NEUTRON SCATTERING AND ABSORPTION PROPERTIES

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This table presents an evaluated set of values for experimental quantities that characterize the properties for scattering and absorption of neutrons. The neutron cross section is given for room temperature neutrons, 20.43°C, corresponding to a thermal neutron energy of 0.0253 electron volts (eV) or a neutron velocity of 2200 meters/second. The neutron resonance integral is defined over the energy range from 0.5 eV to 0.1×10^6 eV, or 0.1 MeV. Bound neutron scattering lengths and neutron cross sections averaged over a Maxwellian spectrum at 30 keV for astrophysical applications are also presented. A list of the major references used is given below. The literature cutoff date is January 2003. Uncertainties are given in parentheses. Parentheses with two or more numbers indicate values to the excited state(s) and to the ground state of the product nucleus.

Table Layout

Column Number	Column Title	Description
1	Isotope/Element	For elements, atomic number and chemical symbol are listed. For nuclides, mass number and chemical symbol are listed. Isomers are indicated by the addition of m, m1, or m2.
2	Isotopic Abundance	in atom percent
3	Half-life	Half-life in decimal notation. μs = microsecond; ms = millisecond; s = second; m = minute; h = hour; d = day; y = year.
4	Thermal Neutron Cross Sections	Cross sections for neutron capture reactions in units of barns (10^{-24} cm^2) or millibarns (mb). Proton, alpha production and fission reactions are designated by σ_p, σ_α, σ_f, respectively. Separate values are listed for isomeric production.
5	Neutron Resonance Integrals	Resonance integrals for neutron capture reactions in barns (10^{-24} cm^2) or millibarns (mb). Proton, alpha production and fission reactions are designated by R.I.$_p$, R.I.$_\alpha$, R.I.$_f$, respectively. Separate values are listed for isomeric production.
6	Neutron Scattering Lengths	Bound coherent scattering lengths for neutron scattering reactions in units of femtometers (fm), which is equal to fermis (10^{-13} cm).
7	Maxwellian Averaged Cross Section	Astrophysical Cross Sections, averaged over a stellar neutron maxwellian spectrum characterized by a thermal energy of 30 keV, expressed in barns (10^{-24} cm^2), millibarns (mb) or microbarns (μb).

General Nuclear Data References

The following references represent the major sources of the nuclear data presented:

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 Inc., New York, New York (1981); Mughabghab, S.F.; Part B, *Z* = 61-100. Academic Press Inc., Orlando, Florida (1984).

Holden, N.E.; *Fifty Years with Nuclear Fission* Conference, Wash., D.C., Gaithersburg, Md. April 26-29, 1989, p. 946. American Nuclear Society, LaGrange Park, Illinois (1989).

Tuli, J.K.; *Nuclear Wallet Cards*, Brookhaven National Laboratory (Jan. 2000).

Holden, N.E.; *Half-lives of Selected Nuclides*, Pure & Applied Chemistry 62, 941 (1990).

Holden, N.E., Hoffman, D.C.; *Spontaneous Fission Half-lives for Ground State Nuclides*, Pure & Applied Chemistry 72, 1525 (2000).

Koester, L., Rauch, H., Seymann, E.; *Neutron Scattering Lengths: A Survey of Experimental Data and Methods*, Atomic Data Nuclear Data Tables 49, 65 (1991).

Sears, V.F.; *Neutron Scattering Lengths and Cross Sections*, Neutron News 3, (3), 26 (1992).

Bao, Z.Y., Beer, H., Käppeler, F., Voss, F., Wisshak, K., Raucher,T.; *Neutron Cross Sections for Nucleo-synthesis Studies*, Atomic Data Nuclear Data Tables 76, 70 (2000).

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
$_1$H			0.332(2)	0.149(1)	-3.739(1)	
^{1}H	99.9885(70)	>2.8×10^{23} y	0.332(2)	0.149(1)	- 3.741(1)	0.25(2) mb*
^{2}H	0.0115(70)		0.51(1)mb	0.23(2) mb	6.671(4)	2.1(4) μb
^{3}H		12.33 y	< 6. μb		4.79(3)	
$_2$He			< 0.05		3.26(3)	
^{3}He	0.000134(3)		$\sigma_p = 5.33(1)\times10^3$	$RI_p = 2.39(1)\times10^3$	5.74(7)	
			0.05(1) mb			8.(1) μb*
^{4}He	99.999867(3)				3.26(3)	
$_3$Li			71.(2)	32.(1)	- 1.90(2)	
^{6}Li	7.59(4)		$\sigma_t = 9.4(1)\times10^2$	RI_t = 422.(4)	2.0(1)	$\sigma_t \approx 1.$

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
			39.(5) mb	17.(2) mb		0.06(1) mb*
^{7}Li	92.41(4)		45.(5) mb	20.(2) mb	- 2.22(2)	42.(3) μb
^{8}Li		0.84 s				< ≈ 5.5 μb
$_{4}$Be			8.8(4) mb	3.9(2) mb	7.79(1)	
^{7}Be		53.28 d	$\sigma_p = 3.9(1)\times10^4$	$RI_p = 1.75(5)\times10^4$		σ_p = 16(4)*
			$\sigma_\alpha \approx 0.1$			
^{9}Be	100.		8.8(4) mb	3.9(2) mb	7.79(1)	
^{10}Be		1.52×10^6 y	<1. mb			
$_{5}$B			$7.6(1)\times10^2$	$3.4(1)\times10^2$	5.30(4)	
^{10}B	19.9(7)		$\sigma_\alpha = 38.4(1)\times10^2$	$RI_\alpha = 17.3(1)\times10^2$	- 0.1(3)	
			0.3(1)	0.13(4)		
			σ_p = 7.(1) mb			
			σ_t = 8.(2) mb			
^{11}B	80.1(7)		5.(3) mb	2.(1) mb	6.65(4)	
$_{6}$C			3.5(1) mb	1.6(1) mb	6.646(1)	
^{12}C	98.93(8)		3.5(1) mb	1.6(1) mb	6.651(2)	16.(1) μb*
^{13}C	1.07(8)		1.4(1) mb	1.7(2) mb	6.19(9)	0.021(4) mb
^{14}C		5715. y	<1.4 μb			3.(1) μb*
$_{7}$N			2.00(6)	0.90(3)	9.36(2)	
^{14}N	99.636(20)		σ_p = 1.93(5)	RI_p = 0.87(3)	9.37(2)	σ_p = 1.8(2) mb*
			0.080(1)	0.034(1)		0.04(1) mb
^{15}N	0.364(20)		0.04(1) mb	0.11(3) mb	6.44(3)	6.(1) μb*
$_{8}$O			0.29(1) mb	0.40(4) mb	5.805(4)	
^{16}O	99.757(16)		0.19(1) mb	0.36(4) mb	5.805(5)	34.(4) μb
^{17}O	0.038(1)		σ_α = 0.257(10)	0.11(1)	5.8(2)	σ_α = 3.9(5) mb*
			0.54(7) mb	0.39(5) mb		
^{18}O	0.205(14)		0.16(1) mb	0.81(4) mb	5.84(7)	9.(1) μb*
$_{9}$F			9.5(1) mb	21.(3) mb	5.65(1)	6.(1) mb
^{19}F	100.		9.5(1) mb	21.(3) mb	5.65(1)	6.(1) mb
$_{10}$Ne			42.(5) mb	19.(3) mb	4.566(6)	
^{20}Ne	90.48(3)		39.(5) mb	18.(3) mb	4.631(6)	0.12(1) mb
^{21}Ne	0.27(1)		0.7(1)	0.31(5)	6.7(2)	≈ 1.5 mb
			σ_α = 0.18(9) mb			
^{22}Ne	9.25(3)		51.(5) mb	23.(3) mb	3.87(1)	58.(4) μb*
$_{11}$Na			0.53(2)	0.32(2)	3.63(2)	2.1(2) mb
^{22}Na		2.605 y	$\sigma_p = 2.8(3)\times10^4$	$RI_p < 2.\times10^5$		
			$\sigma_\alpha = 2.6(4)\times10^2$	$RI_\alpha = 1.2(2) \times 10^2$		
^{23}Na	100.		σ_m = 0.43(3)	RI_m = 0.30(6)	3.63(2)	2.1(2) mb
$_{12}$Mg			66.(6) mb	38.(5) mb	5.375(4)	
^{24}Mg	78.99(4)		0.053(6)	32.(4) mb	5.7(2)	3.3(4) mb
^{25}Mg	10.00(1)		0.20(1)	98.(15) mb	3.6(2)	6.4(4) mb
^{26}Mg	11.01(3)		0.038(1)	25.(2) mb	4.9(2)	0.13(1) mb*
^{27}Mg		9.45 m	0.07(2)	0.03(1)		
$_{13}$Al			0.230(2)	0.17(1)	3.45(1)	
^{26}Al		7.1×10^5 y	σ_p = 1.97(10)			0.14(2)
			σ_α = 0.34(1)			
^{27}Al	100.		0.230(2)	0.17(1)	3.45(1)	2.9(3) mb
$_{14}$Si			0.166(9)	0.12(2)	4.15(1)	
^{28}Si	92.223(19)		0.17(1)	0.11(2)	4.11(1)	2.9(3) mb
^{29}Si	4.685(8)		0.12(1)	0.08(2)	4.7(1)	7.9(9) mb
^{30}Si	3.092(11)		0.107(3)	0.62(6)	4.61(1)	3.2(3) mb*
^{31}Si		2.62 h	73.(6) mb	33.(3) mb		
^{32}Si		1.6×10^2 y	< 0.5			
$_{15}$P			0.17(1)	0.08(1)	5.13(1)	
^{31}P	100.		0.17(1)	0.08(1)	5.13(1)	1.7(1) mb
$_{16}$S			0.54(2)	0.24(2)	2.847(1)	
^{32}S	94.93(31)		0.55(5)	0.25(2)	2.804(2)	4.1(2) mb
			σ_α < 0.5 mb			

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{33}S	0.76(2)		0.46(3)	0.21(2)	4.7(2)	7.4(15) mb
			σ_α = 0.12(1)	RI_α = 0.05(1)		σ_α = 0.18(1)
			σ_p = 2. mb			
^{34}S	4.29(28)		0.25(1)	0.13	3.48(3)	0.23(1) mb
^{36}S	0.02(1)		0.24(2)	0.26(3)		0.17(1) mb*
$_{17}$Cl			33.6(3)	15.(2)	9.58(1)	
^{35}Cl	75.78(4)		43.7(4)	20.(2)	11.7(1)	9.4(3) mb
			σ_p = 0.44(1)	RI_p = 0.2		σ_p = 1.7(2) mb*
			$\sigma_\alpha \approx$ 0.08 mb			
^{36}Cl		3.01×10^5 y	σ_p = 46.(2) mb	RI_p = 0.02		σ_p = 91.(8) mb
			<10.			
			σ_α = 0.59(7) mb			σ_α = 0.9(2) mb
^{37}Cl	24.22(4)		(0.05 + 0.38)	(0.04+0.26)	3.1(1)	2.0(2) mb
$_{18}$Ar			0.66(3)	0.42(5)	1.91(1)	
^{36}Ar	0.3365(30)		5.(1)	2.(1)	24.9(1)	
			σ_α = 5.4(3) mb			
			σ_p < 1.5 mb			
^{37}Ar		35.0 d	σ_α = 1.08(8)×10^3	RI_α = 900.		$\sigma_\alpha \approx$ 1.3
			σ_p = 37.(4)	RI_p = 31.		$\sigma_p \approx$ 0.04
^{38}Ar	0.0632(5)		0.8(2)	0.4(1)	3.5(35)	
^{39}Ar		268. y	6.(2)×10^2			
			σ_α <0.29			
^{40}Ar	99.6003(30)		0.64(3)	0.41(5)	1.83(1)	2.5(3) mb
^{41}Ar		1.82 h	0.5(1)	0.2(1)		
$_{19}$K			2.1(1)	1.0(1)	3.67(2)	
^{39}K	93.2581(44)		2.1(2)	0.9(1)	3.74(2)	11.8(4) mb
			σ_α = 4.3(5) mb			
			σ_p < 0.05 mb			
^{40}K	0.0117(1)	1.26×10^9 y	30.(8)	13.(4)		σ_p = 7.(1) mb
			σ_p = 4.4(4)	2.0(2)		σ_α = 40.(6) mb
			σ_α = 0.42(8)			
^{41}K	6.7302(44)		1.46(3)	1.4(2)	2.69(8)	22.(1) mb
$_{20}$Ca			0.43(2)	0.23(2)	4.70(2)	
^{40}Ca	96.941(156)		0.41(3)	0.22(4)	4.80(2)	6.7(7) mb
			σ_α = 0.13(4) mb			
^{41}Ca		1.02×10^5 y	≈ 4.			
			σ_α = 0.18(3)			
			σ_p = 7.(2) mb			
^{42}Ca	0.647(23)		0.65(10)	0.39(4)	3.4(1)	16.(2) mb
^{43}Ca	0.135(10)		6.(1)	3.9(2)	- 1.56(9)	51.(6) mb
^{44}Ca	2.086(110)		0.8(2)	0.56(1)	1.42(6)	9.(1) mb
^{45}Ca		162.7 d	≈ 15.			
^{46}Ca	0.004(3)	>4×10^{15} y	0.70(3)	0.9(1)	3.6(2)	5.3(5) mb*
^{48}Ca	0.187(21)	4.3×10^{19} y	1.0(1)	0.5(1)	0.39(9)	0.8(1) mb*
$_{21}$Sc			27.2(2)	12.(1)	12.3(1)	
^{45}Sc	100.		(10.+17.)	(5.6+6.4)	12.3(1)	69.(5) mb
^{46}Sc		83.81 d	8.(1)	3.6(5)		
$_{22}$Ti			6.1(1)	2.8(2)	- 3.438(2)	
^{44}Ti		60 y	1.1(2)			
			σ_p<0.2			
^{46}Ti	8.25(3)		0.6(2)	0.4(1)	4.93(6)	27.(3) mb
^{47}Ti	7.44(2)		1.6(2)	1.6(2)	3.63(1)	64.(8) mb
^{48}Ti	73.72(3)		7.9(9)	3.6(2)	- 6.09(2)	32.(5) mb
^{49}Ti	5.41(2)		1.9(5)	1.2(2)	1.04(5)	22.(2) mb
^{50}Ti	5.18(2)		0.179(3)	0.12(2)	6.18(8)	3.6(4) mb
$_{23}$V			5.0(2)	2.8(1)	- 0.382(1)	
^{50}V	0.250(4)	1.4×10^{17} y	21.(4)	50.(20)	7.6(6)	
			σ_p = 0.7(4) mb			

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{51}V	99.750(4)		4.9(1)	2.7(2)	- 0.402(2)	38.(4) mb
$_{24}$Cr			3.0(2)	1.7(1)	3.635(7)	
^{50}Cr	4.345(13)	>1.8×10^{17} y	15.(1)	8.(1)	- 4.5(1)	0.05(1)
^{51}Cr		27.70 d	< 10.			
^{52}Cr	83.789(18)		0.8(1)	0.6(2)	4.91(2)	8.8(4) mb
^{53}Cr	9.501(17)		18.(2)	9.(1)	- 4.2(1)	0.06(1)
^{54}Cr	2.365(7)		0.36(4)	0.25(5)	4.6(1)	7.(2) mb
$_{25}$Mn			13.3(1)	14.0(3)	- 3.75(2)	
^{53}Mn		3.7×10^{6} y	70.(10)	32.(5)		
^{54}Mn		312.1 d	< 10.			
^{55}Mn	100.		13.3(1)	14.0(3)	- 3.75(2)	40.(3) mb
$_{26}$Fe			2.7(1)	1.4(2)	9.45(2)	
^{54}Fe	5.845(35)		2.3(2)	1.3(2)	4.2(1)	29.(2) mb
			σ_α = 10. μb	RI$_\alpha$ = 1.1(1) mb		
^{55}Fe		2.73 y	13.(2)	6.(1)		
			σ_α = 0.01			
^{56}Fe	91.754(36)		2.8(3)	1.4(2)	9.93(3)	11.7(5) mb
^{57}Fe	2.119(10)		1.4(2)	0.8(4)	2.3(1)	40.(4) mb
^{58}Fe	0.282(4)		1.3(1)	1.3(2)	15.(7)	12.(1) mb
^{59}Fe		44.51 d	13.(3)	6.(1)		
$_{27}$Co			37.19(8)	74.(2)	2.49(2)	
^{58m}Co		9.1 h	1.4(1)×10^{5}	2.5(10)×10^{5}		
^{58}Co		70.88 d	1.9(2)×10^{3}	7.(1)×10^{3}		
^{59}Co	100.		(20.7+16.5)	(39.+35.)	2.49(2)	38.(4) mb
^{60m}Co		10.47 m	58.(3)	230.(50)		
^{60}Co		5.271 y	2.0(2)	4.3(10)		
$_{28}$Ni			4.5(2)	2.3(2)	10.3(1)	
^{58}Ni	68.0769(89)	>4×10^{19} y	4.6(4)	2.3(2)	14.4(1)	41.(2) mb
			σ_α < 0.03 mb			
^{59}Ni		≈ 7.6×10^{4} y	σ_{abs} = 92.(4)	RI$_{abs}$ = 1.4(1)×10^{2}		
			σ_α = 14.(2)			
			σ_p = 2.(1)			
^{60}Ni	26.2231(77)		2.9(3)	1.5(2)	2.8(1)	25.(1) mb
^{61}Ni	1.1399(6)		2.5(5)	1.5(4)	7.60(6)	82.(8) mb
			σ_α = 0.03 mb			
^{62}Ni	3.6345(17)		15.(1)	6.8(3)	- 8.7(2)	13.(4) mb
^{63}Ni		100. y	20.(5)	9.(2)		
^{64}Ni	0.9256(9)		1.6(1)	1.2(2)	- 0.37(7)	9.(1) mb
^{65}Ni		2.517 h	22.(2)	10.(1)		
$_{29}$Cu			3.8(1)	4.1(4)	7.718(4)	
^{63}Cu	69.15(15)		4.5(2)	5.(1)	6.43(15)	0.09(1)
^{64}Cu		12.701 h	≈ 270.			
^{65}Cu	30.85(15)		2.17(3)	2.2(1)	10.61(19)	41.(5) mb
^{66}Cu		5.09 m	1.4(1)×10^{2}	60.(20)		
$_{30}$Zn			1.1(2)	2.8(4)	5.680(5)	
^{64}Zn	48.27(32)	>2.3×10^{18} y	0.74(5)	1.4(3)	5.23(4)	59.(5) mb
			σ_p < 12. μb			
			σ_α = 11.(3) μb			
^{65}Zn		243.8 d	66.(8)	30.(4)		
			σ_α = 2.0(2)			
^{66}Zn	27.977(77)		0.9(3)	1.8(2)	5.98(5)	35.(3) mb
			σ_α < 0.02 mb			
^{67}Zn	4.102(21)		6.9(1.4)	25.(5)	7.58(8)	0.15(2)
			σ_α = 0.4 mb			
^{68}Zn	19.02(12)		(0.072 + 0.8)	(0.2 + 2.9)	6.04(3)	19.(2) mb
			σ_α <0.02 mb			σ_m = 3.(1) mb
^{70}Zn	0.631(9)		(8.1+83.) mb	0.9(2)		0.02(1)
$_{31}$Ga			2.9(1)	22.(3)	7.288(2)	

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{69}Ga	60.108(9)		1.68(7)	16.(2)	7.88(4)	0.14(1)
^{71}Ga	39.892(9)	>2.4×10^{26} y	4.7(2)	31.(3)	6.40(3)	0.12(1)
			σ_m = 0.15(5)			
$_{32}$Ge			2.2(1)	6.(2)	8.19(2)	
^{68}Ge		270.8 d	1.0(5)			
^{70}Ge	20.370(89)		(0.3 + 2.7)	2.3(1)	10.0(1)	88.(5) mb
^{72}Ge	27.380(60)		0.9(2)	0.8(3)	8.5(1)	0.07(2)
^{73}Ge	7.759(78)	>1.8×10^{23} y	15.(1)	66.(20)	5.02(4)	0.3(1)
^{74}Ge	36.656(80)		(0.14 + 0.28)	(0.4+0.5)	7.6(1)	53.(7) mb
^{76}Ge	7.835(81)	1.6×10^{21} y	(0.09 + 0.06)	(1.3+0.6)	8.2(15)	0.03(2)
$_{33}$As			4.0(4)	61.(5)	6.58(1)	
^{75}As	100.		4.0(4)	61.(5)	6.58(1)	0.57(4)
$_{34}$Se			12.(1)	14.(3)	7.970(9)	
^{74}Se	0.89(4)		50.(2)	520(50)	0.8(3)	0.2(1)
^{75}Se		119.78 d	3.3(10)×10^2			
^{76}Se	9.37(29)		(22. + 63.)	(9.+31.)	12.2(1)	0.16(1)
^{77}Se	7.63(16)		42.(4)	30.(5)	8.25(8)	0.3(1)
			σ_α = 0.97(3) μb			
^{78}Se	23.77(28)		σ_m = 0.38(2)	RI$_m$ = 4.3(4)	8.24(9)	0.1
^{80}Se	49.61(41)		(0.05+0.54)	(0.15+0.85)	7.48(3)	42.(3) mb
^{82}Se	8.73(22)	≈ 1×10^{20} y	(39.+ 5.2) mb	39.(4) mb	6.34(8)	0.04(2)
$_{35}$Br			6.8(2)	92.(8)	6.79(2)	
^{76}Br		16.0 h	224.(42)			
^{79}Br	50.69(7)		(2.5+8.3)	(36.+96.)	6.79(7)	0.63(4)
						σ_m = 0.08(1)
^{81}Br	49.31(7)		(2.4+0.24)	51.(5)	6.78(7)	0.31(2)
$_{36}$Kr			24.(1)	39.(6)	7.81(2)	
^{78}Kr	0.353(3)	>2.3×10^{20} y	(0.17+6.)	20.(1)		(0.11+0.19)
^{80}Kr	2.286(10)		(4.6+7.)	57.(6)		(0.09+0.18)
^{82}Kr	11.593(3)		(14.+7.)	130.(13)		90.(6) mb
^{83}Kr	11.500(19)		183.(30)	183.(20)		0.24(2)
^{84}Kr	56.987(15)		(σ_m+ σ_g) = 0.11	2.4(3)		(16.+33.) mb
			σ_m = 0.09			
^{85}Kr		10.73 y	1.7(2)	1.8(10)		0.07(2)
^{86}Kr	17.279(41)		3.(2) mb	≈ 1. mb	8.1(3)	3.2(4) mb
$_{37}$Rb			0.39(4)	6.(3)	7.08(2)	
^{84}Rb		32.9 d	σ_p = 12.(2)			
^{85}Rb	72.17(2)		(0.06+0.38)	(0.7+7.)	7.0(1)	0.24(1)
^{86}Rb		18.65 d	<20.			
^{87}Rb	27.83(2)	4.88×10^{10} y	0.10(1)	2.3(4)	7.3(1)	16.(1) mb
^{88}Rb		17.7 m	1.2(3)	0.5(1)		
$_{38}$Sr			1.2(1)	10.(1)	7.02(2)	
^{84}Sr	0.56(1)		(0.6+0.2)	(9.+1.)		0.4(1)
^{86}Sr	9.86(1)		σ_m = 0.81(4)	RI$_m$ = 4.(1)	5.68(5)	(48.+22.) mb
^{87}Sr	7.00(1)		16.(3)	118.(30)	7.41(7)	97.(5) mb
^{88}Sr	82.58(1)		5.8(4) mb	0.07(3)	7.16(6)	6.0(2) mb
^{89}Sr		50.52 d	0.42(4)	0.2		
^{90}Sr		29.1 y	10.(1) mb	0.10(2)		
$_{39}$Y			1.25(5)	1.0(1)	7.75(2)	
^{89}Y	100.		(0.001+1.25)	(0.006+1.0)	7.75(2)	19.(1) mb
^{90}Y		2.67 d	<6.5			
^{91}Y		58.5 d	1.4(3)	0.6(1)		
$_{40}$Zr			0.19(1)	0.95(9)	7.16(3)	
			σ_α <0.1 mb			
^{90}Zr	51.45(40)		≈ 0.014	0.2(1)	6.4(1)	21.(2) mb
^{91}Zr	11.22(5)		1.2(3)	5.(2)	8.8(1)	60.(8) mb
^{92}Zr	17.15(8)		0.2(1)	0.6(2)	7.5(2)	33.(4) mb
^{93}Zr		1.5×10^6 y	<4.	16.(5)		0.10(1)

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{94}Zr	17.38(28)	$>10^{17}$ y	0.049(6)	0.25(3)	8.3(2)	26.(1) mb
^{96}Zr	2.80(9)	$>1.7\times10^{18}$ y	0.020(3)	5.0(5)	5.5(1)	11.(1) mb
$_{41}$Nb			1.11(1)	8.5(6)	7.14(3)	
			σ_α <0.1 mb			
^{93}Nb	100.		1.1	(6.3+2.2)	7.14(3)	266.(5) mb
			σ_m = 0.86			
^{94}Nb		2.4×10^4 y	(σ_m+ σ_g) = 15.(1)	126.(13)		
			σ_m = 0.6(1)			
^{95}Nb		34.97 d	<7.	<200.		
$_{42}$Mo			2.5(1)	26.(5)	6.72(2)	
			σ_α <0.1 mb			
^{92}Mo	14.77(31)	$>3\times10^{17}$ y	0.06	≈ 0.8	6.93(8)	0.07(1)
			σ_m = 0.2 μb			
^{94}Mo	9.226(99)		0.02	≈ 0.8	6.82(7)	0.10(2)
^{95}Mo	15.900(85)		13.4(3)	109.(5)	6.93(6)	0.29(1)
			σ_α = 30.(4) μb			
^{96}Mo	16.674(12)		0.5	17.(3)	6.22(6)	0.11(1)
^{97}Mo	9.560(50)		2.5(2)	14.(3)	7.26(8)	0.34(1)
			σ_α = 0.4(2) μb			
^{98}Mo	24.20(25)		0.14(1)	7.2(7)	6.60(7)	0.10(1)
^{100}Mo	9.67(20)	$\approx 1\times10^{19}$ y	0.19(1)	3.6(3)	6.75(7)	0.11(1)
$_{43}$Tc						
^{98}Tc		$\approx 6.6\times10^6$ y	σ_m = 0.9(2)			
^{99}Tc		2.13×10^5 y	23.(2)	$4.0(4)\times10^2$	6.8(3)	0.93(5)
$_{44}$Ru			2.6 (1)	48.(5)	7.03(3)	
^{96}Ru	5.54(14)	$>3.1\times10^{16}$ y	0.23(4)	7.(2)		0.21(1)
^{98}Ru	1.87(3)		< 8.			0.3(1)
^{99}Ru	12.76(14)		4.(1)	195.(20)		1.2(3)
^{100}Ru	12.60(7)		5.8(6)	11.(2)		0.21(1)
^{101}Ru	17.06(2)		5.(1)	$1.1(3)\times10^2$		1.00(4)
			σ_α <0.15 μb			
^{102}Ru	31.55(14)		1.2(1)	4.3(5)		0.15(1)
^{103}Ru		39.27 d	<20.	≈ 30.		
^{104}Ru	18.62(27)		0.49(2)	6.(2)		0.15(1)
^{105}Ru		4.44 h	0.29(3)	0.13(1)		
^{106}Ru		1.020 y	0.15(4)	2.0(6)		
$_{45}$Rh			145.(2)	$1.2(1)\times10^3$	5.88(4)	
^{103}Rh	100.		(11.+ 134.)	$(0.08+1.1)\times10^3$	5.88(4)	0.81(1)
^{104m}Rh		4.36 m	800.(100)			
^{104}Rh		42.3 s	40.(30)			
^{105}Rh		35.4 h	$1.1(3)\times10^4$	$1.7(4)\times10^4$		
$_{46}$Pd			7.(1)	82.(8)	5.91(6)	
^{102}Pd	1.02(1)		3.2(10)	10.(2)		0.3(1)
^{104}Pd	11.14(8)			16.(2)		0.29(3)
^{105}Pd	22.33(8)		22.(2)	60.(20)	5.5(3)	1.20(6)
			σ_α = 0.5(2) μb			
^{106}Pd	27.33(3)		(0.013+0.28)	(0.2+5.5)	6.4(4)	0.25(3)
^{107}Pd		6.5×10^6 y	1.8(2)	108.(4)		1.34(6)
^{108}Pd	26.46(9)		(0.19+8.5)	(2.+240.)	4.1(3)	0.20(2)
^{110}Pd	11.72(9)		(0.033+0.7)	(0.7+8.)		0.15(2)
$_{47}$Ag			62.(1)	767.(60)	5.922(7)	
^{107}Ag	51.839(8)		(1.+35.)	(3.+105.)	7.56(1)	0.80(3)
^{109}Ag	48.161(8)		(4.1 + 87.)	$(0.7+14.1)\times10^2$	4.17(1)	0.79(3)
^{110m}Ag		249.8 d	82.(11)	20.(4)		
^{111}Ag		7.47 d	3.(2)	105.(20)		
$_{48}$Cd			$2.52(5)\times10^3$	73.(8)	4.87(5)	
^{106}Cd	1.25(6)	$>2.6\times10^{17}$ y	0.20(3)	4.(1)		0.30(2)
^{108}Cd	0.89(3)	$>4.1\times10^{17}$ y	1.	14.(3)	5.4(1)	0.20(1)

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{109}Cd		462.0 d	≈ 180.	6.7(12)×10^3		
			σ_α <0.05			
^{110}Cd	12.49(18)		(0.06+11.)	(6.+34.)	5.9(1)	(0.01+0.22)
^{111}Cd	12.80(12)		3.5(20)	51.(6)	6.5(1)	0.75(1)
^{112}Cd	24.13(21)		(0.012+2.2)	15.	6.4(1)	0.19(1)
^{113}Cd	12.22(12)	7.7×10^{15} y	2.06(4)×10^4	390.(40)	- 8.0(2)	0.67(1)
			σ_α <1. μb			
^{114}Cd	28.73(42)		(0.04+0.29)	16.(7)	7.5(1)	(0.01+0.12)
^{116}Cd	7.49(18)	3.8×10^{19} y	(26.+52.) mb	1.2	6.3(1)	(12.+47.) mb
$_{49}$In			197.(4)	3.3(2)×10^3	4.07(2)	
^{113}In	4.29(5)		(3.1+5.0+3.9)	(220.+90.)	5.39(6)	(0.48+0.31)
^{115}In	95.71(5)	4.4×10^{14} y	(88.+73.+44.)	(1.5+1.2+0.7)×10^3	4.01(2)	(0.69+0.02)
$_{50}$Sn			0.61(3)	8.(2)	6.225(2)	
^{112}Sn	0.97(1)		(0.15+0.40)	(8.+19.)		0.21(1)
^{113}Sn		115.1 d	≈ 9.	210.(50)		
^{114}Sn	0.66(1)		≈ 0.12	5.(1)	6.2(3)	134.(3) mb
^{115}Sn	0.34(1)		σ_α = 0.06 mb	29.(6)		0.34(1)
^{116}Sn	14.54(9)		(0.006+0.14)	(0.5+11.)	5.93(5)	91.(2) mb
^{117}Sn	7.68(7)		1.1(1)	16.(5)	6.48(5)	319.(7) mb
^{118}Sn	24.22(9)		σ_m = 4. mb	4.7(5)	6.07(5)	62.(1) mb
^{119}Sn	8.59(4)		2.(1)	2.9(5)	6.12(5)	0.18(1)
^{120}Sn	32.58(9)		(0.001+0.13)	1.2(3)	6.49(5)	(0.5+36.) mb
^{122}Sn	4.63(3)		(0.15+0.001)	0.81(4)	5.74(5)	(18.+4.) mb
^{124}Sn	5.79(5)	>2.2×10^{18} y	(0.13+0.004)	(8.0+0.08)	5.97(5)	12.(2) mb
$_{51}$Sb			5.2(2)	169.(20)	5.57(3)	
^{121}Sb	57.21(5)		(0.4+5.8)	(13.+192.)	5.71(6)	0.53(2)
^{123}Sb	42.79(5)		(0.02+0.04+4.0)	(1.+119.)	5.38(7)	0.30(1)
^{124}Sb		60.20 d	17.(3)	≈ 8.		
$_{52}$Te			4.2(1)	47.(3)	5.80(3)	
^{120}Te	0.09(1)		(1.+5.)	≈ 1.	5.3(5)	0.4(1)
^{122}Te	2.55(12)		(0.4+3.)	(5.+75.)	3.8(2)	295.(3) mb
^{123}Te	0.89(3)	>5.3×10^{16} y	370.(40)	4.5(3)×10^3	- 0.05	0.83(1)
			σ_α = 0.05 mb			
^{124}Te	4.74(14)		(1.+6.)	(1.4+4.)	8.0(1)	155.(2) mb
^{125}Te	7.07(15)		1.1(2)	21.(4)	5.02(8)	431.(4) mb
^{126}Te	18.84(25)		(0.12+0.8)	(0.6+7.4)	5.56(7)	(28.+53.) mb
^{128}Te	31.74(8)	2.2×10^{24} y	(0.03+0.2)	(0.2+1.6)	5.89(7)	(3.+41.) mb
^{130}Te	34.08(62)	8.×10^{20} y	(0.01+0.19)	(0.03+0.3)	6.02(7)	(4.+11.) mb
$_{53}$I			6.2(1)	1.5(1)×10^2	5.28(2)	
^{125}I		59.4 d	900.(100)	1.4(2)×10^4		
^{127}I	100.		6.2(1)	1.5(1)×10^2	5.28(2)	0.64(3)
^{128}I		25.00 m	22.(4)	≈ 10.		
^{129}I		1.7×10^7 y	(20.7+10.3)	36.(4)		0.44(2)
^{130}I		12.36 h	18.(3)	≈ 8.		
^{131}I		8.021 d	≈ 0.7	8.(4)		
$_{54}$Xe			25.(1)	263.(50)	4.92(3)	
^{124}Xe	0.0953(27)	>10^{17} y	(28.+137.)	(0.6+3.0)×10^3		(0.13+0.51)
^{125}Xe		17.1 h	σ_α < 0.03			
^{126}Xe	0.0890(14)		(0.45+3.)	(8.+52.)		(0.04+0.32)
^{127}Xe		36.34 d	$\sigma_\alpha \leq$ 0.01			
^{128}Xe	1.910(22)		σ_m = 0.48	RI_m = 38.(10)		0.26(1)
^{129}Xe	26.40(18)		22.(5)	250.(50)		0.62(2)
^{130}Xe	4.071(53)		σ_m = 0.45	RI_m = 16.(4)		0.132(3)
^{131}Xe	21.233(62)		90.(10)	9.(1)×10^2		0.45(8)
^{132}Xe	26.9087(680)		(0.05+0.4)	(0.9+3.7)		(5.+60.) mb
^{133}Xe		5.243 d	190.(90)			
^{134}Xe	10.436(29)	>1.1×10^{16} y	(0.003 + 0.26)	0.40(4)		20.(2) mb
^{135}Xe		9.10 h	2.65(11)×10^6	7.6(5)×10^3		

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{136}Xe	8.858(33)	>8×10^{20} y	0.26(2)	0.7(2)		0.9(1) mb
$_{55}$Cs			30.4(8)	422.(50)	5.42(2)	
^{132}Cs		6.48 d	σ_α < 0.15			
^{133}Cs	100.		(2.7+27.3)	(32.+360.)	5.42(2)	(0.04+0.47)
^{134}Cs		2.065 y	140.(10)	54.(9)		
^{135}Cs		2.3×10^{6} y	8.3(3)	38.(3)		
^{137}Cs		30.2 y	(0.20+0.07)	0.36(7)		
$_{56}$Ba			1.3(2)	10.(2)	5.07(3)	
^{130}Ba	0.106(1)	2.2×10^{21} y	(1.+8.)	(25.+200.)	- 3.6(6)	0.76(11)
^{132}Ba	0.101(1)	1.3×10^{21} y	(0.84+9.7)	(4.7+24.)	7.8(3)	0.6(1)
^{133}Ba		10.53 y	4.(1)	85.(30)		
^{134}Ba	2.417(18)		(0.1+1.3)	(5.6+18.)	5.7(1)	0.18(1)
^{135}Ba	6.592(12)		(0.014+5.8)	(0.47+131.)	4.7(1)	0.46(2)
^{136}Ba	7.854(24)		(0.010+0.44)	(0.1+1.5)	4.91(8)	61.(2) mb
^{137}Ba	11.232(24)		5.(1)	4.(1)	6.8(1)	76.(3) mb
^{138}Ba	71.698(42)		0.41(2)	0.4(1)	4.84(8)	4.0(2) mb
^{139}Ba		1.396 h	5.(1)	2.2(5)		
^{140}Ba		12.75 d	1.6(3)	14.(1)		
$_{57}$La			9.2(2)	12.(1)	8.24(4)	
^{138}La	0.090(1)	1.06×10^{11} y	57.(6)	4.1(9)×10^{2}		
^{139}La	99.910(1)		9.2(2)	12.(1)	8.24(4)	38.(3) mb
^{140}La		1.678 d	2.7(3)	69.(4)		
$_{58}$Ce			0.64(4)	0.71(6)	4.84(2)	
^{136}Ce	0.185(2)		(1.0+6.5)	58.(12)	5.80(9)	(0.028+0.3)
^{138}Ce	0.251(2)		(0.025+1.0)	(1.5+5.2)	6.70(9)	179.(5) mb
^{140}Ce	88.450(51)		0.58(4)	0.50(5)	4.84(9)	11.0(4) mb
^{141}Ce		32.50 d	29.(3)	13.(2)		
^{142}Ce	11.114(51)	>1.6×10^{17} y	0.97(3)	1.3(3)	4.75(9)	28.(1) mb
^{143}Ce		1.38 d	6.1(7)	2.7(3)		
^{144}Ce		284.6 d	1.0(1)	2.6(3)		
$_{59}$Pr			11.5(4)	14.(3)	4.58(5)	
^{141}Pr	100.		(4.+7.5)	14.(3)	4.58(5)	111.(2) mb
^{142}Pr		19.12 h	20.(3)	9.(1)		
^{143}Pr		13.57 d	90.(10)	190.(25)		
$_{60}$Nd			51.(2)	49.(5)	7.69(5)	
^{142}Nd	27.2(5)		19.(1)	34.(11)	7.7(3)	35.(1) mb
^{143}Nd	12.2(2)		330.(10)	128.(30)		0.24(1)
			σ_α = 17. mb			
^{144}Nd	23.8(3)	2.1×10^{15} y	3.6(3)	3.9(5)	2.8(3)	81.(2) mb
^{145}Nd	8.3(1)		47.(6)	260.(40)		0.42(1)
			σ_α = 12. μb			
^{146}Nd	17.2(3)		1.5(2)	3.0(4)	8.7(2)	91.(1) mb
^{147}Nd		10.98 d	440.(150)	200.		
^{148}Nd	5.7(1)		2.4(1)	13.(2)	5.7(3)	147.(2) mb
^{150}Nd	5.6(2)	≈ 1×10^{19} y	1.0(1)	14.(2)	5.3(2)	0.16(1)
$_{61}$Pm						
^{146}Pm		5.53 y	8.4(1.7)×10^{3}			
^{147}Pm		2.623 y	(84.+96.)	(1000.+1280.)	12.6(4)	2.(1)
^{148m}Pm		41.3 d	10600.(800)			
^{148}Pm		5.37 d	≈ 10^{3}	2.6(2.4)×10^{3}		
^{149}Pm		2.212 d	1400.(200)			
^{151}Pm		1.183 d	≈ 150.			
$_{62}$Sm			5.6(1)×10^{3}	1.4(2)×10^{3}		
^{144}Sm	3.07(7)		1.6(1)	2.4(3)		92.(6) mb
^{145}Sm		340. d	280.(20)	600.(90)		
^{147}Sm	14.99(18)	1.06×10^{11} y	56.(4), σ_α = 0.6 mb	710.(50)	14.(3)	0.97(1)
^{148}Sm	11.24(10)	7×10^{15} y	2.4(6)	27.(14)		241.(2) mb
^{149}Sm	13.82(7)	10^{16} y	4.01(6)×10^{4}, σ_α = 31. mb	3.1(5)×10^{3}		1.82(2)

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{150}Sm	7.38(1)		102.(5)	290.(30)	14.(3)	422.(4) mb
^{151}Sm		90. y	$1.52(3)\times10^{4}$	3520.(60)		2.(1)
^{152}Sm	26.75(16)		206.(15)	$3.0(3)\times10^{3}$	- 5.0(6)	473.(4) mb
^{153}Sm		1.929 d	420.(180)			
^{154}Sm	22.75(29)		7.5(3)	32.(6)	9.(1)	0.21(1)
$_{63}$Eu			4570.(100)	$3.8(5)\times10^{3}$	5.3(3)	
^{151}Eu	47.81(6)		(4.+3150.+6000.)	$(2.+4.)\times10^{3}$		(1.6+2.2)
			σ_{α} = 8.7(3) μb			
^{152m1}Eu		9.30 h	$6.8(15)\times10^{4}$	$< 10^{5}$		
^{152}Eu		13.5 y	$1.1(2)\times10^{4}$	$1.6(2)\times10^{3}$		5.(2)
^{153}Eu	52.19(6)		300.(20), σ_{α} <1. μb	$1.8(4)\times10^{3}$	8.2(1)	2.8(1)
^{154}Eu		8.59 y	$1.5(3)\times10^{3}$	$1.6(2)\times10^{3}$		4.4(7)
^{155}Eu		4.76 y	$3.9(2)\times10^{3}$	$1.6(2)\times10^{4}$		1.3(1)
$_{64}$Gd			$48.8(6)\times10^{3}$	400.(10)	9.5(2)	
^{148}Gd		75. y	$1.40(14)\times10^{4}$			
^{152}Gd	0.20(1)	1.1×10^{14} y	700.(200), σ_{α} <7. mb	700.(200)		1.05(2)
^{153}Gd		240. d	$2.(1)\times10^{4}$, σ_{α} = 0.03			
^{154}Gd	2.18(3)		(0.035+60.)	230.(50)		1.03(1)
^{155}Gd	14.80(12)		$61.(1)\times10^{3}$, σ_{α} = .08 mb	1540.(100)		2.65(3)
^{156}Gd	20.47(9)		≈ 2.0	104.(15)	6.3(4)	615.(5) mb
^{157}Gd	15.65(2)		$2.54(3)\times10^{5}$, σ_{α} <0.05	800.(100)		1.37(2)
^{158}Gd	24.84(7)		2.3(3)	73.(7)	9.(2)	324.(3) mb
^{160}Gd	21.86(19)	$>1.9\times10^{19}$ y	1.5(7)	6.(1)	9.15(5)	0.15(2)
^{161}Gd		3.66 m	$2.0(6)\times10^{4}$			
$_{65}$Tb			23.2(5)	420.(50)	7.34(2)	
^{159}Tb	100.		23.2(5)	420.(50)	7.34(2)	1.6(2)
^{160}Tb		72.3 d	570.(110)			
$_{66}$Dy			$9.5(2)\times10^{2}$	$1.5(2)\times10^{3}$	16.9(3)	
^{156}Dy	0.056(3)		33.(3), σ_{α} < 9. mb	1000.(100)		1.6(2)
^{158}Dy	0.095(3)		43.(6), σ_{α} < 6. mb	120.(10)	6.1(5)	0.8(2)
^{159}Dy		144. d	$8.(2)\times10^{3}$			
^{160}Dy	2.39(18)		60.(10), σ_{α} < 0.3 mb	1100.(200)	6.7(4)	0.89(1)
^{161}Dy	18.889(42)		600.(50), σ_{α} < 1. μb	1100.(100)	10.3(4)	1.96(2)
^{162}Dy	25.475(36)		170.(20)	2755.(300)	- 1.4(5)	446.(4) mb
^{163}Dy	24.896(42)		120.(10), σ_{α} < 20. μb	1600.(400)	5.0(4)	1.11(1)
^{164}Dy	28.260(54)		$(1.7+1.0)\times10^{3}$	$(4.+2.)\times10^{2}$	49.4(2)	212.(3) mb
^{165m}Dy		1.26 m	$2.0(6)\times10^{3}$			
^{165}Dy		2.33 h	$3.5(3)\times10^{3}$	$2.2(3)\times10^{4}$		
$_{67}$Ho			61.(2)	670.(40)	8.01(8)	
^{163}Ho		4.57×10^{3} y				(0.4+1.7)
^{165}Ho	100.		(3.1+58.), σ_{α} < 20. μb	(?+670.)	8.01(8)	(0.8+0.5)
^{166m}Ho		1.2×10^{3} y	$3.1(8)\times10^{3}$	$10.(3)\times10^{3}$		
$_{68}$Er			$1.5(2)\times10^{2}$	730.(10)	7.79(2)	
^{162}Er	0.139(5)		19.(3), σ_{α} < 11. mb	480.(50)	8.8(2)	1.6(1)
^{164}Er	1.601(3)		13.(3), σ_{α} < 1.2 mb	105.(10)	8.2(2)	1.08(5)
^{166}Er	33.503(36)		(3.+14.), σ_{α} < 70. μb	96.(12)	10.6(2)	0.56(6)
^{167}Er	22.869(9)		$6.5(8)\times10^{2}$, σ_{α} = 3. μb	2970.(70)	3.0(3)	1.4(2)
^{168}Er	26.978(18)		2.3(3), σ_{α} = 0.09 mb	37.(5)	7.4(4)	0.34(4)
^{170}Er	14.910(36)		8.(2)	26.(4)	9.6(5)	0.17(1)
^{171}Er		7.52 h	370.(40)	170.(20)		
$_{69}$Tm			108.(4)	$1.5(2)\times10^{3}$	7.07(3)	
^{169}Tm	100		(8.+100.)	$1.5(2)\times10^{3}$	7.07(3)	1.13(6)
^{170}Tm		128.6 d	100.(20)	460.(50)		
^{171}Tm		1.92 y	≈ 160.	118.(6)		
$_{70}$Yb			52.(10)	$1.7(2)\times10^{2}$	12.43(3)	
^{168}Yb	0.13(1)		$2.4(2)\times10^{3}$, σ_{α} < 0.1 mb	$2.0(5)\times10^{4}$	-4.07(2)	0.7(4)
^{169}Yb		32.02 d	$3.6(3)\times10^{3}$	5200.(500)		
^{170}Yb	3.04(15)		12.(2), σ_{α} < 10. μb	320.(30)	6.8(1)	0.77(1)

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{171}Yb	14.28(57)		53.(5), σ_α < 1.5 μb	315.(30)	9.7(1)	1.21(1)
^{172}Yb	21.83(67)		≈ 1.3, σ_α < 1. μb	25.(3)	9.4(1)	0.34(1)
^{173}Yb	16.13(27)		16.(2), σ_α < 1. μb	380.(30)	9.56(7)	0.75(1)
^{174}Yb	31.83(92)		(46.+17.), σ_α < 0.02 mb	(13.+16.)	19.3(1)	151.(2) mb
^{176}Yb	12.76(41)		3.1(2), σ_α < 1. μb	8.(2)	8.7(1)	116.(2) mb
$_{71}$Lu			78.(7)	8.3(7)×10^2	7.21(3)	
^{175}Lu	97.41(2)		(16.+8.)	(550.+270.)	7.24(3)	(1.04+0.11)
^{176}Lu	2.59(2)	3.73×10^{10} y	(2.+2100.)	(3.+930.)	6.1(2)	1.53(7)
^{177m}Lu		160.7 d	3.2(3)	1.4(2)		
^{177}Lu		6.65 d	1000.(300)			
$_{72}$Hf			106.(3)	19.7(5)×10^2	7.8(1)	
^{174}Hf	0.16(1)	2.0×10^{15} y	600.(50)	400.(50)	11.(1)	0.8(2)
^{176}Hf	5.26(7)		23.(4)	700.(100)	6.6(2)	0.46(2)
^{177}Hf	18.60(9)		(1.+375.), σ_α < 20. μb	7170.(200)		1.5(1)
^{178m2}Hf		31. y	σ_{m2} = 45.(5)	RI_{m2} = 8(1)×10^2		
^{178}Hf	27.28(7)		(54.+32.)	(0.9+1.0)×10^3	5.9(2)	0.31(1)
^{179}Hf	13.62(2)		(0.43+46.)	(6.8+620.)	7.5(2)	(0.01+0.95)
^{180}Hf	35.08(16)		13.0(5), σ_α < 13. μb	32.(1)	13.2(3)	179.(5) mb
^{181}Hf		42.4 d	30.(25)			
$_{73}$Ta			20.(1)	650(20.)	6.91(7)	
^{179}Ta		1.8 y	9.3(6)×10^2	1.22(7)×10^3		
^{180m}Ta	0.012(2)	> 1.2×10^{15} y	≈ 560.	1350.(100)		
^{181}Ta	99.988(2)		(0.012 + 20.), σ_α <1. μb	(0.4+650.)	6.91(7)	0.77(2)
^{182}Ta		114.43 d	8200.(600)	900.(90)		
$_{74}$W			18.(1)	3.6(3)×10^2	4.86(2)	
^{180}W	0.12(1)	7.4×10^{16} y	≈ 4.	210.(30)		0.54(6)
^{182}W	26.50(16)	8.3×10^{18} y	20.(1)	600.(90)	6.97(4)	274.(8) mb
^{183}W	14.31(4)	1.9×10^{18} y	10.5(3)	340.(50)	6.53(4)	0.52(2)
^{184}W	30.64(2)	4.0×10^{18} y	(0.002 + 2.0)	15.(2)	7.48(6)	0.22(1)
^{185}W		74.8 d	≈ 3.3	300.(50)		
^{186}W	28.43(19)	6.5×10^{18} y	37.(2)	510.(50)	- 0.72(4)	176.(5) mb
^{187}W		23.9 h	70.(10)	2760.(550)		
^{188}W		69.78 h	12.(1)			
$_{75}$Re			90.(4)	8.4(2)×10^2	9.2(3)	
^{185}Re	37.40(2)		(0.33+110.)	1700.(50)	9.0(3)	1.54(6)
^{187}Re	62.60(2)	4.2×10^{10} y	(2.+72.)	(9.+310.)	9.3(3)	1.16(6)
$_{76}$Os			17.(1)	1.5(1)×10^2	10.7(2)	
^{184}Os	0.02(1)	>5.6×10^{13} y	3.3(3)×10^3, σ_α <10. mb	1.4(1)×10^3		0.4(2)
^{186}Os	1.59(3)	2.×10^{15} y	≈ 80., σ_α < 0.1 mb	3.8(9)×10^2	12(2)	0.42(2)
^{187}Os	1.96(2)		2.(1)×10^2, σ_α < 0.1 mb	5.0(7)×10^2		0.90(3)
^{188}Os	13.24(8)		≈ 5., σ_α < 30. μb	1.5(2)×10^2	7.6(3)	0.40(2)
^{189}Os	16.15(5)		(0.00026+40.),σ_α<10. μb	(0.013+670.)	10.7(3)	1.17(5)
^{190}Os	26.26(2)		(9.+4.), σ_α < 20. μb	(22.+8.)	11.0(3)	0.30(5)
^{191}Os		15.4 d	3.8(6)×10^2	1.7(3)×10^2		
^{192}Os	40.78(19)		3.(1), σ_α < 10. μb	7.(1)	11.5(4)	0.31(5)
^{193}Os		30.5 h	2.5(5)×10^2	1.1(2)×10^2		
$_{77}$Ir			4.2(1)×10^2	2.8(4)×10^3	10.6(3)	
^{191}Ir	37.3(2)		(0.14+660.+260.)	(1.0+4.2)×10^3		1.35(4)
^{192}Ir		73.83 d	1.4(3)×10^3	4.8(7)×10^3		
^{193}Ir	62.7(2)		(0.04+6.+109.)	1.4(2)×10^3		0.99(7)
^{194}Ir		19.3 h	1.6(3)×10^3	7.(2)×10^2		
$_{78}$Pt			10.(1)	1.3(1)×10^2	9.60(1)	
^{190}Pt	0.014(1)	4.5×10^{11} y	1.5(1)×10^2, σ_α < 8. mb	70.(10)	9.(1)	0.7(2)
^{192}Pt	0.782(7)		(2.0+6.), σ_α < 0.2 mb	115.(20)	9.9(5)	0.6(1)
^{194}Pt	32.967(99)		(0.1+1.1), σ_α < 5. μb	(4.+?)	10.55(8)	(0.03+0.34)
^{195}Pt	33.832(10)		28.(1), σ_α < 5. μb	365.(50)	8.8(1)	0.9(2)
^{196}Pt	25.242(41)		(0.045+0.55)	7.(2)	9.89(8)	(0.01+0.19)
^{198}Pt	7.163(55)		(0.3+3.1)	(5.+53.)	7.8(1)	(3.+79.) mb

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{199}Pt		30.8 m	≈ 15.	≈ 7.		
$_{79}$Au			98.7(1)	1.55(3)×10^3	7.63(6)	
^{197}Au	100.		σ_{m+g} = 98.7(1)	RI_{m+g} = 1.55(3)×10^3	7.63(6)	582.(9) mb
			σ_m = 8.(2) mb	RI_m = 0.06(2)		
^{198}Au		2.695 d	26.5(15)×10^3	≈ 4.×10^4		
^{199}Au		3.14 d	≈ 30.			
$_{80}$Hg			3.7(1)×10^2	87.(5)	12.69(2)	
^{196}Hg	0.15(1)	>2.5×10^{18} y	(105.+3000.)	(53.+410.)	30.(1)	0.4(2)
^{198}Hg	9.97(8)		(0.017+2.)	(1.7+70.)		0.17(2)
^{199}Hg	16.87(10)		2.1(2)×10^3	435(20)	16.9(4)	0.37(2)
^{200}Hg	23.10(16)		≈ 1.	2.1(5)		0.12(1)
^{201}Hg	13.18(8)		≈ 8.	30.(3)		0.26(1)
^{202}Hg	29.86(20)		4.9(5)	4.5(2)	11.(1)	74.(6) mb
^{204}Hg	6.87(4)		0.4(1)	0.8(2)		42.(4) mb
$_{81}$Tl			3.3(1)	12.5(8)	8.776(5)	
^{203}Tl	29.524(14)		11.(1), σ_α < 0.3 mb	41.(2)	7.0(2)	124.(8) mb
^{204}Tl		3.78 y	22.(2)	90.(20)		0.14(5)
^{205}Tl	70.476(14)		0.11(2)	0.6(2)	9.52(7)	54.(4) mb
$_{82}$Pb			0.172(2)	0.14(4)	9.402(2)	
^{204}Pb	1.4(1)		0.68(7)	2.0(2)	10.9(1)	90.(6) mb
^{205}Pb		1.51×10^7 y	≈ 5.	≈ 2.		0.06(1)
^{206}Pb	24.1(1)		0.027(1)	0.10(1)	9.23(5)	16.(1) mb
^{207}Pb	22.1(1)		0.61(3)	0.38(1)	9.28(2)	10.(1) mb
^{208}Pb	52.4(1)	>2×10^{19} y	0.23(1) mb, σ_α < 8. μb	2.0(2) mb	9.50(3)	0.36(4) mb
^{210}Pb		22.6 y	< 0.5			
$_{83}$Bi			0.034(1)	0.19(2)	8.532(2)	
^{209}Bi	100.		(11.+23.) mb,σ_α<0.3 μb	0.19(2)	8.532(2)	2.7(5) mb
^{210m}Bi		3.0×10^6 y	54.(4) mb	0.20(3)		
$_{84}$Po						
^{210}Po		138.4 d	σ_m<0.5 mb, σ_α < 2. mb			
			σ_g<30. mb, σ_f< 0.1			
$_{85}$At						
$_{86}$Rn						
^{220}Rn		55.6 s	<0.2			
^{222}Rn		3.823 d	0.74(5)			
$_{88}$Ra						
^{223}Ra		11.43 d	1.3(2)×10^2, σ_f< 0.7			
^{224}Ra		3.66 d	12.0(5)			
^{226}Ra		1599. y	≈ 13., σ_f< 7. μb	280.(50)	10.(1)	
^{228}Ra		5.76 y	36.(5), σ_f< 2.			
$_{89}$Ac						
^{227}Ac		21.77 y	8.8(7)×10^2, σ_f< 0.35 mb	1.5(4)×10^3		
$_{90}$Th			7.4	85.(3)	10.31(3)	
^{227}Th		18.72 d	σ_f = 2.0(2)×10^2			
^{228}Th		1.913 y	1.2(2)×10^2, σ_f<0.3	1014.(400)		
^{229}Th		7.9×10^3 y	≈ 60.	1.0(2)×10^3		
			σ_f = 30.(3)	RI_f = 466.(75)		
^{230}Th		7.54×10^4 y	23.4(5)	1.0(1)×10^3		
			σ_f < 0.5 mb			
^{232}Th	100.	1.40×10^{10} y	7.37(4)	85.(3)	10.31(3)	
			σ_f = 3.(1) μb			
			σ_α < 1. μb			
^{233}Th		22.3 m	1.5(1)×10^3	4.(1)×10^2		
			σ_f = 15.(2)			
^{234}Th		24.10 d	1.8(5)			
			σ_f < 0.01			

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
$_{91}$Pa						
^{230}Pa		17.4 d	$1.5(3)\times10^{3}$			
^{231}Pa		3.25×10^{4} y	$2.0(1)\times10^{2}$	750.(80)	9.1(3)	
			σ_{f} = 20.(1) mb	RI_{f} = 0.05(1)		
^{232}Pa		1.31 d	$4.6(10)\times10^{2}$	300.(70)		
			σ_{f} = $1.5(5)\times10^{3}$	RI_{f} = $1.0(1)\times10^{3}$		
^{233}Pa		27.0 d	39.(2)	(460.+440.)		
			σ_{m} = 20.(4)			
			σ_{g} = 19.(3)			
			σ_{f} < 0.1			
$_{92}$U			3.4(3); σ_{f} = 4.2(1)	280.(20),RI_{f} = 2.0	8.417(5)	
^{230}U		20.8 d	$\sigma_{f} \approx 25.$			
^{231}U		4.2 d	$\sigma_{f} \approx 250.$			
^{232}U		70. y	73.(2)	280.(15)		
			σ_{f} = 74.(8)	RI_{f} = 350.(30)		
^{233}U		1.592×10^{5} y	47.(2)	137.(6)	10.1(2)	
			σ_{f} = $5.3(1)\times10^{2}$	RI_{f} = 760.(17)		
			σ_{α} < 0.2 mb			
^{234}U	0.0054(5)	2.455×10^{5} y	96.(2)	660.(70)	12.(4)	
			σ_{f} = 0.07(2)	RI_{f} = 6.5		
^{235}U	0.7204(6)	7.04×10^{8} y	95.(5)	144.(6)	10.47(4)	
			σ_{f} = 586.(2)	RI_{f} = 275(5)		
			σ_{α} < 0.1 mb			
^{236}U		2.342×10^{7} y	5.1(3)	360.(15)		
			σ_{f} < 1.3 mb	RI_{f} = 4.38(50)		
^{237}U		6.75 d	$\approx 10^{2}$	1200.(200)		
			σ_{f} < 0.35			
^{238}U	99.2742(10)	4.47×10^{9} y	2.7(1)	277.(3)	8.402(5)	
			$\sigma_{f} \approx$ 3. µb	1.54(15) mb		
			σ_{α} = 1.4(5) µb			
^{239}U		23.5 m	22.(2)			
			σ_{f} = 15.(3)			
$_{93}$Np						
^{234}Np		4.4 d	σ_{f} = $9.(3)\times10^{2}$			
^{235}Np		1.085 y	$1.6(1)\times10^{2}$			
^{236m}Np		22.5 h	σ_{f} = $2.7(2)\times10^{3}$	$7.(4)\times10^{2}$		
^{236}Np		1.55×10^{5} y	σ_{f} = $3.0(2)\times10^{3}$	$1.35(30)\times10^{3}$		
^{237}Np		2.14×10^{6} y	$1.7(1)\times10^{2}$	$6.5(3)\times10^{2}$	10.6(1)	
			σ_{f} = 20.(1) mb	RI_{f} = 4.7		
^{238}Np		2.117 d	σ_{f} = $2.6(3)\times10^{3}$	$1.4(3)\times10^{3}$		
^{239}Np		2.355 d	(32.+19.)			
			σ_{f} < 1.			
$_{94}$Pu						
^{236}Pu		2.87 y	σ_{f} = $1.6(3)\times10^{2}$	1000.(60)		
^{237}Pu		45.7 d	σ_{f} = $2.3(3)\times10^{3}$			
^{238}Pu		87.7 y	$5.1(2)\times10^{2}$	$1.6(2)\times10^{2}$	14.1(5)	
			σ_{f} = 17.(1)	RI_{f} = 26.(2)		
^{239}Pu		2.410 x 10^{4} y	$2.7(1)\times10^{2}$	$2.0(2)\times10^{2}$	7.7(1)	
			σ_{f} = 752.(3)	$3.0(1)\times10^{2}$		
			$\sigma_{\alpha} \leq$ 0.3 mb			
^{240}Pu		6.56×10^{3} y	$2.9(1)\times10^{2}$	$8.4(3)\times10^{3}$	3.5(1)	
			$\sigma_{f} \approx$ 59. mb	RI_{f} = 3.2		
^{241}Pu		14.4 y	$3.7(1)\times10^{2}$, σ_{α} <0.2 mb	$1.6(1)\times10^{2}$		
			σ_{f} = $1.01(1)\times10^{3}$	$5.7(4)\times10^{2}$		
^{242}Pu		3.75 x 10^{5} y	19.(1)	$1.1(1)\times10^{3}$	8.1(1)	
			σ_{f}<0.2	RI_{f} = 0.23		
^{243}Pu		4.956 h	<100.			
			σ_{f} = $2.0(2)\times10^{2}$			

*Extrapolated value.

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^{244}Pu		8.00×10^{7} y	1.7(1)	41.(3)		
^{245}Pu		10.5 h	$1.5(3)\times10^{2}$	220.(40)		
$_{95}$Am						
^{241}Am		432.7 y	$(0.6+6.4)\times10^{2}$	$(1.+14.)\times10^{2}$		
			σ_f = 3.15(10)	14.(1)		
^{242m}Am		141. y	$1.7(4)\times10^{3}$	≈ 200.		
			$\sigma_f = 5.9(3)\times10^{3}$	$RI_f = 1.8(1)\times10^{3}$		
^{242}Am		16.02 h	$\sigma_f = 2.1(2)\times10^{3}$	RI_f = < 300.		
			$3.3(5)\times10^{2}$	$\approx 1.5\times10^{2}$		
^{243}Am		7.37×10^{3} y	(75.+5.)	$(17.1+1.0)\times10^{2}$	8.3(2)	
			σ_f = 79.(2) mb	RI_f = 0.056		
^{244m}Am		≈ 26. m	$\sigma_f = 1.6(3)\times10^{3}$			
^{244}Am		10.1 h	$\sigma_f = 2.2(3)\times10^{3}$			
$_{96}$Cm						
^{242}Cm		162.8 d	≈ 20.	120.(50)		
			σ_f ≈ 5.			
^{243}Cm		29.1 y	$1.3(1)\times10^{2}$	214.(20)		
			$\sigma_f = 6.2(2)\times10^{2}$	$RI_f = 1.6(1)\times10^{3}$		
^{244}Cm		18.1 y	15.(1)	640.(50)	9.5(3)	
			σ_f = 1.1(2)	RI_f = 10.8(8)		
^{245}Cm		8.48×10^{3} y	$3.5(2)\times10^{2}$	110.(10)		
			$\sigma_f = 2.1(1)\times10^{3}$	$RI_f = 8.(1)\times10^{2}$		
^{246}Cm		4.76×10^{3} y	1.2(2)	120.(10)	9.3(2)	
			σ_f = 0.16(7)	13.(2)		
^{247}Cm		1.56×10^{7} y	60.(30)	$5.(1)\times10^{2}$		
			σ_f = 82.(5)	$7.3(7)\times10^{2}$		
^{248}Cm		3.48×10^{5} y	2.6(3)	270.(30)	7.7(2)	
			σ_f = 0.36(7)	13.(2)		
^{249}Cm		64.15 m	≈ 1.6			
^{250}Cm		≈ 9.7×10^{3} y	≈ 80.			
$_{97}$Bk						
^{249}Bk		320. d	$7.(1)\times10^{2}$	$9.(1)\times10^{2}$		
			σ_f ≈ 0.1			
^{250}Bk		3.217 h	$\sigma_f = 1.0(2)\times10^{3}$			
$_{98}$Cf						
^{249}Cf		351. y	$5.0(3)\times10^{2}$	$7.7(4)\times10^{2}$		
			$\sigma_f = 1.7(1)\times10^{3}$	$RI_f = 2.1(3)\times10^{3}$		
^{250}Cf		13.1 y	$2.0(2)\times10^{3}$	$12.(2)\times10^{3}$		
			σ_f = 110.(90)	RI_f = 160.(40)		
^{251}Cf		9.0×10^{2} y	$2.9(2)\times10^{3}$	$1.6(1)\times10^{3}$		
			$\sigma_f = 4.5(5)\times10^{3}$	$RI_f = 5.5(3)\times10^{3}$		
^{252}Cf		2.65 y	20.(2)	43.(3)		
			σ_f = 32.(4)	$RI_f = 1.1(3)\times10^{2}$		
^{253}Cf		17.8 d	18.(2)	8.(1)		
			$\sigma_f = 1.3(2)\times10^{3}$			
^{254}Cf		60.5 d	4.5(10)	2.		
$_{99}$Es						
^{253}Es		20.47 d	(180.+5.8)	$(37.5+1.1)\times10^{2}$		
^{254m}Es		1.64 d	$\sigma_f = 1.8(1)\times10^{3}$			
^{254}Es		276. d	28.(3)	18.(2)		
			$\sigma_f = 1.8(2)\times10^{3}$	$RI_f = 1.2(3)\times10^{3}$		
^{255}Es		40. d	≈ 55.			
$_{100}$Fm						
^{255}Fm		20.1 h	26.(3)	14.(2)		
			$\sigma_f = 3.3(2)\times10^{3}$			
^{257}Fm		100.5 d	$\sigma_f = 3.0(2)\times10^{3}$			

*Extrapolated value.