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Table of Isotopes

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THE following table represents a complete list of all the artificial and natural radioactive isotopes and stable isotopes, together with a number of their important features covering information available by approximately October, 1948, through publications, private communications, and almost all of the restricted distribution reports of the U. S. Atomic Energy Commission, the former "Manhattan District," U. S. Army Corps of Engineers, and the corresponding offices of Great Britain and Canada. With very few exceptions, the criterion for listing a radioactive isotope has been the actual observation of its radiation. A somewhat more extensive treatment of fission product data available up to August 1946 may be found in a Plutonium Project compilation "Nuclei formed in fission," J. Am. Chem. Soc. **68**, 2411 (1946).

The first column lists the atomic numbers and mass numbers of the isotopes. The superscript "m" following the mass number denotes a metastable isomer of measured half-life of either a stable or unstable ground state, but the isomeric transition need not have been observed.

In the second column headed "class" the degree of certainty of each isotopic assignment is indicated with a letter according to the following code:

A = isotope certain (mass number and element certain),
B = isotope probable, element certain,
C = one of few isotopes, element certain,
D = element certain,
E = element probable,
F = insufficient evidence.

In most cases the class is determined by evaluating the uniqueness of the assignment through chemical separation, reaction type and yield considerations, genetic relationships, and type of radiation. In a few cases newer techniques have been used. The term "m.s." in the second column refers to the identification of the mass number by means of a mass spectrograph, and "res.n.act." (resonance neutron activation) refers to the identification of a nuclear isomer by observing both isomers upon irradiation with filtered neutrons. With the mass spectrographic assignment of mass numbers there are some instances in which the mass number is known with greater certainty than the element. Such cases are assigned the appropriate code letter such as "E" followed by "m.s."

The percent abundance of the stable isotopes is listed in column three.

The fourth column lists the type of radiation, with the following meaning for the symbols:

β^- = negative beta-particles (negatrons),
β^+ = positive beta-particles (positrons),
γ = gamma-rays,
α = alpha-particles,
n = neutrons,
e^- = internal-conversion electrons,
K = K-electron capture (or in more general terms, orbital electron capture),
I.T. = isomeric transition (transition from upper to lower isomeric state).

In the cases where it is certain that no gamma-rays are emitted, this fact is expressed explicitly in column seven by the term "No γ." Annihilation gamma-rays and x-rays are not listed. It

may be assumed that x-rays have been observed or actually identified in almost all cases of orbital electron capture listed.

The half-life, followed by the relevant reference, is given in the fifth column. In most cases the determination is direct, either by measuring the decay rate, by weighing a long-lived isotope of known purity, or by comparing the activity with that of a genetically related isotope of known half-life. A number of half-lives are known only from the yield of activity resulting from a nuclear reaction of known or estimated cross section. Half-lives estimated in this manner are indicated by the term "yield." Usually for the cases where more than one value for the half-life has been reported, an attempt has been made to list the best value (an experimental value thought to be taken under the most favorable conditions) rather than a mean value; more than one value is listed where a choice does not seem obvious. Among the natural radioactivities an average value is often used which was taken from an international committee summary report (C60).

In the columns headed "energy of radiation," the energy value is followed by the corresponding reference and by a description of the method used for the energy determination. The beta-particle energies correspond to the observed upper limits of the spectra; in those cases where only the Konopinski-Uhlenbeck (K32) extrapolated value has been reported, this is listed, followed by the designation "K.U." For alpha-particles reported only by a range the "mean range in air" *vs.* energy relationship of Holloway and Livingston (H81) was used. The methods used for the determination of the energy of the particles (alpha and beta) are described in each case with the aid of the following symbols:

abs. = absorption;
cl. ch. = cloud chamber (with magnetic field in case of beta-particles);
spect. = magnetic deflection (magnetic spectrograph or spectrometer or counter with magnetic field);
calor. = calorimetric measurements;
ion. ch. = measurement of pulse sizes in ionization chamber or proportional counter;
coincid. abs. = beta- and gamma-coincidence counters with absorbers;
coincid. = beta- and gamma-coincidence counters (for information on decay scheme —data not necessarily used in the table);
spect. coincid. = coincidence counters arranged with a magnetic field.

The alpha-particle energies listed, where more than a single group exists in high abundance, include the group of highest energy and those groups with abundance greater than ten percent. Conversion electron energies are listed only when it is not known in which shell internal conversion takes place or when no attempt was made to relate the electrons with observed or unobservable gamma-rays; in all other cases entries are made in the column for gamma-rays.

The symbols used to describe the methods employed for the determination of gamma-ray energies have the following meaning:

abs. = absorption;
cl. ch. recoil = secondary electrons in cloud chamber with magnetic field;
cl. ch. pair = positron-electron pairs in cloud chamber with magnetic field;
coincid. abs. = secondary electrons with coincidence counters and absorbers;
spect. conv. = internal-conversion electrons with magnetic spectrograph or spectrometer;
spect. = secondary electrons with magnetic spectrograph or spectrometer;
cryst. spect. = direct measurement of gamma-ray energy by diffraction in a crystal;
abs. of e^- = absorption of internal-conversion electrons;
abs. sec. e^- = absorption of secondary electrons;
coincid. = measurements with gamma-gamma-coincidence counters (for information on decay scheme—data not necessarily used in the table);
Be-γ-n reaction = measurement of neutron energy from Be-γ-n reaction;
D-γ-n reaction = measurement of neutron energy from D-γ-n reaction.

When internal-conversion electrons are emitted, the energy listed in this column is always that of the corresponding gamma-ray transition. Only the main gamma-rays are listed for the natural radioactive isotopes. In a few instances in which a very short-lived metastable state has been identified as the daughter of the isotope in

question, the gamma-rays of the daughter may be listed for both parent and daughter.

When a semicolon is used, it means that the values listed on each side of it are independent determinations of the same item, e.g., independent determinations of the half-life or of the energy of the radiation of a radioactivity. In another usage the semicolon separates the symbols in the "type of radiation" columns when there is more than one type of decay (β^-, β^+, α, K, or I.T.) for the radioactivity.

The observed nuclear reactions (giving the target element, projectile, and outgoing particle, in order) by which the radioactive isotopes are formed, and the corresponding references are listed in the last column (p = proton, n = neutron, α = alpha-particle, d = deuteron, t = tritium or triton (H^3), γ = gamma-ray, e^- = electron). In cases in which the target material is not the naturally occurring element, but one enriched or depleted in a particular isotope, that isotope is indicated. No means for identifying the source or energy of the projectile is given. For example, deuterons varying from low energies to 200 Mev have been used. In many cases, with high energy projectiles, multiple particles are ejected. A reaction such as (d-$\alpha p2n$) is a formal presentation showing what the outgoing particles might be and does not mean that the order of leaving the nucleus was determined nor that the α, p, and n were identified.

In some cases where the path for reaching the product nucleus can even less definitely be stated the reaction is presented in the form (d-$3z10a$) where "$3z$" indicates that the product nucleus is lower in atomic number than the compound nucleus by three units and "$10a$" means that it is lower in mass number by ten units. Where the same isotope has been made by spallation of various target elements with high energy particles, this is indicated by the symbol "spal." followed by the symbols for the target elements.

Stable product nuclei which have been identified by means of the mass spectrograph are indicated by "m.s." following the reference. The neutron-induced fission reactions of the heavy elements are designated by such symbols as U-n, Th-n, Pu-n, and Pa-n, while the gamma-ray, deuteron, and alpha-particle-induced fission reactions are designated by symbols such as U-γ, U-d, and U-α. Usually, but not always, "U-n" will mean the slow neutron fission of U^{235} while "U-d" or "U-α" designated fission products arise from U^{238}. In this last column the method of production for each radioactive fission product is described by these symbols (U-n, etc.) together with the designation of its radioactive parent and its radioactive daughter when these are known. Similarly, for the radioactivities of the heavy natural and artificial families there are listed the immediate parent and daughter isotopes. The natural radioactivities without parents are listed as produced by a "natural source," followed by a reference to the discovery.

Some of the data entered in this table were taken from restricted distribution reports which are not generally available. These have reference numbers from 100–199. References to the open literature have numbers below 100 or over 200. No attempt has been made to list all of the publications or restricted distribution reports connected with a given radioactivity since it has been the aim to keep the table as compact as possible. As a rule references to the original papers are not given when better data are available in more recent publications. The references which are listed usually give a key to the complete literature.

Those references designated by "NNES-PPR" refer to papers which will appear in the forthcoming National Nuclear Energy Series—Plutonium Project Record. Similarly, the symbol "AECD" refers to a declassified U. S. Atomic Energy Commission Document bearing the indicated number, and is used also to cover earlier documents which were issued with the prefix "MDDC." Since it was not possible to check all papers for numbering changes, the paper title is being included in the bibliography to aid in identification.

It is a pleasure to acknowledge the assistance, through helpful discussions, of Dr. T. P. Kohman and Dr. W. H Sullivan, and to thank many of the authors whose work is cited for their aid in evaluating data familiar to them. The selection of isotopic abundances of the stable isotopes was aided by compilations and communications from Professors K. T. Bainbridge, A. J. Dempster, A. O. Nier, and M. G. Inghram. We are also grateful to Mrs. Lorraine Petch and Mrs. Jane Wulf for their painstaking work in the preparation of the manuscript. The compilation of this table was sponsored by the Atomic Energy Commission.

Table of Isotopes

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
1	H^1		99.9844(H70)					
	H^2		0.0156(H70)					
	H^3	*A*		β^-	12.1 yr.(N46); 10.7 yr. (G60)	0.0185(P62) ion.ch.; 0.0169(C85) ion. ch.; 0.015(O3,N6) abs., cl.ch.; 0.011 (W60) abs., (B92) cl.ch.	No γ(G133)	D-*n*-γ(Z101) D-*d*-*p*(A7,A16) He^3-*n*-*p*(C132,H219) Li-*n*-*t*(O4) Be-*d*-*t*(O6,A16) B-*n*-*t*(C15) N-*n*-*t*(C15)
2	He^3 (A7,A30)		1.3×10^{-4} (F35,A34)					
	He^4		99.9999(F35, A34)					
	He^6	*A*		β^-	0.89 sec.(H120); 0.8 sec.(B1); 0.85 sec. (S81)	3.7(B1,B2) cl.ch.; 3.7(K135) abs. Al; 3.5(S81) abs. Al	No γ(K76,S81)	Li-γ-*p*(B83) Li-*n*-*p*(K1) Be-*n*-α(B1,P1,B3)
3	Li^6		7.39(I104)					
	Li^7		92.61(I104)					
	Li^8	*A*		β^-,2α	0.89 sec.(H78); 0.88 sec.(L1,H107)	12(β^-)(B4) cl.ch.; 12 (β^-)(O13) abs. Al; distribution, mean at 2.0(α)(F18)	No γ(R25,B4)	Li-*d*-*p*(C1,L1,R14, D1) Li-*n*-γ(K1,H107, P63,H78) Li^7-*n*-γ(H78) Be-γ-*p*(O13) B-*n*-α(L24)
4	Be^7	*A*		*K*, γ	52.9 days(W76); 43 days(R13,A18)		0.485(K73) spect.; 0.485(Z1) coincid. abs.; 0.476(R44) abs. Pb; 0.453 (S95) spect.; 0.474(Z5) spect.	Li-*d*-*n*(R1,R13,Z1) Li-*p*-*n*(H30,H2) B-*p*-α(R1,M1) B-*d*-α*n*(M63)
	Be^8	*A*		2α	$10^{-15}-10^{-17}$ sec. (W61) calc.	0.055 (each α in center of mass system) (H64) ion.ch.		Be-γ-*n*(C53,H64)
	Be^9		100(N30)					
	Be^{10}	*A* (P48) m.s.		β^-	2.5×10^6 yr.(M85); 2.9×10^6 yr.(H73) yield	0.560(M65,M85) abs. Al; 0.58(H73) abs. Al; 0.65(L78) abs. Al	No γ(M65,L78)	Be-*d*-*p*(M65,L78) Be-*n*-γ(B124,H73) B-*n*-*p*(E35) C-*n*-α(H119)
5	B^{10}		18.83(I5)					
	B^{11}		81.17(I5)					
	B^{12}	*A*		β^-	0.027 sec.(J11); 0.022 sec.(C2,B22)	12(B4) cl.ch.		B-*d*-*p*(C2, F1,B5) N^{15}-*n*-α(J11)
6	C^{10}	*B*		β^+	20 sec.(S202)	~2(S202) abs.		B-*p*-*n*(S202) B^{10}-*p*-*n*(S202)
	C^{11}	*A*		β^+	20.5 min.(S8,T8); 20.0 min (S83)	0.95(D26) cl.ch.; 0.99 (S82) spect.	No γ(S97) coincid.	Be-α-2*n*(M128) B-*d*-*n*(F1,C4,Y1) B-*p*-γ(C3,B23) B-*p*-*n*(B23) C-γ-*n*(B53) C-*n*-2*n*(P2) C-*d*-*dn*(T41) C-*p*-*pn*(C77) C-α-α*n*(M128,T41) N-*p*-α(B23) N-*n*-*p*3*n*(K63) N-γ-*p*2*n*(B53) O-γ-α*n*(?)(B53) O-*n*-α2*n*(M134,K63)
	C^{12}		98.9(N31)					
	C^{13}		1.1(N31)					
	C^{14}	*A*		β^-(K24)	5100 yr.(L130,N45); 6400 yr.(H212); 4700 yr.(R50)	0.156(C82) spect.; 0.154(S200) abs. Al; 0.154(L89) spect.	No γ(R21)	C-*d*-*p*(R17,R21) C-*n*-γ(L110) N-*n*-*p*(R21,H108, L110) O-*n*-α(H129,M71)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
7	N^{13}	*A*		β^+	9.93 min.(W14,T8); 10.13 min.(S98)	1.24(S98) spect.; 1.25(C83) spect.; 0.92, 1.20(L22) spect.	No γ(S97) coincid.; No γ(L79) spect.	B-*α*-*n*(E1,R3) C-*d*-*n*(H3,Y1,C4,F1) C-*p*-γ(H3,C4) N-*n*-2*n*(P2,H44) N-*d*-*t*(B7) N-γ-*n*(B53) O-*n*-*p*3*n*(K63)
	N^{14}		99.62(V20)					
	N^{15}		0.38(V20)					
	N^{16}	*A*		β^-, γ	7.35 sec.(B74); 7.5 sec.(H120); 7.3 sec.(S81); 8 sec. (C5,N1,N106)	3.5, 10(S81) abs. Al, Cu; 10(H120) cl.ch.; 4, 10.3 (B74) cl.ch., abs.	6.2, 6.7(B73) abs. sec. e^-, cl.ch. pair; 4(S101) abs. Pb, Cu; ~6(S81) cl.ch. recoil	N-*n*-γ(H120) N-*d*-*p*(F1) O-*n*-*p*(C5, S101) F-*n*-*α*(N1,P1,N4)
	N^{17}	*A* (A36)		β^-,*n*(K65, A36)	4.14 sec.(K65)	3.7(β^-)(A43)O^{16} recoil—β^- coincid. abs.; 0.9(mean)(*n*) (A43) O^{16} recoil in ion. ch.; 1.0(mean) (*n*)(H153) p recoil in cl.ch.		Spal.(O,F,N,Mg,Al Si,P,S,Cl,K)(C75, K65)
8	O^{14}	*B*		β^+,γ(S216)	76.5 sec.(S216)	1.8(S216) abs.	2.3(S216) abs.	N-*p*-*n*(S216)
	O^{15}	*A*		β^+	126 sec.(M3,B20)	1.7(F1) cl.ch.		C-*α*-*n*(K3) N-*d*-*n*(M3,F1) N-*p*-γ(D2) O-γ-*n*(B20,B53,H44) O-*n*-2*n*(P2)
	O^{16}		99.757(T101)					
	O^{17}		0.039(T101)					
	O^{18}		0.204(T101)					
	O^{19}	*A*		β^- γ	29.4 sec.(F101); 29.5 sec.(H120); 27.0 sec.(B75)	4.5(30%), 2.9(70%) (B75) abs. Al; 4.1(F101) abs.; 3.2(H90) abs. Al	1.6(F101) abs.	O-*n*-γ(M103) F-*n*-*p*(N1,A1)
9	F^{17}	*A*		β^+	70 sec.(N2)	2.1(K4) cl.ch.		N-*α*-*n*(R3) O-*d*-*n*(N2,F1) O-*p*-γ(D2) F-γ-2*n*(B53,P60)
	F^{18}	*A*		β^+	112 min.(S1)	0.7(Y2) cl.ch.; 0.7 (K110) abs. Al; 0.95(20%), 0.6 (80%)(H203) cl.ch.	No γ(K76); 1.4 (H203) cl.ch. recoil	O-*α*-*pn*(T36) O-*p*-*n*(D2) O-*d*-*n*(D22,Y2,W2) O-*t*-*n*(K110) F-*n*-2*n*(P2) F-*d*-*t*(B7,K2) F-γ-*n*(H44,B53) Ne-*d*-*α*(S1) Na-γ-*αn*(?)(B53)
	F^{19}		100(A30)					
	F^{20}	*A*		β^-, γ(B50, C47)	12 sec.(C1)	5.0(F1,B50) cl.ch.	2.2(B50) cl.ch. recoil	F-*d*-*p*(F1,C1) F-*n*-γ(N1) Na-*n*-*α*(N1)
10	Ne^{19}	*A*		β^+	20.3 sec.(W7)	2.20(W7) cl.ch.		F-*p*-*n*(W7)
	Ne^{20}		90.51(D66)					
	Ne^{21}		0.28(D66)					
	Ne^{22}		9.21(D66)					
	Ne^{23}	*A*		β^-	40 sec.(A1,B6); 40.7 sec.(H61)	4.1(P21) abs.		Ne-*d*-*p*(P21,W24) Na-*n*-*p*(A1,N1,P1) Mg-*n*-*α*(A1,B6)
11	Na^{21}	*B*			23 sec.(C27)			Ne-*p*-*n*(C27) Ne-*d*-*n*(P21) Mg^{24}-*p*-*α*(B90)
	Na^{22}	*A*		β^+(~100%), γ, no K (G44)	2.6 yr.(L92); 3.0 yr.(L3)	0.58(L3) cl.ch.; 0.575(G44) spect.; coincid. (M72)	1.3(O2) spect.; 1.30(G44) spect.	F-*α*-*n*(L3,M4) Ne-*d*-*n*(L3) Na-*n*-2*n*(B131,S180) Mg-*d*-*α*(L3)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
11	Na^{23}		100(S61)					
	Na^{24}	*A*		β^-, γ	14.8 hr.(V1)	1.390(S88,S99) spect., coincid.; 1.4(L21,S49,S82) spect.	1.380, 2.758(S88) spect.; 1.4, 2.8 (E7,I2,E8) spect.; 2.87(G16), 2.74 (W64), Be-γ-*n* reaction, D-γ-*n* reaction; 2.56, 2.68, 2.76, 2.89 (K56) cl.ch. pair; coincid. abs. (C56, W65)	Na-*d*-*p*(L4,V1) Na-*n*-γ(A1) Mg-*d*-α(H4) Mg-*n*-*p*(A1) Mg-γ-*p*(B53,H74) Al-*n*-α(A1) Al-*d*-*p*α(C65,C67) Al-γ-*n*2*p*(B53) Si-γ-*n*3*p*(?)(B53)
	Na^{25}	*B*		β^-, γ(B75)	58.2 sec.(B75); 60 sec.(R47); 62 sec. (H54)	3.4(B75) abs. Al; 2.8(H54) abs. Al		Mg-γ-*p*(H61,B53) Mg-*n*-*p*(H61,B75) Al-γ-2*p*(B53,P60)
12	Mg^{23}	*A*		β^+	11.6 sec.(W7)	2.82(W7) cl.ch.		Na-*p*-*n*(W7,D9) Mg-γ-*n*(H43,H44, B53)
	Mg^{24}		78.60(W78)					
	Mg^{25}		10.11(W78)					
	Mg^{26}		11.29(W78)					
	Mg^{27}	*A*		β^-, γ	10.2 min.(H4); 9.6 min.(E31)	0.79(20%), 1.80 (80%)(B86) spect.; 1.8(C13,E31) cl.ch.; coincid. (B75)	1.01, 0.84(B86) spect., coincid.; 0.64, 0.84, 1.02(I2) spect.; 1.05(single γ)(E31) cl.ch. recoil	Mg-*d*-*p*(H4) Mg-*n*-γ(A1) Al-*n*-*p*(A1)
13	Al^{25}	*A*			8 sec.(B84); 7.3 sec. (B90)			Mg^{25}-*p*-*n*(B84)
	Al^{26}	*A*		β^+	6 sec.(B84); 6.3 sec. (B90); 7.0 sec. (W7,F2)	2.99(W7) cl.ch.; 1.8 (F2) abs.		Na-α-*n*(M4,F2) Mg-*p*-*n*(W7,D9) Mg^{26}-*p*-*n*(B84) Mg-*p*-γ(C29) Al-γ-*n*(H43,H44, H58,B53)
	Al^{27}		100(A31)					
	Al^{28}	*A*		β^-,γ(W17)	2.30 min.(E31); 2.4 min.(A1,M5,E2)	3.01(B86) spect.; 2.75(B75) coincid. abs.; 3.3(C6) cl.ch.; 3.0(E31) cl.ch.; 3.10(D54) abs. Al, coincid.	1.80(B75) abs. sec. e^-; 1.80(B86) spect.; 1.8(I2) spect.; 2.1(E31) cl.ch. recoil	Mg-α-*p*(E2,R3) Al-*d*-*p*(M5) Al-*n*-γ(A1) Si-*n*-*p*(A1,B75) Si-γ-*p*(B53,H74) P-*n*-α(A1)
	Al^{29}	*A*		β^-	6.7 min.(B25)	2.5(B25) cl.ch. and abs.		Mg-α-*p*(B25,H21, F3) Si-*n*-*p*(F110) Si-γ-*p*(B53,H74) P-γ-2*p*(B53,P60)
14	Si^{27}	*A*		β^+	4.9 sec.(K10,C27)	3.74(M21) cl.ch.; 3.54(B8) cl.ch.		Al-*p*-*n*(K8,M21,C27, B8) Mg-α-*n*(K10) Si-γ-*n*(H62)
	Si^{28}		92.28(I5)					
	Si^{29}		4.67(I5)					
	Si^{30}		3.05(I5)					
	Si^{31}	*A*		β^-	170 min.(N3,A13)	1.8(K4) cl.ch.	No γ(N3)	Si-*d*-*p*(N3) Si-*n*-γ(A1) P-*n*-*p*(A1,P2) S-*n*-α(S2,C9)
15	P^{29}	*A*		β^+	4.6 sec.(W11)	3.63(W11) cl.ch.		Si-*p*-*n*(W11) Si-*d*-*n*(D12) P-γ-2*n*(?)(B53)

Table of Isotopes—*Continued*

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15	P^{30}	*A*		β^+	2.55 min.(R3,B49)	3.0(B48,B49) cl.ch.; 3.5(M26) spect.		Al-α-n(R3,C7) Si-p-n(B23,B49) Si-He^3-p(A7) P-n-$2n$(P2) P-γ-n(B20,B53) S-d-α(S2)
	P^{31}		100(A31)					
	P^{32}	*A*		β^-	14.30 days(C8); 14.07 days(M39)	1.712(S88) spect.; 1.69(L5) spect.	No γ(K4)	Si-α-p(F3) P-d-p(N3) P-n-γ(A1) S-n-p(A1) S-d-α(S2) Cl-n-α(A1) Cl-d-$p\alpha$(T107) Cu-d-15z33a(M87)
	P^{34}	*B*		β^-,γ(Z4)	12.4 sec.(Z4)	5.1(75%), 3.2(25%) (B42) coincid. abs.; 4.9(H90) abs. Al		S-n-p(Z4) Cl-n-α(Z4,H90)
16	S^{31}	*A*		β^+	2.6 sec.(B57); 3.2 sec.(W11,K10)	3.85(W11,E4) cl.ch.		Si-α-n(K10) P-p-n(W11,V4) S-γ-n(H43,H44,H58)
	S^{32}		95.06(N32)					
	S^{33}		0.74(N32)					
	S^{34}		4.18(N32)					
	S^{35}	*A*		β^-	87.1 days(H53)	0.169(B82,C78) spect.; 0.167 (S200) abs. Al; 0.166(A40) spect.; 0.17(O110) abs. Al		S-n-γ(S102) S-d-p(C25,K13) Cl-n-p(A3,L6,L58, K13) Cl-d-α(K13)
	S^{36}		0.016(N32)					
	S^{37}	*B*		β^-,γ	5.04 min.(Z4); 5.0 min.(H130)	4.3(10%), 1.6(90%) (Z4); 4, 1.4(H130) abs. Al	2.6(B42) abs.; 2.75 (H130) abs. sec. e^-	S-n-γ(H130) Cl-n-p(Z4,H130)
17	Cl^{33}	*A*		β^+	2.4 sec.(W11); 2.8 sec.(S209)	4.13(W11) cl.ch.		S-d-n(H31) S-p-n(W11)
	Cl^{34}	*A*		β^+,γ	33 min.(S2,B21)	2.5(B21) abs.; 5.1, 2.4(H72) cl.ch.	3.4(H72) cl.ch. recoil	P-α-n(F2,R3,B21) S-d-n(S2) S-α-p,n or S-α-d(S45) S-t-n(K110) Cl-n-$2n$(P2) Cl-γ-n(B20,H44)
	Cl^{35}		75.4(N33)					
	Cl^{36}	*A*		β^+; K; β^- (G8)	2×10^6 yr.(H135) yield β^-,β^+; $\sim10^6$ yr.(O110) yield; $>10^3$ yr.(G8,O5) yield	0.64(β^-)(G8) abs.; 0.66(β^-)(O110) abs. Al		Cl-n-γ(G8,O110) Cl-d-p(G8)
	Cl^{37}		24.6(N33)					
	Cl^{38}	*A*		β^-,γ	38.5 min.(H75); 37 min.(V1)	1.19(36%), 2.70 (11%), 5.2(53%) (H75) spect.; 1.1, 2.8, 5.0(W16,W17) spect.; (W17) coincid. abs.	1.60(43%), 2.12 (57%)(H75) spect.; 1.65, 2.15 (C28,I2) spect.	Cl-d-p(K4,V1) Cl-n-γ(A1,K18,A15) K-n-α(H5) Cu-d-13z27a(M87)
	Cl^{39}	*B*		β^-(M49)	1 hr.(M49,H213)			Cu-d-13z26a(M49) Cu-α-14z28a(M49) As-d-17z38a(H213)
18	A^{35}	*A*		β^+	1.88 sec.(E4); 1.84 sec.(S209)	4.4(E4,W11) cl.ch.		S-α-n(K10) Cl-p-n(W11)
	A^{36}		0.307(N34)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
18	A^{37}	*A*		K(H52,W54)	34.1 days(W54)		No γ(W54)	S-*α*-*n*(W18,W54) Cl-*d*-2*n*(W18,W54) Cl-*p*-*n*(W18,W54) K-*d*-*α*(W18,W54) Ca-*n*-*α*(W18,W54)
	A^{38}		0.060(N34)					
	A^{39}	*F*		β^-	4 min.(P2)			K-*n*-*p*(P2)
	A^{40}		99.633(N34)					
	A^{41}	*A*		β^-,γ	110 min.(S3); 109.4 min.(B76)	1.18, 2.55(0.7%) (B76) abs. Al, coincid.; 1.5(K4) cl.ch.(K.U.)	1.37(R8) cl.ch. recoil; 1.3(B76) abs. of e^-	A-*d*-*p*(S3) A-*n*-γ(S3) K-*n*-*p*(H5)
19	K^{37}	*F*		β^+	1.3 sec.(L91)			K-γ-2*n*(L91)
	K^{38}	*A*		β^+,γ	7.7 min.(H5,R3); 7.5 min.(R52)	2.53(R52) abs. Al; 2.3(R3) abs.	2.15(R53) coincid. abs.	Cl-*α*-*n*(H5,R3) K-*n*-2*n*(P2) K-γ-*n*(H43,H44) Ca-*d*-*α*(H5)
	K^{39}		93.3(N34)					
	K^{40} (H88, S62)	*A*	0.011(N34)	β^-(T31,C61, A41); K(T30, B80,A42); K/β^- ratio ~0.1(A42, S204), 1.9 (B80), >1 (T30,A41); γ(K52) (14% of β^-)(G69)	1.8×10^9 yr. (uncorr. for K)(B94); 1.4×10^9 yr. (uncorr. for *K*)(G69); 1.5×10^9 yr. (uncorr. for K(M22)	1.9(B94) abs. Al; 1.7(F43) cl.ch.; 1.41(H98) abs. Al; 1.35(D37) spect. coincid	1.54(with K)(H98) coincid.; 1.55 (G59) abs. Pb; 1.5(with K)(M73) abs. Cu, Pb, coincid.	Natural source(T31, C61)
	K^{41}		6.7(N34)					
	K^{42}	*A*		β^-,γ	12.4 hr.(H5); 12.44 hr.(S65)	2.04(25%), 3.58 (75%)(S65) spect.; ~1.8, 3.50(B75) abs. Al, coincid.; 3.5(K4) cl.ch.	1.4, 2.1(B75) abs. sec. e^-; 1.51(S65) spect., coincid.	A-*α*-*pn*(O109) K-*d*-*p*(H5) K-*n*-γ(H5,A1) Ca-*n*-*p*(H5) Sc-*n*-*α*(H5,B75)
	K^{43}	*B*		β^-,γ	22.4 hr.(O116)	0.24, 0.81(O116) spect.	0.4(O116) abs. Pb	A-*α*-*p*(O116)
	K^{43}	*D*		β^-	27 min.(B138)			Ca-*n*-*p*(B138)
	$K^{43,44}$	*C*		β^-	18 min.(W1,W12)			Ca-*n*-*p*(W1,W12)
20	Ca^{39}	*F*		β^+	4.5 min.(P2,W12)			Ca-*n*-2*n*(?)(P2,W12)
	Ca^{39}	*E*			1.06 sec.(H44)			Ca-γ-*n*(H44)
	Ca^{40}		96.96(N32)					
	Ca^{42}		0.64(N32)					
	Ca^{43}		0.15(N32)					
	Ca^{44}		2.06(N32)					
	Ca^{45}	*A*		β^-	152 days(M74); 180 days(W12)	0.260(S58) abs. Al; 0.25(P106) spect.; 0.21(M74)	No γ(K116,P106)	Ca-*n*-γ(W12) Ca-*d*-*p*(W12,W5) Sc-*n*-*p*(W12,K116) Ti-*n*-*α*(C34,H216) Bi-*d*(G62) Sc-*d*-2*p*(H217)
	Ca^{46}		0.0033(N32)					
	Ca^{47}	*F*		β^-,γ	5.8 days(M74)	1.1(M74)	1.3(M74)	Ca-*d*-*p*(M74)
	Ca^{48}		0.19(N32)					
	Ca^{49}	*A*		β^-,γ	2.5 hr.(W12)	2.3(W12) abs.	0.8(W12) abs. Pb	Ca-*d*-*p*(W12) Ca-*n*-γ(W12)
	Ca^{49}	*B*		β^-	30 min.(W12)			Ca-*d*-*p*(W12) Ca-*n*-γ(W12)
21	Sc^{41}	*A*		β^+	0.87 sec.(K10)	4.94(E4) cl.ch.		Ca-*d*-*n*(K10,E4)
	Sc^{43}	*A*		β^+,γ	3.92 hr.(H92); 4 hr. (W10)	1.12(H92) abs. Al, spect.; 0.4, 1.4 (W10) abs.	1.65(H92) abs. Pb, Cu; 1.0(W10) abs. Pb	Ca-*α*-*p*(F4,W10) Ca-*d*-*n*(W3) Ca-*p*-*n*(D2,D9,H92)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
21	Sc^{44m}	*A*		I.T., e^-,γ (W10)	2.44 days(H92); 2.2 days(W10)		0.27(H9,S19) spect. conv.; 0.28(H92) abs. of e^-	K-α-*n*(W10,H1) Ca-*d*-*n*(W3,S19,H1) Ca-*p*-*n*(D2,D9) Sc-*n*-2*n*(B9,H92) Ti-*d*-α(W4)
	Sc^{44}	*A*		β^+,γ,K(H92)	3.92 hr.(H92); 4.1 hr.(W10)	1.5(W10) abs., (S19) spect.; 1.33(H92) abs. Al	1.33(H92) abs. Pb, Cu, Al	K-α-*n*(W10,H1) Ca-*d*-*n*(W3,S19,H1) Ca-*p*-*n*(D2,D9) Sc-*n*-2*n*(B9,H1) Sc-γ-*n*(B20) Sc^{44m} I.T.(W10) Ti-*d*-α(H60)
	Sc^{45}		100(A31)					
	Sc^{46m}	*A*(G67) res.n.act.		I.T., γ, e^- (G67)	20 sec.(G67)		0.18(G67) abs., abs. of e^-	Sc-*n*-γ(G67)
	Sc^{46}	*A*		β^-,γ, K(W5)	85 days(W5)	0.36(β^-)(F36,M76, P49) spect.; 0.26 (β^-)(M75) abs. Al, coincid.; 0.4(β^-) (K116) abs. Al; 0.26, 1.5(β^-)(W10) abs.; 1.49(β^-) (weak)(P49) spect.	0.88, 1.12(F36,M76, P49) spect.; (J15) coincid.; 1.25 (W10) abs. Pb; 1.5(M42) abs. Pb; 1.4(K116) abs. Pb	Ca-α-*p*(W10) Sc-*d*-*p*(W1,W5) Sc-*n*-γ(W1) Ti-*d*-α(W1) Ti-*n*-*p*(W4,H216)
	Sc^{47}	*B*		β^-	3.4 days(H1,H93)	0.46(H93) abs. Al	No γ(?)(H93)	Ca-α-*p*(H93) Ca-*d*-*n*(H93) Ca-*p*-γ(H93) Ti-*n*-*p*(H216)
	Sc^{48}	*A*		β^-,γ(W10), K(?)(H93)	44 hr.(W10,M2,H93)	0.64(S19) spect.; 0.57(H93) abs. Al	0.98, 1.33(P45) spect.; 1.35(M2, M30) spect.; 1.33 (H93) abs. Pb	Ca-*p*-*n*(H1) Ca-*d*-2*n*(S19,M2, H1,M30) Ti-*n*-*p*(W4,P2,W10, M30) Ti-*d*-α(H60) V-*n*-α(W4,P2,W10)
	Sc^{49}	*A*		β^-	57 min.(W10)	1.8(W10) abs.	No γ(W10)	Ca-*d*-*n*(W10) Ti-*n*-*p*(W10) Ti-γ-*p*(H74) Ca^{49}(2.5 hr.) β^--decay(W10) Ca^{49}(30 min.) β^--decay (S103)
22	Ti^{43}	*E*			0.58 sec.(S209)			Ca-α-*n*(S209)
	Ti^{45}	*A*		β^+	3.08 hr.(A17)	1.2(A17) cl.ch.		Ca-α-*n*(A17) Sc-*p*-*n*(A17) Sc-*d*-2*n*(A17) Ti-*n*-2*n*(A17) Ti-γ-*n*(H45,H62) Cu-*d*-8*z*20*a*(M97)
	Ti^{45}	*D*			21 days(D101)			Sc-*p*-*n*(D101)
	Ti^{46}		7.95(N32)					
	Ti^{47}		7.75(N32)					
	Ti^{48}		73.45(N32)					
	Ti^{49}		5.51(N32)					
	Ti^{50}		5.34(N32)					
	Ti^{51m}	*A*		β^-,γ(W4)	6 min.(S28)	1.6(S28) abs.		Ti-*d*-*p*(W4) Ti-*n*-γ(W4,A1)
	Ti^{51}	*A*		β^-,γ	72 days(W5)	0.45(M89) abs. Al; 0.36(W5) abs.	1.0(W5) coincid. abs.; 1.02(M77) coincid. abs.	Ti-*d*-*p*(W5) Ti-*n*-γ(W8) Cu-*d*-8*z*14*a*(M97)
23	V^{47}	*B*		β^+	33 min.(W4,O7)	1.9(W4,O7) abs.		Ti-*d*-*n*(W4,O7) Ti-*p*-*n*(D9,O7)
	V^{48}	*A*		β^+,K,γ(W5, H60); β^+ (58%), K (42%) (G44)	16 days(W4)	0.72(P45) spect.; 1.0 (W4) cl.ch.; 0.58 (H60)	0.98, 1.33(P45) spect.; 1.05(R4) cl.ch. recoil; 1.50 (H60) abs. Pb	Sc-α-*n*(W6) Ti-*d*-*n*(W4) Ti-*p*-*n*(D9) Cr-*d*-α(W4,P45) Cu-*d*-7*z*17*a*(M87)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
23	V^{49}	*B*		K	600 days(W5)	No β or e^-(W5)	No γ(W5)	Ti-*d*-*n*(W5)
	V^{51}		100(A31)					
	V^{52}	*A*		β^-,γ	3.74 min.(M40); 3.9 min.(W4)	2.05(D24) abs.; 2.65(Y5) cl.ch.	1.46(M93) abs. Pb, Fe, Cu; 1.3(G1) abs. Pb	V-*n*-γ(W4,P2,A1) V-*d*-*p*(W4) Cr-*n*-*p*(W4,P2) Cr-γ-*p*(H74) Mn-*n*-α(W4,P2,A1)
24	Cr^{49}	*A*		β^+,γ	41.9 min.(O7); 45 min.(H62)	1.45(O7) abs., cl.ch.	0.18, 1.55(O7) abs. Pb	Ti-α-*n*(O7) Cr-*n*-2*n*(O7) Cr-γ-*n*(H62) Cu-*d*-6z16*a* or Cu-*d*-6z18*a*(M87)
	Cr^{50}		4.49(N35)					
	Cr^{51}	*A*		K,γ,e^-(W13); no β^+(B34)	26.5 days(W13)		0.32(single)(M120, M67) spect. conv.; 0.320(single)(K73) spect.; 0.330, 0.237(B34) abs. of e^-	Ti-α-*n*(W13) V-*p*-*n*(B34) Cr-*d*-*p*(W13,A14) Cr-*n*-γ(W13,M120) Cr-*n*-2*n*(A14) Cu-*d*-6z14*a*(M87) As-*d*-10z26*a*(H66)
	Cr^{52}		83.78(N35)					
	Cr^{53}		9.43(N35)					
	Cr^{54}		2.30(N35)					
	Cr^{55}	*B*			1.3 hr.(S104); 1.6–2.3 hr.(A14,D14)			Cr-*n*-γ(D14,A14) Cr-*d*-*p*(A14)
25	Mn^{51}	*A*		β^+	46 min.(L7)	2.0(L7) abs.		Cr-*d*-*n*(L7) Cr-*p*-γ(D2,D4) Cu-*d*-5z14*a*(M87)
	Mn^{52m}	*A*		β^+,γ; I.T.(?) (0.05%) (O12)	21 min.(L7)	2.66(O12) spect.; 2.2(H6,L12) cl.ch.	1.46(O12) spect., coincid.; 1.2(H6); 0.39(I.T.?)(O12) spect. conv.	Fe-*d*-α(D5,L7) Cr-*p*-*n*(H6,H12) Fe^{52} β^+-decay(M87)
	Mn^{52}	*A*		β^+(35%), K (65%) (G44),γ	5.8 days(M97); 6.5 days(L7)	0.58(P45) spect.; 0.77(H6,H12) cl.ch.; 0.75(T108) abs. Al	1.0(H6); 0.73, 0.94, 1.46(P45) spect., coincid. abs.	Cr-*p*-*n*(H6,H12) Cr-*d*-2*n*(P45) Fe-*d*-α(L7) Cu-*d*-5z13*a* or Cu-*d*-5z15*a*(M87) As-*d*-9z25*a*(H66)
	Mn^{54}	*A*		K,γ(L7)	310 days(L7)		0.835(D35) spect., coincid.; 0.85(L7) abs. Pb	V-α-*n*(L7) Cr-*d*-*n*(L7) Cr-*p*-*n*(D9) Fe-*d*-α(L7)
	Mn^{55}		100(S63)					
	Mn^{56}	*A*		β^-,γ	2.59 hr.(L7)	0.75, 1.05, 2.86(E12) spect., coincid.; 1.04, 2.88(T8) spect.; 0.75(20%), 1.04(30%), 2.81 (50%)(S66) spect.	2.06(20%), 1.77 (30%), 0.822 (~100%)(S66) spect.; 0.845, 1.81, 2.13(E9,E12) spect.; 2.7($\leqslant$ 1%) (W64,W124,L131) D-γ-*n* reaction	Cr-α-*p*(R3) Mn-*n*-γ(A1) Mn-*d*-*p*(L7) Fe-*d*-α(L7) Fe-*n*-*p*(A1) Fe-γ-*p*(P60) Co-*n*-α(A1) Cu-*d*-*p*2α or Cu-*d*-*p*2α2*n* (M87) As-*d*-9z21*a*(H66)
26	Fe^{52}	*A*		β^+	7.8 hr.(M87)	0.55(M87) abs. Al		Cu-*d*-4z13*a* or Cu-*d*-4z15*a*, parent of Mn^{52m}(M87)
	Fe^{53}	*A*		β^+	8.9 min.(R3)			Cr-α-*n*(R3) Fe-*n*-2*n*(L20) Fe-γ-*n*(H43,H62) Cu-*d*-4z12*a* or Cu-*d*-4z14*a*(M87)
	Fe^{54}		5.81(W78)					
	Fe^{55}	*A*		K, no e^-, no β^+(B46)	~4 yr.(V4)		No γ(P50)	Mn-*d*-2*n*(H127) Mn-*p*-*n*(V4) Fe-*d*-*p*(L23) Co^{55} β^+-decay(L10)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
26	Fe^{56}		91.64(W78)					
	Fe^{57}		2.21(W78)					
	Fe^{58}		0.34(W78)					
	Fe^{59}	*A*		β^-,γ	46.3 days(S174); 45.5 days(G45); 47 days(L20)	0.26, 0.46(D16) spect., coincid. abs.	1.10, 1.30(D16) spect.	Fe-*d*-*p*(L20,D16) Fe-*n*-γ(S105,W101) Co-*n*-*p*(L20,I100) Co-*d*-2*p*(T46) Cu-*d*-α2*p* or Cu-*d*-2α(M87) As-*d*-8z18*a*(H66) Bi-*d*(G62)
27	Co^{55}	*A*		β^+,γ	18.2 hr.(D5)	1.50(L21) spect.	0.16, 0.21, 0.8, 1.2 (C20) cl.ch. recoil	Fe-*d*-*n*(L10) Fe-*p*-γ(L9,L10) Cu-*d*-3z10*a* or Cu-*d*-3z12*a*(M87) As-*d*-7z22*a*(H66)
	Co^{56}	*A*		β^+,γ,K(E9)	72 days(L10)	1.50(E9,E12) spect., coincid.; 1.2(L10) abs., (C17) cl.ch., coincid.	0.845, 1.26, 1.74, 2.01, 2.55, 3.25 (E12) spect., coincid.; 1.7(C17) abs. Pb, coincid.; 1.05 (L10) abs. Pb	Fe-*d*-2*n*(L10,P3,J1) Fe-α-*np*(L10) Ni-*d*-α(L10,C17) Cu-*d*-3z9*a* or Cu-*d*-3z11*a*(T108)
	Co^{57}	*A*		K,γ,e^-; β^+(L10)	270 days(L10)	0.26(β^+)(L10)	0.117, 0.130, 0.202, 0.215(P3) spect.	Fe-*d*-*n*(L9,B24,P4, L10) Fe-*p*-γ(L10)
	Co^{58}	*A*		β^+,γ(15%) (G44); K, γ(85%) (G44)	72 days(L10)	0.470(E13,D35) spect.; (E13) coincid.; 0.4(L10) abs.	0.805(D35) spect., coincid.; 0.6(L10) abs. Pb	Mn-α-*n*(L9,L10) Fe-*d*-*n*(L9,B24,P4, L10) Fe-*p*-*n*(L9) Fe-α-*np*(L10) Fe-*p*-γ(L10) Ni-*d*-α(L11) Ni-*n*-*p*(V5,L10) Cu-*d*-α*p*2*n* or Cu-*d*-α*p*4*n*(T108)
	Co^{59}		100(M52)					
	Co^{60}	*A*		β^-,γ	5.3 yr.(L10)	0.31(D17,D36) spect. coincid. abs.; 0.23(D55) spect.; 0.310(M78) spect.	1.16, 1.32(M78,J8) spect.; 1.16, 1.30 (P106) spect.; 1.10, 1.30(D17, D36) spect., coincid.	Co-*d*-*p*(L9,B24,L10, D17,N10) Co-*n*-γ(R9,L9,L10) Co^{60m} I.T. (L10,D17) Ni-*d*-α(L10) Cu-*n*-α(M64)
	Co^{60m}	*A*		I.T., γ, e^- (>90%) (L10,D17, D36,S103); β^-,γ (<10%) (D17,D36, N10,S103)	10.7 min.(L10)	1.35(β^-)(N10) spect.; 1.25(β^-)(D36) spect.; 1.56(β^-) (P106) spect.	0.056(I.T.)(D17, D36) spect. conv.; 1.5(with β^-)(N10, D36) abs. Pb; 1.32(with β^-) (P106) spect.	Co-*n*-γ(H7,L8,L10, D17) Co-*d*-*p*(N10) Ni-*n*-*p*(H8,L10)
	Co^{61}	*A* (P51) m.s.		β^-	1.75 hr.(P51)	1.1(P51) abs. Al	No γ(P51)	Co-*t*-*p*(K64) Ni-γ-*p*(P60) Ni-*d*-α*n*(P51) Ni^{64}-*p*-α(P51) Ni^{61}-*n*-*p*(P51) Cu-*n*-*n*α(P51) Cu-γ-2*p*(P60) Cu-*d*-α*pn*(M87) As-*d*-7z16*a*(H66)
	Co^{62}	*B*		β^-,γ(P52)	13.8 min.(P52)	2.5(P52) abs. Al, coincid.	1.3(P52) abs. Pb	Ni^{62}-*n*-*p*(P52) Cu-*n*-α(P52) Cu-*d*-α*p*(P52)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
28	Ni^{57}	*A*		β^+	36 hr.(L11); 34 hr. (H66)	0.67(L11) abs.		Fe-α-n(L11,N11, D18) Ni-n-2n(L11,N11, D18) Ni-γ-n(H45,H62) Cu-d-2z8a or Cu-d-2z10a(M87) As-d-6z20a(H66)
	Ni^{58}		67.76(W78)					
	Ni^{59}	*B*		K, no β^- (B96)	5×10^4 yr.(B96) yield; 16 yr.(C124) yield	~0.05(C102,C124) abs. Al		Fe-α-n(C117) Ni-n-γ(C102,B96) Ni-d-p(C102) Co-d-2n(B96)
	Ni^{60}		26.16(W78)					
	Ni^{61}		1.25(W78)					
	Ni^{62}		3.66(W78)					
	Ni^{63}	*B*		β^-(F49)	300 yr. (B96) yield; long(F49) yield	0.05(F49) abs. Al; (B96) abs. A, Al		Ni-n-γ(F49) Ni^{62}-n-γ(B96)
	Ni^{64}		1.16(W78)					
	Ni^{65}	*A*		β^-,γ	2.6 hr.(L11)	1.9(L11,S161) abs. Al	1.1(L11) abs. Pb; 0.280, 0.65, 0.93 (G3) spect.	Ni-d-p(L11,N11) Ni-n-γ(H8,N11,D18) Ni^{64}-n-γ(G134,C55) Cu-n-p(H8) Zn-n-α(H8) Cu^{65}-n-p(S87) Cu-d-2p(M87) As-d-6z12a(H66)
	Ni^{66}	*A*		β^-	56 hr.(G62)			As-d-6z11a(H66) Bi-d, parent of Cu^{66} (G62)
29	Cu^{58}	*D*		β^+	7.9 min.(D4); 10 min.(L83)			Ni-p-n(D4)
	Cu^{58}	*B*			3 sec. (A39)			Ni-p-n(A39) Ni^{58}-p-n(A39)
	Cu^{59}	*E*		β^+	81 sec.(D4)			Ni-p-n(D4)
	Cu^{60}	*A* (L83) m.s.		β^+,γ	24.6 min.(L83)	1.8, 3.3(<5%)(L83) abs. Al	1.5(L83) abs. Pb.	Ni-p-n(L80) Ni^{60}-p-n(L83) Ni^{60}-d-2n(L83) Ni^{58}-α-pn(L83) Cu-d-p4n(M87) As-d-5z17a(H66)
	Cu^{61}	*B*		β^+; K(A4)	3.4 hr.(T1,R3); 3.33 hr.(C80)	1.205(C80) spect.; 0.9(R3) abs.; 1.23 (B36)	No γ(G2,B36)	Ni-d-n(T1) Ni-p-n(D4) Ni^{61}-p-n(L83) Ni-p-γ(D4) Ni-α-p(R3) Cu-γ-2n(P60) Cu-d-p3n or Cu-d-p5n(M87) As-d-5z16a(H66)
	Cu^{62}	*A*		β^+,γ	10.5 min.(H8); 10.1 min.(L83)	2.6(C13) cl.ch.; 2.5 (T108) abs. Al	0.56(T108) abs. Pb	Co-α-n(R3) Ni-p-n(S18) Ni-p-γ(S18) Cu-n-2n(H8) Cu-γ-n(B20,H44, H45,H62) Cu-e^--e^--n(S59) Cu-d-t(K22,K14) Zn^{62} K-decay(M87)
	Cu^{63}		69.09(I104)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
29	Cu^{64}	*A*		K(54%); β^-(31%); β^+(15%) (C86,B44); γ(1.5%) (with K) (B44)	12.8 hr.(V2)	0.571(β^-), 0.657(β^+) (C73) spect.; 0.58 (β^-), 0.66(β^+)(T6, T11,T8) spect.; 0.57(β^-), 0.64(β^+) (P106) spect.	1.35(2.5%)(D62) spect.; 1.34(weak) (K73) spect.; 1.20 (weak)(B44) coincid. abs.	Ni-*p*-*n*(S18,D4) Cu-*d*-*p*(V2) Cu-*n*-γ(H8) Cu-*n*-2*n*(H8) Cu-*p*-*pn*(R45) Cu-γ-*n*(H45,H62) Zn-*d*-α(B51) Zn-*n*-*p*(H8) As-*d*-5*z*13*a*(H66)
	Cu^{65}		30.91(I104)					
	Cu^{66}	*A*		β^-,γ	5 min.(A1)	2.9(S5) cl.ch.(K.U. ; 2.58(G15)	1.32(M79) abs. Pb	Cu-*n*-γ(A1) Cu-*d*-*p*(L31) Zn-*n*-*p*(H8) Ga-*n*-α(C5) Ni^{66} β^--decay(G62)
	Cu^{67}	*B*		β^-	56 hr.(G62); 61 hr. (H66)	0.56(H204) abs. Al		As-*d*-5*z*10*a*(H66) Bi-*d*(G62) Zn-γ-*p*(D68)
30	Zn^{62}	*A*		K(?)(M87)	9.5 hr.(M87)			Cu-*d*-3*n* or Cu-*d*-5*n*, parent of Cu^{62} (M87) As-*d*-4*z*15*a*(H204)
	Zn^{63}	*A*		β^+(93%); K(7%), γ(H207)	38 min.(D4,B20)	2.3(S18) abs., (T11, T8) spect.; 2.36 (85%), 1.40(7%), 0.47(1%)(H207, B45) spect.	0.96(weak), 1.9 (weak), 2.6(weak) (B45,H207)	Ni-α-*n*(R3) Cu-*p*-*n*(S18,D4) Cu-*d*-2*n*(L31,T8, M87) Cu-*d*-4*n*(M87) Zn-*n*-2*n*(H8,P2) Zn-γ-*n*(B20) As-*d*-4*z*14*a*(H204)
	Zn^{64}		48.89(L88)					
	Zn^{65}	*A*		β^+(1.3%), K (98.7%) (G46),γ,e^-	250 days(L12)	0.32(β^+)(P106) spect.; 0.4(β^+) (D9) cl.ch.	1.11(J8) spect.; 1.14 (D19,M34) spect.; 1.14(46% of K), no γ(54% of K) (G46) x-ray-e^- coincid.; 0.45, 0.65, 1.0(W15,I3) cl.ch. recoil	Cu-*d*-2*n*(P4) Cu-*p*-*n*(B12) Zn-*d*-*p*(L12) Zn-*n*-γ(S6) Ga^{65} *K*-decay(L10)
	Zn^{66}		27.81(L88)					
	Zn^{67}		4.07(L88)					
	Zn^{68}		18.61(L88)					
	Zn^{69m}	*A*		I.T., γ(K11)	13.8 hr.(L12)		0.439(H9,G3) spect. conv.	Zn-*d*-*p*(L12,K11,V7) Zn-*n*-γ(T2,L12) Ga-*d*-α(L12) Ga-*n*-*p*(L12) As-*d*-2α(H66)
	Zn^{69}	*A*		β^-	57 min.(L12)	1.0(L12) abs.	No γ(L12)	Zn-*d*-*p*(L12,K11,V7) Zn-*n*-γ(T2) Ga-*d*-α(L12) Ga-*n*-*p*(L12) As-*d*-2α(H66) Zn^{69m} I.T. (K11)
	Zn^{70}		0.620(L88)					
	Zn^{71}	*B*		β^-,γ(H130)	2.2 min.(H130)	2.1(H130)		Zn-*n*-γ(H130) Ge-*n*-α(H130)
	Zn^{72}	*A*		β^-,γ(S149, G120)	49 hr.(S149)	~0.3(95%), ~1.6 (5%)(S149) abs. Al		U-*n*, parent of Ga^{72} (G121) Bi-*d*(G62) As-*d*-4*z*5*a*(H66)
31	Ga^{64}	*B*		β^+	48 min.(B13)			Zn-*p*-*n*(B13)
	Ga^{65}	*A*		K,e^-	15 min.(A4,L10)		0.054, 0.117(D9) spect. conv.	Zn-*d*-*n*(A4,L10) Zn-*p*-γ(D9)
	Ga^{66}	*A*		β^+	9.4 hr.(B13,R3)	3.1(M7) abs.		Cu-α-*n*(M7,R3) Zn-*p*-*n*(B13) As-*d*-3*z*11*a*(H66) Ge^{66} decay(H147)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
31	Ga^{67}	*A*		K,γ,e^-	78.3 hr.(M88); 83 hr.(A4)		0.094, 0.174, 0.187, 0.301(C21) spect.; 0.0925, 0.180, 0.297(H9) spect. conv., spect.; 0.292(G3) spect.	Zn-*d*-*n*(A4,G6,V7) Zn-α-*p*(M8) Zn-*p*-*n*(B13,V7) As-*d*-3*z*10*a*(H66) Ge^{67} β^+-decay(H147)
	Ga^{68}	*A*		β^+	68 min.(R3)	1.9(R3,M7) abs.		Cu-α-*n*(R3,M7) Zn-*p*-*n*(D2,B13) Zn-*p*-γ(?)(D2) Zn-*d*-*n*(G6,V7) Ga-*n*-2*n*(P2) Ga-γ-*n*(B20) Ge-γ-*pn*(P61) Ge-*d*-α(S29) As-*d*-3*z*9*a*(H66) Ge^{68} *K*-decay(H66)
	Ga^{69}		60.2(I17)					
	Ga^{70}	*A*		β^-,γ	20.3 min.(B139); 20 min.(B20,A1)	1.68(S25) cl.ch. (K.U.); 1.65 (H209) spect.; 1.62 (B139) abs. Al		Zn-*p*-*n*(D2,V7) Zn-α-*p*(M8) Ga-*n*-γ(A1) Ga-*n*-2*n*(P2) Ga-γ-*n*(B20) Ge-*d*-α(S29) Ge-*n*-*p*(S29,G121)
	Ga^{71}		39.8(I17)					
	Ga^{72}	*A*		β^-,γ	14.3 hr.(M30,G121, S149); 14.1 hr.(S6)	0.64(40%), 0.955 (32%), 1.48 (10.5%), 2.52 (8%), 3.15(9.5%) (H209) spect.; ~0.77, 2.3(M68) coincid. abs.; (M94) spect.; 0.8(~65%), ~3.1 (~35%)(S149) abs. Al	0.63(24%), 0.84 (100%), 1.05 (4.5%), 1.59 (4.5%), 1.87 (7.8%), 2.21 (33%), 2.51 (26.5%)(H209) spect.; 0.64(~8%), 0.84(~46%), 2.25(~46%) (M67) spect.; 2.50 (W64) D-γ-*n* reaction; (M94) spect.	Ga-*d*-*p*(L20) Ga-*n*-γ(S6,G121) Ge-*n*-*p*(S29,G121) As-*d*-α*p*(C130) U-*n*, Zn^{72} β^--decay (G121) Bi-α(P56) Tl-α(T109) U-α(O115)
	Ga^{73}	*B*		β^-(S150, G121)	5 hr.(S150,G121)	1.4(S150) abs. Al	No γ(S150)	Ge-*n*-*p*(G121) Ge-γ-*p*(P61) U-*n*(S150,S149)
32	Ge^{66}	*A*			~140 min.(H147)			Ge-*d*-*p*5*n*, parent of Ga^{66}(H147)
	Ge^{67}	*A*		β^+(H147)	23 min.(H147)			Ge-*d*-*p*4*n*, parent of Ga^{67}(H147)
	Ge^{68}	*A*		K(H66)	250 days(H66); ~195 days(M8)			Zn-α-2*n*(M8,M99) As-*d*-α5*n*(H66) Parent of Ga^{68}(H66)
	Ge^{70}		20.55(I105)					
	Ge^{71}	*A*		K,e^-(?) (S30); K, no β^- or e^-(S104); β^+(?)(M67)	11 days(S30) 11.3 days(D101); 11.4 days(H66)	~0.6(β^+?)(M67)	0.6(S30) abs. of e^-	Ga-*d*-2*n*(S30) Ga-*p*-*n*(D101) Ge-*d*-*p*(S30) Ge-*n*-γ(S104) As-*d*-α2*n*(H66)
	Ge^{71}	*B*		β^+	39.7 hr.(D101); 40 hr.(S30); 36 hr.(H62); 38 hr.(H66)	1.2(S30) abs.		Zn-α-*n*(M8) Ga-*d*-2*n*(S30) Ga-*p*-*n*(D101) Ge-*n*-γ(S6,S29) Ge-*d*-*p*(S6,S30,S29) Ge-*n*-2*n*(S25,S29) Ge-γ-*n*(H62) As-*d*-α2*n*(H66) Se-*n*-α(S29) As^{71} β^+-decay(?) (H66)
	Ge^{72m}	*A*		I.T., e^-(B93)	5×10^{-7} sec.(B93)	0.68(e^-)(B93) coincid. abs.		Ga^{72} β^--decay(B93)
	Ge^{72}		27.37(I105)					

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
32	Ge^{73}		7.61(I105)					
	Ge^{74}		36.74(I105)					
	Ge^{75}	*A*		β^-,γ(S30)	89 min.(S30)	1.1(S25,S29) cl.ch. (K.U.); 1.2(S30) abs. Al		Ge-*n*-γ(S6,S29) Ge-*d*-*p*(S6,S29,S30) Ge-*n*-2*n*(S29,S30) Ge-γ-*n*(H62) As-*n*-*p*(S29,S30) Se-*n*-α(S29,S30)
	Ge^{76}		7.67(I105)					
	Ge^{77}	*A*		β^-(S29), γ(S152)	12 hr.(S30,S106)	2.0(S106) abs. Al; 1.9(S25,S29) cl.ch. (K.U.); 1.8(S152) abs. Al		Ge-*n*-γ(S6,S29) Ge-*d*-*p*(S29,S30) Se-*n*-α(S30) U-*n*(S106) parent of As^{77}(S151,S152) U^{238}-*n*(S184)
	Ge^{77m}	*B*		β^-	59 sec.(A37)	2.8(A37) abs.Al		Ge-*n*-γ(A37) Parent of As^{77}(A37)
	Ge^{78}	*D*		β^-,γ(S152)	2.1 hr.(S152)	~0.9(S152) abs. Al		U-*n*, parent of As^{78} (S106,S152)
33	As^{71}	*B*		β^+(H66)	52 min.(H66)			As-*d*-*p*5*n*(H66) Se^{71} β^+-decay(H66)
	As^{71}	*A*		K(H213)	60 hr.(H213)			Parent of Ge^{71} (11d.)(H213)
	As^{72}	*B*		β^+,γ	26 hr.(V4)	2.78(M80) abs. Al, coincid.	2.4(M80) coincid. abs.	Ga-α-*n*(M80) Ge-*p*-*n*(V4) As-*d*-*p*4*n*(H66) Se^{74}-*d*-α(M99) Se^{72} *K*-decay(H66)
	As^{73}	*B*		K,e^-(E10)	90 days(S26)		0.052(E10) spect. conv.	Ge-*d*-*n*(S26,E10) Ge^{70}-α-*p*(?)(M88)
	As^{74}	*A*		β^-,β^+,γ(S26)	17.5 days(M88); 19.0 days(H66); 16 days(S26)	1.3(β^-), 0.9(β^+)(S26) cl.ch. (K.U.)	0.582(D15) spect.	Ga-α-*n*(M88) As-*n*-2*n*(S26,C11) As-*d*-*p*2*n*(H66) Ge-*d*-*n*(S26,S29,I4) Se-*d*-α(F8) Ge-*p*-*n*(D9) Bi-*d*(G62)
	As^{75}		100(N30)					
	As^{76}	*A*		β^-,γ; no β^+ (B81, W70); β^+, K, γ(S23)	26.8 hr.(W9,W19)	1.29(15%), 2.49 (25%), 3.04(60%) (β^-)(S67) spect.; 1.1, 1.7, 2.7(β^-) (S23,W9,W19) cl.ch.; 0.7, 2.6(β^+) (S23) cl.ch.; coincid.(M35)	0.55, 1.20, 1.70(S67) spect.; 0.557, 1.22, 1.78(weak)(W70) spect.; 1.94, 0.83 (M6) spect.; coincid.(M35); 2.15 (weak), 1.84 (weak), 1.25 (~30%), 0.57 (~70%)(M120, M67) spect.; 3.2, 2.2, 1.5(S23) cl.ch. pair	Ge-*p*-*n*(V4) As-*d*-*p*(C11,T3) As-*n*-γ(C11) Se-*n*-*p*(S26) Se-γ-*p*(H74) Se-*d*-α(F8) Br-*n*-α(C11)
	As^{77}	*A*		β^-(S106)	40 hr.(S151)	0.8(S152) abs. Al		U-*n*(S151), Ge^{77} β^--decay(S152) Th-α(N116) Bi-*d*(G62) Ge^{77}(59 sec.) β^--decay(A37)
	As^{78}	*A*		β^-,γ	80 min.(C11); 65 min.(S9,S26)	1.4(S26) cl.ch.(K.U.)	0.27(S26) abs. Pb	Br-*n*-α(S9,C11,S26) Se-*n*-*p*(S26)
	As^{78}	*D*		β^-	90 min.(S106,S152)	1.4(~30%), 4.1 (~70%)(S152) abs. Al		U-*n*, Ge^{78} β^--decay (S106,S152)
34	Se^{71}	*B*		β^+(H66)	44 min.(H66)			As-*d*-6*n*, parent of As^{71}(H66)
	Se^{72}	*B*		K(H66)	9.5 days(H66)			As-*d*-5*n*(H66) Parent of As^{72}(H66)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
34	Se^{73}	*B*		β^+(H66, C79); K(C79)	6.7 hr.(H66) 7.1 hr.(C79)	1.29(C79) abs. Al		Ge-α-n(C79) Ge^{70}-α-n(C79) As-d-$4n$(H66)
	Se^{74}		0.87(W78)					
	Se^{75}	*A*		K,γ,e^-	127 days(C79); 125 days(G143); 115 days(F46); 120 days(H66)		0.077, 0.099, 0.124, 0.139, 0.269, 0.281, 0.405(J14,J131) spect., spect. conv.; 0.50(D9) spect. conv.; several <0.3(K30) spect. conv.; 0.335, 0.18(B117); 0.22, 0.43(C79) abs. Pb	As-p-n(D9) As-d-$2n$(K30,S107) Se-n-γ(F46,B130)
	Se^{76}		9.02(W78)					
	Se^{77}		7.58(W78)					
	Se^{77m}	*A*		I.T., γ (D122,A37)	17.5 sec.(A37)	0.135(e^-)(G71) abs.	~0.15(A37)	Se-n-γ(A37) Se^{76}-n-γ(D122) Se-x-rays(G71)
	Se^{78}		23.52(W78)					
	Se^{80}		49.82(W78)					
	Se^{81m}	*B*		I.T., e^-(L30)	59 min.(G125); 57 min.(S9,L30)		0.099(H9) spect. conv.	Se-d-p(S9,L30) Se-n-γ(S9,H10) Se^{80}-n-γ(L131) Se-γ-n(B20) Br-n-p(S9,L30) U-n, parent of Se^{81} (G125)
	Se^{81}	*B*		β^-	17 min.(G125); 19 min.(L30)	1.5(L30,G125) abs. Al	No γ(G126)	Se-d-p(S9,L30) Se-n-γ(S9,H10) Se-γ-n(B20) Se^{81m} I.T.(L30) Br-n-p(L30) U-n, Se^{81m} I.T. (G125,G101)
	Se^{82}		9.19(W78)					
	Se^{83m}	*A*		β^-,γ(A37)	67 sec.(A37)	3.4(A37) abs. Al		Se-n-γ(A37) U-n(S177)
	Se^{83}	*A*		β^-,γ(G120, G125)	25 min.(M121,G125); 30 min.(L30)	1.5(M121,G125) abs. Al	0.17, 0.37, 1.1 (G125) abs. Pb	Se-d-p(L30) Se-n-γ(L30) U-n, parent of Br^{83} (G101) Th-n(G101)
	Se^{84}	*A*		β^-	~2.5 min.(G125); <10 min.(E111)			U-n, parent of Br^{84} (E111)
35	Br^{75}	*B*		β^+;K(W77)	1.7 hr. (W77)	1.6(W77) abs. Al	No γ(W77)	Se^{74}-d-n(W77) Se^{74}-p-γ(?)(W77) Parent of Se^{75}(?) (W77)
	Br^{76}	*D*		β^+,γ,e^- (H213)	15.7 hr.(H213)	3.15(β^+), 0.18(e^-) (H213) spect.	2(H213) abs. Pb	As-α-$3n$(H213)
	Br^{77}	*B*		β^+;K,γ,e^- (H213, W77); K(95%), β^+(5%) (W77)	57.2 hr.(H213); 58 hr.(W77)	0.36(β^+)(H213) spect., (W77) abs. Al, spect.	0.7(H213) abs. Pb	As-α-$2n$(H213) Se^{74}-α-p(W77) Se^{76}-d-n(W77)
	Br^{78}	*A*		β^+,e^-,γ	6.4 min.(S9)	2.3(β^+)(S9) abs.	0.046, 0.108(V7) spect. conv.	As-α-n(S9) Se-d-n(S9) Se-p-n(B13,V7) Br-γ-n(B20,C5) Br-n-$2n$(H10)
	Br^{79}		50.5(W63)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
35	Br^{80m}	*A*		I.T., e^-, γ (S10,V3, V7,G22)	4.4 hr.(B13)		0.049, 0.037, or 0.025 (V7) spect. conv.; 0.037(G22) abs. Al	Se-α-*p*(W77) Se-*p*-*n*(B13,V7) Br-*n*-γ(S9,S10,A2), (~30%)(G137) Br-*d*-*p*(S9) Br-γ-*n*(B20) Br-*n*-2*n*(P2) Th-*n*(?)(P12,P16)
	Br^{80}	*A*		β^-,γ; β^+(3%) (B81)	18 min.(S9,S10)	2.0(β^-)(A2) spect.; 0.73(β^+)(B81) spect., abs.	<0.5(B13,S9) abs.	Se-*p*-*n*(B13) Br-*n*-γ(S9), (~70%)(G137) Br-*d*-*p*(S9) Br-γ-*n*(B20) Br-*n*-2*n*(P2) Br^{80m} I.T.(S10,S31, D20)
	Br^{81}		49.5(W63)					
	Br^{82}	*A*		β^-,γ	34 hr.(S9)	0.465(R6,D21) spect.; (D23) coincid.	0.547, 0.787, 1.35 (R6,D15) spect.; (D23) coincid.	Se-*p*-*n*(B13,R7) Se-*d*-2*n*(S9) Br-*n*-γ(K5,S9) Br-*d*-*p*(S9) Rb-*n*-α(S9,P2) U-*n*(F113) Pb-α(P104) Tl-α(T109) Bi-α(P56) Bi-*d*(P56) U-α(O115)
	Br^{83}	*A*		β^-	2.4 hr.(G101); 140 min.(L30)	1.05(L30) abs.; 0.9 (G125) abs. Al	No γ(S9,G101)	Se-*d*-*n*(S9) Se^{83} β^--decay(S9, L30), parent of Kr^{83m}(L30) U-*n*, Se^{83} β^--decay, parent of Kr^{83m} (L30,M9,S35, G101) U^{233}-*n*(S184) Th-*n*(B15,L30,S108, G101) Th-α(N116) Pu-*n*(F102,K72) Bi-*d*(P56) Pb-α(P104) Bi-α(P56) U-α(O115)
	Br^{84}	*A*		β^-,γ	30 min.(S35); 33 min.(K104,K111)	5.3(K111) abs. Al; 4.5(B30) abs.		Rb-*n*-α(B29) U-*n*(D6,H22,H57, M9,S35,B29, K104), Se^{84} β^--decay(E111) Th-*n*(P12,B101) Bi-*d*(P104)
	Br^{85}	*A*		β^-	3.00 min.(S205); 3.0 min.(S35,B29)	2.5(S205) abs. Al	No γ(S205)	U-*n*, parent of Kr^{85} (S35,B29,S43)
	Br^{87}	*B*		β^-(S35); β,*n*(S60) β^-	55.6 sec.(H220); 55.0 sec.(R51); 56 sec.(S60)	0.25(mean)(*n*)(H220) abs. paraffin; 0.3 (mean)(*n*)(B134) *p* recoil in cl.ch.		U-*n*, parent of Kr^{87} (S35,B29,S43,S60, R51) Pu-*n*(R51)
	Br^{87} (G70)	*D* (S68)		β^-,*n*(L125, S68)	4.51 sec.(H131); 4.5 sec.(L125)	0.43(mean)(*n*)(H220) abs. paraffin; 0.7 (mean)(*n*)(B134) *p* recoil in cl.ch.		U-*n*(L125)
	Br^{88}	*B*		β^-	16.0 sec.(R107)			U-*n*, ancestor of Rb^{88} (R107)
36	Kr^{77}	*B*		K(70%), β^+(30%), γ(W75)	1.1 hr.(W75)	1.7(W75) abs. Al		Se-α-*n*(W75) Se^{74}-α-*n*(W75)

Table of Isotopes—*Continued*

Isotope Z	A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev Particles	γ-rays	Produced by
36	Kr^{78}		0.342(L75)					
	Kr^{79}	*A*		β^+(B41), (2%) (W75); γ(H109); K(98%) (W75)	34 hr.(B41, W75)	~0.9(30%), ~0.6 (70%)(H109) abs. Al; 0.4(C41) cl.ch.	0.2(H109) abs. Pb	Se-*α*-*n*(C45,C22) Se^{76}-*α*-*n*(W75) Br-*d*-2*n*(C64) Br-*p*-*n*(B41,C41) Kr-*d*-*p*(C45,S9,C22) Kr-*n*-γ(H109)
	$Kr^{79,81}$	*C*		I.T.(?),e^-,γ; no β^+(C41)	13 sec.(C41)		0.187(C41) spect. conv.	Br-*p*-*n*(B41,C41)
	$Kr^{79,81}$	*C*		I.T.(?),e^-,γ; no β^+(C41)	55 sec.(C41)		0.127(C41) spect. conv.	Se-*α*-*n*(?)(K3) Br-*p*-*n*(B41,C41)
	Kr^{80}		2.223(L75)					
	Kr^{82}		11.50(L75)					
	Kr^{83}		11.48(L75)					U-*n*(T43) m.s.
	Kr^{83m}	*A*		I.T., e^-(L30)	113 min.(L30)		0.029, 0.046(H9) spect. conv.	Se-*α*-*n*(C45,C22) Kr-*d*-*p*(C45,C22) Kr-*n*-γ(W57) Kr-*x*-rays(W57) U-*n*, Br^{83} β^--decay (L30)
	Kr^{84}		57.02(L75)					U-*n*(T43) m.s.
	Kr^{85}	*A*		β^-,γ(H109)	4.5 hr.(H109); 4.0 hr.(C22); 4.6 hr.(S43)	1.0(H109) abs. Al; 0.85(B30) abs.	0.17, 0.37(H109) abs. Pb	Kr-*d*-*p*(S9,C45,C22) Kr-*n*-γ(H109) Rb-*n*-*p*(B29) Sr-*n*-*α*(B29) U-*n*, Br^{85} β^--decay (B29,S43)
	Kr^{85}	*B* (T43) m.s.		β^-(W113, H114)	9.4 yr(T110); ~10 yr.(H114,T43); >2.5 yr.(W113)	0.74(H114) abs. Al; ~0.8(W113) abs. Al	No γ(H114)	Kr-*n*-γ(H109) U-*n*(W113,H114)
	Kr^{86}		17.43(L75)					U-*n*(T43) m.s.
	Kr^{87}	*B*		β^-	74 min.(S9)	~4(B30) abs. Al		Kr-*d*-*p*(S9) Rb-*n*-*p*(B29) U-*n*, Br^{87} β^--decay (B29,S43)
	Kr^{88}	*A*		β^-	3 hr.(L27,H28)	2.5(W19) cl.ch. (K.U)		Th-*n*(H29,A5,L27) U-*n*, parent of Rb^{88} (H28,H11,G9, G21,H46)
	Kr^{89}	*A*		β^-	2.6 min.(D114); 2.5 min.(H56)			U-*n*, ancestor of Sr^{89} (G9, G21,S41, H46,H47) U-*d*(O101) Pu-*n*(A105)
	Kr^{90}	*A*		β^-	~33 sec.(K124); short(D108)			U-*n*, ancestor of Sr^{90} (D108) Pu-*n*(A105)
	Kr^{91}	*B*		β^-	9.3 sec. (D114); 5.7 sec.(O101)			U-*n*, ancestor of Sr^{91} (S110,D114), ancestor of Y^{91}(S110, D108) U-*d*(O101) Pu-*n*(A105)
	Kr^{92}	*A*		β^-	2.3 sec.(D114); <0.5 min.(H28)			U-*n*(H28,H46,H47) ancestor of Y^{92} (D102) Th-*n*(H29) Pu-*n*(A105)
	Kr^{93}	*A*		β^-	2.2 sec.(D114); 2.0 sec.(A104)			U-*n*, ancestor of Y^{93} (S171) U-*d*(O101,H102) Pu-*n*(A105)
	Kr^{94}	*B*		β^-	1.4 sec.(A104)			U-*n*, ancestor of Y^{94} (H56,A103)
	Kr^{97}	*B*		β^-	Short(A105)			U-*n*, ancestor of Zr^{97} (A105) Pu-*n*(A105)

Table of Isotopes— *Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
37	Rb^{81}	*A* (R54) m.s		β^+, γ, e^- (R54)	5.0 hr. (R54)	0.9(β^+), 0.2(e^-)(R54) abs. Al, spect.	0.8(R54) abs. Pb	Br-α-2n(R54)
	Rb^{82}	*A* (R54) m.s.		β^+,γ(R54)	6.3 hr.(R54); 6.5 hr. (H51)	0.9(R54) abs. Al	1.0(R54) abs. Pb	Br-α-n(R54,H51) Kr-d-2n(H51)
	Rb^{82}	*D*			20 min.(H51)			Br-α-n(H51)
	Rb^{84}	*B*		β^+(B81)	~40 days(B81)			Rb-n-2n(B81) Sr-d-α(B81)
	Rb^{85}		72.8(N34)					
	Rb	*F*			42 min.(H51)			Kr-d-n(H51)
	Rb	*F*			200 hr.(H51)			Kr-d-n(H51)
	Rb^{86}	*A*		β^-,γ(H52)	19.5 days(H13); ~17 days(H62)	1.82(80%), 0.716 (20%)(Z6) spect., coincid.; (J15) coincid.; 1.56(H13) abs.; 1.60(H32) spect.; 1.80(F117) abs. Al	1.081(Z6) spect., coincid.; (J15) coincid.	Rb-n-γ(S9,S20) Rb-γ-n(H62) Sr-d-α(H13) Bi-d(G62) U-n(F114,F117)
	Rb^{87} (H89, H84)	*A*	27.2(N34)	β^-(T31,C61), γ,e^-(O30)	6.3×10^{10} yr.(S74); 5.8×10^{10} yr.(E33); 1.2×10^{11} yr.(M22)	0.132(L6) spect.; 0.25(K53); 0.13 (O30) spect.; 0.144(S64) spect.	0.034, 0.053, 0.082, 0.102, 0.129(O30) spect. conv.	Natural source (T31, C61)
	Rb^{88}	*A*		β^-	17.5 min.(W19)	4.6(G21) abs. Al; 5.1(W19) cl.ch.		Rb-n-γ(S9,P2,S20) Pa-n(G7) U-n, Kr^{88} β^--decay (H28,L27,H11, G21,W19,H46) Th-n(A5)
	Rb^{89}	*A*		β^-,γ(G21)	15 min.(G9,G21)	3.8(G21) abs.		U-n, Kr^{89} β^--decay (G9,G21,S41,H46, H47); parent of Sr^{89}(G21)
	Rb^{90}	*A*		β^-	Short(D108)			U-n, Kr^{90} β^--decay, parent of Sr^{90} (D108)
	Rb^{91}	*A*		β^-	Short(H42,S110)			U-n, Kr^{91} β^--decay, ancestor of Y^{91} (S110,D105)
	$Rb^{>90}$	*D*		β^-	80 sec.(H28)			U-n(H28,H46,H47, H56)
	Rb^{93}	*A*		β^-	Short(D105,D104)			U-n, Kr^{93} β^--decay, ancestor of Y^{93} (D105,D104)
	Rb^{94}	*B*		β^-	Short(H56)			U-n, Kr^{94} β^--decay, ancestor of Y^{94} (H56)
	Rb^{97}	*B*		β^-	Short(A105)			U-n, Kr^{97} β^--decay, ancestor of Zr^{97} (A105)
38	Sr^{84}		0.56(N36)					
	Sr^{85m}	*A*		I.T., e^-, γ (D25)	70 min.(D25)		0.170(D25) spect. conv.	Rb-p-n(D13,D25)
	Sr^{85}	*A*		K, γ(D13)	65 days(D13)		0.8(D13,D25) abs. Pb	Rb-p-n(D13,D25) Rb-d-2n(O102)
	Sr^{86}		9.86(N36)					
	Sr^{87m}	*A*		I.T., e^-, γ (D11)	2.7 hr.(D11)		0.37(D11) spect. conv.; 0.386(H9) spect. conv.	Rb-p-n(D11) Sr-n-n(D13,R15, D25,R20) Sr-x-rays(W56) Sr-e^--e^-(W56) Sr-d-p(D11) Sr-n-γ(D11,R15, F103) Sr^{86}-n-γ(S69) Sr-p-p(?)(D25) Y^{87} K-decay(D11, D25) Zr-n-α(S46)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
38	Sr^{87}		7.02(N36)					
	Sr^{88}		82.56(N36)					
	Sr^{89}	*A* (L112, H96) m.s.		β^-	53 days(G149); 55 days(S24)	1.50(S24) cl.ch.; 1.48(N102) spect.; 1.5(W102,R49) spect.	No γ(G106,S24, W112)	Sr-*d*-*p*(S11,S24) Sr-*n*-γ(S11,S24) Y-*n*-*p*(S12) Zr-*n*-α(?)(S46) U-*n*, Rb^{89} β^--decay (G9,H28,G21, H46,H47,G51) U-*d*(O103) U^{238}-*n*(G65,S184) Th-*n*(B101) Th-α(N116) Pu-*n*(F102) Bi-α(T109) Bi-*d*(G62) Pb-α(P104) Pt-α(T109)
	Sr^{90}	*A* (H96) m.s.		β^-(N112)	25 yr.(G150); ~30 yr.(C113)	0.61(M51) spect.; 0.6(G51,G150) abs. Al	No γ(G150,G122)	U-*n*, Rb^{90} β^--decay, parent of Y^{90}(H47, N112,D103,G122, G51) U^{238}-*n*(G65) Th-α(N116)
	Sr^{91}	*A*		β^-,γ	9.7 hr.(K117); 10 hr.(H47)	1.3(40%), 3.2(60%) (K105,F111,K112) abs. Al	~1.3(K117) abs. Pb	Zr-*n*-α(S48) U-*n*, Rb^{91} β^--decay, parent of Y^{91} (~60%)(F111) and Y^{91m} (~40%) (F111), (H56, H47,G13,K105) Th-*n*(B101) Th-α(N116) Pu-*n*(S111,F102, K72) Bi-α(P56) Pt-α(T109) Pb-α(P104) Bi-*d*(P104)
	Sr^{92}	*A*		β^-	2.7 hr.(G13)			U-*n*, parent of Y^{92} (G13,H47,H56, S110,K105) Th-*n*(B101) Th-α(N116) U-γ(L2)
	Sr^{93}	*A*		β^-	7 min.(L26)			U-*n*,Rb^{93} β^--decay, parent of Y^{93} (H56,L26,H28, H47)
	Sr^{94}	*B*		β^-	~2 min.(H47)			U-*n*, Rb^{94} β^--decay, parent of Y^{94} (H56,H47)
	Sr^{97}	*B*		β^-	Short(A105)			U-*n*, Rb^{97} β^--decay, ancestor of Zr^{97} (A105)
39	Y^{87m}	*B*		I.T., e^-, γ (D25)	14 hr.(S24,D13)		0.5(D25) abs.	Sr-*d*-*n*(S24,D13, D25) Sr-*p*-*n*(D13,D25)
	Y^{87}	*A*		K(D13)	80 hr.(D25)		No γ(?)(D25)	Rb-α-*n*(R18) Sr-*p*-*n*(D13,D25) Sr-*d*-*n*(D13,S24, D25)
	Y^{88}	*A*		β^+	2.0 hr.(S24)	1.65(O113) abs. Al; 1.2(S11) cl.ch. (K.U.)		Sr-*d*-*n*(S11,S24) Sr-*p*-*n*(D13,D25) Y-*n*-2*n*(S11)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
39	Y^{88}	*A* (H211) m.s.		K,γ(D25, H33);β^+ (0.19%) (P111)	105 days(D25,O109)	0.83(β^+)(P111) spect.	0.908, 1.853, 2.76 (P111) spect.; 0.908, 1.89(D28) spect. coincid.; 0.95, 1.92(R12) cl.ch.; 1.87(S32) Be-γ-*n*; 2.8(1%) (G47)D-γ-*n*	Sr-*p*-*n*(D13,D25) Sr-*d*-2*n*(P11,H33, G47,O102) Y-*n*-2*n*(H33,O110)
	Y^{89}		100(D40)					
	Y^{90}	*A* (H211) m.s.		β^-(N112)	62 hr.(G122); 65 hr. (N118); 60 hr. (S11)	2.35(M59) spect.; 2.16(N102) spect.; 2.6(S11) cl.ch. (K.U.); 2.5(G150) abs. Al	No γ(G150,G122)	Y-*d*-*p*(S11) Y-*n*-γ(S11,S12) Zr-*n*-*p*(S46) Zr-*d*-α(S46) Cb-*n*-α(S42,S13) U-*n*, Sr^{90} β^--decay (H47,G122,G51) Bi-*d*(G62) Bi-α(P56) Pt-α(T109) Tl-α(T109)
	Y^{91m}	*A*		I.T., γ, e^- (~9%) (K112)	51.0 min.(F111); 50 min.(G13)		0.61(F111) abs. Pb, abs. Al of e^-	Zr-*n*-*p*(S48) U-*n*, Sr^{91} β^--decay (H47,G13)
	Y^{91}	*A* (L112, H96) m.s.		β^-	57 days(H42,G13); 61 days(G51)	1.53(L118) spect.; 1.6(B30) abs.	No γ(B102)	Zr-*n*-*p*(S48) U-*n*, Sr^{91} β^--decay (H47,G13); Y^{91m} I.T.(G13,F111) U^{233}-*n*(G65) U-*d*(O101) Th-*n*(B101) Pu-*n*(F102) Bi-*d*(G62)
	Y^{92}	*A*(K72)		β^-,γ(H56)	3.5 hr.(H56)	3.5 (K105,H112) abs. Al; 3.6(B30) abs. Al	~1(K105) abs. Pb	Zr-*n*-*p*(S46,S48) U-*n*, Sr^{92} β^--decay (G13,H47,H56, K105) Th-*n*(B101) Pu-*n*(K72)
	Y^{93}	*A*(K72, S171)		β^-,γ(B121)	10.0 hr.(B121); 11.5 hr.(H47)	3.1(B121) abs. Al	0.7(B121) abs. Pb	U-*n*, Sr^{93} β^--decay (H47,H56,B104) Th-*n*(B101) Pu-*n*(K72)
	Y^{94}	*B*(K72)		β^-,γ(H56)	20 min.(H47)			Zr-*n*-*p*(S48) U-*n*, Sr^{94} β^--decay (H47,H56,D110) Pu-*n*(K72)
	Y^{97}	*B*		β^-	Short(A105)			U-*n*, Sr^{97} β^--decay, parent of Zr^{97} (A105)
40	Zr^{89}	*A*		e^-,γ,I.T. or K(D13, D25)	4.5 min.(D25)			Y-*p*-*n*(D13,D25) Zr-*n*-2*n*(?)(A19)
	Zr^{89}	*A*		β^+(S12,D13)	80.1 hr.(O104); 78 hr.(D25)	1.07(O104) abs. Al; 1.0(β^+)(S12) cl.ch. (K.U.), (D25) abs.	No γ(D25)	Y-*d*-2*n*(O104) Y-*p*-*n*(D13,D25) Zr-*n*-2*n*(S12,S46) Mo-*n*-α(S46)
	Zr^{90}		51.46(W78)					
	Zr^{91}		11.23(W78)					
	Zr^{92}		17.11(W78)					
	Zr^{94}		17.40(W78)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
40	Zr^{95}	*A*		β^-,γ,e^-	65 days(B105,G51); 65.5 days(P17); 63 days(S46)	0.394(98%), 1.0(2%) (N109) spect.; 0.42(95%), 1.0 (5%)(E101) abs. Al	0.73(93%), 0.23 (93%), 0.92(7%) (N109) spect. conv.; 0.80(E101) abs. Pb	Zr-*n*-γ(S46) Zr-*d*-*p*(S46,J105) Mo-*n*-α(S46) U-*n*, parent of Cb^{95} (35 days) and Cb^{95} (90 hr.)(?)(H55, G18, B104,S112, G104,G51) U^{233}-*n*(G65,S184) Pu-*n*(F102,K72) U-α(O115) Bi-*d*(G62) Th-α(N116)
	Zr^{96}		2.80(W78)					
	Zr^{97}	*B*		β^-,γ	17.0 hr.(G18,K113)	2.2(K113) abs. Al; 1(G18) abs.	~0.8(K113) abs. Pb	Zr-*n*-γ(S46) Mo-*n*-α(S46) U-*n*, Sr^{97} β^--decay (A105), parent of Cb^{97} (G18,H39, C105) U-α(O115) Th-α(N116) Pu-*n*(K72)
	Zr	*E*			5 sec.(A19)			Zr-*n*-γ(?)(A19)
	Zr	*E*		β^-	18 min.(S46)			Zr-*n*-γ(?)(S46,A19)
	Zr	*F*		β^-	90 min.(S12)	~1.5(S46) abs.		Zr-*d*-?(S12,S46)
	Zr	*E*		β^-	70 hr.(S46)	1.17(S46) cl.ch. (K.U.)		Zr-*n*-?(S46)
41	Cb	*E*			4 min.(D9)			Zr-*p*-*n*(?)(D9)
	Cb	*E*			12 min.(D9)			Zr-*p*-*n*(?)(D9)
	Cb	*E*			38 min.(D9)			Zr-*p*-*n*(?)(D9)
	Cb^{90}	*B*		β^+,γ	15.6 hr.(B95); 18 hr. (J121); 21 hr.(D9)	~1(J121) abs. Al	1(B95) abs. Pb	Zr-*p*-*n*(?)(D9) Zr-*d*-2*n*(J121) Mo^{92}-*d*-α(B95) Mo-*d*-α(J121)
	Cb^{91m}	*A*		I.T., e^-, γ(B95)	62 days(B95); 60 days(J121); ~55 days(S46)		~0.15(S46,M33) abs. of e^-; 0.94 (M33)	Zr-*d*-*n*(J121) Mo^{94}-*d*-α*n*(B95)
	Cb^{92}	*A*		β^-,γ	10.1 days(K58); 11 days(S42,S13)	1.38(S42) cl.ch. (K.U.); 1.38(K58); 0.59(M33)	1.0(M33,K58)	Zr-*p*-*n*(M33) Cb-*n*-2*n*(S42,S13) Cb-*d*-*t*(K58,W62) Mo-*n*-*p*(S46) Mo^{94}-*d*-α(B95)
	Cb^{92}	*A*		β^-,γ(W62)	21.6 hr.(W62)	1.2(W62) abs. Al	0.6(W62) abs. Pb	Cb-*d*-*t*(W62) Mo^{94}-*d*-α(B95)
	Cb^{93}		100(S63)					
	Cb^{93m}	*F*		I.T.(W56)	42 days(W56)			Cb-x-rays(W56)
	Cb^{94m}	*A*		I.T., e^- (~99.9%), β^-(~0.1%) (G50,G138)	6.6 min.(S42)	1.3(G138) coincid. abs. Al	0.058(G138) abs. of e^-; 1.0(C133) abs. Pb	Cb-*n*-γ(S42,S13,P2) Cb-*d*-*p*(K57,W62)
	Cb^{94}	*A*			$>10^4$ yr.(G138)			Cb-*n*-γ, Cb^{94m} I.T.(G138, G50)
	Cb^{95m}	*A*		I.T., e^- (100%) (L113, H151)	90 hr.(L113,H151); 80 hr.(E101)		0.216(H151) spect.; 0.24(L113,L114) spect. conv.	U-*n*, Zr^{95} β^-decay (~2%)(E101, C103,S112,H151) parent of Cb^{95} (S162,L114) Mo^{97}-*d*-α(B95)
	Cb^{95}	*A*		β^-(L103, F104, E106)γ,e^-	35 days(E101); 37 days(J121)	0.146(H151) spect.; 0.15(G104,E101) abs. Al; 0.154 (N109) spect.	0.75(W112,R49) spect.; 0.79(J101) spect.; 0.775 (N109) spect. conv.; 0.92(M45) coincid. abs., coincid.	Zr^{95} β^--decay(J121) Mo-*d*-α(J121) Mo^{97}-*d*-α(B95) U-*n*, Zr^{95} β^--decay (~98%)(G104, G51)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
41	Cb^{96}	*A*		β^-, γ	2.8 days(B95); 3 days(J121); 4 days(D9)	1.8(B95) abs. Al	1(B95) abs. Pb, coincid. abs.	Zr-*p*-*n*(D9) Zr-*d*-2*n*(J121) Mo-*d*-*α*(J121) Mo^{98}-*d*-*α*(B95)
	Cb^{97}	*A*		β^-, γ	68 min.(B95); 75 min.(G18)	1.4(K113) abs. Al	0.78(K113) abs. Pb	Mo-*n*-*p*(S46) Mo-*γ*-*p*(H74,P60) Mo^{100}-*d*-*αn*(B95) U-*n*, Zr^{97} β^--decay (G18,S46,H39)
	Cb^{98}	*A*		β^-	30 min.(B95)			Mo^{100}-*d*-*α*(B95)
42	Mo^{92}		15.86(W63)					
	Mo^{93}	*B*		β^+, γ	6.70 hr.(K57); 7 hr. (D9)	0.3, 0.7(K57)	1.6(K57)	Zr-*α*-*n*(K57) Cb-*p*-*n*(D9,K57) Cb-*d*-2*n*(K57,W62) Mo-*d*-*p*(W62)
	Mo^{93}	*F*		β^+	17 min.(B20,S12)	2.65(S46) cl.ch. (K.U.)		Cb-*d*-2*n*(W62) Mo-*n*-2*n*(H10,S12, S46) Mo-*γ*-*n*(B20) Mo-*d*-*p*(W62)
	Mo^{94}		9.12(W63)					
	Mo^{95}		15.7(W63)					
	Mo^{96}		16.5(W63)					
	Mo^{97}		9.45(W63)					
	Mo^{98}		23.75(W63)					
	Mo^{99}	*A*		β^-, γ	67 hr.(S14,K118); 66.0 hr.(S181)	1.3(K105) abs. Al; 1.5(S14) abs.; 0.24, 1.03(M90) coincid. abs.	0.4(S14) abs. Cu, Pb; 0.24(20%), 0.75(80%)(M120) spect.; 0.77, 0.815, 0.84(S91) spect.; 0.71(M90) coincid. abs.	Zr-*α*-*n*(D12,E32) Mo-*d*-*p*(S14) Mo-*n*-*γ*(S14,S12) Mo^{98}-*n*-*γ*(M139) Mo-*n*-2*n*(S46) U-*n*, parent of Tc^{99m} (H23,H41,K105) U^{238}-*n*(S184) Th-*n*(H24,B101) Th-*α*(N116) Pu-*n*(F102,K72) Bi-*α*(P56) Bi-*d*(G62) Tl-*α*(T109) Pt-*α*(T109)
	Mo^{100}		9.62(W63)					
	Mo^{101}	*A*		β^-, γ	14.6 min.(M25)	1.0, 2.2(M38); 1.8 (S40) cl.ch.(K.U.)	0.3, 0.9(M38)	Mo-*n*-*γ*(S40,S22, S46,M25) Mo^{100}-*n*-*γ*(M139) U-*n*, parent of Tc^{101} (H41,B28)
	Mo^{102}	*D*		β^-	12 min.(H41)			U-*n*, parent of Tc^{102} (H41)
	Mo^{105}	*B*		β^-	Short(B31)			U-*n*, ancestor of Ru^{105} (B31)
43	Tc^{92}	*B*		β^+, γ	4.5 min.(M95)	4.3(M95) abs.	1.3(M95) abs.	Mo^{92}-*d*-2*n*(M95)
	$Tc^{92,93}$	*C*		β^+, γ(M95)	2.7 hr.(D4)	1.2(M95) abs.	2.4(M95) abs. Pb	Mo^{92}-*d*-2*n*(M95) Mo-*p*-*n*(D4) Mo-*d*-*n*(S14)
	Tc^{94m}	*B*		I.T., e^-(H67)	53 min.(G54)		0.0334(H67) spect. conv.	Mo-*p*-*n*(G55,D4,E3) Mo^{94}-*d*-2*n*(M96)
	Tc^{94}	*B*		β^+; K(65%), *γ*(G54)	<53 min.(H67)	2.47(β^+)(G54) spect.; 2.5(β^+)(M96) abs. Al	0.380, 0.873, 1.48, 1.85, 2.74(H67) spect.	Mo-*p*-*n*(G55) Mo^{94}-*d*-2*n*(M96)
	Tc^{95}	*A*		K,*γ*(E34), e^-; β^+ (~1%) (H201)	56 days(B142); 52 days(E34); 62 days(C12)	0.4(β^+)(H201) cl.ch.	0.25, 0.84(E34) abs. Pb; 0.201, 0.57, 0.81, 1.01(H201) spect., spect. conv., coincid.	Mo-*d*-*n*(C12,C24, E32) Mo-*p*-*n*(E34) Mo^{95}-*d*-2*n*(M57)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
43	Tc^{95}	*A*		K,γ,e^-(E39)	20.0 hr.(E39)		0.762, 0.932, 1.071 (M48) spect. conv.; 0.78(E39) abs. Pb; 0.8(M96) abs. Pb	Mo-*p*-*n*(E39) Mo-*d*-*n*(S14) Mo^{96}-*d*-2*n*(M96) Ru^{95} β^+-decay(E39)
	Tc^{96}	*A*		K(E32),e^-(?), γ(E5)	4.30 days(E34); 4.33 days(G55)	0.64(e^-)(E34) abs. Al; no β^-, no e^-, (M57); ~0.8(β^-?) (M48) spect.	0.312, 0.771, 0.806, 0.842, 1.119(M48) spect. conv., spect., coincid.; 0.92(E32) spect.; 0.8(M57) abs. Pb	Cb-α-*n*(E32) Mo-*p*-*n*(E3,E32) Mo-*d*-*n*(E32,S14) Ru-*n*-*p*(B132) Mo^{96}-*d*-2*n*(M57)
	Tc^{97m}	*A*		I.T.(H9), e^-(E34)	90 days(C12,M57); 93 days(M69); 95 days(E34)		0.097(H9) spect. conv.; 0.108(E34) abs. of e^-	Mo^{97}-*d*-2*n*(M57) Mo-*d*-*n*(C12,C24) Mo-*p*-*n*(E34,G55) Ru^{97} *K*-decay(M130, M69)
	Tc^{97}	*A*			>100 yr.(B142)			Mo^{97}-*d*-2*n*, Tc^{97m} I.T.(B142)
	Tc^{98}	*B*		β^-;K(?),γ (G127)	2.7 days(G127); 2.8 days(M96)	1.3(M96) abs. Al; 0.75(G127) abs. Al	0.9(M96) abs. Pb; 1.0(G127) abs. Pb	Mo^{98}-*d*-2*n*(M96) Ru-*n*-*p*(G127)
	Tc^{99m}	*A*		I.T.,e^-,γ (S14)	6.0 hr.(B127); 5.9 hr.(G151); 6.6 hr. (S14)		0.136(S14) spect. conv.; ~0.18 (S14) abs. Cu, Pb	Mo^{99} β^--decay(S14) Ru-*n*-*p*(B132) U-*n*, Mo^{99} β^--decay (H41,G110) Th-*n*(B101)
	Tc^{99}	*A* (I9) m.s.		β^-	9.4×10^5 yr.(M86); 4.7×10^5 yr.(P107); $\sim3\times10^5$ yr.(S154) yield	0.32(M86) abs. Al; ~0.4(L115) abs. Al; ~0.3(S154) abs. Al	No γ(S154,M86)	Tc^{99m} I.T.(S14) U-*n*(S154,L115)
	Tc^{100}	*B*		β^-,γ	80 sec.(M95)	2.3(M95) abs. Al	0.6(M95) abs. Pb	Tc^{99}-*n*-γ(B142) Mo^{100}-*d*-2*n*(M95)
	$Tc^{<101}$	*F*		β^-	36.5 hr.(D4)			Mo-*p*-*n*(D4)
	$Tc^{<101}$	*E*		β^-	18 sec.(D9)			Mo-*p*-*n*(D3,D9)
	Tc^{101}	*A*		β^-,γ	14.0 min.(M25)	1.3(M38); 1.1(S40) cl.ch.(K.U.)	0.30(M38)	Mo^{101} β^--decay (S40, S46) U-*n*, Mo^{101} β^--decay (S22,H41,M25) Ru-γ-*p*(P60)
	Tc^{102}	*D*		β^-	<1 min.(H41)			U-*n*, Mo^{102} β^--decay (H41)
	$Tc^{<104}$	*F*		K(?), γ(G127)	60 days(G127)			Ru-*n*-*p*(G127)
	Tc^{105}	*B*		β^-	Short(B31)			U-*n*, Mo^{105} β^--decay, parent of Ru^{105} (B31)
44	Ru^{95}	*F*			20 min.(D7)			Ru-*n*-2*n*(?)(D7,P2)
	Ru^{95}	*A*		β^+,K,γ (E39)	1.65 hr.(E39)	1.1(β^+)(E39) abs. Al	0.95(E39) abs. Pb	Mo-α-*n*(E39) Mo^{92}-α-*n*(E39) Ru-*n*-2*n*(E39) Parent of Tc^{95}(E39)
	Ru^{96}		5.68(E20)					
	Ru^{97}	*A*		K,γ,e^-(S113, S90)	2.8 days(S113,S90); 3.0 days(M130)		0.23(S113,S90) abs. Pb	Mo^{94}-α-*n*(E39) Ru-*d*-*p*(S113,S90) Ru-*n*-γ(S113,M130, S90) Parent of Tc^{97m} (M130,M69)
	Ru^{98}		2.22(E20)					
	Ru^{99}		12.81(E20)					
	Ru^{100}		12.70(E20)					
	Ru^{101}		16.98(E20)					
	Ru^{102}		31.34(E20)					

Table of Isotopes— *Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
44	Ru^{103}	*A*		β^-,γ	42 days(S113,S90); 41 days(B87); 45 days(N15); 37 days(G51)	0.25(G51); 0.3(95%), 0.8(5%)(S113) abs. Al; 0.75(B87) abs. Al	0.56(G105,S113) abs. Pb; 0.4(B87) abs. Pb	Ru-*d*-*p*(L13,S113) Ru-*n*-γ(S113) U-*n*(N12,N15,G104, S113), parent of Rh^{103m}(G152) U^{233}-*n*(G65,S184) Th-*n*(B101) Pu-*n*(F102) Bi-*d*(G62) Pb-α(P104)
	Ru^{104}		18.27(E20)					
	Ru^{105}	*B*		β^-,γ	4.5 hr.(S113); 4.4 hr. (B87); 4 hr.(D7, L13,N12)	1.4(S113) abs. Al; 1.5(B31) abs.; 1.3 (B87) abs. Al	0.76(S113) abs. Pb; 0.7(B87) abs. Pb	Ru-*n*-γ(D7,S113) Ru-*d*-*p*(L13,S113) U-*n*, Tc^{105} β^--decay parent of Rh^{105} (B31,N12,D7,L13, S33,S113) Th-*n*(S33,B101) Bi-α(P56) Pb-α(P104) Tl-α(T109) Pt-α(T109)
	Ru^{106}	*A* (H96) m.s.		β^-	1.0 yr.(G152); 290 days (G51)	~0.03(G152) abs. Al; very soft(S133)	No γ(G152)	U-*n*, parent of Rh^{106} (G106,S113,G107, G108,G104) U^{233}-*n*(G65,S184) U-*d*(O107) Th-*n*(B101) Th-α(N116) Pu-*n*(F102) Bi-*d*(G62)
	Ru^{107}	*D*		β^-	4 min.(B31)	~4(B31) abs. Al		U-*n*, parent of Rh^{107} (B31)
45	Rh^{100}	*B*		K,γ(S113), e^-,β^+ (~5%) (L86)	19.4 hr.(L86); 21 hr. (S113)	0.6(e^-), 3.0(β^+)(L86) spect.	1.2(L86) abs. Pb; 1.8(S113) abs.Pb	Ru-*d*-*n*(S113) Pd^{100} *K*-decay (L86)
	Rh^{101}	*B*		K,γ,e^- (S113)	4.3 days(L86); 5.9 days(S113)		0.35(L86) abs. Pb, spect. conv.	Ru-*d*-*n*(S113) Pd^{101} *K*- and β^+-decay (L86)
	Rh^{102}	*A*		β^-,β^+, γ(M23), K(S113)	210 days(M23); 215 days(H77)	1.04(β^-), 1.13(β^+) (H76) cl.ch.; 1.3(S113) abs. Al; 1.1(β^-)(M23) abs.	0.46(annih.?)(S113) abs. Pb	Ru-*d*-*n*(S113) Rh-*n*-2*n*(M23,H76)
	Rh^{103}		100(C50)					
	Rh^{103m}	*A*		I.T., e^-(F31, S150,W57)	57 min.(G108,G107); 52 min.(F37); 48 min.(F31); 45 min.(W57,W58)	0.034(e^-)(H77) spect.; ~0.03(e^-)(G152) abs. Al	0.040(W57) abs. argon of e^-; 0.042(F37) abs. of e^-	Rh-*n*-*n*(F31) Rh-e^--e^-(W57) Rh-x-rays(W57) Pd^{103} *K*-decay (B122, M81) U-*n*, Ru^{103} β^--decay (S150,G107)
	Rh^{104m}	*A*		I.T.,γ,e^- (P5,A38)	4.2 min.(P5); 4.4 min.(F31); 4.7 min.(C134)		0.069(O9,H77) spect. conv.; 0.087 (F37); 0.09(A38) abs. Al	Ru-*p*-*n*(D9) Rh-*n*-γ(P5,A1,P2), (~10%)(G137) Pd-γ-*p*(H74)
	Rh^{104}	*A*		β^-,γ(S50), e^-(C134)	44 sec.(P5,A1)	2.3(C13) cl.ch.; 2.6 (H77) spect.; 2.3 (S50) abs. Al	0.041, 0.18, 0.95 (C134) abs., abs. of e^-	Ru-*p*-*n*(L13) Rh-*n*-γ(P5,A1), (~90%)(G137) Rh^{104m} I.T.(P5)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
45	Rh^{105}	*A*		β^-,γ,e^-	36.5 hr.(S113); 37 hr.(B87); 34 hr. (N12,N13)	0.65(S113) abs. Al; 0.78(B87) abs. Al; 0.5(N13) abs.	0.33(weak)(S113) abs. Pb	Ru-*d*-*n*(S113) Ru^{105} β^--decay (S113) Rh-*t*-*p*(K64) Pd-γ-*p*(P60) U-*n*, Ru^{105} β^--decay (N12,D7,L13, S113) Th-*n*(B101) Pu-*n*(K72)
	Rh^{106}	*A*		β^-,γ	30 sec.(G108,G107)	3.55(82%), 2.30 (18%)(P57) spect., coincid. abs.; 3.9 (80%), 2.8(20%) (G152) abs. Al, coincid. abs.; 4.5 (S133) abs. Al	1.25(1%), 0.73 (17%), 0.51(17%) (P57) spect.; 0.3 (20%), 0.8(20%) (G152) abs. Pb	U-*n*, Ru^{106} β^--decay (G107,G108,G51) Pu-*n*(F102)
	Rh	*E*		β^-,γ	9 hr.(B128)	~1.3(B128) abs. Al	0.8(B128) abs. Pb	U-*n*(B128)
	Rh^{107}	*D*		β^-	24 min.(B31)	1.2(B31) abs. Al		U-*n*, Ru^{107} β^--decay (B31)
46	Pd^{100}	*B*		K,γ(L86)	4.0 days(L86)		0.090, 1.8(L86) abs. Al, Ag, Pb	Rh-*d*-5*n*(L86) Sb-*d*-6*z*23*a*(L86) Parent of Rh^{100}(L86)
	Pd^{101}	*B*		K(~90%); β^+(~10%) (L86)	9 hr.(L86)	2.3(β^+)(L86) spect.	No γ(L86)	Rh-*d*-4*n*(L86) Sb-*d*-6*z*22*a*(L86) Parent of Rh^{101}(L86)
	Pd^{102}		0.8(S63)					
	Pd^{103}	*A*		K(B129)	17 days(B129,M81)			Rh-*d*-2*n*(M81) Rh-*p*-*n*(M81) Pd-*n*-γ, parent of Rh^{103m} (B129)
	Pd^{104}		9.3(S63)					
	Pd^{105}		22.6(S63)					
	Pd^{106}		27.2(S63)					
	Pd^{108}		26.8(S63)					
	Pd^{109}	*A* (R46) m.s.		β^-	13 hr.(K6)	1.03(K6) cl.ch.; 1.0 (S155,H95) abs. Al; 1.1(S156) abs. Al	No γ(S156)	Pd-γ-*n*(P55) Pd-*d*-*p*(K6) Pd-*n*-γ(A1,K6) Ag-*n*-*p*(F5) Ag-*d*-2*p*(H95) Ag-*t*-He^3(K60) U-*n*, parent of Ag^{109m} (S155) U^{233}-*n*(S184) Pu-*n*(K72)
	Pd^{110}		13.5(S63)					
	Pd^{111}	*A*		β^-	26 min.(S33)	3.5(B31) abs.		Pd-*d*-*p*(K6,A1) Pd-*n*-γ(K6,A1) U-*n*, parent of Ag^{111} (S33,N14) Th-*n*(S33)
	Pd^{112}	*A*		β^-(S33,N14)	21 hr.(S155)	0.2(S156) abs. Al	No γ(S156)	U-*n*, parent of Ag^{112} (S33,N14,S155) Th-*n*(S33) Th-α(N116) Bi-*d*(G62) Pu-*n*(K72)
47	$Ag^{102,104}$	*C*		β^+; K(L87)	73 min.(E6)			Pd-*p*-*n*(E6) Sb-*d*-21*a*5*z*(L87)
	Ag^{104}	*E*			16.3 min.(E6)			Pd-*p*-*n*(E6)
	Ag^{105}	*E*		K,γ	45 days(E6)		0.282, 0.345, 0.430, 0.650, >1.0(D19) spect.; 0.29, 0.42, 0.50, 0.62(E6) spect.	Pd-*p*-*n*(E6)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
47	Ag^{106}	*A*		β^+	24.5 min.(P6,D2)	2.04(F5) abs.	No γ(F5)	Rh-α-*n*(P6,K3) Pd-*d*-*n*(P6) Pd-*p*-γ(D2) Pd-*p*-*n*(D2,E6) Ag-*n*-2*n*(P6) Ag-*d*-*t*(K58) Ag-γ-*n*(B20) Ag-e^--e^--*n*(S59) Ag-*d*-*p*2*n*(K15,K31) Cd-*n*-*p*(P6)
	Ag^{106}	*A*		K,e^-,γ(H50, P6,F5,A4)	8.2 days(P6,K6)	1.2(e^-)(F5) abs.	1.06, 0.69(E6) spect.; 1.63, 1.06, 0.72(?) (D19) spect.	Rh-α-*n*(P6) Pd-*d*-*n*(P6,K6) Pd-*p*-*n*(D2,E6) Ag-*n*-2*n*(P6,K6) Ag-*d*-*p*2*n*(?)(K23) Cd-*n*-*p*(P6) Sn-*d*-?(L123)
	Ag^{107}		51.35(W78)					
	Ag^{107m}	*A*		I.T., e^-, γ	44.3 sec.(B38,B77); 40 sec.(A12,H34)		0.093(V7,A12,H9) spect. conv.; 0.094 (B37,B77) spect. conv.	Ag-*n*-*n*(F31) Ag-x-rays(F9,W32, T35) Ag-e^--e^-(W32) Cd^{107} *K*-decay (A12, H34,B37,H95)
	Ag^{108}	*A*		β^-	2.3 min.(A1,B20); 2.4 min.(F31)	2.8(N4) cl.ch.		Pd-*p*-*n*(D2,E6) Ag-*n*-γ(A1,F31) Ag-γ-*n*(B20,P55) Ag-e^--e^--*n*(S59) Ag^{107}-*n*-γ(F33) Ag-*d*-*p*(K12,K15) Cd-*n*-*p*(P6)
	Ag^{109m}	*A*		I.T., e^-,γ	40.4 sec.(W32); 40 sec.(H34); 39.2 sec.(B43)		0.087(H34) spect. conv.; 0.088(B37) spect. conv.	Pd^{109} β^--decay(S33) Ag-*n*-*n*(F31) Ag-x-rays(F9,W32, T35) Ag-e^--e^-(W32) Cd^{109} *K*-decay(H34, B37,H95)
	Ag^{109}		48.65(W78)					
	Ag^{110}	*A*		β^-,γ(P6)	24.2 sec.(H97); 22 sec.(A1,P6); 28 sec.(F31)	2.6(H97) abs.; 2.8 (G4) cl.ch.(K.U.)		Ag-*n*-γ(A1,F31) Ag^{109}-*n*-γ(F33) Cd-*n*-*p*(P6) Cd-γ-*p*(H97,H74)
	Ag^{110}	*A* (G49) res. n.act.		K,γ,e^-(K15, H59); β^-(K15, D63)	225 days(L14,R10)	1.3(K15) abs. Al; 0.38(S115) abs. Al; 0.59(W112) spect.	1.40(9%), 0.90(47%), 0.66(44%)(R49) spect. conv., spect.; 0.650, 0.925, 1.51(D19) spect.; 0.6(K15) abs. Al	Ag-*n*-γ(R10,L14, A8,M12) Ag^{109}-*n*-γ(G134) Ag-*d*-*p*(K12,K15, H59)
	Ag^{111}	*A*		β^-	7.5 days(K6,P6, S116)	~0.24(?), 1.0(S116) abs., ~0.8(B30) abs.	No γ(K6,P6,S116)	Pd-*d*-*n*(K6,P6) Pd-α-*p*(P6) Cd-*n*-*p*(P6) Cd-γ-*p*(H74) U-*n*, Pd^{111} β^--decay (K6,S33,N14, S116,G51) U^{233}-*n*(G65) U-α(O115) Th-α(N116) Pu-*n*(F102) Bi-*d*(G62)
	Ag^{112}	*A*		β^-,γ(S114)	3.2 hr.(P6)	3.6(S155) abs. Al; 2.2(P6) cl.ch.	0.86(S156) abs. Al	Cd-*n*-*p*(P6) Cd-γ-*p*(H74) In-*n*-α(P6) U-*n*, Pd^{112} β^--decay (N9,S33,N14, S155) U^{233}-*n*(S184) U-α(O115)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
47	Ag^{113}	*A*		β^-	5.3 hr.(T113,D68)	2.2(T113) abs. Al; 2.0(D68) abs. Al	No γ(T113,D68)	U-*n*(T113) Cd^{114}-γ-*p*(D68)
	Ag	*E*		β^-,γ	22 min.(T113)	~3(T113) abs. Al		U-*n*(T113)
48	$Cd^{105,107}$	*D*		β^+	33 min.(P2)			Cd-*n*-2*n*(P2)
	Cd^{106}		1.215(L88)					
	Cd^{107}	*A*		K(~100%), γ(4%), β^+ (0.3%) (B38)	6.7 hr.(D4,R5)	0.32(β^+)(B38) spect.	0.84(weak)(B38) spect.; 0.53(V7) abs. Pb; 0.7(H9) abs.	Ag-*p*-*n*(D4,R5,V7, W11) Ag-*d*-2*n*(K12,A12, H34,K15) Ag-α-*p*3*n*(H95) Cd^{106}-*n*-γ(H95,G134) Sb-*d*-16*a*4*z* or Sb-*d*-18*a*4*z*(L123) Sn-*d*-?(L123)
	Cd^{108}		0.875(L88)					
	Cd^{109}	*A*		K	330 days(B43)			Ag-*d*-2*n*(H34,K15) Ag-α-*pn*(H95) Cd^{108}-*n*-γ(H95,G134) Sn-*d*-?(L123) Sb-*d*-14*a*4*z* or Sb-*d*-16*a*4*z*(L123)
	Cd^{110}		12.39(L88)					
	Cd^{111m}	*A*		I.T.,e^-	48.7 min.(W30,W32)		0.148, 0.247(H144) spect. conv.; 0.195(W30,W32) abs. of e^-; 0.145, 0.230(H208) spect. conv., spect.	Pd-α-*n*(H206) Ag-α-*pn*(H206) Cd-*n*-*n* or Cd-*n*-γ(D8) Cd-x-rays(F9,W30, W32,T35) Cd-e^--e^-(W30,W32) Cd^{110}-*n*-γ(G144) U-*n*(N9,N14)
	Cd^{111}		12.75(L88)					
	Cd^{112}		24.07(L88)					
	Cd^{113}		12.26(L88)					
	Cd^{113m}	*A*		I.T.	2.3 min.(H206)			Cd^{113}-*n*-*n*(H206)
	Cd^{114}		28.86(L88)					
	Cd^{115}	*A*		β^-,γ	2.33 days(L57, M123); 2.5 days (G5)	0.6, 1.13(L57) spect.; 0.55, 1.25(M122) abs. Al; 1.11(C14) spect.	0.65(M34) spect.; 0.55(L57) cl.ch. recoil	Cd-*d*-*p*(C14) Cd-*n*-γ(G5,M10) Cd-*n*-2*n*(G5) In-*n*-*p*(S117) Sb-*d*-2α2*n*(L123) U-*n*, parent of In^{115m} (N9,N14,M104) U^{233}-*n*(S184) Th-α(N116)
	Cd^{115m}	*A*		β^-,γ	43 days(S51); 44 days (G153); 40 days (C14)	1.85(M123) abs. Al; 1.7(G153) abs. Al; 1.5(S51) abs. Al	0.5(S51) abs. Pb	Cd-*d*-*p*(C14) Cd-*n*-γ(S51) In-*n*-*p*(S51) Sn-*n*-α(?)(S115) U-*n*(M123) U^{233}-*n*(S184) Pu-*n*(G153,F102) Bi-*d*(G62) Th-α(N116)
	Cd^{116}		7.58(L88)					
	Cd^{117}	*A*		β^-	170 min.(L57); 2.72 hr.(M126)	1.3–1.7(L57) spect.		Cd-*d*-*p*(C14) Cd-*n*-γ(M10,G5) U-*n*, parent of In^{117} (N9,N14,M104)
49	In^{108}	*E*		K(?), γ(G68)	~5 hr (G68)		0.65(G68)	Ag-α-3*n*(G68)
	In^{109}	B(G68) m.s.		K; β^+(T37), γ	6.5 hr.(T37); 5.2 hr. (G68)	2(β^+)(T37)	0.5(G68)	Ag-α-2*n*(T39,G68)
	In^{110}	*A*(G68) m.s.		β^+	65 min.(B17)	1.6(B17) spect.		Ag-α-*n*(K9,T39,G68) Cd-*p*-*n*(B17) Cd-*d*-2*n*(L57)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
49	In	*D*		β^+(L87)	72 min.(L87)	2.2(L85) abs. Be		Sn(4.5 hr.) *K*-decay (L87)
	In^{111}	*A*(G68) m.s.		K,γ,e^-(L57)	2.7 days(B17,C14)		0.17, 0.25(B17,C14) spect. conv.	Ag-α-2*n*(T39,L57, G68) Cd-*p*-*n*(B17) Cd-*d*-*n*(L57) In-*n*-3*n*(C14)
	In^{112m}	*B*		I.T.,γ,e^- (S34,T39)	20 min.(B17); 23 min.(T37)		0.16(B17) spect. conv.; 0.12(S44) abs. of e^-	Ag-α-*n*(T39) Cd-*d*-*n*(L57) Cd-*p*-*n*(B17) In-*n*-2*n*(S34,T39) Parent of In^{112}(T39, S34)
	In^{112}	*B*		β^+,β^-(?)(S34, T39)	9 min.(T39)	1.5(β^+)(S34) abs.; 1.7(β^+)(L57) cl.ch.; 0.47(β^-?) (S34) abs.		Ag-α-*n*(S34,T39) In-*n*-2*n*(S34,T39) In^{112m} I.T. (S34,T39, G64)
	In^{113m}	*A*		I.T.,γ,e^- (B17)	105 min.(B17)		0.39(B17,L57) spect. conv.	Cd-*p*-*n*(B17) Cd-*d*-*n*(L57) In-x-rays(D111) Sn^{113} *K*-decay(B17, S22)
	In^{113}		4.23(W78)					
	In^{114m}	*A*		I.T.,e^-(L57, L48)	48 days(B17)		0.19(B17,L57) spect. conv.; 0.186(L132) spect. conv.	Cd-*p*-*n*(B17) Cd-*d*-*n*(L57) In-*n*-γ(L15,M12) In-*d*-*p*(L57) In-*n*-2*n*(L57) Sn-*d*-α(?)(L123)
	In^{114}	*A*		β^-	72 sec.(L15,B17)	1.98(L32) cl.ch.; 1.98(L132) spect.		Cd-*p*-*n*(B17) In^{114m} I.T.(L48,L57, G64) In-*n*-2*n*(L15,P2) In-γ-*n*(B11,C5) In^{113}-*n*-γ(G144)
	In^{115m}	*A*		I.T.,e^-,γ (L57)	4.50 hr.(D56); 4.53 hr.(L32); 4.1 hr. (G5,B18)		0.34(L57) spect. conv.; 0.3(M122) abs. Al of e^-	Cd-*d*-*n*(L57) In-*n*-*n*(G5) In-*p*-*p*(B18) In-α-α(L16) In-x-rays(P7,C10) In-e^--e^-(W31) U-*n*, Cd^{115} (2.5 days) β^--decay (G5,N14, M104)
	In^{115}		95.77(W78)					
	In^{116}	*A*		β^-	13 sec.(A1,C14)	2.8(C14) cl.ch.	No γ(M11)	Cd-*p*-*n*(D9) In-*n*-γ(A1,L15), (25%)(G137) In-*d*-*p*(L15)
	In^{116}	*A*		β^-,γ	54.31 min.(R103); 54 min.(A1,L15)	0.85(C14,C44) spect., cl.ch.	2.32, 1.31, 1.12, 0.428(D19) spect.; 1.8, 1.4, 1.0, 0.6, 0.4, 0.2(C44) cl.ch. recoil; 2.08 (~60%), ~1.8 (~40%)(J120) Be-γ-*n* reaction	Cd-*p*-*n*(B17) In-*n*-γ(A1,M11), (75%)(G137) In-*d*-*p*(L15) Sn-γ-*p*(H74)
	In^{117}	*A*		β^-	117 min.(L32); 1.90 hr.(M126)	1.73(C14) spect.; 1.95(M126) abs. Al	No γ(L57)	Cd-*d*-*n*(C14,L57) Sn-γ-*p*(H74) U-*n*, Cd^{117} β^--decay (G5,N14,M104) Pu-*n*(K72)
50	Sn	*D*		K(L87)	4.5 hr.(L87)			Sb-*d*-?, parent of In (70 min.)(L87)
	Sn^{112}		0.90(W78)					

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
50	Sn^{113}	*A*		K,e^-,γ	105 days(C71,B17); ~70 days(L17)		0.085(B17) spect. conv.; no γ(C71)	Cd-α-*n*(L17) In-*p*-*n*(B17) In-*d*-2*n*(C71) Sn-*d*-*p*(L17) Sn-*n*-γ(S103) Sb-*d*-10*a*2*z* or Sb-d-12*a*2*z*(L123) Parent of In^{113m}(B17, S22)
	Sn^{114}		0.61(W78)					
	Sn^{115}		0.35(W78)					
	Sn^{116}		14.07(W78)					
	Sn^{117}		7.54(W78)					
	Sn^{118}		23.98(W78)					
	$Sn^{<119}$	*E*		β^-	25 min.(L17)			Sn-*n*-γ(G121) Cd-α-*n*(L17)
	$Sn^{<119}$	*E*		β^-	3 hr.(L17)			Cd-α-*n*(L17)
	Sn^{119m}	*D*		I.T.,γ,e^- (L87)	13 days(L17); 14 days(L87)	0.13(e^-)(L87) spect.	0.17(L87) abs. Pb	Cd-α-*n*(L17) Sb-*d*-α(L87)
	Sn^{119}		8.62(W78)					
	Sn^{120}		33.03(W78)					
	Sn^{121}	*A*		β^-	28 hr.(L85); 26 hr. (L17)	0.4(L85) abs. Al	No γ(L85)	Sn-*d*-*p*(L17) Sn-*n*-γ(L17) Sn^{120}-*d*-*p*(L85) Th-α(N116)
	$Sn^{121,123}$	*C*		β^-	130 days(L119); 136 days(G51)	1.5–1.6(L119) abs. Al; 1.2(G51)	No γ(L119)	U-*n*(L119,G51) U^{233}-*n*(G65) Th-α(N116)
	Sn^{122}		4.78(W78)					
	$Sn^{>120}$	*D*		β^-	~80 hr.(H55); 60 hr. (N15)	0.76(S120) abs. Al		U-*n*(H55,N15,S120) U-α(O115)
	Sn^{123}	*D*		β^-,γ(?)(S120)	10 days(L17,S164); 11 days(H55, S120); 9 days(C71)	2.6(S164) abs. Al; 2.5(C71) abs. Al		Sn-*d*-*p*(L17) Sn-*n*-γ(L17) U-*n*(H55,S120) U^{233}-*n*(S184)
	Sn^{124}		6.11(W78)					
	Sn^{125}	*B*		β^-,γ	10 min.(S173); 9 min.(L17)	~2.2(S173) abs. Al	~0.74(S173) abs. Pb	Sn-*d*-*p*(L17) Sn-*n*-γ(L17,S173)
	Sn^{123}	*D*		β^-	40 min.(L17)	~3(N113) abs. Al		Sn-*d*-*p*(L17) Sn^{124}-*d*-*t*(N113) Sn-*n*-2*n*(P2)
	Sn^{121}	*B*		β^-	36 min.(N113)	1.5(N113) abs. Al		Sn^{120}-*d*-*p*(N113)
	$Sn^{<126}$	*D*		β^-	~400 days(L17)			Sn-*d*-*p*(L17) Sn-*n*-γ(?)(S115)
	$Sn^{>120}$	*E*		β^-	17.5 days(G51)	1.7(G51)		U-*n*(G51) U^{233}-*n*(G65)
	$Sn^{>120}$	*E*		β^-	7.0 days(G51)	1.8(G51)		U-*n*(G51)
	Sn^{126}	*D*		β^-,γ	70 min.(N15,H55, S120); 80 min. (S164)	0.7 or 2.8(S164) abs. Al	1.2(S164) abs. Pb	U-*n*, parent of Sb^{126} (N15,H55,S120)
	$Sn^{>125}$	*D*		β^-	~20 min.(H55)			U-*n*(H55)
51	Sb^{117}	*D*		K,e^-(C71)	2.8 hr.(C71); 3 hr. (L18)	0.46(e^-)(C71) abs. Al		Sn-*d*-*n*(C71,L18) Sn-*p*-*n*(C71)
	Sb^{118}	*D*		K,γ,e^-(C71)	5.1 hr.(C71)	0.20(e^-)(C71) abs. Al	1.5(C71) abs. Pb	In-α-*n*(C71) Sn-*d*-*n*(C71)
	Sb^{118}	*B*		β^+	3.3 min.(L123); 3.6 min.(R16)	3.1(L85) abs. Be		In-α-*n*(L16,R16) Sn-*p*-*n*(D9) Te^{118} *K*-decay(L85)
	Sb^{119}	*B*		K	39 hr.(C71,L85)		No γ, no e^-(C71)	Sn-*d*-*n*(C71) Sn-*p*-*n*(C71) Sb-*d*-*p*3*n*(L85) Te^{119} *K*-decay(L85)

Table of Isotopes— *Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
51	Sb^{120}	*A*		β^+	17 min.(H10,L18)	1.53(A10) cl.ch.		Sn-*d*-*n*(L18) Sn-*p*-*n*(D9) Sn^{120}-*d*-2*n*(L85) Sb-*n*-2*n*(P2,H10) Sb-γ-*n*(B20,P55, M98) Sb-*d*-*t*(K14) Sb-*p*-*pn*(R45)
	Sb^{120}	*B*		K,γ,e^-(L85)	6.0 days(L85)		1.1(L85) abs. Pb	Sn^{120}-*d*-2*n*(L85) Sb-*d*-*p*2*n*(L85)
	Sb^{121}		57.25(W78)					
	Sb^{122m}	*A*		I.T.,e^-(D59)	3.5 min.(D59)		0.14(D59) abs. of e^-	Sb-*n*-γ(D59) Sb^{121}-*n*-γ(D69)
	Sb^{122}	*A*		β^-,γ,e^- (M120)	2.8 days(L28)	1.36, 1.94(M120, M67) spect.; 0.81, 1.64(A10,M35) cl.ch., abs.; 1.19, 1.77(M84) coincid. abs., abs. Al	0.57(R49,M67) spect. conv.; 0.96 (M35) coincid. abs.; 0.80(M34) spect.	Sn-*d*-2*n*(L18) Sn-*p*-*n*(D9) Sb-*d*-*p*(L18) Sb-*n*-γ(A1,L18) Bi-*d*(G62)
	Sb^{123}		42.75(W78)					
	Sb^{124}	*A*		β^-,γ	60 days(L18)	2.37, 1.62, 1.00, 0.65, 0.48(K67) spect.; (C76) spect.; (M91) coincid. abs.; 0.74, 2.45 (H35,H49) spect.; 2.25, 0.53(M120, M67) spect.; 1.53 (M35) abs.; 0.654 (J9) spect.; 0.67, 2.45(W68) coincid. abs.	2.04(weak), 1.708, 0.732, 0.654, 0.608, 0.121(C76) spect., spect. conv.; (K67) spect.; 1.72 (W112,R49) spect.; 1.82(M35) coincid. abs.; 1.67 (W64), 1.71(H138) Be-γ-*n* reaction; 1.70(K56) cl.ch. pair	Sb-*d*-*p*(L18) Sb-*n*-γ(L18) I-*n*-α(L18) Sn-*d*-2*n*(L18)
	Sb^{124m}	*A*		I.T., β^-, γ(D59)	21 min.(D59)		0.02(I.T.)(D59) abs. of e^-	Sb-*n*-γ(D59) Sb^{123}-*n*-γ(D59)
	Sb^{124m}	*A*		β^-,γ; I.T. (D69)	1.3 min.(D59)	3.2(D59) abs. Al	0.014(I.T.)(D69) abs. of e^-	Sb-*n*-γ(D59) Sb^{123}-*n*-γ(D59)
	Sb^{125}	*A*		β^-,γ	2.7 yr.(L120); several yr.(G51)	0.3(65%), 0.7(35%) (S165) abs. Al; 0.56(G51)	0.55(L120) abs. Pb; 0.6(S165) abs. Pb	Sn-*n*-γ, β^--decay (S165), parent of Te^{125m} (F47) Sn-*d*-*n*(L18) U-*n*(S121,L120) U^{233}-*n*(G65) Th-α(N116)
	$Sb^{>125}$	*E*		β^-	28 days(G51)	1.86(G51)		U-*n*(G51)
	Sb^{126}	*D*		β^-	60 min.(N15)	2.8 or 0.7(S164) abs. Al		U-*n*, Sn^{126} β^-decay (N15)
	Sb^{127}	*A*		β^-,γ	93 hr.(S121); 90 hr. (G51)	1.2(S121) abs. Al; 0.8(G51)	0.72(S122) abs. Pb	U-*n*, parent of Te^{127} (A6,S121,G51) U^{233}-*n*(S184) Pu-*n*(K72)
	Sb^{129}	*A*		β^-	4.2 hr.(A6)			U-*n*, parent of Te^{129} (A6) Pu-*n*(K72)
	Sb^{132}	*B*		β^-	5 min.(A6)			U-*n*, parent of Te^{132} (A6)
	Sb^{133}	*A*		β^-	<10 min.(A6,W21)			U-*n*, parent of Te^{133} (A6,S21,W21) Th-*n*(S21,W21)
	Sb^{134}	*B*		β^-	<10 min.(A6)			U-*n*, parent of Te^{134} (A6)
52	$Te^{<118}$	*D*		β^+(L87)	2.5 hr.(L85)			Sb-*d*-?(L85)
	Te^{118}	*B*		K(L85)	6.0 days(L85)		No γ(?)(L85)	Sb-*d*-5*n*, parent of Sb^{118}(3.3 min.) (L85)
	Te^{119}	*B*		K,γ,e^-(L85)	4.5 days(L85)	0.2, 0.5(e^-)(L85) spect.	1.4(L85) abs. Pb	Sb-*d*-4*n*, parent of Sb^{119}(L85) Bi-*d*(G62)
	Te^{120}		0.091(W78)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
52	Te^{121m}	*A*		I.T.(E40), e^- (S15,O8), γ(Y6,E40)	143 days(E40); 125 days(S15)		0.0365(?), 0.082, 0.0885, 0.159, 0.213(H221) spect. conv.; 0.0820, 0.0883, 0.136, 0.1573, 0.2108 (K17) spect. conv.; 0.05(B47,B55) spect. conv., abs. Ag; 0.22(E40) abs. Pb	Sn-α-*n*(S15) Sb-*d*-2*n*(S15) Sb-*p*-*n*(S15)
	Te^{121m}	*A*		I.T.,γ(B55)	5×10^{-8} sec.(B55)		0.23(B55) coincid. abs.	Te^{121m} (143 days) I.T., parent of Te^{121} (B55)
	Te^{121}	*A*		K,γ(E40)	17 days(E40)		0.61(E40) abs. Pb; 0.615(K17) spect. conv.	Sb-*d*-2*n*(E40) Sb-*p*-*n*(E40) Te^{121m} (143 days, 5×10^{-8} sec.) I.T. (E40,B55)
	Te^{122}		2.49(W78)					
	Te^{123}		0.89(W78)					
	Te^{124}		4.63(W78)					
	Te^{125}		7.01(W78)					
	Te^{125m}	*A*		I.T.,e^- (F47)	~60 days(F47)	~0.12(e^-)(F47) abs. Al		Sb^{125} β^--decay(F47) I^{125} *K*-decay(?) (F47,R48)
	Te^{126}		18.72(W78)					
	Te^{127m}	*A*		I.T., e^-(S15)	90 days(S15)		0.086(H9) spect. conv.	Te-*n*-γ(S15) Te-*d*-*p*(S15) I-*n*-*p*(S15) U-*n*, parent of Te^{127} (N104,G51) U^{233}-*n*(G65,S184)
	Te^{127}	*A*		β^-	9.3 hr.(S15,C106)	0.76(C106) abs. Al	No γ(C106)	Te-*n*-γ(S15) Te-*d*-*p*(S15,T4) Te-*n*-2*n*(T4) I-*n*-*p*(S15) U-*n*, Te^{127m} I.T.(S15, N104) U-*n*, Sb^{127} β^--decay (A6,C106)
	Te^{128}		31.72(W78)					
	Te^{129m}	*A*		I.T., e^-(S15)	32 days(S15,N103)		0.102(H9) spect. conv.; no hard γ(N103)	Te-*n*-γ(S15) Te-*d*-*p*(S15,T4) Te-*n*-2*n*(T4) U-*n*, parent of Te^{129} (H55,N103,G51) U^{233}-*n*(G65)
	Te^{129}	*A*		β^-,γ	72 min.(S15,A6)	1.8(W112,R49) spect.	0.3, 0.8(G139) abs. Pb	Te-*n*-γ(S15) Te-*d*-*p*(S15,T4) Te-γ-*n*(B20) Te-*n*-2*n*(H10,T4) U-*n*, Te^{129m} I.T.(S15, N104,G51) U-*n*, Sb^{129} β^--decay (A6) Th-*n*(B101)
	Te^{130}		34.46(W78)					
	Te^{131m}	*A*		I.T., e^-(S15)	30 hr.(S15,A6)		0.177(H9) spect. conv.	Te-*n*-γ(S15) Te-*d*-*p*(S15) U-*n*, parent of Te^{131} (A6,H22,S15)
	Te^{131}	*A*		β^-	25 min.(S15)			Te-*d*-*p*(S15) Te-*n*-γ(S15) U-*n*, Te^{131m} I.T., parent of I^{131}(A6, S15)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
52	Te^{132}	*B*		β^-,γ	77 hr.(A6,N110)	0.36(N110) abs. Al; ~0.3(B30) abs.	0.22(N110) abs. Pb	U-*n*, Sb^{132} β^--decay, parent of I^{132}(A6, H22,N110) Th-*n*(H24) Th-α(N116) Pu-*n*(K72)
	Te^{133}	*A*		β^-	60 min.(A6,W21)			U-*n*, parent of I^{133} (A6,H22,S21,W21) Pu-*n*(K72)
	Te^{134}	*B*		β^-	43 min.(A6)			U-*n*, Sb^{134} β^--decay, parent of I^{134}(A6, H22) Th-*n*(P12) Pu-*n*(K72)
	Te^{135}	*A*		β^-	<2 min.(S135)			U-*n*, parent of I^{135} (S21,W21)
	Te	*D*		β^-	~1 min.(H55)			U-*n*(H55)
53	I^{124}	*A*		β^+	4.0 days(L19,D9)			Sb-α-*n*(L19) Te-*p*-*n*(D9) Bi-*d*(G62)
	I^{125}	*B*		K, no β^+, (R48,G56)	56 days(R48)	~0.1(weak)(e^-?) (R48)	No γ, no e^-(G56)	Te-*d*-*n*(R48) Bi-*d*(G62)
	I^{126}	*A*		β^-,γ	13.0 days(L19,T4)	1.1(L19) abs.	0.5(L19) abs. Pb	Sb-α-*n*(L19) Te-*d*-*n*(L19) Te-*p*-*n*(D9) I-*n*-2*n*(T4,L19) I-γ-*n*(P61) Bi-*d*(G62)
	I^{127}		100(N30)					
	I^{128}	*A*		β^-,γ	24.99 min.(H36)	1.59(7%)(by diff.), 2.02(93%)(S89) spect.; 1.05, 2.10 (B14) cl.ch.(K.U.)	0.428(7%)(S89) spect.; 0.4(L19) abs. Pb	I-*n*-γ(A1,T4) Te-*d*-2*n*(L19) Te-*p*-*n*(D9)
	I^{129}	*A*		β^-	long(K61)			U-*n*(K61)
	I^{130}	*A*		β^-,γ	12.6 hr.(L19)	0.61, 1.03(R23) spect. coincid.	0.417, 0.537, 0.667, 0.744(R23) spect. conv., spect., coincid.	Te-*d*-2*n*(L19) Te-*p*-*n*(D9) Cs-*n*-α(W21) Th-*n*(?)(P15) I^{129}-*n*-γ(K61)
	I^{131}	*A*		β^-,γ,e^-	8.0 days(L19)	0.595(D29,D30,D31) spect., coincid.; 0.687(T7) cl.ch.	0.367, 0.080(D30, D31) spect., spect. conv., coincid.; 0.65(15%)(D60) abs.; 0.4(L19) abs. Pb	Te-*d*-*n*(L19,R19) U-*n*, Te^{131} β^--decay (S15,A6,H22, G104,S123,K106, G51) U^{233}-*n*(G65,S184) U-α(F10,O115) Th-α(N116) Pu-*n*(F102)
	I^{132}	*B*		β^-,γ	2.4 hr.(A6)	0.9 2.2(N110) abs. Al; ~1.35(B30) abs.	0.6, 1.4(N110) abs. Pb; 0.85(B30) abs.	U-*n*, Te^{132} β^--decay (A6,H22,P12, M106,G51), parent of Xe^{132} (T104,T102) U^{233}-*n*(G65) U-α(F10,O115) Th-*n*(B101)
	I^{133}	*A*		β^-,γ	22 hr.(A6,W21); 20.5 hr.(B118)	1.4(S123) abs. Al; 1.1(P13) cl.ch.	0.55(S123) abs. Pb; 0.528(P109) spect.	U-*n*, Te^{133} β^--decay, parent of Xe^{133} (H22,A6,S21,W21, K106) U-α(F10,O115) Pu-*n*(F102) Pb-α(T109)
	I^{134}	*B*		β^-,γ	54 min.(A6)		>1(G123) abs. Pb	U-*n*, Te^{134} β^--decay (H22,A6,P12,P15, K107) Th-*n*(D6) U-α(F10) Pu-*n*(F102)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
53	I^{135}	*A*		β^-,γ	6.7 hr.(G123,K119); 6.6 hr.(S21,D27, W21)	1.40(25%), 1.00 (40%), 0.47(35%) (P109) spect.; 1.4 (K119) abs. Al; 1.6(S123) abs.	1.6(K119) abs. Pb; 1.3(S123) abs.; 1.27, 2.00(P109) spect.	U-*n*, Te^{135} β^--decay, parent of Xe^{135} (S21,W21,K106), parent of Xe^{135m} (~10%), Xe^{135} (~90%)(W59) Th-*n*(B101) Pu-*n*(F102) U-α(O115)
	I^{136}	*D*		β^-,γ	1.8 min.(S35); 86 sec. (K126)	6.5(K126) abs. Al	2.9(K126) abs. Pb	U-*n*(S35), parent of Xe^{136}(T104,T102)
	I^{137}	*D*		β^-, *n* (S60)	22.0 sec.(H131); 22.5 sec.(R51); 18 sec.(R107)	0.56(mean)(*n*) (H220) abs. paraffin; 0.7(mean)(*n*) (B134) *p* recoil in cl.ch.		U-*n*, parent of Xe^{137} (S35,S43,S60,R51) Pu-*n*(R51)
	I^{138}	*D*		β^-	5.9 sec.(S205)			U-*n*, ancestor of Cs^{138} (R107)
	I^{139}	*D*		β^-	2.6 sec.(R107)			U-*n*, ancestor of Ba^{139}(R107)
	I	*F*			30 days(S124)			Xe-*n*-*p*(S124)
54	Xe^{124}		0.094(N30)					
	Xe^{126}		0.088(N30)					
	Xe^{127}	*B*		I.T.(?), e^-, γ(C41)	75 sec.(C41)		0.175, 0.125(C41) spect. conv.	I-*p*-*n*(B41,C41)
	Xe^{127}	*B*		e^-, γ(C41)	34 days(C41)		0.9(C41) abs. of e^-	Xe-*n*-γ(C125) I-*p*-*n*(C41) I-*d*-2*n*(O102)
	Xe^{128}		1.90(N30)					
	Xe^{129}		26.23(N30)					
	Xe^{130}		4.07(N30)					
	Xe^{131}		21.17(N30)					U-*n*(T43) m.s.
	Xe^{132}		26.96(N30)					U-*n*(T43) m.s.
	Xe^{m}	*F*		I.T., e^- (C125)	11 days(C125)			Xe-*n*-*n*(C125)
	Xe^{133}	*A*		β^-,γ,e^-	5.3 days(E102, E103); 5.4 days (C22)	0.34(E102) abs.; 0.049(e^-)(E102) abs.; 0.260(W109, W59) abs. Al; 0.42(E109) abs. Al	0.085(E109) abs. Cu,Pb	Te-α-*n*(C22) Xe-*d*-*p*(C22) Xe-*n*-γ(R22,C125) Cs-*n*-*p*(W21,C125, W59) Ba-*n*-α(W21,C125, W59) U-*n*, I^{133} β^--decay (S21,D27,W21, B30,E102,W59)
	Xe^{134}		10.54(N30)					U-*n*(T43) m.s.
	Xe^{135}	*A*		β^-,γ(B30), e^-(10%) (M124)	9.2 hr.(H114); 9.4 hr.(S21,W21)	0.93(P109) spect.; 0.95(B30) abs. Al; 0.9(W109,W59) abs. Al; 1.0(H114) abs. Al	0.247(P109) spect.; 0.25(W109,W59) abs. Pb	Xe-*d*-*p*(C22) Ba-*n*-α(W21,S47, W59) U-*n*, I^{135} β^--decay (S21,D27,W21), Xe^{135m} I.T. (W59)
	Xe^{135m}	*A*		γ(B30); I.T., γ,e^-(W59)	15.6 min.(R22); 10 min.(W59)		0.52(P109) spect.; ~0.5(W109,W59) abs. Pb; 0.6(S47) abs. Al of e^-	Xe-*n*-γ(R22) U-*n*, I^{135} β^--decay (G11,W59),parent of Xe^{135}(W59)
	Xe^{136}		8.95(N30)					U-*n*(T43) m.s.
	Xe^{137}	*D*			68 min.(C22)			Xe-*d*-*p*(C22)
	Xe^{137}	*B*		β^-	3.8 min.(S43,S205); 3.4 min.(R22)	4(B30) abs. Al		Xe-*n*-γ(R22,S205) U-*n*, I^{137} β^--decay (S43), parent of Cs^{137}(G123)
	Xe^{138}	*D*		β^-	17 min.(G21)			U-*n*, parent of Cs^{138} (H28,H22,G9, G21,S47)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
54	Xe^{139}	*A*		β^-	41 sec.(D102,D117); ~0.5 min.(H28)			U-*n*, parent of Cs^{139} (H28,H22,H11, D103) Th-*n*(H29,A5)
	Xe^{140}	*A*		β^-	16 sec.(D117); <0.5 min.(H28); 9.8 sec.(O101)			U-*n*, ancestor of Ba^{140}(H28,S110 O101) Th-*n*(H29) U-*d*(O101)
	Xe^{141}	*A*		β^-	1.7 sec.(O101)			U-*n*, ancestor of Ce^{141} (S110,O101) U-*d*(O101)
	Xe^{143}	*A*		β^-	~1.3 sec.(D102)			U-*n*, ancestor of Pr^{143} (S110)
	Xe^{144}	*A*		β^-	Short(D108)			U-*n*, ancestor of Ce^{144}(D108)
	Xe^{145}	*D*		β^-	0.8 sec.(D120); short (S110)			U-*n*, ancestor of Pr^{145} (S110)
55	Cs^{130}	*B*			30 min.(R18)			I-α-*n*(R18)
	Cs^{131}	*B*		K(K62), γ, e^-(Y7)	10.2 days(K62); 10.0 days(Y7)		No γ(K62); 0.145 (Y7) abs. of e^-	Ba^{131} *K*-decay(K62, Y7)
	Cs^{132}	*B*		K,γ,e^-(C125)	7.1 days(C125)	0.6(e^-)(C125) abs. Al	0.62(C125) abs. Pb	Cs-*n*-2*n*(C125)
	Cs^{133}		100(N30)					
	Cs^{134m}	*A*		β^-(K26); γ(S92); I.T., e^- (P106, G63)	3.15 hr.(S92); 3 hr. (K26)	2.4(S92) abs. Al; 1(K26) abs.	0.7(S92) abs. Pb; 0.15(I.T.)(P106) spect. conv.; 0.16 (I.T.)(M140) abs. of e^-	Cs-*n*-γ(A1,M16, K26) Cs-*d*-*p*(K26)
	Cs^{134}	*A*		β^-,γ(K26), e^-(2.5%) (W69)	2.3 yr.(G136); 1.7 yr.(K26)	0.09(25%), 0.66 (75%)(E36) spect.; 0.65(S93) spect.; 0.75(G136) abs. Al; 0.64(P106) spect.; 0.9(K26) abs.; 0.8(W68) coincid. abs.	0.57(25%), 0.60 (100%), 0.79 (100%)(E36,S57) spect.; 0.58, 0.78, 1.35(weak)(S93) spect., coincid.; 0.61, 0.80(P106) spect.	Cs-*n*-γ(A8,S20,K26) Cs-*d*-*p*(K26) Ba-*d*-α(H103)
	Cs^{136}	*A*		β^-,γ	13.7 days(G140); 13 days(F118); 10.2 days(C125)	~0.28(F118) abs. Al; ~0.35(G140) abs. Al	0.9(G140) abs. Pb; 1.2(F115) abs. Pb	Ba-*n*-*p*(C125) La-*n*-α(C125,G140) U^{233}-*n*(G65) Pu-*n*(F115) Th-α(N116)
	Cs^{137}	*A* (H96) m.s.		β^-	37 yr.(E115) yield; 33 yr.(G123) yield	0.550(single)(T42) spect.; 0.57(E115) abs. Al		Xe-*n*-γ, Xe β^--decay (T106) Parent of Ba^{137m} (E115,T45) U-*n*(G111) U^{233}-*n*(G65) Pu-*n*(F102) Th-α(N116)
	Cs^{138}	*D*		β^-,γ	33 min.(H28)	2.6(G21) abs.	1.2(G123) abs. Pb	Ba-*n*-*p*(S47) U-*n*, Xe^{138} β^--decay (H28) Pa-*n*(G7) Th-*n*(A5,H29)
	Cs^{139}	*A*		β^-	9.7 min. (R109); 7 min.(H28); 10 min.(A5)			U-*n*, Xe^{139} β^--decay, parent of Ba^{139} (H28,H22,H11, H29,D103) Th-*n*(A5)
	Cs^{140}	*D*		β^-	65 sec. (R109); 40 sec.(H28)			U-*n*(H28)
	Cs^{141}	*A*		β^-	Short(S110)			U-*n*, Xe^{141} β^--decay, ancestor of Ce^{141} (S110)
	Cs^{142}	*D*		β^-	Short(H48)			U-*n*, parent of Ba^{142} (H48)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
55	Cs^{143}	*A*		β^-	Short(S110)			U-*n*, Xe^{143} β^--decay, ancestor of Pr^{143} (S110)
	Cs^{144}	*A*		β^-	Short(D108)			U-*n*, Xe^{144} β^--decay, ancestor of Ce^{144} (D108)
	Cs^{145}	*D*		β^-	Short(S110)			U-*n*, Xe^{145} β^--decay, ancestor of Pr^{145} (S110)
56	Ba^{130}		0.101(N36)					
	Ba^{131}	*B*		K,γ(K62); no β^+, e^- (Y7)	12.0 days(K62); 11.7 days(Y7)		0.22, 0.50, 1.7(weak) (Y7); 0.26, 0.5, 1.2(weak)(K62) abs. Pb, abs. of e^-	Ba-*n*-γ(K62,Y7) Parent of Cs^{131}(K62, Y7)
	Ba^{132}		0.097(N36)					
	Ba^{133m}	*A*		I.T., e^-, γ (C30)(?)	38.8 hr.(W28); 37.8 hr.(O103)		0.30(D9) spect. conv.; 0.276(C30) spect. conv.	Cs-*p*-*n*(D9) Cs-*d*-2*n*(C30) Ba-*n*-2*n*(K26,W22) Ba-*d*-*p*(W22) Bi-α(P56) Bi-*d*(G62) Pb-α(P104)
	Ba^{133}	*A*		K,γ,e^-(K62)	>20 yr.(K62)		0.36(K62) abs. Pb, abs. of e^-; 0.085, 0.320(Y9) abs., abs. of e^-, cl.ch.	Ba-*n*-γ(K62) Ba^{133m} I.T.(Y9)
	Ba^{134}		2.42(N36)					
	Ba^{135m}	*D*		I.T.,γ,e^- (W22)	28.7 hr.(Y9)	0.28(e^-)(Y9) abs. Al	0.34(weak)(W22) abs. Pb	Ba-*n*-γ(K26) Ba-*d*-*p*(W22) U-α(O115)
	Ba^{135}		6.59(N36)					
	Ba^{136}		7.81(N36)					
	Ba^{137m}	*A*		I.T.,γ,e^- (E115, T45)	2.63 min.(T45); 2.5 min.(E115)	0.626(e^-)(T45) spect., coincid.; 0.7(e^-) (E115) abs. Al. coincid.	0.663(T45) spect. conv., spect.; 0.75 (E115) abs. Pb	Cs^{137} β^--decay(E115, T45) Ba-*n*-γ(A1,P2,K26)
	Ba^{137}		11.32(N36)					
	Ba^{138}		71.66(N36)					
	Ba^{139}	*A*		β^-,γ	84 min.(S217); 85 min.(D115); 86 min.(P8,H28)	2.27(S217) spect.; 2.3(B30) abs.	0.163, 1.05(S217) spect. conv., abs. Pb, coincid.; 0.6 (K26) abs. Pb, Cu	Ba-*d*-*p*(P8,K26) Ba-*n*-γ(A1,P2) La-*n*-*p*(P8) Ce-*n*-α(W22) U-*n*, Cs^{139} β^--decay (H29,H22,H11, D103) U-γ(L2) Th-*n*(B101,A5) Pu-*n*(S111,F102, K72)
	Ba^{140}	*A* (H211) m.s.		β^-,γ,e^- (W112)	308 hr.(S181); 12.8 days(E113); 12.5 days(G104)	1.05(R49) spect.; 0.4(25%), 1.0 (75%)(E104) abs. Al; 1.2(B30) abs.; 1.1(L104) abs.	0.529(N109) spect.; 0.54(R49) spect., spect. conv.; 0.5 (25%)(E104) abs. Pb	U-*n*, Xe^{140} (and Cs^{140}) β^--decay, parent of La^{140} (H28,H48,H22, G21,S110,O101, G51) U^{233}-*n*(S184) U-*d*(O101) U-α(O115) Th-*n*(B101) Th-α(O115,N116) Pu-*n*(S111,F102, K72)
	Ba^{141}	*A*		β^-,γ(G124)	18 min.(H48)			U-*n*, Cs^{141} β^--decay, parent of La^{141} (H48) Th-*n*(H15,H14) U-γ(L2)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
56	Ba^{142}	*D*		β^-	6 min.(H48)			U-*n*, Cs^{142} β^--decay, parent of La^{142} (H48) Th-*n*(H15,H14) U-γ(L2)
	Ba^{143}	*B*		β^-	<1 min.(H14)			U-*n*, parent of La^{143} (H14,H15) Th-*n*(H15)
	Ba^{144}	*A*		β^-	Short(D108)			U-*n*, descendant of Xe^{144}, ancestor of Ce^{144}(D108)
	Ba^{145}	*D*		β^-	Short(S110)			U-*n*, descendant of Xe^{145}, ancestor of Pr^{145}(S110)
57	$La^{<139}$	*D*		β^+(M47)	10 min.(M47)	2.1(M47) abs. Al		Ba-*d*-*n*(M47)
	La^{135}	*B*		K,γ(W23, M24)	19.5 hr.(C74); 17.5 hr.(W23)		0.88(W23) abs. Pb	Cs-α-2*n*(C74) Ba-*d*-*n*(W23,M24) Ba-*p*-*n*(W23,W22) Ce^{135} β^+-decay(C74)
	La^{136}	*B*		β^+(C74)	2.1 hr.(C74)	0.84(C74) abs. Al	No γ(C74)	Cs-α-*n*(C74)
	La^{137}	*A*(I19) m.s.			>400 yr.(C74)			Ce^{137} *K*-decay(C74, I19)
	La^{138}		0.089(I14)					
	La^{139}		99.911(I14)					
	La^{140}	*A* (H96) m.s.		β^-,γ	40.4 hr.(S181); 40.0 hr.(W23); 39.5 hr. (B85)	0.90(20%), 1.40 (70%), 2.12(10%) (O11) spect.; 1.41 (W23) abs. Al, spect.; 1.45(W112) spect.; 1.8(L104) abs.	0.335(2%), 0.49 (5%), 0.87(10%), 1.65(77%), 2.3 (6%)(R49) spect.; 0.335(1%), 0.49 (7%), 0.83(14%), 1.63(74%), 2.3 (4%)(M120,M67) spect.; 2.49(weak) (W64)D-γ-*n* reaction	Ba-*d*-γ(?)(W23) La-*d*-*p*(P8,W23, M24) La-*n*-γ(P9,M13, W23,M24,G14) Ce-*n*-*p*(W23) U-*n*, Ba^{140} β^--decay (H28,H48,H22, G21,G104,G51) U^{233}-*n*(G65) Th-*n*(B101) Pu-*n*(S111,F102)
	La^{141}	*A*		β^-	3.7 hr.(K120); 3.5 hr.(H48)	2.9(K120) abs. Al	No γ(?)(K120)	U-*n*, Ba^{141} β^--decay, parent of Ce^{141} (H48) Th-*n*(C16,B101)
	La^{142}	*D*		β^-,γ(K120)	74 min.(H48); 77 min.(K120)			U-*n*, Ba^{142} β^--decay (H48) Th-*n*(H15)
	La^{143}	*A*		β^-	20 min.(B123); 15 min.(H55)			U-*n*, Ba^{143} β^--decay (H14,H15), parent of Ce^{143}(B123)
	La^{144}	*A*		β^-	Short(D108)			U-*n*, descendant of Xe^{144}, parent of Ce^{144}(D108)
	La^{145}	*D*		β^-	Short(S110)			U-*n*, descendant of Xe^{145}, ancestor of Pr^{145}(S110)
58	Ce^{135}	*B*		β^+(C74)	~16 hr.(C74)			La-*d*-6*n*, parent of La^{135}(C74)
	Ce^{136}		0.193(I14)					
	Ce^{137}	*B*		K,γ,e^-(C74)	36 hr. (C74)		0.28, 0.75(C74) abs. Pb	La-*d*-4*n*(C74)
	Ce^{138}		0.250(I14)					
	Ce^{139}	*B*		K,γ,e^-(M81)	140 days(P14)		0.18, 1.8(C74) abs. Pb; 0.18, ~0.8 (P58) abs. Pb	Ba-α-2*n*(P14) La-*d*-2*n*(P14) Bi-*d*(G62)
	Ce^{140}		88.48(I14)					

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
58	Ce^{141}	*A* (H96) m.s.		β^-,γ	28 days(B106); 30.6 days(P58)	0.60(B108) abs. Al; 0.66(P58) abs. Al; 0.4(B85) abs. Al	0.21(B108) abs. Pb; 0.2(P14)	Ba-α-n(P14) Ce-d-p(P14) Ce-n-γ(P14) Ce-n-$2n$(P14) Pr-n-p(P14) U-n, La^{141} β^--decay (G104,B106,O101, B107) Th-n(B101) Pu-n(F102) U-d(O101)
	Ce^{142}		11.07(I14)					
	Ce^{143}	*A*		β^-,γ	33 hr.(E105,B85, O103); 36 hr.(P14)	1.36(B108) abs. Al; 1.3(B85) abs. Al	0.5(B108) abs. Pb; 0.6(P58) abs. Pb	Ce-d-p(P14,B108) Ce-n-γ(P14) U-n, La^{143} β^--decay, parent of Pr^{143} (E105,B123,B108, O103) U-d(O103) Th-n(B101) Th-α(N116) Pu-n(F102,K72)
	Ce^{144}	*A* (H96) m.s.		β^-,e^-(P106)	275 days(B119); 300 days(B30)	0.348(N109) spect.; 0.25(N105) abs.; 0.30(P106) spect., 0.075, 0.12(e^-) (P106) spect.	No γ(S158)	U-n, descendant of Xe^{144}, parent of Pr^{144}(B30,H55, G104,N105,D103) U^{233}-n(G65,S184) U-d(O106) Pu-n(F102) Th-α(N116)
	Ce^{145}	*D*		β^-	1.8 hr.(B110)			U-n, descendant of Xe^{145}, parent of Pr^{145}(B110,S110)
	Ce^{146}	*D*		β^-	14.6 min.(S157); 11 min.(G57)			U-n, parent of Pr^{146} (H55,G57)
59	Pr^{140}	*A*		β^+	3.5 min.(P9)	2.5(H90) abs. Al; 2.40(D32) cl.ch.		Pr-n-$2n$(P9,A1,W23, D32) Pr-γ-n(H90)
	Pr^{141}		100(A31,I16)					
	Pr^{142}	*A*		β^-,γ	19.3 hr.(D32); 19.2 hr.(B85)	2.14(D32) spect.; 2.23(P106) spect.	1.9(D32) abs. Pb; ~1.3, ~1.65 (P106) spect.	La-α-n(D32) Ce-p-n(D32) Pr-d-p(D32) Pr-n-γ(P9,P2,M13, A1,W23,D32) Nd-n-p(P9,P2)
	Pr^{143}	*A* (H96) m.s.		β^-	13.8 days(M127); 13.5 days(P14, P58); 14.2 days (O103); 12.7 days (J5)	0.95(B108) abs. Al; 1.0(M127) abs. Al; 0.83(P58) abs. Al	No γ(B108,M127)	Ce^{143} β^--decay (B108,B85) U-n, Ce^{143} β^--decay (H55,P14,B111) U-d(O103) Pu-n(F102)
	Pr^{144}	*A*		β^-,γ,e^-	17.5 min.(N105); 17 min.(H55); 18 min.(G122)	3.07(N107) spect.; 3.1(B30,H55) abs.; 2.99(P106) spect.	0.135(N109) spect. conv.; 1.25, 0.22 (S159) abs. Pb	U-n, Ce^{144} β^--decay (H55,N105) U-d(O106) Pu-n(F102)
	Pr^{145}	*D*		β^-	4.5 hr.(B110)	3.2(K121) abs. Al	No γ(K121)	U-n, Ce^{145} β^--decay (B110)
	Pr^{146}	*D*		β^-,γ	24.6 min.(S166); 25 min.(G57)	~3(S166) abs. Al	1.4(S166) abs. Pb	U-n, Ce^{146} β^--decay (G57)
60	Nd^{141}	*B*		β^+(3%); K(97%),γ (W80)	2.42 hr.(W80); 2.5 hr.(K19)	0.78(K19); 0.7(W80) abs. Al	1.05(W80) abs. Pb	Pr-p-n(K19,W80) Nd-d-h(?)(P9,K19) Nd-n-$2n$(P9,K19, L25) Nd-γ-n(L25,K19)
	Nd^{142}		27.13(I16)					
	Nd^{143}		12.20(I16)					

Table of Isotopes— *Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
60	Nd^{144}		23.87(I16)					
	Nd^{145}		8.30(I16)					
	Nd^{146}		17.18(I16)					
	Nd^{147}	*A*		β^-,γ,e^-	11.0 days(M46, M127); 11.1 days (B85); 12.1 days (M141)	0.4(40%), 0.9(60%), 0.03(e^-)(M46, M127) abs. Al; 0.76(M141) abs.	0.58(40%)(M46) abs. Pb coincid.; 0.45(M141) abs.	Nd-n-γ, parent of Pm^{147}(M46) U-n(G121,S160)
	Nd^{148}		5.72(I16)					
	Nd^{149}	*B*		β^-,γ(?) (M132)	1.7 hr.(M132,M46); 2.0 hr.(B85)	1.6(B85) abs. Al; 1.5(M132,M46) abs. Al		Nd-n-γ(M132,G121) Nd-d-p(P9) Nd-n-2n(P9) Parent of Pm^{149}(?) (M46)
	Nd^{150}		5.60(I16)					
	Nd^{150}	*E* (K75)		β^-(L34)	$\sim 5\times10^{10}$ yr.(L34)	0.011(L34) abs. air		Natural source(L34)
	Nd^{151}	*E*		β^-	21 min.(P9)			Nd-n-γ(P9,M18)
	Nd^{151}	*F*		β^-	Short(M132)			Nd-n-γ, parent of Pm^{151}(M132)
61	Pm^{148}	*B* (W125)		K,e^-,γ (W25, W125)	~200 days(W25); ~1 yr.(W125)		0.67(W25) abs.	Pr-α-2n(W25,W125) Nd-d-n(K20,K21)
	Pm	*E*		β^-,γ	2.7 hr.(K20)	2(K20)		Nd-p-n(K20,L25) Nd-d-n(K20,L25) Nd-α-p(L25)
	Pm	*E*		β^-,γ	16 days(K20)	1.7(K20)		Nd-d-n(K20)
	Pm^{147}	*A* (L117, H96) m.s.		β^-(G121, B120)	3.7 yr.(S185); ~4 yr.(B120); 2–3 yr. (G121)	0.223(L124) spect.; ~0.2(B120) abs. Al; 0.20(M46) abs. Al	No γ(M127)	U-n(S159,B120,M46) U^{233}-n(G65) Nd-n-γ, Nd^{147} β^--decay(M46)
	Pm^{148}	*A* (P53) m.s.		β^-,γ	5.3 days(K20,P53)	2.5(P53) abs.; 2(K20)	0.8(P53) abs.	Pm^{147}-n-γ(P53) Nd-p-n(K20) Nd-d-2n(K20,K21, L25) Nd-α-p(K21,L25)
	Pm^{149}	*A* (I11) m.s.		β^-,γ	47 hr.(W25,L25, M46,M121); 47.5 hr.(B85); 55 hr. (I11)	1.1(M121,B85,M46) abs. Al	0.25(weak)(M133) abs. Pb	Nd-n-γ, Nd β^--decay (M121,B85,M46) U-n(M121,M46) Pu-n(K72)
	Pm	*F*		β^-	12.5 hr.(P9)			Nd-d-n(P9)
	Pm^{151}	*F*		β^-	12 min.(M132,M46)			Nd-n-γ, Nd^{151} β^--decay(M132,M46)
62	Sm^{144}		3.16(I15)					
	Sm^{145}	*F* (I12) m.s.			>150 days(C81); >72 days (I12)		0.242, 0.95(C81) spect. conv., abs. Pb	Sm-n-γ(I12)
	Sm^{147}		15.07(I15)					
	Sm^{148}		11.27(I15)					
	Sm^{149}		13.84(I15)					
	Sm^{150}		7.47(I15)					
	Sm^{151}	*A* (L117, H96) m.s.		β^-	~20 yr.(I12)	0.06(P113) abs. Al	No γ(?)(P113)	Sm-n-γ(I12) U-n(L117)
	Sm^{152}		26.63(I15)					
	Sm^{152}	*B* (D61) m.s.		α(H85,L74)	1.0×10^{12} yr.(total Sm)(H86); 1.2×10^{12} yr. (total Sm)(W40)	2.14(C35) photo-film track; 2.0 (H86) cl.ch.		Natural source(H85, L74,B89)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
62	Sm^{153}	*A* (H99) m.s.		β^-,γ(W115, W116); e^-(B140)	47 hr.(W115); 46 hr. (P9)	0.78(W116,B88) abs. Al	0.0695, 0.103(H202) spect. conv.; 0.57 (weak), 0.10 (W116) abs. Pb, Cu; ~0.6, 0.11 (M67) spect.; 0.61 (weak), 0.11(B88) abs., coincid. abs.	Nd-α-n(K19) Sm-n-γ(P9,H20, R11,H17,W25, L25) Sm-n-$2n$(P9,K19) Sm-d-p(L25,K19) Sm-γ-n(L25) U-n(W116) U^{233}-n(S184) Pu-n(W115)
	Sm^{154}		22.53(I15)					
	Sm^{155}	*B*		β^-,γ	25 min.(W123); 21 min.(P9)	1.9(W123) abs. Al; 1.8(K19)	~0.3(W123) abs. Pb	Nd-α-n(K19) Sm-n-γ(P9,A1,M13, H17,L25) Sm-d-p(L25,K19) U-n(W123)
	Sm^{156}	*A*		β^-	~10 hr.(W116)	~0.8(W119) abs. Al		U-n, parent of Eu^{156} (W114)
63	Eu^{147}	*D*			53 days(M136); 40 days(E20)			Sm-d-n(K20,M136)
	Eu^{149}	*D*			14 days(M136)			Sm-d-n(M136)
	Eu^{150}	*E*		β^+	27 hr.(P9)			Eu-n-$2n$(?)(P9,R11)
	Eu^{151}		47.77(H218)					
	Eu^{152}	*A* (H99) m.s.		β^-,γ,e^-(T6); K(R2, M142, B85)	9.2 hr.(P9); 9.3 hr. (B85)	1.88(β^-)(T6) spect.; 0.36, 1.8(β^-) (M142) abs. Al	0.123, 0.163, 0.725 (T6) spect. conv.; 1.0(M142) abs. Pb	Eu-n-γ(P9,M13, H17, H20,F11) Eu-n-$2n$(P9) Eu-d-p(F7,F11)
	Eu^{152}	*A* (I6,I7) m.s.		β^-,γ,e^- (S214)	Long(I7)	0.75(β^-)(S214) spect.		Eu-n-γ(I6)
	Eu^{153}		52.23(H218)					
	Eu^{154}	*A* (I7) m.s.		β^-,γ(R11, F7); K(M142, B85)	>20 yr.(K70); 5–8 yr.(F11)	0.9(R11) spect.; 0.34, 0.84(M142) abs. Al; 0.62, 1.0(W68) coincid. abs.; 1.4 (K70) abs. Al; 1.0 (B85) abs. Al	1.1(M142) abs. Pb; 0.040, 0.122, 0.247, 0.286, 0.343, 0.408, 1.23(C81,C72) spect. conv., abs.; 0.9(K70) abs. Pb	Sm-d-$2n$(?)(K20) Eu-n-γ(S20,R11, F7,F11) Eu-d-p(F11,K70)
	Eu^{155}	*A* (L117, H96) m.s.		β^-,γ	2–3 yr.(W114)$_\varphi$	0.18(P113) abs. Al; 0.23(W126) abs. Al	0.084(W104) abs. Al, crit. abs. Tl, Hg	Sm-n-γ,Sm^{155} β^--decay(I12) U-n(W104) Th-α(N116)
	Eu^{156}	*A* (I12) m.s.		β^-,γ	15.4 days(W104)	0.5(60%), 2.5(40%) (W104) abs. Al	2.0(60%)(W104) abs. Pb	Eu^{155}-n-γ(I12) U-n(W105,W104), Sm^{156} β^--decay (W114,W116) Pu-n(F102) Th-α(N116)
	Eu^{157}	*D*		β^-,γ	15.4 hr.(W106)	~1.0(~75%), ~1.8 (~25%)(W106, W114) abs. Al	0.2, 0.6(W117) abs. Pb	U-n(W106) Th-α(N116) Pu-n(K72)
	$Eu^{>154}$	*D*		β^-	60 min.(W106,W114)	~2.5(W106,W114) abs. Al		U-n(W106)
64	Gd^{152}		0.20(H218)					
	Gd^{153}	*B* (I12) m.s.		K,e^-,γ(H215)	155 days(H215); 155–170 days(F11); ~110 days(C81)	0.22, 0.40(weak)(e^-) (H215) abs. Al	0.102(C81) spect. conv.; 0.083, 0.270 (H215) abs. Cu, Pb	Eu-d-$2n$(F11,K70) Gd-n-γ(I12)
	Gd^{154}		2.15(H218)					
	Gd^{155}		14.78(H218)					
	Gd^{156}		20.59(H218)					
	Gd^{157}		15.71(H218)					
	Gd^{158}		24.78(H218)					
	Gd^{160}		21.79(H218)					
	Gd^{161}	*D*		β^-,γ(K66)	18.0 hr.(K70); 20 hr. (S153)	0.85(K66)	0.3(K66)	Gd-n-γ(S153,K66, I103) Gd-d-p(K66)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
64	Gd	*D*			8.6 days(S153)			Gd-*n*-γ(S153,I103)
	Gd^{161}	*B*(K101)		β^-,γ(K101)	4.5 min.(I103)	1.5(K101) spect.	0.37(K101)	Gd-*n*-γ(I103)
65	Tb^{152}	*D*		K(W125)	4.5 hr.(W125)			Eu-α-3*n*(W125)
	Tb^{153}	*D*		K,e^-(W125)	5.1 days(W125)	0.15, 0.4(e^-)(W125) abs. Al		Eu-α-2*n*(W125)
	Tb^{154}	*D*		β^+,K,γ,e^- (W125)	17.2 hr.(W125)	2.6(β^+), 0.22, ~1(e^-) (W125) spect., abs. Al	1.4(W125) abs. Pb	Eu-α-3*n*(W125) Gd-*p*-*n*(W125)
	Tb^{155}	*D*		K,e^-(W125)	~1 yr.(W125)	0.1(e^-)(W125) abs. Al		Eu-α-2*n*(W125)
	Tb^{159}		100(A33, H218)					
	Tb^{160}	*A*		β^-	3.9 hr.(H16,M13)			Tb-*n*-γ(H17,P9, M13,H20)
	Tb^{160}	*A* (I12) m.s.		β^-,γ(B33)	73.5 days(B56); 77.3 days(C81)	0.546, 0.882(C81) spect.; 0.75(B56) abs. Al; 0.71(K70) abs. Al	0.086, 0.195, 0.212, 0.297, 1.15(C81) spect. conv., abs. Pb	Gd-*d*-2*n*(K70) Tb-*n*-γ(B33)
	Tb^{161}	*F*		β^-,γ	420 days(H139)	0.23(H139)	~0.1, 0.5(H139)	U-*n*(H139)
	Tb^{161}	*B*(K101)		β^-,γ	5.5 days(K70)	0.5(K70) abs. Al	1.28(K70) abs. Pb	Gd-*d*-*n*(K70)
66	Dy^{156}		0.0524(I18)					
	Dy	*F*		β^+	2.2 min.(P9)			Dy-*n*-γ(?)(P9)
	Dy^{158}		0.0902(I18)					
	Dy^{160}		2.294(I18)					
	Dy^{161}		18.88(I18)					
	Dy^{162}		25.53(I18)					
	Dy^{163}		24.97(I18)					
	Dy^{164}		28.18(I18)					
	Dy^{165m}	*A* (G67) res.n.act.		I.T., e^-(F32, F34)	1.25 min.(F34)	0.13(e^-)(F32) abs. Al		Dy-*n*-γ(F32) Dy^{164}-*n*-γ(I8)
	Dy^{165}	*A* (I13) m.s.		β^-,γ	145 min.(S94); 140 min.(S104,B56); 2.5 hr.(H17,P9, M13)	0.42, 0.88, 1.25(S94) spect.; 1.20(C31) abs. coincid.; 1.18 (D33) spect.; 1.40 (E11) cl.ch.	0.091, 0.37, 0.78(S94) spect. conv., spect.; 1.1(C31) abs. coincid.; ~1, 0.37(M67) spect.	Dy-*n*-γ(H17,H20, P9,M13,M31) Dy^{164}-*n*-γ(I8)
67	Ho^{160}	*D*		K(?)(W125)	~20 min.(W125)			Tb-α-3*n*(W125)
	$Ho^{161,162}$	*C*		K(?),γ,e^- (W125)	60 days(W125)	0.6, 0.16(e^-)(W125) abs. Al		Tb-α-2*n*(W125) Dy-*d*-2*n*(W125) Dy-*p*-*n*(W125)
	$Ho^{162,161}$	*C*		β^+,K, γ(W125)	4.5 hr.(W125)	2.0(β^+), 0.3(e^-) (W125) spect., abs. Al	1.1(W125) abs. Pb	Tb-α-*n*(W125) Dy-*p*-*n*(W125)
	Ho^{163}	*B*		K,e^- (W125)	7 days(W125)	0.4(e^-)(W125) abs. Al		Dy-*p*-*n*(W125)
	Ho^{164}	*D*		β^-	35 min.(W125); 47 min.(P9)	0.7(W125) abs. Al		Ho-*n*-2*n*(?)(P9) Dy-*p*-*n*(W125)
	Ho^{165}		100(A33)					
	Ho^{166}	*A* (I7) m.s.		β^-	27.0 hr.(B135); 27.5 hr.(I7); 27.3 hr. (B56); 30 hr.(S126)	1.8(B56) abs. Al; 1.9(M31) abs.; 1.6(H20) abs.		Ho-*n*-γ(H17,H20, P9,M31,S126)
68	Er^{162}		0.1(W42)					
	Er^{164}		1.5(W42)					
	Er^{165}	*F*		β^+	1.1 min.(P9)			Er-*n*-2*n*(?)(P9)
	Er^{166}		32.9(W42)					
	Er^{167}		24.4(W42)					
	Er^{168}		26.9(W42)					
	Er^{169}	*B*		β^-	9.4 days(K74)	0.33(K74) spect.	No γ(K74)	Er-*n*-γ(B135,K74)
	$Er^{169,171}$	*F*			6 min.(B56); 7 min. (M13)			Er-*n*-γ(M13,M18)
	Er^{170}		14.2(W42)					

Table of Isotopes— *Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
68	Er^{171}	*B*		β^-,γ,e^- (K74)	7.5 hr.(K74); 5.7–7.1 hr.(B56); 12 hr.(H17,P9)	1.49(6%), 1.05(71%), 0.67(22%)(K127) spect., coincid.	0.81(22%), 0.31 (71%), 0.113(71%) (K127) spect., spect. conv.	Er-*n*-γ(H17,P9, R24,B135) Parent of Tm^{171m} (70%), Tm^{171} (30%)(K74)
	Er^{171}	*F*		β^-,γ	20 hr.(B85)	0.6(B85) abs. Al		Er-*n*-γ(B85)
69	Tm^{166}	*B*		β^+,K,γ,e^- (W125)	7.7 hr.(W125)	2.1(β^+), 0.24, ~1(e^-) (W125) spect., abs. Al	1.5(W125) abs. Pb	Ho-α-3*n*(W125)
	Tm^{167}	*B*		K,γ,e^- (W125)	9 days(W125)	0.21(e^-)(W125) abs. Al	0.22, 0.95(W125) abs. Pb	Ho-α-2*n*(W125) Ta-*d*-5*z*16*a*(W125)
	$Tm^{167,168}$	*C*		K(?), e^- (W125)	~100 days(W125)	0.16, 0.5(e^-?)(W125) abs. Al		Ho-α-2*n*(W125)
	Tm^{169m}	*B*		I.T., γ, e^- (D67)	1×10^{-6} sec.(D67)	0.12(e^-)(D67) coincid. abs.		Yb^{169} K-decay (M143, D67)
	Tm^{169}		100(A33)					
	Tm^{170}	*A*		β^-,γ	127 days(B56); ~125 days(B135); 105 days(H20)	0.98(K133) spect.; 1.1(B56) abs. Al	0.83(K101) spect. conv., spect.	Tm-*d*-*p*(K133) Tm-*n*-γ(H20,N7)
	Tm^{171m}	*B*		I.T., e^- (D67)	2.5×10^{-6} sec.(D67)		0.113(K74) spect. conv.; 0.1(M143) coincid. abs. of e^-	Er^{171}(7.5 hr.) β^--decay(D67)
	Tm^{171}	*B*		β^-	500 days(K128)	0.1(K128) abs. Al; 0.100(K133) spect.		Er^{171}(7.5 hr.) β^--decay(K74)
70	Yb^{168}		0.06(W43)					
	Yb^{169}	*B*		K,γ(B56), e^-(?) (B133)	33 days(B56); 33.5 days(I105); 32.5 days(K133)		0.2, 0.4(B56) abs. Pb, coincid.	Tm-*d*-2*n*(K133) Yb-*n*-γ(B56,B133)
	Yb^{170}		4.21(W43)					
	Yb^{171}		14.26(W43)					
	Yb^{172}		21.49(W43)					
	Yb^{173}		17.02(W43)					
	Yb^{174}		29.58(W43)					
	Yb^{175}	*A* (I13) m.s.		β^-,γ(B56)	99 hr.(I6,B56); 100 hr.(A35); 102 hr. (I13)	0.50, 0.13(B56) abs. Al; 0.45(A35) cl.ch.	0.35(B56) abs. Pb, coincid.	Yb-*n*-γ(I6)
	Yb^{176}		13.38(W43)					
	Yb^{177}	*B*		β^-	2.4 hr.(B56); 2.7 hr. (I13); 3.5 hr.(H17, M13); 1.9 hr.(A35)	1.3(B56); 1.15(A35) cl.ch.		Yb-*n*-γ(H20,H17, M13,P9)
71	Lu^{170}	*B*		K,γ,e^-,β^+ (W125)	2.15 days(W125)	1.7(β^+), 0.1(e^-) (W125) spect., abs. Al	1.5(W125) abs. Pb	Tm-α-3*n*(W125) Yb-*d*-2*n*(W125) Ta-*d*-3*z*13*a*(W125)
	Lu^{171}	*B*		K(?),γ,e^- (W125)	9 days(W125)	0.17, 0.7(e^-)(W125) abs. Al		Tm-α-2*n*(W125) Yb-*d*-2*n*(W125) Ta-*d*-3*z*12*a*(W125)
	$Lu^{171,172}$	*C*			>100 days(W125)	0.11, 0.22(e^-?) (W125) abs. Al		Tm-α-2*n*(W125) Yb-*d*-2*n*(W125)
	Lu^{175}		97.5(M54)					
	Lu^{176} (H80, M54)	*A*	2.5(M54)	β^-(H80,L70), (33%) (F45), γ(F16); K (67%)(F45)	7.3×10^{10} yr.(uncorr. for K)(L70); 2.4×10^{10} yr. (corr. for K)	0.215(L70) abs. Al, spect.; 0.40(F16) abs. Al	0.260(F16) abs. Pb	Natural source(H80)
	Lu^{176m}	*B*		β^-	3.67 hr.(A35); 3.75 hr.(W125); 3.7 hr. (B56); 3.4 hr. (F16,D57)	1.04(W125) abs. Al; 1.15(F16) abs. Al; 1.25(A35) cl.ch.	No γ(B56,A35)	Lu-*d*-*p*(W125) Lu-*n*-γ(H20,H17, M13,M18,F16) Lu-x-rays(D57)
	Lu^{177}	*A* (I13) m.s.		β^-,γ(B56)	6.8 days(B56); 6.6 days(F16,A35); 6.9 days(W125)	0.440(F16) abs. Al; 0.52(B56) abs. Al; 0.47(A35) cl.ch.	0.2(B56) abs. Pb; 0.2, 1.3(weak) (W125) abs. Pb	Lu-*n*-γ(H17,H20, F6,F16) Lu-*d*-*p*(W125) Hf-*d*-α(W125)
72	Hf^{174}		0.18(M55)					
	Hf^{175}	*B*		K,γ,e^-(W80)	70 days(W80)	0.3(e^-)(W80) abs. Al	0.3, 1.5(W80) abs. Pb	Lu-*d*-2*n*(W80) Lu-*p*-*n*(W80)

Table of Isotopes—*Continued*

Isotope Z	A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	γ-rays	Produced by
72	Hf^{176}		5.30(M55)					
	Hf^{177}		18.47(M55)					
	Hf^{178}		27.10(M55)					
	Hf^{179}		13.84(M55)					
	Hf^{180}		35.11(M55)					
	Hf^{181}	*A*		β^-,γ(D52)	46 days(S118); 55 days(H19)	0.460(B91) spect.; 0.45(M83) abs. Al; 0.42(D67) abs. Al; 0.28(N47) abs. Al, coincid.; 0.63 (V23) abs., coincid.	0.485, 0.347, 0.134, 0.087(J14) spect. conv.; 0.342, 0.128, 0.472(B91) spect. conv., coincid.; 0.52, 0.30 (M83) abs. Pb; 1.4(N47) coincid. abs.; 0.52, 0.13(V23) abs., coincid. abs.	Hf-*n*-γ(H19) Parent of Ta^{181m} (D52)
	Hf^{m}	*D*		I.T., e^-(?) (F32,F34)	19 sec.(F32)	0.19(e^-)(F32) abs. Al		Hf-*n*-γ(F32)
73	Ta^{176}	*B*		K,γ,e^- (W125)	8.0 hr.(W125)	0.12, 0.18, 1.2(e^-) (W125) abs. Al	1.7(W125) abs. Pb	Lu-α-3*n*(W125) Ta-*d*-*p*6*n*(W125)
	Ta^{177}	*B*		K,e^-(W125)	2.66 days(W125)	0.1(e^-)(W125) abs. Al		Lu-α-2*n*(W125) Hf-*d*-2*n*(W125) Ta-*d*-*p*5*n*(W125)
	$Ta^{178,177}$	*C*		K,e^-, or β^- (W125)	16 days(W125)	1.1(e^-?)(W125) abs. Al		Lu-α-*n*(W125) Hf-*d*-2*n*(W125)
	Ta^{180}	*A*		K,e^-,γ(O1); β^-(?)	8.2 hr.(O1)	<0.5(e^-?)(O1) abs.		Ta-*n*-2*n*(O1,P2) Ta-γ-*n*(M98)
	Ta^{181m}	*A*		I.T., γ,e^- (D113, D52)	2.0×10^{-5} sec.(B97); 2.2×10^{-5} sec. (D67)	0.12(e^-)(D67) coincid. abs.	0.128, 0.472(B91) spect. conv., coincid.; 0.20, 0.49 (B97) coincid. abs.	Hf^{181} β^--decay (D113,D52,M83)
	Ta^{181}		100(D40, W78)					
	Ta^{182}	*A*		β^-,γ,e^-	117 days(Z2,S52); 113 days(S213)	1.0(H37) abs.; 0.98, 0.32, 0.050(Z2); 0.53(R49) spect.; 0.499(J9) spect.; 1.1(N47) abs. Al, coincid.	1.22(57%), 1.13 (37%), 0.22(4%), 0.15(2%)(R49) spect., spect. conv.; 1.6(Z2); 0.23(N47) abs. Pb	Ta-*n*-γ(O1,F6,H37) Ta-*d*-*p*(O1,Z2)
	Ta^{182m}	*E*		I.T.(?)(C135)	0.40 sec.(C135)			Ta-*n*-γ(C135)
	Ta^{182}	*B*		β^-,γ(?)(S52)	16.2 min.(S52)	0.2(S52) abs. Al		Ta-*n*-γ(S52)
74	$W^{179,178}$	*C*		K,e^-,γ (W125)	135 min.(W125)	0.15, 0.45(e^-)(W125) abs. Al	~0.5, 1.2(W125) abs. Pb	Ta-*d*-4*n*(W125)
	W^{180}		0.122(I5)					
	W^{181}	*B*		K,γ,e^-	140 days(W66)		~0.14, 1.83(weak) (W66) abs. of e^-, abs. Pb	Ta-*d*-2*n*(W66)
	W^{182}		25.77(I5)					
	W^{183}		14.24(I5)					
	W^{184}		30.68(I5)					
	W^{185}	*A*		β^-,γ(?)(M36)	73.2 days(S207); 74 days(F12); 77 days(M36)	0.428(S213,S214) spect.; 0.430(P59) spect.; 0.6(S84) abs. Al	No γ(S84,C68)	W-*n*-γ(M36,F12) W-*n*-2*n*(M36,F12) W-*d*-*p*(F12) Re-*d*-α(F12)
	W^{186}		29.17(I5)					
	W^{m}	*D*		I.T., e^-(D65)	5.5 sec.(D65)	~0.080(e^-)(D65) abs. Al		W-*n*-γ(D65)
	W^{187}	*A*		β^-,γ(M36) e^-	24.1 hr.(F12)	0.63(70%), 1.33 (30%)(P59) spect.; 0.562, 1.35(L126) spect.; 1.3, 0.6 (M67) spect.; 1.4, 0.6(S84) abs. Al	0.135, 0.101, 0.086 (V6) spect. conv.; 0.135, 0.48, 0.69 (M120) spect. conv.; 0.90(C31) coincid. abs., coincid.; 0.14, 0.21, 0.48, 0.62, 0.69 (P59) spect. conv.	W-*n*-γ(M14,A1, M36,F12) W-*d*-*p*(F12) U-α-55*a*20*x*(O32)

Table of Isotopes—*Continued*

Isotope Z	A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
75	Re	*E*		β^+(C42)	30-55 min.(C32,D9)			W-*p*-*n*(D9,C32)
	Re	*E*			13 min.(C42)			W-*p*-*n*(C42)
	Re^{182}	*B*		K,γ,e^- (W125)	64 hr.(W125)	0.11, 0.27, 0.6(e^-) (W125) abs. Al	0.22, 1.52(W125) abs. Pb	Ta-α-3*n*(W125) W-*p*-*n*(W125)
	$Re^{183,184}$	*C*		K,(?),e^- (W125)	13 hr.(W125)		1.6(W125) abs.Pb	W-*p*-2*n*(W125) Ta-α-*n*(W125)
	$Re^{184,183}$	*C*		K,γ,e^- (W125)	~80 days(W125)	0.1(e^-)(W125) abs. Al	1.0(W125) abs.Pb	Ta-α-*n*(W125) W-*p*-*n*(W125)
	Re^{184}	*A*		β^-,K,γ (S85)	50 days(S85); 52 days(F12)	0.22–0.26(S85); 0.1 (e^-), 0.22, 0.86(e^-?) (C32) abs. Al	0.17, 1.05(S85); 0.85(F12); 0.17, 1(C32) spect. conv., abs. Pb	W-*p*-*n*(D9,C42,C32) W-*d*-*n*(F12) Re-*n*-2*n*(F12)
	Re^{185}		37.07(W78)					
	Re^{186}	*A* (H79) m.s.		β^-	92.8 hr.(G52); 90 hr. (S16)	1.07(G52) abs. Al; 1.05(Y4) cl.ch.	No γ(C42,S85)	W-*d*-2*n*(F12) W-*p*-*n*(D9,C32) Re-γ-*n*(P55) Re-*n*-γ(S16,K7,Y4, F12) Re-*n*-2*n*(S16,Y4, F12) Re-*d*-*p*(F12)
	Re^{187m}	*A*		I.T. ,e^-,γ (D58)	0.65×10^{-6} sec.(D58)	$\leqslant$ 0.13(e^-)(D67) coincid. abs.		W^{187} β^--decay(D58)
	Re^{187}		62.93(W78)	β^-(N44)	4×10^{12} yr.(N44,S215)	0.043(N44) abs. Al		Natural source(N44, S215)
	Re^{188}	*A* (H79) m.s.		β^-,γ,e^-	18.9 hr.(G52); 18 hr. (P2,S85)	2.05(G52) abs. Al; 2.5(S16) cl.ch. (K.U.); 2.5(S85) abs.; 0.12(e^-), 0.23(β^-)(M45) coincid. abs.	0.16, 0.48, 0.64, 0.94, 1.43(M67) spect.; 0.7(S85) abs. Pb; 1.39(M45) coincid. abs., coincid.	Re-*n*-γ(P2,K7,S16, Y4,F12) Re-*d*-*p*(F12) U-α-19*z*54*a*(O32)
76	Os^{184}		0.018(N37)					
	Os^{185}	*B*		K,γ(G48)	97 days(K71); 94.7 days(G52)		0.75(K71) abs. Pb	Re-*d*-2*n*(G48,K71) Os-*n*-γ(K71)
	Os^{186}		1.59(N37)					
	Os^{187}		1.64(N37)					
	Os^{188}		13.3(N37)					
	Os^{189}		16.1(N37)					
	Os^{190}		26.4(N37)					
	Os^{191}	*B* (F48)		β^-,γ,e^-	15.0 days(K71); 16.1 days(S207); 17 days(S36)	0.142(S207) spect.; $\leqslant$0.16(K71) abs. Al; 0.35(S36) abs. Al; 0.64(W68) coincid. abs.	0.039, 0.127(S207) spect. conv.; 0.13(K71) abs. Pb; 0.129(C72) spect. conv.	Os-*n*-γ(S36,Z3) U-α-18*z*51*a*(O32)
	Os^{192}		41.0(N37)					
	Os^{193}	*A* (F48)		β^-,γ(S36)	32 hr.(S36); 31.9 hr. (G52); 30 hr. (Z3,S104)	1.5(S36) abs. Al; 0.95(G52) abs. Al; 1.15(M45) abs. Al; 0.14(e^-)(M45) coincid. abs.	1.17(G52) abs.Pb; 1.58(M45) coincid. abs.	Os-*n*-γ(K7,S36,Z3) Os-*d*-*p*(G48) Ir-*d*-2*p*(?)(G48)
77	Ir^{190}	*B*		K(?),e^-(?),γ	10.7 days(G52)	0.091(e^-?)(G52) abs. Al	0.25(G52) abs. Pb	Os-*d*-*n*(G52) Ir-*n*-2*n*(G52) Ir-γ-*n*(G48)
	Ir^{191}		38.5(S63)					
	Ir^{192m}	*A* (G135) res.n.act.		I.T.,γ,e^- (G135, G58)	1.5 min.(M15)	0.038(e^-)(G146) abs. Al	0.06(G58) abs. Al of e^-, abs. Pb	Ir-*n*-γ(M15)
	Ir^{192}	*A* (D116, R46) m.s.		β^-,γ,e^- (~30%) (W69, S206)	70 days(F103); 60 days(M15,F6); 75 days(G52)	0.67(L81) spect.; 0.68(W68) coincid. abs.; 0.56(M89) abs. Al; 0.59(G52) abs. Al	0.307, 0.467, 0.603 (D34) spect.; 0.137, 0.209, 0.295, 0.307, 0.316, 0.468, 0.488, 0.591, 0.607, 0.615(L81,H65) spect. conv.; 0.52 (G52) abs. Pb	Os-*d*-2*n*(G52) Ir-*n*-γ(M15,F6,J4) Ir-*n*-2*n*(G52) Ir-*d*-*p*(G52) Ir-γ-*n*(G48)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
77	Ir^{193}		61.5(S63)					
	Ir^{194}	*A* (D116, R46) m.s.		β^-,γ	19.0 hr.(G52); 19 hr. (M15,A1); 20.7 hr.(S104,S153)	2.2(A2) spect.; 2.18 (W29) spect.; 2.11(W29) abs. Al; 2.07(G52) abs. Al; 0.48(M89) coincid. abs.	1.35(M34,M89) spect.; 1.65, 0.38 (G52) abs. Pb; (M89) coincid.	Ir-*n*-γ(M15,A1, P2,J4) Au-*d*-α*p*(?)(C18) Ir-*d*-*p*(G52)
78	Pt^{191}	*B*		K,e^-,γ(W67)	3.00 days(W67)	0.5(e^-)(W67) abs. Al	0.57, 1.5(W79) abs. Pb	Pt-*n*-2*n*(W67) Ir-*d*-2*n*(W67) Au^{191} *K*- or β^+-decay (W67)
	Pt^{192}		0.78(I104)					
	Pt^{193}	*B*		K,γ,e^-(W67)	4.33 days(W67)	0.11(e^-)(W79) abs. Al; 0.115(e^-)(M58) abs. Al	0.18, 1.5(W79) abs. of e^-, abs. Pb	Ir-α-*pn*(W67) Ir-*d*-2*n*(W67) Pt-*n*-γ(M58) Pt-*d*-*p*(W67) Pt-*n*-2*n*(W67) Au^{193} *K*-decay(W67)
	Pt^{194}		32.8(I104)					
	Pt^{195}		33.7(I104)					
	Pt^{196}		25.4(I104)					
	Pt^{196m}	*D*		I.T.,e^- (S37),γ	80 min.(S37)		0.337(H214) spect. conv.	Pt-*d*-*p*(S37) Hg-*n*-α(S37)
	Pt^{197}	*B*		β^-	18 hr.(M15)	0.65(S37) abs.; 0.72 (K27) abs.		Pt-*n*-γ(M15,S37) Pt-*d*-*p*(C19,S37, K27) Pt-*n*-2*n*(S37) Hg-*n*-α(S37)
	Pt^{197}	*B*		β^-,γ(K27)	3.3 days(M15)			Pt-*n*-γ(M15,P2) Pt-*d*-*p*(K27)
	Pt^{198}		7.23(I104)					
	Pt^{199}	*A*		β^-	31 min.(M15)	1.8(S37,K27) abs.		Pt-*n*-γ(M15,A1, M14,S37) Pt-*d*-*p*(C19,K27,S37) Hg-*n*-α(S37)
79	$Au^{<190}$	*F*		α(T116)	~5 min.(T116)	5.2(T116) ion. ch.		Au-*d*-?(T116)
	Au^{191}	*D*		K or β^+(W67)	~1 day(W67)			Ir-α-4*n*(W67) Pt-*d*-3*n*(W67) Parent of Pt^{191}(W67)
	Au^{192}	*B*		K,γ,e^-(W67)	4.7 hr.(W67)	0.4(e^-)(W79) abs. Al	2.3(W79) abs. Pb	Ir-α-3*n*(W67) Pt-*d*-2*n*(W67)
	Au^{193}	*B*		K,e^-(W67)	15.8 hr.(W67)	<0.2(e^-)(W79) abs. Al		Ir-α-2*n*(W67) Pt-*d*-3*n*(W67) Parent of Pt^{193}(W67)
	Au^{194}	*B*		K,γ,e^-(W67)	39.5 hr.(W67); 39 hr.(S208)	0.31, 1.8(e^-)(W67) abs. Al	0.329, 1.48, 0.286, 0.46, 2.0(S20,8) spect. conv., spect.; 0.4, 1.8(W79) abs. of e^-, abs. Pb	Ir-α-3*n*(W67) Pt-*d*-2*n*(W67) Pt-*p*-*n*(S208)
	Au^{195}	*B*		K,γ,e^-(W67)	185 days(W79); 180 days(S208)	0.1(e^-)(W79) abs. Al	0.19, 1.6(W79) abs. of e^-, abs Pb; 0.096(90%), 0.129 (10%)(S208) spect. conv., coincid.	Ir-α-2*n*(W67) Pt-*d*-2*n*(W67) Pt-*p*-*n*(S208)
	Au^{196}	*B*		β^-; K or I.T. (W79)	14.0 hr.(W79); 13 hr. (M15)			Au-*n*-2*n*(M15)
	Au^{196}	*B*		β^-,γ,e^- (K27); K(70%), β^-(30%) (S208)	5.55 days(W67); 5.6 days(L29,K27)	~0.27, ~0.43(S208) spect., coincid.; 0.36(C43)	0.139, 0.358(with *K*), 0.173, 0.334 (with β^-)(S208) spect. conv., coincid.; 0.41(C43); 0.41, 1.7(W67) abs. Pb	Au-*n*-2*n*(M15) Pt-*d*-*n*(K27) Pt-*p*-*n*(S208)
	Au^{197}		100(D44)					
	Au^{197m}	*A*		I.T.,e^-(W56)	7.5 sec.(W56)	0.07(e^-), 0.25(e^-) (F38) abs. Al, coincid.	0.273(H210) spect. conv. coincid.; 0.25 (W56) abs. of e^-	Au-x-rays(W56) Au-*n*-*n*(W56,F38) Hg^{197}(25 hr.) *K*-decay (4%)(F38)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
79	Au^{198}	*A*		β^-,γ,e^- (4.7%) (W69)	2.69 days(S213); 2.7 days(M15,A1); 65.5 hr.(D38)	0.960(100%)(S201) spect.; 0.970 (85%), 0.605 (15%)(L84) spect.; 0.97(100%)(P59) spect.; 0.985(F41) abs. Al, coincid.; (J15) coincid.	0.4112(D64) cryst. spect.; 0.408 (100%), 0.157 (15%), 0.208(15%) (L84) spect., spect. conv.; 0.065(F41) abs., coincid.; (C31,S53,J15,R53) coincid.	Au-*n*-γ(M15,A1,P2, D33) Au-*d*-*p*(C18,K28) Hg-*n*-*p*(S37) Pt-*p*-*n*(S208) U-α-15z44*a*(O32)
	Au^{199}	*A*		β^-,γ(K27)	3.3 days(M15)	0.38(M58) abs. Al, coincid.; 1.01(K27) abs.	0.18(M58) abs. Pb, coincid.; 0.45(K27) abs.	Pt^{199} β^--decay(M15) Pt-*d*-*n*(K27) Hg-*n*-*p*(S37)
	$Au^{200,202}$	*D*		β^-	48 min.(S37,M32)	2.5(S37) abs.		Hg-*n*-*p*(S37,M32) Tl-*n*-α(M32)
80	$Hg^{<195}$	*E*		α(T116)	0.7 min.(T116)	5.7(T116) ion. ch.		Au-*d*-?(T116)
	Hg^{196}		0.15(N30)					
	Hg^{197}	*A*		K,γ,e^-(F13)	23 hr.(F13); 25 hr. (D101)		0.161, 0.130(H38) spect. conv.; 0.125, 0.157(V8) spect. conv.; 0.165, 0.135(F38) coincid. abs., (H210) spect. conv.	Pt-α-*n*(S37) Au-*d*-2*n*(F13,W26, K28) Au-*p*-*n*(D101) Hg-*n*-2*n*(F13,W26) Hg-*n*-γ(F13,W26, M15,A9) Hg-*d*-*p*(K29)
	Hg^{197}	*A*		K,γ,e^-(F13)	64 hr.(F13,D101)		0.075(H38) spect. conv.; 0.077(F38) abs. of e^-, (H210) spect. conv.	Au-*d*-2*n*(F13,W26) Au-*p*-*n*(D101) Hg-*n*-2*n*(F13,W26) Hg-*n*-γ(F13,W26)
	Hg^{198m}	*F*		I.T.,γ,e^-	~0.3×10^{-6} sec. (M83)		0.4(M83)β^--e^- coincid.(?)	Au^{198} β^--decay(M83)
	Hg^{198}		10.1(N30)					
	Hg^{199}		17.0(N30)					
	Hg^{m}	*D*		I.T.,e^-,γ (F13)	43 min.(H10,M15); 43.5 min.(H208)		~0.53(F13) abs. of e^-; 0.222, 0.362 (H208)(spect. conv.)	Pt-α-*n*(?)(S37) Hg-*n*-2*n*(M15,H10, P2) Hg-*n*-*n*(?)(F13,W26) Hg-*d*-*p*(K29) Hg-x-rays(W56)
	Hg^{200}		23.3(N30)					
	Hg^{201}		13.2(N30)					
	Hg^{202}		29.6(N30)					
	$Hg^{203,205}$	*C*		β^-,γ(F13),e^-	45.8 days(S213); 51.5 days(F13)	0.205(S211) spect.; <0.3(M120,M67) spect.; 0.46(F13) abs. Al; 0.11, 0.44 (W68) coincid. abs.	0.286(S211) spect. conv.; 0.30(F13) abs. Pb; 0.28 (M67) spect.	Hg-*n*-γ(F13,W26, S37) Hg-*d*-*p*(K29) Tl-*n*-*p*(M32)
	Hg^{204}		6.7(N30)					
	Hg^{205}	*A*		β^-	5.5 min.(K29,M32)	1.62(K29) abs. Al		Hg-*d*-*p*(K29) Hg-*n*-γ(F13,W26) Tl-*n*-*p*(M32) Pb-*n*-α(M32)
81	Tl	*D*		K(?),e^-,γ (K29)	10.5 hr.(K29)		1.0(K29) abs. Pb	Hg-*d*-2*n*(K29)
	Tl	*D*		K(?),e^-(K29)	44 hr.(K29)			Hg-*d*-2*n*(K29)
	Tl^{198}	*D*		K,γ,e^-(O31)	1.8 hr.(O31)	0.4(e^-)(O31) abs. Al, Be	1.3(O31) abs. Pb	Au-α-3*n*(O31)
	Tl^{199}	*B*		K,γ,e^-(O31)	7 hr.(O31); 7.5 hr. (N117)	0.5(e^-)(O31) abs. Al, Be	1.5(O31) abs. Pb	Au-α-2*n*(O31) Pb^{199} *K*-decay(N117)
	Tl^{200}	*B*		K,γ,e^-(O31)	27 hr.(O31)	0.4(e^-)(O31) abs. Al, Be		Au-α-*n*(O31) Pb^{200} K-decay(N117)
	Tl^{201}	*D*		*K*	75 hr.(N117)			Pb^{201} K-decay(N117)
	Tl^{202}	*B*		K(?),γ,e^- (K29,M32)	11.8 days(F14); 13 days(M32)		0.40(M32)	Hg-*d*-2*n*(K29) Tl-*n*-2*n*(F14,M32)
	Tl^{203}		29.1(N36)					

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
81	Tl^{204}	*B*		β^-	2.7 yr.(V110); 3.5 yr.(F14)	0.80(H141) abs. Al; 0.87(F14) cl.ch.; 0.77(P106) spect.	No γ(F14)	Tl-*n*-γ(P10,P2,H10) Tl-*d*-*p*(F17,K29)
	Tl^{205}		70.9(N36)					
	Tl^{206}	*A*		β^-(B116)	4.23 min.(F17)	1.65(F14) abs.; 1.77 (K29) abs. Al	No γ(F17)	Tl-*n*-γ(P10,P2,H10) Tl-*d*-*p*(F17,K29) Pb-γ-*p*(B53) RaE^{210} α-decay(B78)
	AcC''^{207}	*A*		β^-,γ(C60)	4.76 min.(C60,S70)	1.47(S71) abs. Al		Pb-*n*-*p*(B16) Natural source, AcC^{211} α-decay
	ThC''^{208}	*A*		β^-,γ(C60)	3.1 min.(C60)	1.72(S99) spect.; 1.82(S72) abs. paper	2.62(R40)	Natural source, ThC^{212} α-decay
	Tl^{209}	*A*		β^-	2.2 min.(H146)	1.8(H146) abs. Al		Bi^{213} α-decay, parent of Pb^{209}(E108, H143)
	RaC''^{210}	*A*		β^-	1.32 min.(C60)	1.80(L71) cl.ch.		Natural source, RaC^{214} α-decay, parent of RaD^{210}
82	Pb^{199}	*B*		*K*	1–2 hr.(N117)			Bi^{199} *K*-decay, parent of Tl^{199} (N117)
	Pb^{200}	*B*		K	18 hr.(N117)			Bi^{200} *K*-decay, parent of Tl^{200} (N117)
	Pb^{201}	*D*		K,e^-,γ(H118)	8 hr. (N117); ~5 hr.(H118)			Tl-*d*-4*n*(H118)
	Pb^{203}	*B*		I.T.(?) or K(?)e^-,γ (F14,K29, L33,M32)	52 hr.(F17,F14); 54 hr.(D101)		~0.45(F17,F14, K29) abs. of e^-, (F14,M32,L33) abs. Pb, (L33) spect., (M32) spect. conv., 0.27 (L33,M32) spect. conv., abs. Pb	Tl-*d*-2*n*(F14,K29, F17,H118) Tl-*p*-*n*(D101) Pb-*n*-2*n*(M32) Pb^{204}-*n*-2*n*(T38) Pb-γ-*n*(B53)
	Pb^{204}		1.5(N38)					
	Pb^{204m}	*B*		I.T.,γ,e^- (F14,M32, T38)	68 min.(M32); 65 min.(F14)		1.1(F14) abs. of e^-, abs. Pb; 0.90 (M32)	Tl-*d*-*n*(F14) Tl-*d*-3*n*(T38) Pb-*n*-*n*(D10,M32) Pb-*x*-rays(B53) Bi^{204} *K*-decay(T38)
	Pb^{206}		23.6(N38)					
	Pb^{207}		22.6(N38)					
	Pb^{208}		52.3(N38)					
	Pb^{209}	*A*		β^-	3.32 hr.(F14)	0.70(K29,F14) abs.; 0.68(R49) spect.; 0.750(M32); 0.71 (L108) abs. Al; 0.70(L108) spect.	No γ, no e^-(W102); no γ(L108)	Pb-*d*-*p*(T5,K29,F14 F15) Pb-*n*-γ(M32) Bi-*n*-*p*(M32) Po^{213} α-decay(H69, E38)
	RaD^{210}	*A*		β^-,γ(R40)	22 yr.(C60)	0.0255(L72) spect.; 0.0292(S64) spect.	0.047(R40); 0.0472 (T44) spect. conv.; several weak lines of lower energy (B35,F42,T32,T33)	Natural source, RaC''^{210} β^--decay, RaC'^{214} α-decay, parent of RaE^{210}
	AcB^{211}	*A*		β^-,γ(S71)	36.1 min.(S70)	0.5, 1.40(S71) abs. Al	0.8(S71) abs.	Natural source, AcA^{215} α-decay, parent of AcC^{211}
	ThB^{212}	*A*		β^-,γ(R40)	10.6 hr.(C60)	0.36(S72) spect.		Natural source, ThA^{216} α-decay, parent of ThC^{212}
	RaB^{214}	*A*		β^-,γ(R40)	26.8 min.(C60)	0.65(S72) spect.		Natural source, RaA^{218} α-decay parent of RaC^{214}

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
83	Bi^{197}	*E*(N117)		α(T40)	2 min.(T40).	6.2(N117) ion.ch.		Pb-*d*-?(T40)
	Bi^{198}	*D*		α;K(?)(T40)	9 min.(T40)	5.83(N117) ion.ch.; ~5.5(α)(T40) ion. ch.		Pb-*d*-?(T40)
	Bi^{199}	*B*(N117)		α;K(T40)	27 min.(T40)	5.47(N117) ion.ch., abs. mica; ~5.5(α) (T40) ion.ch.		Pb-*d*-?(T40)
	Bi^{200}	*B*(N117)		α;K(T40)	62 min.(N117); ~100 min.(T40)	5.15(N117) ion.ch.; ~5.5(α)(T40) ion. ch.		Pb-*d*-?(T40)
	Bi^{204}	*B*		K,e^-,γ(T38)	12 hr.(T38)	0.2(e^-), ~0.8(e^-, weak)(T38) spect., abs. Al		Pb^{204}-*d*-2*n*(T38) Tl-α-3*n*(T38) Parent of Pb^{204m} (~4%)(T38)
	Bi^{206}	*A*		K(?),e^-,γ (L33)	6.4 days(K29)		0.74(K29) abs. of e^-; 0.93(F14) abs. of e^-; 1.1(F14) abs. Pb; ~0.4, 1.1 (T38) abs. Pb	Tl-α-3*n*(T38) Pb-*d*-2*n*(F14,F15, K29) Pb^{207}-*d*-3*n*(T38) Po^{206} *K*-decay(T38)
	Bi^{208}	*F*		K(N117)	short(N117)			Bi-*n*-2*n*(N117)
	Bi^{209}		100(N36)					
	RaE^{210}	*A*		β⁻(~100%); α(10^{-4}–10^{-5}%) (B116)	5.0 days(C60)	1.17(β⁻)(F30,N40, L76) spect.; 4.77 (α)(B78) calc.	No γ(G23)	Natural source, RaD^{210} β⁻-decay, parent of Po^{210} and Tl^{206}(B78) Bi-*d*-*p*(L13,C26, H27) Pb-α-*pn*(T38) Bi-*n*-γ(M29)
	AcC^{211}	*A*		α(99.68%) (C60), γ(R40); β⁻(0.32%) (C60), γ(C60)	2.16 min.(C60)	6.619(α,84%), 6.273 (α,16%)(H81) spect.		Natural source, AcB^{211} β⁻-decay, parent of AcC'^{211} and AcC''^{207} At^{215} α-decay(G66)
	ThC^{212}	*A*		α(33.7%) (K50), γ(R40); β⁻ (66.3%) (K50), γ(C60)	60.5 min.(C60)	6.081(α,27%), 6.042 (α,70%)(α, others, 3%)(L73) spect.; 2.20(β⁻) (S72) spect.		Natural source, ThB^{212} β⁻-decay, parent of ThC'^{212} and ThC''^{208} At^{216} α-decay (G66)
	Bi^{213}	*A*		β⁻; α(2%) (E38), (4%)(H69)	47 min.(H69); 46 min.(E38)	~1.3(β⁻)(E38) abs. Al; ~1.2(β⁻) (H69); 5.86(α) (E38) ion.ch.; 6.0 (α)(H69) ion.ch.		At^{217} α-decay, parent of Po^{213}(H69,E38)
	RaC^{214}	*A*		α(0.04%) (C60); β⁻ (99.96%) (C60), γ(R40)	19.7 min.(C60)	5.505(α,45%), 5.444 (α,55%)(L73) spect.; 3.15(β⁻) (S72) abs. Al, spect.	1.8(R40)	Natural source RaB^{214} β⁻-decay, At^{218} α-decay, parent of RaC'^{214} and RaC''^{210}
84	Po^{203}	*D*		α;K(K134)	40 min.(K134)	5.56(α)(K134) ion.ch.		Pb-α-7*n*(K134)
	Po^{205}	*D*		α; K(K134)	4 hr.(K134)	5.35(α)(K134) ion.ch.		Pb-α-5*n*(K134)
	Po^{206}	*A*		K(~90%), γ,e^-; α(~10%) (T36)	9 days(T36)	5.2(α)(T36) ion.ch.	0.8(T36) abs. Pb	Pb^{204}-α-2*n*, parent of Bi^{206}(T36)
	Po^{207}	*A*		K(~100%), γ;α(0.01%) (T36)	5.7 hr.(T36)	5.1(α)(T36) ion.ch.	1.3(T36) abs. Pb	Pb^{206}-α-3*n*(T36)
	Po^{208}	*B*		α(T36)	3 yr.(T36)	5.14(T36) ion.ch.	No γ(T36)	Pb^{206}-α-2*n*(T36) Pb^{207}-α-3*n*(T36) Bi-*d*-3*n*(T36) Bi-*p*-2*n*(L111)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
84	Po^{210}	*A*		α,γ(R40)	138 days(B141); 140 days(C60)	5.298(H81) spect.; 5.303(C66) spect.	0.773(S54) spect. conv.; 0.8(weak) (D53) abs. Pb	Natural source, RaE^{210} β⁻-decay (L13,C26,H27) Pb-α-2*n*(T36) Bi-*d*-*n*(V4,C26,H27) At^{210} *K*-decay(K132)
	AcC'^{211}	*A*		α	5×10^{-3} sec.(C60)	7.434(L73) spect.		Natural source, AcC^{211} β⁻-decay At^{211} *K*-decay(C46, C23)
	ThC'^{212}	*A*		α	3.0×10^{-7} sec.(H205); 3.4×10^{-7} sec. (J13); 2.6×10^{-7} sec.(B51); 3×10^{-7} sec.(D50)	8.776(B70,H81) spect.		Natural source, ThC^{212} β⁻-decay Em^{216} α-decay (M145)
	Po^{213}	*A*		α(H69,E38)	4.2×10^{-6} sec.(J13)	8.336(C84) ion.ch.; 8.30(H69) ion.ch.		Bi^{213} β⁻-decay, parent of Pb^{209} (H69,E38) Em^{217} α-decay (M145)
	RaC'^{214}	*A*		α	1.5×10^{-4} sec.(D50, R41,W50); 1.55×10^{-4} sec. (J7); 1.4×10^{-4} sec. (R55)	7.680(B70,H81) spect.		Natural source, RaC^{214} β⁻-decay, parent of RaD^{210} Em^{218} α-decay(S146)
	AcA^{215}	*A*		α(~100%); β⁻(5×10^{-4}%) (K55)	1.83×10^{-3} sec.(W50)	7.365(L73) spect.		Natural source, An^{219} α-decay, parent of AcB^{211} and At^{215}
	ThA^{216}	*A*		α(~100%); β⁻(0.014%) (K33)	0.158 sec.(W50)	6.774(B70,H81)(α) spect.		Natural source, Th^{220} α-decay, parent of ThB^{212} and At^{216}
	RaA^{218}	*A*		α(99.96%); β⁻(0.04%) (K51)	3.05 min.(C60)	5.998(α)(B70,H81) spect.		Natural source, Rn^{222} α-decay, parent of RaB^{214} and At^{218}
85	At^{207}	*D*		α;K(?)(T115)	1.7 hr.(T115)	5.76(α)(T115) ion. ch.		Bi-α-6n(T115)
	At^{208}	*D*		α;K(?)(T115)	4.5 hr.(T115)	5.66(α)(T115) ion. ch.		Bi-α-4n(T115)
	At^{210}	*A*		K,γ(K132)	8.3 hr.(K132)		1.0(K132)	Bi-α-3*n*, parent of Po^{210}(K132)
	At^{211}	*A*		α(40%) (C46); K(60%) (C46)	7.5 hr.(C46,C23)	5.89(α)(T115) ion. ch.; 5.94(α)(C46) abs.		Bi-α-2*n*(C46,C23) Th-α-25*a*7*z*(O115) U-α-31*a*9*z*(O115)
	At^{212}	*A*		α(W74)	0.25 sec.(W74)			Bi-α-*n*(W74)
	At^{214}	*B*		α(M145)	Very short(M145)	8.78(M145) ion.ch.		Fr^{218} α-decay(M145)
	At^{215}	*A* (G66)		α(K55,G66)	~10^{-4} sec.(G66); short(K55)	8.00(G66) ion.ch.; 8.4(K55) ion.ch.		Natural source, AcA^{215} β⁻-decay, parent of AcC^{211} (K55) Fr^{219} α-decay, parent of AcC^{211}(G66)
	At^{216}	*A* (G66)		α(K33,G66)	3×10^{-4} sec.(M145); ~10^{-3} sec.(G66); short (<54 sec.) (K33)	7.79(G66) ion.ch.; 7.64(K33) ion.ch.		Natural source, ThA^{216} β⁻-decay, parent of ThC^{212} (K33) Fr^{220} α-decay, parent of ThC^{212}(G66)
	At^{217}	*A*		α(E38,H69)	0.018 sec.(H69); 0.021 sec.(E38)	7.02(C84) ion.ch.; 7.00(H69) ion.ch.		Fr^{221} α-decay, parent of Bi^{213}(E38,H69)
	At^{218}	*F*		α(K51)	Several sec.(?)(K51)	6.72(K51) ion.ch.		Natural source, RaA^{218} β⁻-decay, parent of RaC^{214} (K51)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
86	Em^{216}	*A*		α(M145)	Very short(M145)	8.07(M145) ion.ch.		Ra^{220} α-decay, parent of ThC'^{212} (M145)
	Em^{217}	*A*		α(M145)	$\sim 1\times10^{-3}$ sec.(M145)	7.74(M145) ion.ch.		Ra^{221} α-decay, parent of Po^{213}(M145)
	Em^{218}	*A*		α(S146)	0.019 sec.(S169) S146)	7.12(J12) ion.ch.; 7.1(S146) ion.ch.		Ra^{222} α-decay, parent of RaC'^{214}(S146)
	An^{219}	*A*		α	3.92 sec.(C60)	6.824(82%), (others 18%)(H81,L73) spect.		Natural source, AcX^{223} α-decay, parent of AcA^{215}
	Tn^{220}	*A*		α	54.5 sec.(C60)	6.282(B70,H81) spect.		Natural source, ThX^{224} α-decay, parent of ThA^{216}
	Rn^{222}	*A*		α	3.825 days(C60)	5.486(B70,H81) spect.		Natural source, Ra^{226} α-decay, parent of RaA^{216}
87	Fr^{218}	*B*		α(M145)	Very short(M145)	7.85(M145) ion.ch.		Ac^{222} α-decay, parent of At^{214} (M145)
	Fr^{219}	*A*		α(G66)	~0.02 sec.(M145)	7.30(G66) ion.ch.		Ac^{223} α-decay, parent of At^{215}(G66)
	Fr^{220}	*A*		α(G66)	27.5 sec.(M145); ~30 sec.(G66)	6.69(G66) ion.ch.		Ac^{224} α-decay, parent of At^{216}(G66)
	Fr^{221}	*A*		α(E38,H69)	4.8 min.(H69); 5 min.(E38)	6.30(H69,C84) ion. ch.		Ac^{225} α-decay, parent of At^{217}(E38,H69)
	Fr^{223} (AcK)	*A*		β^-,γ(P41, P43)	21 min.(P40,P43)	1.20(P42,P41) cl.ch.	0.090(L82) abs. Al	Natural source, Ac^{227} α-decay (P40), parent of AcX^{223}
88	Ra^{220}	*A*		α(M145)	Short(M145)	7.49(M145) ion.ch.		Th^{224} α-decay, parent of Em^{216} (M145)
	Ra^{221}	*A*		α(M145)	31 sec.(M145)	6.71(M145) ion.ch.		Th^{225} α-decay, parent of Em^{217} (M145)
	Ra^{222}	*A*		α(S146)	38 sec.(S146)	6.51(J12) ion.ch.; 6.5(S146) ion.ch.		Th^{226} α-decay, parent of Em^{218} (S146)
	AcX^{223}	*A*		α,γ(R40)	11.2 days(C60)	5.717(55%),5.606 (36%), (others 9%)(L73) spect.		Natural source, $RdAc^{227}$ α-decay, AcK^{223} β^--decay, Ac^{223} K-decay (M145), parent of An^{219} U-α-19*a*6*s*(O115) U-*d*-17*a*5*s*(O115)
	ThX^{224}	*A*		α	3.64 days(L71)	5.681(B70) spect.; 5.66(C120) ion.ch.		Natural source, $RdTh^{228}$ α-decay, parent of Th^{220} U-α-18*a*6*s*(O32) U-*d*-16*a*5*s*(O115) Ac^{224} *K*-decay(G147)
	Ra^{225}	*A*		β^-(E38,H69)	14.8 days(H69); 14 days(E38)	~0.2(H69) abs. Al; <0.05(E38) abs.		Th^{229} α-decay, parent of Ac^{225} (E38,H69)
	Ra^{226}	*A*		α,γ(C60)	1622 yr.(A106,K125); 1631 yr.(C123); 1590 yr.(C60)	4.791(L73) spect.	0.19(R40)	Natural source, Io^{230} α-decay, parent of Rn^{222}
	Ra^{227}	*A*		β^-				Ra-*n*-γ, parent of Ac^{227}(P105)
	$MsTh_1^{228}$	*A*		β^-	6.7 yr.(C60)	<0.015(L90) cl.ch.; 0.053(L72) spect., abs. Al		Natural source, Th^{232} α-decay, parent of $MsTh_2^{228}$
89	Ac^{222}	*B*		α(M145)	Short(M145)	6.96(M145) ion.ch.		Pa^{226} α-decay, parent of Fr^{218}(M145)

Table of Isotopes— *Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
89	Ac^{223}	A		α(99.9%); K(0.1%) (M145)	2.2 min.(M145)	6.64(G66) ion.ch.		Pa^{227} α-decay, parent of Fr^{219}(G66) and AcX^{223}(M145)
	Ac^{224}	A		α(~10%); K (~90%) (G66)	2.9 hr.(M145); 2.5 hr.(G66)	6.17(G66) ion.ch.		Pa^{228} α-decay, parent of Fr^{220} and ThX^{224} (G66)
	Ac^{225}	A		α(E38,H69)	10.0 days(H69,E38)	5.80(H69,C84) ion.ch.		Ra^{225} β^--decay(E38, H69) Th^{228} *K*-decay (M145) Pa^{229} α-decay(H106) Parent of Fr^{221} (E38, H69) U-*d*-15*a*4*z*(O115)
	Ac^{226}	A		β^-	22 hr.(S186)			U-α-16*a*5*z*, parent of Th^{226}(S186)
	Ac^{227}	A		α(1.2%) (P40,P54), (1.25%) (P112); β^-(99%) (P40, P112),γ, e^-(L82)	21.7 yr.(C69); 13.5 yr.(C60)	4.94(α)(100%) (H148) ion.ch.; 4.95(α)(85%), 4.6(α)(15%)(G61) ion.ch.; 4.95(α) (P112) ion.ch.; <0.01(?)(β^-)(L82)	0.037(weak)(L82, P54) abs. Al	Natural source, Pa^{231} α-decay, parent of $RdAc^{227}$ and AcK^{223} Ra^{227} β^--decay (P105)
	$MsTh_2^{228}$	A		β^-,γ(C60); α(?)(G40)	6.13 hr.(C60)	1.55(β^-)(L6) spect.; 4.54(α)(G40) abs. air		Natural source, $MsTh_1^{228}$ β^--decay parent of $RdTh^{228}$
90	Th^{224}	A		α(M145)	Short(M145)	7.20(M145) ion.ch.		U^{228} α-decay, parent of Ra^{220}(M145)
	Th^{225}	A		α(90%); K(10%) (M145)	7.8 min.(M145)	6.57(M145) ion.ch.		U^{229} α-decay, parent of Ra^{221} and Ac^{225} (M145)
	Th^{226}	A		α(S146)	30.9 min.(S146)	6.30(J12) ion.ch.; 6.3(S146) ion.ch.		U^{230} α-decay, parent of Ra^{222}(S146) Ac^{226} β^--decay (S186)
	$RdAc^{227}$	A		α,γ(C60)	18.6 days(P110); 18.9 days(C60)	6.049(20%), 5.988 (25%), 5.764 (20%), 5.717 (15%)(others 20%) (L73) spect.		Natural source, Ac^{227} β^--decay, parent of AcX^{223} U-*d*-13*a*3*z*(O115)
	$RdTh^{228}$	A		α,γ(C60)	1.90 yr.(C60)	5.418(83%), 5.333 (17%)(L73) spect.; 5.38(C120) ion.ch.		Natural source, $MsTh_2^{228}$ β^--decay, parent of ThX^{224} U^{232} α-decay(G112) Pa^{228} *K*-decay(G147)
	Th^{229}	A		α(H69,E38)	7000 yr.(H69); ~10^4 yr.(E38)	5.02, 4.94, 4.85(J136) ion.ch.; 5.05 (~10%), 4.95 (~20%), 4.85 (~70%)(H123) ion.ch.		U^{233} α-decay, parent of Ra^{225}(H69,E38)
	Io^{230}	A		α,γ(W53)	8.0×10^4 yr.(H124); 8.3×10^4 yr.(C60)	4.66(G41) abs. air; 4.81(W51) calor.; 4.66(C119,C120) ion. ch.		Natural source, UII^{234} α-decay, parent of Ra^{226} Pa^{230} K-decay(S187)
	UY^{231}	A		β^-,γ,e^-	25.65 hr.(J135); 25.5 hr.(K130); 24.0 hr.(G43); 24.6 hr. (C60)	0.21(K130); ~0.2 (E30,J133) abs.	0.035(K130); 0.035, 0.065(J133) abs. Pb, Cu, Ag	Natural source, AcU^{235} α-decay, parent of Pa^{231} Th-*n*-2*n*(N5,S128)
	Th^{232}	A	100(D45)	α	1.39×10^{10} yr.(K50)	3.98(C120) ion.ch.; 4.20(S73) ion.ch.		Natural source (C62,S76), parent of $MsTh_1^{228}$
	Th^{233}	A		β^-	23.5 min.(S128); 23 min.(C12)	1.2(S128) abs. Al	No γ(S128)	Th-*n*-γ(M17,S128) Th-*d*-*p*(G112)

Table of Isotopes—*Continued*

Isotope Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
90	UX_1^{234}	*A*		β^-,γ(M60, F40)	24.10 days(K131); 24.1 days(S70); 24.5 days(C60)	0.11, 0.20(F40) abs. Al; 0.13(S72) abs. Al, spect.; 0.190 (J6) spect.; 0.205 (B79) spect.	0.092(M60)(1%) (F40); 0.092(J6) spect. conv.; 0.093(20%)(B52, B79) spect. conv.	Natural source, U_I^{238} α-decay, parent of UX_2^{234m}
91	Pa^{226}	*B*		α(M145)	1.7 min.(M145)	6.81(M145) ion.ch.		Th-*d*-8*n*, parent of Ac^{222}(M145)
	Pa^{227}	*A*		α(~80%); K (~20%) (G66)	38 min.(G66)	6.46(G66) ion.ch.		Th-*d*-7*n*, parent of Ac^{223} and $RdAc^{227}$ (G66) U-α-3*z*15*a*(O32) Np^{231} α-decay(G147)
	Pa^{228}	*A*		α(~2%); K (~98%) (G66)	22 hr.(G66)	6.09(G66) ion.ch.		Th-*d*-6*n*, parent of Ac^{224} and $RdTh^{228}$ (G66)
	Pa^{229}	*A*		α(~1%); K(~99%) (M145)	1.5 days(H145); 1.4 days(H106)	5.69(M145) ion.ch.; 5.66(H145) ion.ch.		Th^{230}-*d*-3*n*(H106) Parent of Ac^{225} (H106)
	Pa^{230}	*A*		β^-(S146), γ(O108); K(M145, S187) (~90%) (S187)	17.7 days(O108); 17 days(S146)	~1.1(O108) abs. Al	0.94(O108) abs. Pb	Parent of U^{230}(S146) Th-α-*p*5*n*(S146) Th^{230}-*d*-2*n*(H106) Th-*d*-4*n*(S146) Pa-*d*-*p*2*n*(O108) Pa-α-α*n*(O108) U^{233}-*d*-α*n*(H104)
	Pa^{231}	*A*		α(C60), γ(S152)	3.43×10^4 yr.(V101); 3.2×10^4 yr.(G42)	5.012(87%), 4.736 (13%)(C119) ion. ch.; 5.00(~85%), 4.69–4.72(~15%) (T34) ion.ch.; 5.049(R42) spect.	0.095, 0.294, 0.323 (M70) spect. conv.; 0.308(S179) abs. Pb	Natural source, UY^{231} β^-decay, parent of Ac^{227} Th-*d*-3*n*(S146) Th-*n*-2*n*, UY^{231} β^--decay (S128)
	Pa^{232}	*A*		β^-,γ(G112), e^-(J134)	1.32 days(J128); 1.4 days(O108, S146); 1.6 days (G112)	~0.28(J134) abs. Al	1.05, ~0.23(J134) abs. Pb; 1.0 (O108) abs. Pb	Th-*d*-2*n*(G112,S146) Th-α-*p*3*n*(S146) Pa-*d*-*p*(O108)
	Pa^{233}	*A*		β^-,γ,e^-(H40, S128, M108, F106)	27.4 days(G12)	0.4(S38) abs. Al; 0.23(H40) spect.; 0.5(S128) abs. Al; ~0.7(F106) spect.	0.084, 0.298, 0.309, 0.337(L81) spect. conv.; e^- lines at 0.063, 0.077, 0.192, 0.293(H40) spect.; 0.33(S147) abs. Pb	Th^{233} β^--decay (S38, G12,H39,S128) Np^{237} α-decay (L106), parent of U^{233}(S128,S55) Th-*d*-*n*(G112,S146) Th-α-*p*2*n*(S146)
	UZ^{234}	*A*		β^-,γ(F40)	6.7 hr.(C60)	0.56, 1.55(F40) abs. Al; 0.45(B39) spect.	0.70(F40) abs. Pb, W	Natural source, UX_2^{234m} I.T.(F40), parent of U_{II}^{234}
	UX_2^{234m}	*A*		β^-,γ(M61); I.T. (0.15%) (F40, B39)	1.14 min.(C60); 1.22 min.(H142)	1.52(5%), 2.32(95%) (M61) spect.; 2.32(S72) abs. Al	0.802(5%)(M61) spect. conv.; 0.782, 0.822(B32) spect. conv.; 0.396(I.T.) (B39) spect. conv.	Natural source, UX_1^{234} β^--decay, parent of UZ^{234} and U_{II}^{234}
92	U^{228}	*A*		α(80%); K (20%) (M145)	9.3 min.(M145)	6.72(M145) ion.ch.		Th-α-8*n*, parent of Th^{224}(M145) Pu^{232} α-decay(J132)
	U^{229}	*A*		α(~20%); K(~80%) (M145)	58 min.(M145)	6.42(M145) ion.ch.		Th-α-7*n*, parent of Th^{225}(M145)
	U^{230}	*A*		α(S146)	20.8 days(S146)	5.85(J12) ion.ch.; 5.86(S146) ion.ch.		Pa^{230} β^--decay (S146, O108), parent of Th^{226}(S146) Pu^{234} α-decay(P102) Th-α-6*n*(S146) Pa-*d*-3*n*(O108) Pa-α-*p*4*n*(O108) U-*d*-10*az*(O115)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
92	U^{231}	*B*		K(O108)	4.2 days(O108)			Pa-*d*-2*n*(O108) Pa-*α*-*p*3*n*(O108)
	U^{232}	*A*		*α*(G112)	70 yr.(J109); 30 yr. (G112)	5.31(J125) abs. Al; 5.27(K122)		Th-*α*-4*n*(N115) Pa^{232} *β*⁻-decay (G112,O108) Pu^{236} *α*-decay(J109), parent of $RdTh^{228}$ (G112) Pa-*d*-*n*(O108) Pa-*α*-*p*2*n*(O108)
	U^{233}	*A*		*α*(S128,S55), *γ*,*e*⁻(S168)	1.62×10^5 yr.(H105); 1.63×10^5 yr. (L121); 1.2×10^5 yr.(S128)	4.823(C84) ion.ch.; 4.80(C110) abs. air	0.31, 0.080, 0.040 (weak)(S168) abs. Pb, Cu, Al	Pa^{233} *β*⁻-decay(S128, S55), parent of Th^{229}(H69,E38)
	U_{II}^{234}	*A*	0.0051 (W118)	*α*	2.35×10^5 yr.(C126, C54); 2.69×10^5 yr.(N41)	4.763(C119) ion.ch.; 4.78(S75) abs. air; 4.76(S77) ion.ch.		Natural source, UX_2^{234m} and UZ^{234} *β*⁻-decay, parent of Io^{230}
	AcU^{235}	*A*	0.71(N39)	*α*,*γ*(S178, M144)	8.91×10^8 yr.(C119); 7.07×10^8 yr. (N41); 8.52×10^8 yr.(B113)	4.56(M144)(20%) (C119), 4.396 (80%)(C119) ion. ch.; 4.35(B113); 4.34(B114) ion.ch.	0.162(M144) abs. Pb; 0.187(S178) abs.Pb	Natural source (D51), parent of UY^{231}
	U^{237}	*A*		*β*⁻,*γ*(M37), *e*⁻(B115)	6.8 days(W107); 6.63 days(M50)	~0.23(M50) spect.; 0.135, 0.35, (1.6?) (B115) abs. Al; 0.26(M37) abs.; 0.17, 0.22(A101) abs. Al, Cellophane	0.057, 0.204, 0.260, 0.032(M50) spect, conv.; 0.14, 0.23, 0.53(B115) abs. Pb	U-*n*-2*n*(M37,N8, W107,A101), parent of Np^{237} (W72) U-*d*-*t*(B115,A101, J109) U-*α*-*αn*(J109) Pu^{241} *α*-decay (K109, S144)
	U_I^{238}	*A*	99.28(N39)	*α*	4.51×10^9 yr.(N41); 4.498×10^9 yr. (C119)	4.180(C119) ion.ch.; 4.23(S75) abs. air; 4.21(S77) ion.ch.		Natural source (B72), parent of UX_I^{234}
	U^{239}	*A*		*β*⁻,*γ*,*e*⁻(F39)	23.5 min.(F107,F39); 23 min.(I1,S4); 23.2 min.(W108); 23.54 min.(M109)	1.20(F39,F44) abs. Al; 1.2(W108, M108) abs. Al; 1.12, 2.06(weak) (S203) spect.	0.076, >0.3(weak) (F107,F39,F44) abs. Pb; 0.073, 0.92(S203) spect. conv., abs. Pb	U-*n*-*γ*(H18,H14,I1, M19,S44), parent of Np^{239}(M28, S39,S44) U-*d*-*p*(S131)
93	Np^{231}	*A*		*α*, K(G147)	53 min.(G147)	6.2(*α*)(G147) ion.ch.		U-*d*-9*n*, parent of Pa^{227}(G147) U^{235}-*d*-6*n*(G147) U^{238}-*d*-4*n*(G147)
	Np^{234}	*B*		K,*γ*(J109)	4.40 days(H104); 4.4 days(O108)		1.9(H104) abs. Pb	Pu^{234} *K*-decay(?) (P102) U^{233}-*d*-*n*(H104) U^{235}-*d*-3*n*(J109) Pa-*α*-*n*(O108) U^{233}-*α*-*p*2*n*(H104, P102) U^{235}-*α*-*p*4*n*(J109) U^{235}-*p*-2*n*(G131)
	Np^{235}	*B*		K(J109); *α* (~0.1%) (J130)	435 days(J130); 400 days(J109)	5.06(*α*)(J130) ion.ch.	No *γ*(?)(J109)	U^{235}-*d*-2*n*(J109) U^{233}-*α*-*pn*(H104) U^{235}-*α*-*p*3*n*(J109)
	Np^{236}	*A*		*β*⁻,*γ*(J109)	22 hr.(J109)	0.5(M146) abs. Be		Parent of Pu^{236} (J109) U^{235}-*d*-*n*(J109) U-*d*-4*n*(J109) U^{233}-*α*-*p*(H104) U^{235}-*α*-*p*2*n*(J109) Np-*d*-*t*(J110) Np-*α*-*αn*(J110)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
93	Np^{237}	*A*		α(W107, W72)	2.20×10^6 yr.(M129, M92); 3×10^6 yr. (W107,W72)	4.77(G148) ion.ch.; 4.75(G113) abs. air; 4.73(J102) abs. Al; 4.72(L122) abs. mica		U^{237} β^--decay(W107, W72), parent of Pa^{233}(L106)
	Np^{235}	*A*		β^-,γ(S79), ϵ^-(J107)	2.10(J126); 2.0 days (S131)	0.22, 1.39(J126) abs. Al; 1.0(S131) abs. Al	1.2, 0.075(J126) abs. Pb, abs. of ϵ^-; 1.1(S131) abs. Pb	Parent of Pu^{235}(S80) U^{238}-*d*-2*n*(K108) U-*d*-2*n*(S79,S131, K108) Am^{242} α-decay(S144) U-α-*p*3*n*(J109) U-α-*p*(J109) Np-*n*-γ(J107) Np-*d*-*p*(J110)
	Np^{239}	*A*		β^-,γ,ϵ^-(F107, W108, M108)	2.33 days(W108); 2.3 days(M28, M19); 2.35 days (F107)	0.68, 0.33, 0.090 (H125) abs.; 0.47 (M28) abs.; 0.14, 0.40, 0.63(F107) abs. Al; 0.78 (S131,W108) abs. Al; 0.288, 0.403, 0.673, 1.179(S203) spect.	0.057, 0.061, 0.067, 0.206, 0.227, 0.275 (S203) spect. conv.; 0.2094, 0.2280, 0.2774, numerous softer γ's(F108) spect. conv.; 0.22, 0.27 (H25) spect. conv., spect.	U^{239} β^--decay(M28, S39,S44,), parent of Pu^{239} (K69) U-*d*-*n*(S79,S131, J109) U-α-*p*2*n*(J109)
94	Pu^{232}	*B*		α(J132)	22 min.(J132)	6.6(J132) ion.ch.		U^{236}-α-7*n*, parent of U^{228}(J132)
	Pu^{234}	*A*		α; K(P102)	8 hr.(H104); 8.5 hr. (P102)	6.2(P102) ion.ch.; 6.0(H104) ion.ch.		U^{233}-α-3*n*(H104, P102) Parent of U^{230} and Np^{234}(?)(P102)
	Pu^{236}	*A*		α(J109)	2.7 yr.(J109)	5.75(G148) ion. ch.; 5.7(J109) ion.ch.		Np^{236} β^--decay (J109) Cm^{240} α-decay(S142) Parent of U^{232}(J109) U^{235}-α-3*n*(J109) U^{233}-α-*n*(H104,P102) U-α-6*n*(J109) Np-α-*p*4*n*(J110) Np-*d*-3*n*(J110)
	Pu^{237}	*B*		K(J109)	40 days(J109)		No γ(J109)	U^{235}-α-2*n*(J109) U-α-5*n*(J109) Np-*d*-2*n*(J110)
	Pu^{238}	*A*		α(S80)	92 yr.(S142); 89 yr.(J123); 40 yr.(S131)	5.51(C110,C70) abs. air; 5.5(S131) abs. air, Al; 5.4(F109) abs. Al; 5.493 (J10) ion.ch.		Np^{238} β^--decay(S80, S131,K108) Cm^{242} α-decay(S142) Np-*d*-*n*(J110) U-α-4*n*(J109) U^{235}-α-*n*(J109)
	Pu^{239}	*A*		α(K69),γ,ϵ^- (G114)	2.411×10^4 yr.(S56) calor.; 2.44×10^4 yr.(W110)	5.15(C110,C70) abs. air; 5.1(K102) abs. air; 5.16(P101) cl.ch.; 5.140(J10) ion.ch.; 5.159 (C84) ion.ch.)	0.42, 0.2(weak) (S170) abs. Pb; 0.05, 0.3(weak) (G114) abs. Pb, Al	Np^{239} β^--decay(K69) Natural source (S134) U-α-3*n*(J109)
	Pu^{240}	*A*		α(J109)	~6000 yr.(J109) yield	5.1(J109) ion.ch.		U-α-2*n*(J109)
	Pu^{241}	*A* (B126) m.s.		β^-(S144); α (K109, S144) (~.002%) (S145)	~10 yr.(S144) yield	0.01–0.02(β^-)(S144) abs. hydrocarbon; 5.0(α)(S210) calc.		U-α-*n*(S144,J109) Parent of Am^{241} (S144) and U^{237} (K109,S144)
95	Am^{238}	*D*		K(?)(J129)	1.5 hr.(J129)			Pu-*d*-3*n*(J129)
	Am^{239}	*B* (J129)		K(~100%), ϵ^-, γ; α(~0.1%), (S144)	12 hr.(S144)	5.77(α)(J129) ion.ch.	0.285(S144) abs. Pb, abs. of ϵ^-	Pu-*d*-2*n*(S144) Pu-*p*-*n*(J129) Np-α-2*n*(S144)

Table of Isotopes—*Continued*

Z	Isotope A	Class	Percent abundance	Type of radiation	Half-life	Energy of radiation in Mev: Particles	Energy of radiation in Mev: γ-rays	Produced by
95	Am^{240}	*B* (J129)		K,γ,e^-(S144)	50 hr.(S144); 53 hr. (J129)		1.3(S144) abs. Pb, abs. of e^-	Pu-*d*-*n*(J129,S144) Np-α-*n*(S144)
	Am^{241}	*A*		α,γ(S144)	490 yr.(C136); 510 yr.(C129)	5.48(G148) ion.ch.; 5.45(S144) ion.ch.	0.062(S144) abs. Pb	Pu^{241} β^--decay(S144)
	Am^{242m}	*A*		β^-(A107)	16 hr.(A107); 17 hr. (S144)	0.8(S144) abs. Al		Am-*n*-γ(A107,S144) Parent of Cm^{242} (S142,A107)
	Am^{242}	*A*		α(~0.2%), β^-(S144)	~400 yr.(T114, S144)	~0.5(β^-)(S144) abs. Al; 5.2(α)(S210) calc.		Am-*n*-γ, parent of Cm^{242} and Np^{238} (S144)
96	Cm^{238}	*B*		α(S188)	~2.5 hr.(S188)	6.50(S188) ion.ch.		Pu-α-5*n*(S188)
	Cm^{240}	*A*		α(S142)	26.8 days(S142)	6.26(G148) ion.ch.; 6.3(S142) ion.ch.		Pu-α-3*n*(S142) Parent of Pu^{236}(S142)
	Cm^{241}	*E*		K(S142)	55 days(S142)			Pu-α-2*n*(S142)
	Cm^{242}	*A*		α(S142)	150 days(S142)	6.08(G148) ion.ch.; 6.1(S142) ion.ch.		Pu-α-*n*(S142) Am^{242} and Am^{242m} β^--decay(S142, A107) Parent of Pu^{238} (S142)

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