**, 173–174 (1975).

184. Damany-Astoin, N. (unpublished work, 1975, obtained from Ref. 233).

185. Hagemann, H. J., Gudat, W., and Kunz, C., J. Opt. Soc. Am. **65**, 742–745 (1975).

186. Lang, J., and Watson, W. S., J. Phys. B **8**, L339–343 (1975).

187. Loomis, T. C., and Keith, H. D., Appl. Spectrosc. **29**, 316–322 (1975).

188. Lurio, A., and Reuter, W., Appl. Phys. Lett. **27**, 704–706 (1975).

189. Short, M. A., and Tabock, J. X-Ray Spectrom. **4**, 119–122 (1975).

190. Bordas, J. and West, J. B., Phil. Mag. **34**, 501–505 (1976).

191. Hartl, W., and Hammer, J. W., Z. Phys. A **279**, 135–139 (1976).

192. Senemaud, C., and Costa Lima, M. T., J. Phys. Chem. Solids **37**, 83–87 (1976).

193. Steele, W. J., and Johnson, J.M., Lawrence Livermore National Laboratory, Livermore, CA, UCRL-77839 (1976).

194. West, J. B. and Marr, G. V., Proc. R. Soc. Lond. A **349**, 397–421 (1976).

195. Codling, K., Hamley J. R., and West, J. B., J. Phys. B **10**, 2797–2807 (1977).

196. Creagh, D. C., Phys. Status Solidi A **39**, 705–715 (1977).

197. Jézéquel, G., Lemonnier, J. C., and Thomas, J., J. Phys. F **7**, 1613–1622 (1977).

198. Jézéquel, G., Lemonnier, J. C., and Thomas, J., J. Phys. F **7**, 2613–2621 (1977).

199. Lawrence, J. K., Acta Crystallogr., Sect. A **33**, 343 (1977).

200. Lurio, A., Reuter, W., and Keller, J., *Advances in X-ray Analysis* (Plenum Press, New York 1977) **20**, p. 481–486.

201. Murty, V. R. K., et al., Nuovo Cimento A **39**, 125–130 (1977).

202. Rao, D. V., Govelitz, G. F., and Sastry, K. S. R., Med. Phys. **4**, 109–114 (1977).

203. Rao, K. S., Murty, V. R. K., Parthasaradhi, K., Rao, J. R., and Lakshimarayana, V., Pramana **9**, 321–328 (1977).

204. Samson, J. A. R., Gardner, J. L., and Haddad, G. N., J. Electron Spectrosc. and Related Phenom. **12**, 281–292 (1977).

205. Shahnawaz, and Rao, V. V., Curr. Sci. **46**, 256 (1977).

206. Steele, W. J., Lawrence Livermore National Laboratory, Livermore, CA, UCRL-75503 (1977).

207. Codling, K., Hamley, J. R. and West, J. B., J. Phys. B **11**, 1713–1716 (1978).

208. Ejiri, A., Sugawara, F., and Onuki, H., Jap. J. Appl. Phys. **17** Supplement 17–2 , 204–207 (1978).

209. Marr, G. V., J. Phys. B **11**, L121–123 (1978).

210. Mehlman, G., Ederer, D. L., and Salomon, E. B., J. Chem. Phys. **68**, 1862–1864 (1978).

211. Truong, V. V., LeBlanc, L. J., and Turpin, G. J., J. Opt. Soc. Am. **68**, 1017–1018 (1978).

212. Barrus, M. D., Blake, R. L., Burek, A. J., Chambers, K. C., and Pregenzer, A. L., Phys. Rev. A **20**, 1045–1061 (1979).

213. Berry, A. A., and Lawrence, J. L., Acta Cryst. **35**, 316–318 (1979).

214. Bruhn, R., Sonntag, B., and Wolff, H. W., J. Phys. B **12**, 203–212 (1979).

215. Lawrence, J. L., Acta Crystallogr. A **35**, 845–848 (1979).

216. Puttaswamy, K. S., Gowda, R., and Sanjeevaiah, B., Can. J. Chem. **57**, 92–98 (1979).

217. Hemidy, A., and de Thy, B., Analysis **8**, 138–41 (1980).

218. Samson, J. A., private communication, (1980).

219. Wall, W. E., Ribarsky, M. W., and Stevenson, J. R., J. Appl. Phys. **51**, 661–667 (1980).

220. Del Grande, N. K., and Oliver, A. J., Lawrence Livermore National Laboratory, Livermore, CA, UCRL-85683 (1981).

221. Quemarais, A., Loisel, B., Jézéquel, G., Thomas, J., and Lemonnier, J. C., J. Phys. F **11**, 293–303 (1981).

222. Rao, V. V., Shahanawaz, and Rao D. V., Physica C **111**, 107–110 (1981).

223. Weaver, J. H., Krafka, C., Lynch, D. W., Koch, E. E., *Optical Properties of Metals* (Fachinformationszentrum Energie—Physik—Mathematik, Karlsruhe, W. Germany 1981).

224. Schafer, G. F., and Fischer, K. F., Z. Krystallogr. **159**, 303–309 (1982).

225. Gerward, L., Acta Cryst. A **39**, 322–325 (1983).

226. Filatova, E. O., Vinogradov, A. S., Sorokin, I. A., and Zimkina, T. M., Sov. Phys. Solid State **25**, 736–739 (1983).

227. Girouard, F. E., and Truong, V-V, J. Opt. Soc. Am. B **1**, 76–79 (1984).

228. Samson, J. A. R., and Parek, P. N., Phys. Rev. A **31**, 1470–1476 (1985).

229. Del Grande, N. K., Proc. SPIE **691**, 2–10 (1986).

230. Del Grande, N. K., and Tirsell, K. G., (private communication, 1987).

231. Del Grande, N. K., and Barbee, T. W., (private communication, 1987).

232. Windt, D., Ph. D. Thesis (Univ. of Colorado, Boulder, CO 1987).

233. Saloman, E. B., Hubbell, J. H., and Scofield, J. H., Atomic Data and Nuclear Data Tables **38**, 1–197 (1988).