International Atomic Energy Agency

INDC(NDS)-440
Distr. PG+R

I N D C INTERNATIONAL NUCLEAR DATA COMMITTEE

THERMAL NEUTRON CAPTURE CROSS SECTIONS RESONANCE INTEGRALS AND G-FACTORS

S.F. Mughabghab
Brookhaven National Laboratory
Upton, NY 11973-5000
U.S.A.

Research carried out under the auspices of the U.S. Department of Energy under Prime Contract No. DE-AC02-98CH10886, and under IAEA contract No 11376/USA

February 2003

IAEA NUCLEAR DATA SECTION, WAGRAMER STRASSE 5, A-1400 VIENNA

Reproduced by the IAEA in Austria
February 2003

INDC(NDS)-440
Distr. PG+R

THERMAL NEUTRON CAPTURE CROSS SECTIONS
RESONANCE INTEGRALS AND G-FACTORS

S.F. Mughabghab
Brookhaven National Laboratory
Upton, NY 11973-5000
U.S.A.

Research carried out under the auspices of the U.S. Department of Energy under
Prime Contract No. DE-AC02-98CH10886, and under IAEA contract No 11376/USA

Abstract

The thermal radiative capture cross sections and resonance integrals of elements and isotopes with atomic numbers from 1 to 83 (as well as ^{232}Th and ^{238}U) have been re-evaluated by taking into consideration all known pertinent data published since 1979. This work has been undertaken as part of an IAEA co-ordinated research project on "Prompt capture gamma-ray activation analysis". Westcott g-factors for radiative capture cross sections at a temperature of 300K were computed by utilizing the INTER code and ENDF-B/VI (Release 8) library files. The temperature dependence of the Westcott g-factor is illustrated for ^{113}Cd , ^{124}Xe and ^{157}Gd at temperatures of 150, 294 and 400K. Comparisons have also been made of the newly evaluated capture cross sections of ^{6}Li, ^{7}Li, ^{12}C and ^{207}Pb with those determined by the k_0 method.

February 2003

CONTENTS

THERMAL NEUTRON CAPTURE CROSS SECTIONS RESONANCE INTEGRALS AND G-FACTORS

Thermal neutron radiative capture cross sections play an important role in prompt capture gamma-ray activation analysis. Therefore, this section is devoted to the re-evaluation of these cross sections, as well as the Westcott g-factors, and resonance integrals of the stable nuclides; the temperature dependence of the Wescott g-factors is also briefly described. These re-evaluations are part of an on-going project at the National Nuclear Data Center, Brookhaven National Laboratory, to update the Neutron Cross Sections compendia, Vol. 1, parts A and B, Neutron Resonance Parameters and Thermal Capture Cross Sections, published previously by Academic Press in 1981 and 1984 [1, 2].

1. Methodology

A brief description of the evaluation procedure is presented below. As an initial step in the evaluation procedure, CINDA retrievals were carried out on the relevant quantities, such as thermal capture, scattering and total cross sections, as well as coherent scattering amplitudes for measurements since 1979 (cutoff date of the publication of Neutron Cross Sections, Vol.1, part A). The search engines of the American Physical Society and Elsevier Science Web sites were utilized for the most recent publications, which may not be referenced in CINDA.

Since the present evaluated capture cross sections are applied to test the validity of the k_o methodology, the capture cross sections derived by this technique were not included in the present evaluation. As in previous studies [1, 2], various factors were considered when evaluating the thermal capture cross sections, including the following:

a) normalization of the reported cross section under consideration to recent recommended standard cross sections (^{1}H, ^{14}N, ^{35}Cl, ^{55}Mn, ^{59}Co, ^{197}Au and ^{235}U), half-lives of the product nuclei, branching ratios and conversion coefficients;

b) measurement accuracy;

c) measurement technique (i.e., specific or non-specific), such as an absorption measurement by a pile oscillator method as compared with an activation method;

d) sample characteristics, which include information regarding the isotopic enrichment, impurities, chemistry and sample thickness;

e) measurers' experience and general consistency;

f) characterization of the neutron spectrum;

g) paramagnetic scattering cross sections of rare earth nuclei when dealing with total cross sections;

h) accurate total cross section measurements from which capture cross sections can be obtained, provided the scattering cross sections are well known.

Measured reactor capture cross sections can be converted to 2200 m s^{-1} values in some cases, if the thermal reactor-index and the capture-resonance integrals are known.

The direct capture cross section for near-magic, light and medium nuclides can shed some light on the measured capture cross section. This parameter can be computed within the framework of the Lane-Lynn theory [3-5], and following the Mughabghab procedure outlined in Ref. [4].

Contributions of positive-energy resonances to the thermal capture cross section can be computed and compared with measurements. Negative-energy resonances are postulated for the majority of nuclei in order to achieve consistency between calculations and measurements. However, in some cases such as ^{162}Dy [2], the computed thermal capture cross section can be accounted for in terms of positive-energy resonances.

Finally, consistency between the isotopic and elemental cross-sections is sought. If the initial attempt to achieve this condition is not fulfilled, several iterations are made in the evaluation procedure until this objective is realized

2. Results

2.1 Thermal Neutron Capture Cross Sections

The resulting evaluated thermal capture cross sections for elements Z = 1-60 and Z = 61-92 [6] are summarized in column 3 of Tables I and II respectively, and are compared with previous recommendations [1, 2]. An asterisk in these tables indicates that the units of the relevant quantity are expressed in millibarns. The quoted natural abundances in column 2 are adopted from Ref. [7].[#] Close examination of Tables I and II reveals that the uncertainties of the presently evaluated capture cross sections have been substantially reduced for the following nuclides:

> ^{14}N, ^{24}Mg, ^{25}Mg, ^{28}Si, ^{29}Si, ^{30}Si, ^{32}S, ^{33}S, ^{36}S, ^{47}Ti, ^{49}Ti, ^{51}V, ^{55}Mn, ^{58}Fe, ^{66}Zn, ^{71}Ga, ^{73}Ge, ^{74}Ge, ^{75}As, ^{79}Br, ^{81}Br, ^{82}Kr, ^{83}Kr, ^{105}Pd, ^{108}Cd, ^{117}Sn, ^{128}Xe, ^{136}Ba, ^{137}Ba, ^{146}Nd, ^{148}Nd, ^{150}Nd, ^{144}Sm, ^{156}Gd, ^{174}Yb, ^{174}Hf, ^{182}W, ^{187}Os, ^{192}Os, ^{190}Pt and ^{232}Th, and elements. Mg, Si, S, Ge, Xe, and Ba.

Also, for:

> ^{9}Be, ^{33}S, ^{36}S, ^{49}Ti, ^{104}Ru, ^{117}Sn, ^{128}Xe, ^{137}Ba, ^{144}Sm, ^{187}Os, ^{192}Os, ^{190}Pt, ^{196}Pt, ^{206}Pb, ^{207}Pb and ^{208}Pb (17 nuclides), and element Xe,

the recommended capture cross sections are not consistent with previous evaluation [1, 2], lying outside the sum of the uncertainties of previous and present recommendations. The significant change of the capture cross section of ^{207}Pb from 0.712 ± 0.012 b to 0.620 ± 0.014 b is particularly important, because this cross section is utilized as a standard in thermal neutron capture cross section measurements by the method of prompt gamma rays produced by the capture of thermal neutrons.

[#] Reference 7 contains a comprehensive table that includes two columns of isotopic abundances (6 and 9). Column 6 lists recommended data that describe the "**Best Measurement Available from a Single Terrestrial Source**" as quoted in this report, while column 9 contains "**Representative Isotopic Composition**" (RIC). The RIC values are the best choice of data for most practical applications, since the vast majority of samples in NAA are not directly related to reference materials. Even without individual isotopic analysis, the data in column 9 are judged to be representative of all unspecified samples with the 'range of natural variation' given in column 4 of Ref. 7. **Representative Isotopic Composition** should be used for Prompt Gamma Activation Analysis.

^{14}N is an important standard in capture cross section and gamma-ray spectra measurements. Therefore, all available measured capture cross sections for this nuclide are assembled in Table III [8-10].

2.2 Capture Resonance Integrals

The recommended total resonance capture integrals are generally based on the reported measurements. Furthermore, the capture resonance integrals are computed from the recommended resonance parameters [1, 2], and compared with measurements. Subsequently, adjustments are made until consistency is achieved between measurements and calculations. When measurements have not been made (particularly for compound nuclei that do not activate), the resonance integrals are based on calculations. The evaluated capture resonance integrals of the isotopes and natural elements are summarized in the last column of Tables I and II, in which an asterisk denotes that the units of the relevant quantity are expressed in millibarns.

2.3 Westcott g-factors for Capture, and their Temperature Dependence

The Westcott g-factor is defined elsewhere in this report (ratio of the Maxwellian-averaged capture cross section to the 2200 m s^{-1} cross section). These quantities are calculated from ENDF/B-VI, Release 8 evaluations for a neutron spectrum with a temperature of 300K by means of the ENDF INTER computer code, and are displayed in the fourth column of Tables I and II. A blank entry in the fourth column indicates the lack of an ENDF/B evaluation for that isotope.

Depending on the type of departure of the cross section from 1/v due to the location of resonances close to thermal energy, the temperature dependence of the Westcott g-factor can be an increasing or decreasing function of the neutron temperature [11, 12]. Previous measurements of the temperature dependence of the g-factor were carried out for ^{233}U, ^{235}U and ^{239}Pu fission and for ^{63}Cu, ^{115}In, ^{175}Lu, ^{176}Lu, ^{232}Th and ^{238}U capture in the temperature range 37 to 529K [13], and were compared with values calculated on the basis of ENDF/B-V evaluations [12].

The temperature dependence of the g-factor was calculated in the present study at temperatures of 150, 292 and 400K for ^{113}Cd, ^{124}Xe and ^{157}Gd, whose g-factors are larger than, equal to and smaller than unity, respectively. Results of these calculations are displayed in Table IV. More extensive calculations of the g-factors at several temperatures ranging from 20 to 600K and for other isotopes are summarized elsewhere in this report.(Section 2.1.5). However, the latter values are calculated on the basis of the EAF-99 library. A comparison of the two calculational routes serves to illustrate the dependence of the g-factors on the evaluated capture cross section near the thermal region.

2.4 Comparison of Evaluated Cross Sections with Values Obtained by the k_0 Method

Since the capture cross sections of ^{12}C and ^{6}Li were adopted in this project as tests of the validity of the k_0 methodology, the published capture cross section measurements for these isotopes are summarized in Table V [13-23] and Table VI [13, 24-26]. Note that the capture cross section of ^{12}C (3.89 ± 0.06 mb) as determined by the k_0 method is not consistent with the accurate measurements of Jurney et al. [14], Prestwich et al. [15] and Nichols [18]. Similarly, a significant discrepancy exists for the capture cross section of ^{6}Li (52.6 ± 2.2 mb [13]), which is not consistent with 38.5 ± 3.0 mb obtained by Jurney [24] or 29 ± 8 mb reported by Bartholomew [26] (Table VI). This observation contrasts with the reported capture cross section of ^{7}Li of 45.7 ± 0.9 mb [13], which is in excellent agreement with 45.4 ± 3.0 mb obtained in Ref. [24]. Table VII also shows that there is very good agreement between the result of the k_0 measurement [13] and Blackmon et al. [27] regarding the capture cross section of ^{207}Pb, in contrast to the result derived from the capture cross section of natural Pb (using the pile oscillator method). At the present time, the sources of these discrepancies are not understood, and a close scrutiny of these discrepant cases is highly recommended.

3. Concluding Remarks

The thermal radiative neutron capture cross sections and resonance integrals of elements and isotopes with atomic numbers from 1 to 84, as well as ^{232}Th and ^{238}U, have been re-evaluated by considering recent data published since 1979. Improvements in the accuracy of the recommended cross sections were made in a few cases, while the new measurement supported earlier recommendations for others [1, 2].

The temperature dependence of the Wescott g-factor has been investigated. Characterization of the Maxwellian neutron spectrum is extremely important in the application of the g-factor. Comparisons between the capture cross sections obtained by the k_0 method and other methods were carried out:

> for some nuclei (such as ^{12}C and ^{6}Li), the capture cross sections derived by k_0 method do not support the earlier measurements;
>
> there is excellent agreement between k_0 and other methods for nuclei such as ^{7}Li, ^{9}Be and ^{207}Pb.

The reason for the discrepancies is not known, and further investigations are required to resolve this problem.

Table I. Thermal Neutron Capture Cross Sections of Stable Isotopes and Elements, Z = 1-60.

Asterisk (*) denotes quantity is expressed in millibarns;
[a] reference [7], column 6; [b] reference [6]; [c] reference [1];
[d] value calculated from recommended resonance parameters.

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
H-1	99.9844	0.3326 ± 0.0007	0.3326 ± 0.0007	1.0004	0.149
H-2	0.01557	0.519 ± 0.007*	0.519 ± 0.007*	1.0001	0.23*
He-0					
He-3	0.000134	0.031 ± 0.009*	0.031 ± 0.009*	1.0003	0.014*
He-4	99.99987				
Li-0		0.0449± 0.0030	0.0448 ± 0.0030		
Li-6	7.589	0.0386 ± 0.0036	0.0385 ± 0.0036	1.0003	0.017
Li-7	92.411	0.0454 ± 0.0030	0.0454 ± 0.0030	1.0003	0.020
Be-9	100	8.77 ± 0.35*	7.6 ± 0.08*	1.0003	4.4*
B-00		0.10 ± 0.04	0.10 ± 0.04		
B-10	19.82	0.5 ± 0.1	0.5 ± 0.1	0.9999	0.22
B-11	80.18	5.5 ± 3.3*	5.5 ± 3.3*	1.0005	2.7*
C-00		3.50 ± 0.06*	3.50 ± 0.07*	1.0031	1.57 ± 0.05*
C-12	98.892	3.53 ± 0.05*	3.53 ± 0.07*	1.0031	1.57 ± 0.05*
C-13	1.108	1.37 ± 0.04*	1.37 ± 0.04*		1.7 ± 0.2*
N-00		79.5 ± 1.4*	74.7 ± 7.3*		
N-14	99.6337	79.8 ± 1.4*	75.0 ± 7.5*	1.0001	34 ± 1*
N-15	0.3663	0.024 ± 0.008*	0.024 ± 0.008*	1.0010	0.032*
O-00		0.190 ± 0.019*	0.190 ± 0.019*	1.0005	0.085*
O-16	99.7628	0.190 ± 0.019*	0.190 ± 0.019*	1.0005	0.085*
O-17	0.0372	0.538 ± 0.065*	0.538 ± 0.065*	0.9996	

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
O-18	0.200	0.16 ± 0.01	0.16 ± 0.01		
F-19	100	9.6 ± 0.05*	9.6 ± 0.05*		
Ne-00		39 ± 4*	39 ± 4*		
Ne-20	90.4838	37 ± 4*	37 ± 4*		18*
Ne-21	0.2696	0.666 ± 0.110	0.666 ± 0.110		0.30
Ne-22	9.2465	45.5 ± 6*	45.5 ± 6*		23 ± 3*
Na-23	100	0.530 ± 0.005	0.530 ± 0.005	1.0003	0.311 ± 0.010
Mg-00		63 ± 3*	63 ± 3*		
Mg-24	78.992	53.6 ± 1.5*	51 ± 5*	1.0009	0.032 ± 0.004
Mg-25	10.003	200 ± 5*	190 ± 30*		0.098 ± 0.015
Mg-26	11.005	38.6 ± 6*	38.2 ± 0.8*		0.026 ± 0.002
Al-27	100	231 ± 3*	231 ± 3*	1.0008	0.14 ± 0.01
Si-00		171 ± 3*	171 ± 3*		
Si-28	92.2297	177 ± 5*	177 ± 5*	1.0003	0.082
Si-29	4.6832	119 ± 3*	101 ± 14*	1.0004	0.077 ± 0.015
Si-30	3.0872	107 ± 2*	107 ± 2*	1.0003	0.63 ± 0.03
P-31	100	172 ± 6*	172 ± 6*	0.9899	0.14
S-00		534 ± 7*	520 ± 10*	1.0003	0.24
S-32	95.018	548 ± 10*	530 ± 40*	1.0095	0.81
S-33	0.7500	454 ± 25*	350 ± 40*		
S-34	4.215	235 ± 5*	227 ± 5*		
S-36	0.017	230 ± 20*	150 ± 30*		

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Cl-00		33.1 ± 0.3	33.1 ± 0.3		
Cl-35	75.771	43.55 ± 0.40	43.6 ± 0.4	1.0002	18 ± 2
Cl-37	24.229	0.430 ± 0.006	0.433 ± 0.006		0.295 ± 0.004
Ar-00		675 ± 9*	675 ± 9*		
Ar-36	0.3365	5.2 ± 0.5	5.2 ± 0.5		
Ar-38	0.632	0.8 ± 0.2	0.8 ± 0.2		
Ar-40	99.6003	0.660 ± 0.010	0.660 ± 0.010	1.0003	0.41 ± 0.03
K-00		2.1 ± 0.1	2.1 ± 0.1	1.0003	1.2 ± 0.1
K-39	93.2581	2.1 ± 0.2	2.1 ± 0.2		1.1 ± 0.1
K-40	0.01167	30 ± 4	30 ± 4		
K-41	6.7302	1.45 ± 0.03	1.46 ± 0.03		1.40 ± 0.04
Ca-00		0.43 ± 0.02	0.41 ± 0.02	1.0003	0.215
Ca-40	96.941	0.41 ± 0.02	0.41 ± 0.02		0.22 ± 0.02
Ca-42	0.647	0.68 ± 0.07	0.68 ± 0.07		0.29 ± 0.04
Ca-43	0.135	6.2 ± 0.6	6.2 ± 0.6		3.93 ± 0.15
Ca-44	2.086	0.88 ± 0.05	0.88 ± 0.05		0.58 ± 0.01
Ca-46	0.004	0.72 ± 0.03	0.74 ± 0.03		0.94 ± 0.04
Ca-48	0.187	1.09 ± 0.07	1.09 ± 0.14		
Sc-45	100	27.2 ± 0.2	27.2 ± 0.2	1.0002	12.0 ± 0.5
Ti-00		6.09 ± 0.13	6.09 ± 0.13	0.9999	3.1 ± 0.2
Ti-46	8.249	0.59 ± 0.18	0.59 ± 0.18		0.30 ± 0.09
Ti-47	7.437	1.52 ± 0.11	1.7 ± 0.2		1.5 ± 0.2
Ti-48	73.720	7.88 ± 0.25	7.84 ± 0.25		3.9 ± 0.2

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Ti-49	5.409	1.79 ± 0.12	2.2 ± 0.2		1.2 ± 0.2
Ti-50	5.185	0.179 ± 0.003	0.179 ± 0.003		0.118 ± 0.011
V-00		5.09 ± 0.04	5.08 ± 0.04	0.9998	2.8 ± 0.1
V-50	0.250	21 ± 4	60 ± 40		43 ± 15
V-51	99.75	4.92 ± 0.04	4.9 ± 0.1		2.7 ± 0.1
Cr-00		3.07 ± 0.08	3.07 ± 0.08		1.6 ± 0.1
Cr-50	4.345	15.9 ± 0.2	15.9 ± 0.2	1.0002	7.8 ± 0.4
Cr-52	83.790	0.76 ± 0.06	0.76 ± 0.06	1.0003	0.50 ± 0.06
Cr-53	9.500	18.2 ± 1.5	18.2 ± 1.5	1.0003	8.9 ± 0.9
Cr-54	2.365	0.36 ± 0.04	0.36 ± 0.04	1.0003	0.20 ± 0.03
Mn-55	100	13.36 ± 0.05	13.3 ± 0.1	1.0003	14.0 ± 0.3
Fe-00		2.56 ± 0.03	2.56 ± 0.03		
Fe-54	5.845	2.25 ± 0.18	2.25 ± 0.18	1.0002	1.2 ± 0.2
Fe-56	91.754	2.59 ± 0.14	2.59 ± 0.14	1.0002	1.4 ± 0.2
Fe-57	2.119	2.48 ± 0.30	2.48 ± 0.30	1.0002	1.6 ± 0.2
Fe-58	0.282	1.30 ± 0.03	1.28 ± 0.05	1.0012	1.7 ± 0.1
Co-59	100	37.18 ± 0.06	37.18 ± 0.06	1.0004	75.9 ± 2.0
Ni-00		4.49 ± 0.16	4.49 ± 0.16		
Ni-58	68.077	4.5 ± 0.2	4.6 ± 0.3	1.0002	2.2 ± 0.2
Ni-60	26.223	2.9 ± 0.2	2.9 ± 0.2	1.0002	1.5 ± 0.2
Ni-61	1.140	2.5 ± 0.8	2.5 ± 0.8	1.0000	1.5 ± 0.4
Ni-62	3.635	14.5 ± 0.3	14.5 ± 0.3	1.0000	6.6 ± 0.2
Ni-64	0.926	1.63 ± 0.07	1.52 ± 0.03	1.0002	0.98 ± 0.15

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Cu-00		3.78 ± 0.02	3.78 ± 0.02		4.1 ± 0.1
Cu-63	69.174	4.52 ± 0.02	4.50 ± 0.02	1.0002	4.97 ± 0.08
Cu-65	30.826	2.17 ± 0.03	2.17 ± 0.03	1.0002	2.19 ± 0.07
Zn-00		1.11 ± 0.02	1.11 ± 0.02		
Zn-64	48.63	1.1 ± 0.1	0.76 ± 0.02		1.45 ± 0.06
Zn-66	27.90	0.62 ± 0.06	0.85 ± 0.20		1.8 ± 0.3
Zn-67	4.10	9.5 ± 1.4	6.8 ± 0.8		25 ± 3
Zn-68	18.75	0.072 ± 0.004	0.072 ± 0.004		3.4 ± 0.03
Zn-70	0.62	0.091 ± 0.005	0.091 ± 0.005		0.86 ± 0.06
Ga-00		2.9 ± 0.1	2.9 ± 0.1	1.0003	22 ± 2
Ga-69	60.108	1.68 ± 0.07	1.68 ± 0.07		15.6 ± 1.5
Ga-71	39.892	4.73 ± 0.15	4.71 ± 0.23		31.2 ± 1.9
Ge-00		2.20 ± 0.04	2.3 ± 0.1		6.0 ± 1.0
Ge-70	21.234	3.17 ± 0.14	3.15 ± 0.07		1.5 ± 0.3
Ge-72	27.662	0.95 ± 0.11	0.98 ± 0.09	1.0003	0.8 ± 0.2
Ge-73	7.717	14.4 ± 0.4	15 ± 2	1.0004	64 ± 6
Ge-74	35.943	0.53 ± 0.05	0.51 ± 0.08	1.0003	1.0 ± 0.2
Ge-76	7.444	0.14 ± 0.02	0.15 ± 0.02	1.0003	1.8 ± 0.4
As-75	100	4.23 ± 0.08	4.5 ± 0.1	1.0005	61 ± 4
Se-00		11.7 ± 0.2	11.7 ± 0.2		13 ± 2
Se-74	0.889	51.8 ± 1.2	51.8 ± 1.2		560 ± 50
Se-76	9.366	85 ± 7	85 ± 7	1.0003	40 ± 4
Se-77	7.535	42 ± 4	42 ± 4	1.0003	30 ± 3

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Se-78	23.772	0.38 ± 0.02	0.38 ± 0.02	1.0003	4.0 ± 0.6
Se-80	49.607	0.61 ± 0.05	0.61 ± 0.05	1.0003	1.6 ± 0.2
Se-82	8.731	0.043 ± 0.003	0.043 ± 0.003	1.0003	30 ± 4
Br-00		6.9 ± 0.2	6.9 ± 0.2		
Br-79	50.686	10.32 ± 0.13	11.0 ± 0.7	1.0007	127 ± 14
Br-81	49.314	2.36 ± 0.05	2.7 ± 0.2	1.0004	50 ± 5
Kr-00		25.1 ± 0.7	25 ± 1		39 ± 6
Kr-78	0.3535	4.73 ± 0.68	6.2 ± 0.9		19.5 ± 2.0
Kr-80	2.2809	11.5 ± 0.5	11.5 ± 0.5	1.0002	56.1 ± 5.6
Kr-82	11.5830	19.0 ± 4.0	28 ± 20	1.0000	130 ± 13
Kr-83	11.4953	202 ± 10	180 ± 30	0.9983	183 ± 25
Kr-84	56.9889	0.111 ± 0.015	0.110 ± 0.015	1.0003	2.4 ± 0.2
Kr-86	17.2984	3 ± 2*	3 ± 2*		0.023 ± 0.03
Rb-00		0.38 ± 0.04	0.38 ± 0.04		
Rb-85	72.1654	0.48 ± 0.01	0.48 ± 0.01	1.0003	5.9 ± 0.5
Rb-87	27.8346	0.12 ± 0.03	0.12 ± 0.03	1.0004	2.7 ± 0.4
Sr-00		1.28 ± 0.06	1.28 ± 0.06		
Sr-84	0.5574	0.62 ± 0.06	0.87 ± 0.05		8.6 ± 0.4
Sr-86	9.8566	1.04 ± 0.07	1.04 ± 0.07	1.0003	4.80 ± 0.3
Sr-87	7.0015	17 ± 3	16 ± 3	1.0064	117 ± 30
Sr-88	82.5845	5.8 ± 0.4*	5.8 ± 0.4*	1.0003	6.5 ± 0.3*
Y-89	100	1.28 ± 0.02	1.28 ± 0.02	1.0002	1.0 ± 0.1
Zr-00		0.185 ± 0.003	0.185 ± 0.003		

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Zr-90	51.452	0.011 ± 0.005	0.011 ± 0.005	1.0003	0.13 ± 0.02
Zr-91	11.223	1.24 ± 0.25	1.24 ± 0.25	1.0004	5.2 ± 0.7
Zr-92	17.146	0.220 ± 0.060	0.220 ± 0.060	1.0002	0.63 ± 0.02
Zr-94	17.380	0.0499 ± 0.0024	0.0499 ± 0.0024	1.0004	0.27 ± 0.03
Zr-96	2.799	0.020 ± 0.001	0.0229 ± 0.010	1.0007	5.6 ± 0.2
Nb-93	100	1.15 ± 0.05	1.15 ± 0.05	1.0019	8.5 ± 0.5
Mo-00		2.51 ± 0.05	2.55 ± 0.05	1.0003	24 ±2
Mo-92	14.8362	0.019[d]	0.019[d]	0.93947	0.81 ± 0.08
Mo-94	9.2466	0.015[d]	0.015[d]	1.0003	0.82 ± 0.12
Mo-95	15.9201	13.4 ± 0.3	14.0 ± 0.5	1.0000	111 ± 5
Mo-96	16.6756	0.5 ± 0.2	0.5 ± 0.2	1.0004	17 ± 3
Mo-97	9.5551	2.5 ± 0.2	2.1 ± 0.5		14 ± 3
Mo-98	24.1329	0.137 ± 0.005	0.130 ± 0.006		6.9 ± 0.3
Mo-100	9.6335	0.199 ± 0.003	0.199 ± 0.003	1.0003	3.8 ± 0.1
Tc-99		20 ± 1	20 ± 1	1.0039	320 ± 20
Ru-000		2.56 ± 0.13	2.56 ± 0.13		
Ru-96	5.5420	0.22 ± 0.02	0.29 ± 0.02		6.5 ± 0.4
Ru-98	1.8688	< 8	< 8	1.202	
Ru-99	12.7579	7.1 ± 1.0	7.1 ± 1.0	1.0024	160 ± 20
Ru-100	12.5985	5.0 ± 0.6	5.0 ± 0.6	1.0003	11.2 ± 1.1
Ru-101	17.0600	3.4 ± 0.9	3.4 ± 0.9	1.0017	100 ± 20
Ru-102	31.5519	1.21 ± 0.07	1.21 ± 0.07	1.0001	4.2 ± 0.1
Ru-104	18.6210	0.47 ± 0.02	0.32 ± 0.02	1.0003	6.4 ± 0.5

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Rh-103	100	145 ± 2	145 ± 2	1.0244	1100 ± 50
Pd-000		6.9 ± 0.2	6.9 ± 0.2		
Pd-102	1.020	3.4 ± 0.3	3.4 ± 0.2	0.9318	10.0 ± 2.0
Pd-104	11.14	0.6 ± 0.3	0.6 ± 0.3	1.0005	16 ± 2
Pd-105	22.33	21.0 ± 1.5	20.0 ± 3.0	0.9994	98 ± 5
Pd-106	27.33	0.315 ± 0.029	0.315 ± 0.029	1.0084	5.7 ± 0.6
Pd-108	26.46	7.6 ± 0.4	8.3 ± 0.5	1.0096	244 ± 4
Pd-110	11.72	0.227 ± 0.032	0.227 ± 0.032	1.0007	3.1 ± 0.4
Ag-000		63.3 ± 0.4	63.3 ± 0.4		
Ag-107	51.8392	37.6 ± 1.2	37.6 ± 1.2	0.9981	100 ± 48
Ag-109	48.1608	91.0 ± 1.0	91.0 ± 1.0	1.0057	1400 ± 48
Cd-000		2520 ± 50	2520 ± 50		
Cd-106	1.25	~ 1	~ 1	0.9999	4 ± 1
Cd-108	0.89	0.72 ± 0.13	1.1 ± 0.3	1.0002	11 ± 3
Cd-110	12.49	11 ± 1	11 ± 1	1.0000	41 ± 3
Cd-111	12.80	24 ± 3	24 ± 3	0.9939	50 ± 5
Cd-112	24.13	2.2 ± 0.5	2.2 ± 0.5	1.0000	12 ± 2
Cd-113	12.22	20600 ± 400	20600 ± 400	1.3604	390 ± 40
Cd-114	28.73	0.34 ± 0.02	0.34 ± 0.02	1.0002	14.1 ± 0.7
Cd-116	7.49	0.075 ± 0.020	0.075 ± 0.020	1.0000	1.6 ± 0.3
In-000		193.8 ± 1.5	193.8 ± 1.5	1.0207	3167 ± 100
In-113	4.288	12.0 ± 1.1	12.0 ± 1.1	1.0057	310 ± 30
In-115	95.712	202 ± 2	202 ± 2	1.0203	3300 ± 100

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Sn-000		0.626 ± 0.009	0.626 ± 0.009		4.1 ± 0.3
Sn-112	0.973	0.86 ± 0.09	1.01 ± 0.09	1.006	29 ± 2
Sn-114	0.659	0.115 ± 0.030	0.115 ± 0.030	1.0003	5.1 ± 1.5
Sn-115	0.339	30 ± 7	30 ± 7	1.0003	29 ± 6
Sn-116	14.536	0.13 ± 0.03	0.14 ± 0.03	1.0004	11.9 ± 1.0
Sn-117	7.676	1.32 ± 0.18	2.3 ± 0.5	1.0004	15.7 ± 2.5
Sn-118	24.223	0.22 ± 0.05	0.22 ± 0.05	1.0004	3.4 ± 0.4
Sn-119	8.585	2.2 ± 0.5	2.2 ± 0.5	1.0003	2.9 ± 0.5
Sn-120	32.593	0.14 ± 0.03	0.14 ± 0.03	1.0005	1.2 ± 0.3
Sn-122	4.629	0.139 ± 0.015	0.180 ± 0.020	1.0005	0.81 ± 0.04
Sn-124	5.789	0.134 ± 0.005	0.134 ± 0.005	1.0008	8.0 ± 0.2
Sb-000		5.1 ± 0.1	5.2 ± 0.1		
Sb-121	57.213	5.9 ± 0.2	5.9 ± 0.2	1.0040	205 ± 20
Sb-123	42.787	4.1 ± 0.1	4.1 ± 0.1	1.0010	127 ± 20
Te-000		4.7 ± 0.1	4.7 ± 0.1		
Te-120	0.096	2.3 ± 0.3	2.3 ± 0.3	1.209	
Te-122	2.603	3.9 ± 0.5	3.4 ± 0.5	1.0006	89 ± 10
Te-123	0.908	418 ± 30	418 ± 30	1.0126	5630 ± 325
Te-124	4.816	6.8 ± 1.3	6.8 ± 1.3	1.0003	5.3 ± 0.7
Te-125	7.139	1.55 ± 0.16	1.55 ± 0.16	1.0003	21 ± 3
Te-126	18.952	1.04 ± 0.15	1.04 ± 0.15	1.0003	7.5 ± 1.0
Te-128	31.687	0.215 ± 0.008	0.215 ± 0.008	1.0003	1.6 ± 0.1
Te-130	33.799	0.29 ± 0.06	0.29 ± 0.06	1.0003	0.3 ± 0.1

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
I-127	100	6.2 ± 0.2	6.2 ± 0.2	1.0002	150 ± 10
Xe-000		24.2 ± 0.4	23.9 ± 1.2		
Xe-124	0.0891	165 ± 11	165 ± 11		3600 ± 700
Xe-126	0.0888	3.8 ± 0.8	3.5 ± 0.8		60 ± 10
Xe-128	1.9117	5.2 ± 1.3	< 8		38 ± 19
Xe-129	26.4396	21 ± 7	21 ± 7		250 ± 50
Xe-130	4.0827	4.8 ± 1.2	< 26		
Xe-131	21.1796	85 ± 10	85 ± 10	1.0015	900 ± 100
Xe-132	26.8916	0.415 ± 0.045	0.45 ± 0.06	1.0000	4.6 ± 0.6
Xe-134	10.4423	0.265 ± 0.020	0.265 ± 0.020		0.4 ± 0.1
Xe-136	8.8689	0.26 ± 0.02	0.26 ± 0.02	1.0003	0.7 ± 0.2
Cs-133	100	30.3 ± 1.1	29.0 ± 1.0	1.0030	437 ± 26
Ba-000		1.15 ± 0.07	1.2 ± 0.1		
Ba-130	0.1058	8.7 ± 0.9	11.3 ± 1.0		170 ± 10
Ba-132	0.1012	6.5 ± 0.8	6.5 ± 0.8		33 ± 3
Ba-134	2.417	1.5 ± 0.3	2.0 ± 1.6	1.0001	22 ± 3
Ba-135	6.592	5.8 ± 0.9	5.8 ± 0.9	1.0001	97 ± 7
Ba-136	7.853	0.68 ± 0.17	0.4 ± 0.4	1.0001	1.7 ± 0.3
Ba-137	11.232	3.6 ± 0.2	5.1 ± 0.4	0.9992	4.3 ± 1.0
Ba-138	71.699	0.404 ± 0.040	0.360 ± 0.036	1.0003	0.32 ± 0.04
La-000		9.04 ± 0.04	8.97 ± 0.05		12.4 ± 0.6
La-138	0.0902	57.2 ± 5.7	57.2 ± 5.7		362 ± 25
La-139	99.9098	9.04 ± 0.04	8.93 ± 0.04	0.9996	12.1 ± 0.6

Table I. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Ce-000		0.63 ± 0.04	0.63 ± 0.04		0.66 ± 0.05
Ce-136	0.186	6.5 ± 1.0	6.3 ± 1.5		77 ± 12
Ce-138	0.251	1.02 ± 0.24	1.1 ± 0.3		
Ce-140	88.449	0.58 ± 0.02	0.57 ± 0.04	1.0003	0.54 ± 0.05
Ce-142	11.114	0.97 ± 0.02	0.95 ± 0.05	1.0003	1.15 ± 0.05
Pr-141	100	11.5 ± 0.3	11.5 ± 0.3	0.9993	17.4 ± 2.0
Nd-000		49.5 ± 2.0	50.5 ± 2.0		45 ± 5
Nd-142	27.16	18.7 ± 0.7	18.7 ± 0.7	1.0003	9.0 ± 1.0
Nd-143	12.18	325 ± 10	325 ± 10	0.9964	130 ± 30
Nd-144	23.83	3.6 ± 0.3	3.6 ± 0.3	1.0003	5.4 ± 0.5
Nd-145	8.30	42 ± 2	42 ± 2	1.0000	240 ± 35
Nd-146	17.17	1.41 ± 0.05	1.4 ± 0.1	1.0002	23.2 ± 0.5
Nd-148	5.74	2.58 ± 0.14	2.5 ± 0.2	1.0004	14 ± 1
Nd-150	5.62	1.03 ± 0.08	1.2 ± 0.2	1.0003	14 ± 2

Table II. Thermal Neutron Capture Cross Sections of Stable Isotopes and Elements, Z = 61-92.

Asterisk (*) denotes quantity is expressed in millibarns;
[a] reference [7], column 6; [b] reference [6]; [c] reference [2].

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-Factor	Resonance Integral (b)
Pm-147		168.4 ± 3.5	168.4 ± 3.5		1274 ± 66
Sm-000		5670 ± 100	5670 ± 100		1400 ± 200
Sm-144	3.1	1.64 ± 0.10	0.70 ± 0.30		2.38 ± 0.17
Sm-147	15.1	57 ± 3	57 ± 3	0.9965	775 ± 50
Sm-148	11.3	2.4 ± 0.6	2.4 ± 0.6		35 ± 7
Sm-149	13.9	40140 ± 600	40140 ± 600	1.7102	3390 ± 200
Sm-150	7.4	100 ± 4	104 ± 4	0.9985	358 ± 50
Sm-152	26.6	206 ± 6	206 ± 6		2970 ± 100
Sm-154	22.6	8.3 ± 0.5	8.4 ± 0.5		36 ± 4
Eu-000		4565 ± 100	4565 ± 100		2320 ± 150
Eu-151	47.81	9200 ± 100	9200 ± 100	0.8940	3300 ± 300
Eu-153	52.19	312 ± 7	312 ± 7	0.986	1420 ± 100
Gd-000		48890 ± 104	48890 ± 104	0.8467	390 ± 10
Gd-152	0.20	735 ± 20	735 ± 20		2020 ± 160
Gd-154	2.18	85 ± 12	85 ± 12	0.9967	245 ± 30
Gd-155		60900 ± 500	60900 ± 500	0.8390	1447 ± 100
Gd-156	20.47	1.8 ± 0.7	1.5 ± 1.2	1.0007	104 ± 15
Gd-157	15.65	254000 ± 815	254000 ± 815	0.84715	754 ± 20
Gd-158	24.84	2.2 ± 0.2	2.2 ± 0.2	1.0009	73 ± 7
Gd-160	21.86	1.4 ± 0.3	0.77 ± 0.02	0.9997	7.4 ± 1.0
Tb-159	100	23.3 ± 0.4	23.4 ± 0.4		418 ± 20
Dy-000		943 ± 15	940 ± 15		1480 ± 100

Table II. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-Factor	Resonance Integral (b)
Dy-156	0.056	33 ± 3	33 ± 3		884 ± 80
Dy-158	0.096	43 ± 6	43 ± 6		120 ± 10
Dy-160	2.34	55 ± 3	56 ± 5		1122 ± 90
Dy-161	18.91	600 ± 25	600 ± 25	0.9896	1075 ± 80
Dy-162	25.51	194 ± 10	194 ± 10	1.0052	2740 ± 270
Dy-163	24.90	134 ± 7	124 ± 7	1.012	1470 ± 100
Dy-164	28.19	2650 ± 70	2650 ± 100	0.9870	341 ± 20
Ho-165	100	64.7 ± 1.2	64.7 ± 1.2	1.0020	665 ± 22
Er-000		156.4 ± 3.0	159.2 ± 3.6		730 ± 10
Er-162	0.137	19 ± 2	19 ± 2		480 ± 50
Er-164	1.609	13 ± 2	13 ± 2		134 ± 10
Er-166	33.61	16.9 ± 1.6	19.6 ± 1.5	0.9997	95 ± 7
Er-167	22.93	649 ± 8	659 ± 16		2970 ± 70
Er-168	26.79	2.74 ± 0.08	2.74 ± 0.09		37 ± 5
Er-170	14.93	8.85 ± 0.30	5.8 ± 0.3		35.4 ± 5.9
Tm-169		105 ± 2	105 ± 2		1720 ± 30
Yb-000		34.8 ± 0.6	35.0 ± 0.6		
Yb-168	0.127	2300 ± 170	2300 ± 170		21300 ± 1000
Yb-170	3.04	9.9 ± 1.8	11.4 ± 1.0		293 ± 30
Yb-171	14.28	58.3 ± 4.0	48.6 ± 2.5		315 ± 30
Yb-172	21.83	1.30 ± 0.8	0.8 ± 0.4		25 ± 3
Yb-173	16.13	15.5 ± 1.5	17.1 ± 1.3		380 ± 30
Yb-174	31.83	63.2 ± 1.5	69.4 ± 5.0		27 ± 3
Yb-176	12.76	2.85 ± 0.05	2.85 ± 0.05		6.3 ± 0.6
Lu-000		74.9 ± 2.0	76.4 ± 2.1		622 ± 50

Table II. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-Factor	Resonance Integral (b)
Lu-175	97.416	23.1 ± 1.1	23.1 ± 1.1	1.0027	610 ± 50
Lu-176	2.584	2090 ± 70	2090 ± 70	1.7579	1087 ± 40
Hf-000		104.1 ± 0.5	104.1 ± 0.5		1992 ± 50
Hf-174	0.1620	549 ± 7	561 ± 35	0.9769	436 ± 35
Hf-176	5.2604	23.5 ± 3.1	23.5 ± 3.1	1.0015	880 ± 40
Hf-177	18.5953	373 ± 10	373 ± 10	1.0213	7173 ± 200
Hf-178	27.2811	84 ± 4	84 ± 4	1.0033	1950 ± 120
Hf-179	13.6210	41 ± 3	41 ± 3	0.9980	630 ± 30
Hf-180	35.0802	13.04 ± 0.07	13.04 ± 0.07	0.9997	35.0 ± 1.0
Ta-000		20.6 ± 0.5			660 ± 23
Ta-180	0.0123	563 ± 60	563 ± 60		1349 ± 100
Ta-181	99.9877	20.5 ± 0.5	20.5 ± 0.5	1.0041	660 ± 23
W-000		18.4 ± 0.3	18.4 ± 0.3	1.0018	352 ± 25
W-180	0.1198	30 (+120/-20)	30 (+120/-20)		214 ± 30
W-182	26.4985	19.9 ± 0.2	20.7 ± 0.5	1.0033	604 ± 90
W-183	14.3136	10.3 ± 0.2	10.1 ± 0.3	0.9992	337 ± 50
W-184	30.6422	1.7 ± 0.1	1.7 ± 0.1	0.9991	14.7 ± 1.5
W-186	28.4259	38.5 ± 0.5	37.9 ± 0.6	1.0017	485 ± 15
Re-000		89.7 ± 1.7	89.7 ± 1.7		831 ± 20
Re-185	37.398	112 ± 2	112 ± 2	1.0053	1717 ± 50
Re-187	62.602	76.4 ± 1.0	76.4 ± 1.0	0.9942	300 ± 20
Os-000		16.0 ± 0.4	16.0 ± 0.4		180 ± 20
Os-184	0.0197	3000 ± 150	3000 ± 150		601 ± 51
Os-186	1.5859	80 ± 13	80 ± 13		280 ± 30
Os-187	1.9644	245 ± 40	320 ± 20		500 ± 70
Os-188	13.2434	4.7 ± 0.5	4.7 ± 0.5		152 ± 20

Table II. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-Factor	Resonance Integral (b)
Os-189	16.1466	25 ± 4	25 ± 4		674 ± 70
Os-192	40.7815	3.12 ± 0.16	2.0 ± 0.1		4.6 ± 0.2
Ir-000		425.3 ± 2.4	425.3 ± 2.4		2150 ± 100
Ir-191	37.272	954 ± 10	954 ± 10	0.9964	3500 ± 100
Ir-193	62.728	111 ± 5	111 ± 5	1.0180	1350 ± 100
Pt-000		10.3 ± 0.3	10.3 ± 0.3		140 ± 6
Pt-190	0.01364	142 ± 4	152 ± 4		67 ± 5
Pt-192	0.78266	10.0 ± 2.5	10.0 ± 2.5		115 ± 20
Pt-194	32.96700	0.58 ± 0.19	1.44 ± 0.19		3.1 ± 0.1
Pt-195	33.83156	28.5 ± 1.2	27.5 ± 1.2		365 ± 50
Pt-196	25.24166	0.41 ± 0.04	0.72 ± 0.04		5.1 ± 0.3
Pt-198	7.16349	3.66 ± 0.19	3.66 ± 0.19		54 ± 4
Au-197	100	98.65 ± 0.09	98.65 ± 0.09	1.0054	1550 ± 28
Hg-000		372.3 ± 4.0	372.3 ± 4.0		73 ± 5
Hg-196	0.15344	3080 ± 180	3080 ± 180		472 ± 16
Hg-198	9.968	2.0 ± 0.3	2.0 ± 0.3		71 ± 2
Hg-199	16.873	2150 ± 48	2150 ± 48		435 ± 20
Hg-200	23.096	< 60	< 60		2.1
Hg-201	13.181	5.7 ± 1.2	7.8 ± 2.0		30 ± 3
Hg-202	6.865	4.42 ± 0.07	4.89 ± 0.05		4.2 ± 0.2
Tl-000		3.43 ± 0.06	3.43 ± 0.06		12.9 ± 0.8
Tl-203	29.524	11.4 ± 0.2	11.4 ± 0.2		43.0 ± 2.0
Tl-205	70.476	0.104 ± 0.017	0.104 ± 0.017		0.61 ± 0.15
Pb-000		0.138 ± 0.004	0.171 ± 0.002		

Table II. (continued)

Isotope	Abundance (%)[a]	Capture Cross Section (b)[b]	Capture Cross Section (b)[c]	Westcott g-factor	Resonance Integral (b)
Pb-204	1.4245	0.661 ± 0.070	0.661 ± 0.070		2.0 ± 0.2
Pb-206	24.1447	0.0266 ± 0.0012	0.0306 ± 0.0008	1.0002	0.097 ± 0.014
Pb-207	22.0827	0.625 ± 0.030	0.712 ± 0.010	1.0002	0.39 ± 0.01
Pb-208	52.3481	0.230 ± 0.030*	0.49 ± 0.03	1.0003	0.0020 ± 0.0002
Bi-209	100	0.0338 ± 0.0007	0.0338 ± 0.0007	1.0003	0.190 ± 0.020
Th-232		7.35 ± 0.03	7.37 ± 0.06	0.9981	85 ± 3
U-238		2.680 ± 0.019	2.680 ± 0.019	1.0024	277 ± 3

Table III. Neutron-capture Cross Section of ^{14}N – Capture Gamma-ray Measurements.

Column 2 lists the reported capture cross section, whereas column 3 displays the renormalized cross section.

Standard	Φ (mb)	Φ (mb)	Reference
^{12}C (3.53 ± 0.07 mb)	79.7 ± 2.4	79.7 ± 2.4	[8]
^{35}Cl (43.6 ± 0.4 b)	80.1 ± 2.0	80.0 ± 2.0	[8]
^{207}Pb (712 ± 10 mb)	79.6 ± 1.6	69.3 ± 1.4	[8]
^{27}Al (230 ± 3 mb)	76.7 ± 2.7	77.0 ± 2.7	[9]
^{35}Cl (43.6 ± 0.5 b)	79.7 ± 2.4	79.6 ± 2.4	[9]
H (332 ± 2 mb)	75.0 ± 7.5	75.1 ± 7.5	[10]

Table IV. Temperature Dependence of Wescott Capture g-factor for ^{113}Cd, ^{124}Xe and ^{157}Gd over Temperature Range from 150 to 400K.

T (K)	E (eV)	^{113}Cd	^{124}Xe	^{157}Gd
150	0.0129	0.9638	0.9967	0.9027
294	0.0253	1.3374	1.0018	0.8501
400	0.0344	1.7235	1.0048	0.7961

Table V. Neutron-capture Cross Section Measurements of ^{12}C.

Measurement Method	Capture Cross Section (mb)	Reference
Prompt gamma ray	3.89 ± 0.06	[13]
Prompt gamma ray	3.53 ± 0.07	[14]
Prompt gamma ray	3.50 ± 0.16	[15]
Pulsed neutrons	3.72 ± 0.15	[16]
Prompt gamma ray	3.8 ± 0.4	[10]
Pulsed neutrons	3.83 ± 0.06	[17]
Reactivity	3.57 ± 0.03	[18]
Diffusion length	3.44 ± 0.08	[19]
Pile oscillator	3.5 ± 0.3	[20]
Pile oscillator	3.65 ± 0.15	[21]
Mass spectrometry	3.30 ± 0.15	[22]
Pile oscillator	3.85 ± 0.15	[23]

Table VI. Neutron-capture Cross Section of ^{6}Li – Prompt Gamma-ray Measurements.

Standard cross section	Reported Cross Section (mb)	Renormalized Value (mb)	Reference
H (332.6 mb)	52.6 ± 2.2	52.6 ± 2.2	[13]
H (332 ± 1 mb)	38.5 ± 3.0	38.7 ± 3.0	[24]
No details	48 ± 15	-	[25]
Na (505 ± 10 mb)	28 ± 8	29 ± 8	[26]

Table VII. Neutron-capture Cross Section of ^{207}Pb.

Measurement Method	Standard Cross Section	Capture Cross Section (mb)	Reference
k_0 method		622 ± 14	[13]
Prompt gamma ray	^{12}C (3.53 ± 0.07 mb)	610 ± 30	[27]
Prompt gamma ray	Au (98.8 b)	698 ± 46	[28]
Pile oscillator	Harwell B (766.6 b)	709 ± 10	[10, 29]
Pile oscillator	Au (98.8 b)	730 ± 70	[30]

REFERENCES

[1] MUGHABGHAB, S.F., DIVADEENAM, M., HOLDEN, N.E., Neutron Cross Sections, Vol. 1, Neutron Resonance Parameters and Thermal Cross Sections, Part A, Z = 1-60, Academic Press, New York, 1981.

[2] MUGHABGHAB, S.F., Neutron Cross Sections, Vol. 1, Neutron Resonance Parameters and Thermal Cross Sections, Part B, Z = 61-100, Academic Press Inc., Orlando, 1984.

[3] LANE, A.M., LYNN, J.E., Theory of Radiative Capture in the Resonance Region, Nucl. Phys. **17** (1961) 563-585; LANE, A.M., LYNN, J.E., Anomalous Radiative Capture in the Neutron Resonance Region: Analysis of the Experimental Data on Electric Dipole Transitions, Nucl. Phys. **17** (1961) 586-608.

[4] MUGHABGHAB, S.F., Verification of the Lane-Lynn Theory of Direct Neutron Capture, Phys. Lett. **81B** (1979) 93-97.

[5] MUGHABGHAB, S.F., CHRIEN, R.E., "Nonstatistical Effects in Neutron Capture, A Review of Recent Experiments", pp. 265-283 in Proc. 3rd Int. Symp. Neutron Capture Gamma-ray Spectroscopy and Related Topics, 18-22 September 1978, Brookhaven National Laboratory and Sate University of New York, (Chrien, R.E., Kane, W.R., Eds.), Plenum Press, New York, 1979.

[6] MUGHABGHAB, S.F., Brookhaven National Laboratory, to be published.

[7] ROSMAN, K.J.R., TAYLOR, P.D.P., Isotopic Compositions of the Elements 1997, Pure Appl. Chem. **70** (1998) 217-235.

[8] ISLAM, M.A., KENNETT, T.J., PRESTWICH, W.V., Re-estimation of the Thermal Neutron Capture Cross Section of ^{14}N, Nucl. Instrum. Meth. **A287** (1990) 460-464.

[9] ISLAM, M.A., PRESTWICH, W.V., KENNETT, T.J., Determination of the Thermal Radiative Capture Cross Section of ^{14}N, Nucl. Instrum. Meth. **188** (1981) 243-245.

[10] JURNEY, E.T., MOTZ, H.T., "Thermal Neutron Capture in D and ^{16}O", pp. 236-242 in Int. Conf. Neutron Physics with Reactor Neutrons, ANL-6797 (1963).

[11] WESTCOTT, C.H., Effective Cross Section Values for Well-moderated Thermal Reactor Spectra, AECL-1101 (1960).

[12] OKAZAKI, A., JONES, R.T., "Measured Dependence of Some Effective Cross Sections on Thermal Neutron Temperatures in the Range -195ºC to 297ºC", pp. 541-544 in Proc. Int. Conf. Nuclear Data for Basic and Applied Sciences, Vol. 1, 13-17 May 1985, Santa Fe, New Mexico, USA, (Young, P.G., Brown, R.E., Auchampaugh, G.F., Lisowski, P.W., Stewart, L., Eds.), Gordon and Breach Science Pub. Inc., New York, 1986.

[13] Values deduced from data reported in this IAEA-TECDOC.

[14] JURNEY, E.T., BENDT, P.J., BROWNE, J.C., Thermal Neutron Capture Cross Section of Deuterium, Phys. Rev. **C25** (1982) 2810-2811.

[15] PRESTWICH, W.V., ISLAM, M.A., KENNETT, T.J., A Determination of the Carbon Thermal Neutron Capture Cross Section, Nucl. Sci. Eng. **78** (1981) 182-185.

[16] SAGOT, M., TELLIER, H., Mesure des Paramètres de Diffusion du Graphite, Reactor Sci. Technol. (J. Nucl. Energy **A/B) 17** (1963) 347-348.

[17] STARR, E.G., PRICE, G., Measurement of the Diffusion Parameters of Graphite and Graphite-Bismuth by Pulsed Neutron Methods, pp. 1034-1073 in Proc. Brookhaven Conf. Neutron Thermalization, BNL-719 (1962) 1034-1073.

[18] NICHOLS, P.F., Absorption Cross Section of Graphite, Nucl. Sci. Eng. **7** (1960) 395-399.

[19] HENDRIE, J.M., PHELPS, J.P., PRICE, G.A., WEINSTOCK, E.V., "Slowing Down and Diffusion Lengths of Neutrons in Graphite-Bismuth Systems", pp. 695-704 in 2nd Geneva Conference, Vol. 12, 1958; see also PRICE, G.A., A Note on the Measurement of the Transport Mean Free Path of Thermal Neutrons in Graphite by a Poison Method, Nucl. Sci. Eng. **18** (1964) 410-412.

[20] MUEHLHAUSE, C.O., HARRIS, S.P., ROSE, D., SCHROEDER, H.P., THOMAS, G.E., WEXLER, S., pp. 19 in Proc. French-American Conf. Graphite Reactors, BNL-489, Brookhaven National Laboratory (1957).

[21] French measurements cited by Nichols, P.F., in Ref. [18].

[22] HENNING, G.R., “The Slow Neutron Absorption Cross Section of Graphite”, pp. 19-20 in Proc. French-American Conf. Graphite Reactors, 12-15 November 1957, Brookhaven National Laboratory; see also ANL-4410 (1950).

[23] KOECHLIN, J.C., TANGUY, P., ZALETSKI, C.P., “French Results on Natural Uranium-Graphite Lattices”, pp. 97-126 in Proc. French-American Conf. Graphite Reactors, BNL-489 (1957).

[24] JURNEY, E.T., The US Nuclear Data Committee, Thermal Capture Cross Sections for ^{6}Li and ^{7}Li, USNDC-9 (1973) 109-114.

[25] JARCZYK, L., LANG, J., MÜLLER, R., WÖLFLI, W., (n, γ)-Spektren und Wirkungsquerschnitte von Lithium, Beryllium und Kohlenstoff, Helv. Phys. Acta **34** (1961) 483-484.

[26] BARTHOLOMEW, G.A., CAMERON, P.J., Neutron Capture Gamma Rays from Lithium, Boron and Nitrogen, Can. J. Phys. **35** (1957) 1347-1379.

[27] BLACKMON, J.C., RAMAN. S., DICKENS, J.K., LINDSTROM, R.M., PAUL, R.L., LYNN, J.E., Thermal-neutron Capture of ^{208}Pb, Phys. Rev. **C65** (2002) 045801-1/045801-9.

[28] CRANSTON, F.P., WHITE, D.H., Thermal Neutron Capture Cross Sections in Calcium, Nucl. Phys. **A169** (1971) 95-100.

[29] JOWITT, D., PATTENDEN, S.K., ROSE, H., SMALL, V.G., TATTERSALL, R.B., The Measurement of Thermal Neutron Cross Sections Using the Dimple Oscillator, AERE R/R 2516 (1958).

[30] POMERANCE, H., Thermal Neutron Capture Cross Sections, Phys. Rev. **88** (1952) 412-413.