

人工放射性元素表 (1939 末現在)

放射性同位元素は現在既に原子番號 85 以下の總ての元素に互つて報告されてゐる。本表は自然活性核 (本誌前號, p. 98—106 参照) 以外の總ての人工的放射性同位元素を, その主要なる特性に關聯する事項と共に, J. J. Livingood 及 G. T. Seaborg が 1939 年十二月一日迄の文獻に據て, 今年の *Reviews of Modern Physics* 誌上に掲載した一覽表を再録したものである。

必要な參考文獻は夫々アルファベットと數字との組合せ (例へば, A1, A2, B1, B2 の如し) を以て之を表はし, 表中各關聯する項目の箇所に夫々附記される。各參考文獻の明細は更に取纏めて表の最後に記載される。

1. *Z*- 欄は原子番號。
2. *A*- 欄は質量數。
3. *Class*- 欄は各記載事項の確實性程度の差違を示すもので, 次の省略記號に依て之が示される。即ち

A— 同位元素確定的 (質量數及元素確定的)

B— 同位體可能的, 元素確定的

C— 數箇の同位體の内何れか一つ, 元素確定的

D— 元素確定的

E— 元素可能的

F— 證據不十分

G— 多分誤謬ならん (不純物或は不適當な半減期決定等の爲めに)。

4. *Type of Radiation*- 欄には次の略號が用ひられる。即ち

β^- — 陰 β -粒子

β^+ — 陽 β -粒子

γ — γ -線

e^- — 内部變換電子

K — K- 軌道電子捕獲

I.T. — 異性核轉移 (核異性の高い状態より低い状態への轉移)。

γ 線放出のない事が確實な場合には, 此事實を “no γ ” の記號を以て第 7 欄に記入される。

5. *Half-Life*- 欄, 半減期に數箇の數値が報告されてゐる場合には, その最良と思はれる實驗値が引用される。
6. *Energy of Radiation*- 欄にはエネルギー値と共に其出所文獻及エネルギー決定に用ひられた方法が記入される。此處に與へられる β - 粒子のエネルギーはスペクトルの上

限の観測値に相当し、唯單に Konopinski-Uhlenbeck の外挿値のみが報告されてゐる場合には、“K. U.” の記號を之に附して其數値が記載される。

- (i) 粒子のエネルギー決定に用ひられた方法は次の略號に依て夫々表示される。即ち

abs.— 吸収

cl. ch.— 磁場をもつた cloud chamber

spect.— 電子の磁氣スペクトル或はスペクトロメター。

- (ii) 又 γ -線のエネルギー決定に用ひられた方法を附記する爲めに次の記號を用ふる。

abs.— 吸収

cl. ch. recoil— 磁場をもつた cloud chamber 中の二次電子

cl. ch. pair— 磁場をもつた cloud chamber 中の陰陽電子對

coincidl. abs.— coincidence counters 及 absorber に依る二次電子

spect. conv.— 磁氣スペクトログラフに依る internal conversion electrons

spect.— 磁氣スペクトログラフに依る二次電子

abs. of e^- — 内部變換電子の吸収。

内部變換電子が放出される場合には、掲出のエネルギー値は常に相當する γ 線轉移のエネルギーである。

7. “Produced by” 欄には夫々所定の放射性同位元素生成に就て観測された核反應（ターゲット元素、投射粒子及生成殘餘粒子の順序に表示する）及其參考文獻が列舉される。
(p =プロトン, n =ニウトン, α = α -粒子, d =重水素イオン, γ = γ -線)

ニウトロンに依て誘導される重元素の分裂反應は U- n , Th- n , 及 Pa- n の記號に依て記入されてゐる。

RADIO-ELEMENT		CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
Z	A				PARTICLES	γ -RAYS		
1	H ³	A	β^-	~ 150 d.(A7)	~ 0.02 (A7) abs.		D-d-p(A7)	A7
2	He ⁴	A	β^-	0.8 s.(B1)	3.7(B1, B2) cl. ch.		Be-n-a(B1, P1, B3) (Li-n-p)(K1, N1)	B1, N1, K1, P1, B2, B3
3	Li ⁶	A	β^-, α	0.88 s.(L1)	12(β^-)(B4) cl. ch.		Li-d-p(C1, L1, R14, D1) B-n-a(L24), (Li-n-y)(K1)	L1, B4, C1, D1, R14, K1, L24
4	Be ⁷	A	K, γ	43 d.(R1)		0.45(R1, M1) abs. Pb.	Li-d-n(R1, R13) B-p-a(R1, M1) Li-p-n(H1, H2)	R1, M1, H1, H2, R13
5	B ¹¹	A	β^-	0.022 s.(C2, B22)	12(H4) cl. ch.		B-d-p(C2, F1, B5)	C2, F1, B4, B5, B22
6	C ¹¹	A	β^+	21.0 m.(R11)	1.15(F1) cl. ch.		B-d-n(F1, C4, Y1) B-p-y(C3, B23) B-p-n(H23) N-p-a(B23) C-n-2n(P2)	F1, C3, Y1, C4, P2, B23 R11
7	N ¹²	A	β^+, γ	9.93 m.(W12)	0.92, 1.20 (L22) spect.	0.28(R2) cl. ch. recoil	C-d-n(H13, Y1, C4, F1) C-p-y(H3, C4) B-a-n(E1, R3) N-n-2n(P2) N-d-p(F1) O-n-p(C5) F-n-a(N1, P1, N4)	H3, E1, Y1, R2, C4, F1, P2, B20, L22, W12 F1, C5, P1, N1, N4
	N ¹⁴	A	β^-	8 s.(C5, N1)	6.0(F1) cl. ch.			
8	O ¹⁵	A	β^+	126 s.(M3, B20)	1.7(F1) cl. ch.		N-d-n(M3, F1) O-p-n(B20) O-n-2n(P2) N-p-y(D2) C-a-n(K3) F-n-p(N1, A1)	M3, F1, B20, P2, D2, K3
	O ¹⁷	A	β^-	31 s.(N1)				N1, A1
9	F ¹⁷	A	β^+	70 s.(N2)	2.1(K4) cl. ch.		O-d-n(N2, F1) N-a-n(R3) O-p-y(D2) Ne-d-a(S1) O-p-n(D2) F-n-2n(P2) O-d-n or O-d-y(Y2) F-d-p(F1, C1) F-n-y(N1) Na-n-a(N1)	N2, K4, F1, R3, D2 S1, D2, P2, Y2, B20
	F ¹⁸	A	β^+	112 m.(S1)	0.7(V2) cl. ch.			
	F ²⁰	A	β^-	12 s.(C1)	5.0(F1) cl. ch.			F1, C1, N1
10	Ne ¹⁸	A	β^+	20.3 s.(W7)	2.20(W7) cl. ch.		F-p-n(W7)	W7
	Ne ²³	A	β^-	40 s.(A1, B6)			Na-n-p(A1, N1, P1) Mg-n-a(A1, B6)	A1, N1, B6, P1
11	Na ²²	A	β^+	3.0 y.(L3)	0.58(L3) cl. ch.	1.3(O2) spect.	Mg-d-a(L3) F-a-n(L3, M4) Ne-d-n(L3) Na-d-p(L4, V1) Na-n-y(A1) Mg-n-p(A1) Al-n-a(A1) Mg-d-a(H4)	L3, M4, O2
	Na ²⁴	A	β^-, γ	14.8 h. (V1)	1.4(L21) spect.	1.0, 2.0, 3.0(K4) cl. ch. recoil		L4, A1, R4, H4, V1, L21
12	Mg ²⁴	A	β^+	11.6 s.(W7)	2.82(W7) cl. ch.		Na-p-n(W7, D9)	W7, D9
	Mg ²⁷	A	β^-, γ	10.2 m.(H4)	1.8(C13) cl. ch.	0.9(R4) cl. ch. recoil	Mg-d-p(H4) Mg-n-y(A1) Al-n-p(A1)	H4, A1, R4, C13
13	Al ²⁴	A	β^+	7.0 s.(W7, F2)	2.99(W7) cl. ch.		Na-a-n(M4, F2) Mg-p-n(W7, D9) Al-d-p(M5) Al-n-y(A1) Si-n-p(A1) P-n-a(A1) Mg-a-p(E2, R3) Mg-a-n(B27, H21, F3)	M4, F2, W7, D9 M5, C6, A1, E2, R3
	Al ²⁵	A	β^-, γ	2.4 m.(A1, M5, E2)	3.3(C6) cl. ch.	2.3(C6) cl. ch. recoil		B27, H21, F3
	Al ²⁸	A	β^-	6.7 m.(B27)	2.5(B27) cl. ch. and abs.			
14	Si ²⁷	A	β^-	3.7 s.(K8)			Al-p-n(K8) Si-d-p(N3) Si-n-y(A1) P-n-p(A1, P2) S-n-a(S2, C9)	K8
	Si ³¹	A	β^-	170 m.(N3)	1.8(K4) cl. ch.	No γ (N3)		N3, K4, A1, P2, S2, C9

RADIO-ELEMENT		CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
Z	A				PARTICLES	γ -RAYS		
15	P ³⁰	A	β^+	2.55 m.(R3)	3.6(A2) spect.		Al- α -n(R3, C7) S-d- α (S2) P-n-2n(P2) P- γ -n(B20) Si-p-n(B23) Si-He ⁺ -p(A7) P-d-p(N3) P-n- γ (A1) S-n-p(A1) Cl-n- α (A1) S-d- α (S2) Si- α -p(F3)	C7, R3, A2, S2, P2, B20, A7, B23
	P ³²	A	β^-	14.30 d.(C8)	1.69(L5) spect.	No γ (K4)		N3, L5, C8, A1, K4, S2, F3
16	S ³¹	F	β^+	26 m.(P2)			S-n-2n(P2) Cl-n-p(A3, L6)	P2
	S ³⁴	A	β^-	88 d.(L6)	0.107(L6) spect.			A3, L6
17	Cl ³⁴	A	β^+	33 m.(S2, B21)	2.5(B21) abs.		P- α -n(F2, R3, B21) S-d-n(S2) Cl-n-2n(P2) Cl- γ -n(B20) Cl-n- γ (G9) Cl-d-p(G9)	F2, R3, S2, P2, B20, B21
	Cl ³⁶	A	β^+ , K, β^-	>1 y.(G9)	0.7(β^-)(G9) abs.			G9
	Cl ³⁸	B	β^- , γ	37 m.(V1)	4.8(K4) cl. ch.	2.0, 2.5(R7) cl. ch. recoil	Cl-d-p(K4, V1) Cl-n- γ (A1) K-n- α (H5)	K4, R7, V1, H5, A1
18	A ³⁸	G	β^-	4 m.(P2)			K-n-p(P2) A-d-p(S3) K-n-p(H5) A-n- γ (S3) S- α -n(?) (K3)	P2
	A ⁴¹	A	β^- , γ	110 m.(S3)	2.7(K4) cl. ch.	1.37(R8) cl. ch. recoil		S3, K4, R8, H5
	A ^{40, 37}	F		1.1 hr.(K3)				K3
19	K ⁴¹	A	β^+ , γ	7.7 m.(H5, R3)	2.3(R3) abs.		Cl- α -n(H5, R3) Ca-d- α (H5) K-n-2n(P2) K-d-p(H5) K-n- γ (H5, A1) Ca-n-p(H5) Sc-n- α (H5) Ca-n-p(W1, W8)	H5, R3, P2
	K ⁴²	A	β^-	12.4 h.(H5)	3.5(K4) cl. ch.			H5, K4, A1
	K ^{43, 44}	C	β^-	18 m.(W1, W8)				W1, W8
20	Ca ³⁹	F	β^+	4.5 m.(P2, W8)			Ca-n-2n(?) (P2, W8) Ca-d-p(W8) Ca-n-2n(W8) Ca-n- γ (W8) Ca-d-p(W8, W5) Sc-n-p(W8) Ca-d-p(W8) Ca-n- γ (W8) Ca-d-p(W8)	P2, W8
	Ca ⁴⁰	B	K, γ (W8)	8.5 d.(W8)		1.1(W8) abs. Pb		W8
	Ca ⁴⁶	A	β^- , γ	180 d.(W8)	0.2, 0.9(W8) abs.	0.7(W8) abs.		W8, W5
	Ca ⁴⁷	A	β^- , γ	2.5 h.(W8)	2.3(W8) abs.	0.8(W8) abs.		W8
	Ca ⁴⁸	B	β^-	30 m.(W8)				W8
21	Sc ⁴³	A	β^+	13.4 d.(W8)	1.4(W8) abs.		K- α -n(W8) Ca- α -p(F4, W3) Ca-d-n(W3) Ca-p-n(D2, D9) Sc-n-2n(B9) K- α -n(W3) Ca-d-n(W3) Ca-p-n(D2, D9) Ti-d- α (W4) Sc-n-2n(B9) K- α -n(W3) Ca-d-n(W3) Ca-p-n(D2, D9) Sc- γ -n(B20) Sc ⁴⁴ (52h.) / T.(W8) Sc-d-p(W1, W5) Sc-n- γ (W1) Ti-d- α (W1) Ca- α -p(W8) Ti-n-p(W4) Ca- α -p(W8), Ti-n-p(W8) Ti-n-p(W4, P2, W8) V-n- α (W4, P2, W8) Ca-d-n(W8) Ti-n-p(W8) Ca ⁴⁴ (2.5 h.) β^- decay (W8)	W8
	Sc ⁴³	A	β^+	4 h.(W3)	1.3(W3) cl. ch.	1.0(W8) abs. Pb		F4, W3, D2, D9, W8
	Sc ⁴⁴	A	I.T., e^- (W8)	52 h.(W3)		0.25(W8) abs. of e^-		B9, W3, D2, W4, D9, W8
	Sc ⁴⁶	A	β^+	4 h.(B9)	1.6(W3) cl. ch.			B9, W3, D2, D9, B20, W8
	Sc ⁴⁸	A	β^- , γ ; K(W5)	85 d.(W5)	0.26, 1.5(β^-)(W8) abs.	1.25(W8) abs. Pb		W1, W5, W8, W4
	Sc ⁴⁷	B	β^- , γ	63 h.(W8)				W8
	Sc ⁴⁸	A	β^- , γ (W8)	44 h.(W8)	1.1(W8) abs. 0.5, 1.4(W8) abs.	0.9(W8) abs.		W4, P2, W8
	Sc ⁴⁹	A	β^-	57 m.(W8)	1.8(W8) abs.	No γ (W8)		W8
22	Ti ⁴¹	A	β^- , γ (W4)	2.9 m.(W4)			Ti-d-p(W4) Ti-n- γ (W4, A1) Ti-d-p(W5) Ti-n- γ (W8)	W4, A1
	Ti ⁴³	A	β^- , γ	72 d.(W5)	0.36(W5) abs.	1.0(W5) coincid. abs.		W5, W8
23	V ⁴³	B	K	600 d.(W5)	No β^+ or e^- (W5)	No γ (W5)	Ti-d-n(W5)	W5

Z	A	CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
					PARTICLES	γ -RAYS		
23	V ⁵¹	A	β^+ ; K, γ (W5)	16 d.(W4)	1.0(W4) cl. ch.	1.05(R4) cl. ch. recoil	Ti-d-n(W4) Sc-a-n(W6) Cr-d-a(W4) Ti-p-n(D9) Ti-d-n(W4) Ti-a-p(W4) Ti-p-n(D9) V-n-2n(W4) Ti-d-n(W4) Ti-a-p(W4) V-n- γ (W4, P2, A1) V-d-p(W4) Cr-n-p(W4, P2) Mn-n-a(W4, P2, A1)	W4, R4, W6, W5, D9
	V ⁵⁰	B	β^+	33 m.(W4)	1.9(W4) abs.			W4, D9
	V ⁵⁰	A	β^+	3.7 h.(W4)				W4
	V ⁴⁸	A	β^+	3.9 m.(W4)				A1, W4, P2
24	Cr ⁵¹	B	K, ϵ^+ , γ ; β^+ (?) (W8)	26.5 d.(W8)		0.5(?), 1(W8) coincid. abs.	Ti-a-n(W8) Cr-d-p(W8) Cr-n- γ (W8)	W8
25	Mn ⁵¹	A	β^+	46 m.(L7)	2.0(L7) abs.		Cr-d-n(L7) Cr-p- γ (D2, D4) Fe-d-a(D5, L7) Cr-p-n(H6)	D2, L7, D4
	Mn ⁵²	A	β^+ , γ	21 m.(L7)	2.2(H6)	1.2(H6)		L7, H6, D5
	Mn ⁵³	A	β^+ , γ ; K(H6)	6.5 d.(L7)	0.77(H6)	1.0(H6)	Fe-d-a(L7) Cr-p-n(H6)	L7, H6
	Mn ⁵⁴	A	K, γ (L7)	310 d.(L7)		0.85(L7) abs. Pb	Fe-d-a(L7) Cr-d-n(L7) V-a-n(L7) Cr-p-n(D9)	L7, D9
	Mn ⁵⁴	A	β^+ , γ	2.59 h.(L7)	1.2, 2.9(B10) cl. ch. K, U.	1.65(M6, L29) coincid. abs.	Mn-n- γ (A1) Mn-d-p(L7) Fe-d-a(L7) Fe-n-p(A1) Co-n-a(A1) Cr-a-p(R3)	A1, L7, B10, M6, R3, L29
26	Fe ⁵²	A	β^+	8.9 m.(R3)			Cr-a-n(R3) Fe-n-2n(L20) Fe-d-p(L23) Mn-p-n(V4) Fe-d-p(L20) Co-n-p(L20)	R3, L20
	Fe ⁵⁵	A	K, ϵ^+	~ 4 y.(V4)				L23, V4
	Fe ⁵⁶	A	β^+ , γ	47 d.(L20)	0.4, 0.9(L20) abs.	1.0(L20) abs. Pb		L20
27	Co ⁵⁶	A	β^+ , γ	18.2 h.(D5)	1.50(L21) spect.	0.16, 0.21, 0.8, 1.2(C20) cl. ch. recoil	Fe-d-2n(D5, L8) Fe-p- γ (L9)	D5, L8, L21, L9, C20
	Co ⁵⁸	B	K, γ , ϵ^+ (L10)	270 d.(L10)			Fe-d-2n(L9, B24, P4) Ni-d-a(L11) Fe-p-n(L9) Fe-d-n(L9, B24, P4) Mn-a-n(L9) Ni-d-a(L11) Fe-p-n(L9)	L10, B24, P4, L9, L11
	Co ⁵⁸	A	β^+	70 d.(L10)				L10, B24, P4, L9, L11
	Co ⁶⁰	A	β^+ , γ	7 y.(L10)	0.16, 1.5(R9) abs.	1.3(L9) abs. Pb	Co-d-p(L9, B24) Co-n- γ (R9, L9) Ni-n-p(V5) Co-n- γ (H7, L8) Ni-n-p(H8)	R9, L9, L10, B24, V5
	Co ⁶¹ , ⁶⁰	C	β^+	11 m.(H7)				H7, H8, L8
28	Ni ⁵⁷	A	β^+	36 h.(L11)	0.67(L11) abs.		Fe-a-n(L11) Ni-n-2n(?) (L11) Ni-d-p(L11) Ni-n- γ (H8) Cu-n-p(H8) Zn-n-a(H8) Ni-n-2n(H8)	L11
	Ni ⁶²	A	β^+ , γ	2.6 h.(L11)	1.9(L11) abs.	1.1(L11) abs. Pb		L11, H8
29	Cu ⁶⁴ , ⁶⁰	C	β^+	81 s.(D4)			Ni-p-n(D4) Ni-p-n(D4) Ni-d-n(T1) Ni-p-n(D4) Ni-p- γ (D4) Ni-a-p(R3) Cu-n-2n(H8) Cu- γ -n(B20) Co-a-n(R3) Ni-p-n(S18) Ni-p- γ (S18) Cu-d-p(V2) Cu-n- γ (H8) Cu-n-2n(H8) Ni-p-n(S18, D4) Zn-n-p(H8) Cu-n- γ (A1) Zn-n-p(H8) Ga-n-a(C5)	D4
	Cu ⁶⁴ , ⁶⁰	C	β^+	7.9 m.(D4)				D4
	Cu ⁶¹	B	β^+ ; K(A4)	3.4 h.(T1, R3)	0.9(R3) abs.	No γ (G2)		T1, D4, R3, G2, A4
	Cu ⁶²	A	β^+	10.5 m.(H8)	2.6(C13) cl. ch.			H8, B20, R3, S18, C13
	Cu ⁶⁴	A	β^+ ; β^+ ; K(A4)	12.8 h.(V2)	0.58(β^+), 0.66(β^+)(T6) spect.	No γ (T6)		V2, H8, T6, S18, D4, A4
	Cu ⁶⁴	A	β^+	5 m.(A1)	2.9(S5) cl. ch. K, U.			A1, H8, C5, S5
30	Zn ⁶³	A	β^+	38 m.(D4, B20)	2.3(S18) abs.		Zn-n-2n(H8, P2) Zn- γ -n(B20), Cu-d-2n(L33) Cu-p-n(S18, D4) Ni-a-n(R3)	H8, B20, P2 D4, R3, S18 L33

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					PARTICLES	γ -RAYS		
30	Zn ⁶⁴	A	β^+ ; K, γ , e^-	250 d.(L12)	0.4(β^+)(D9) cl. ch.	1.0(L12) abs. Pb	Zn-d-p(L12) Cu-d-2n(P4) Cu-p-n(B12) Zn-n- γ (S6) Ga ⁶⁴ K decay (L10)	L12, P4, B12, S6, D9, L10
	Zn ⁶⁵	A	β^- ; γ (K11)	13.8 h.(L12)		0.47(K11) abs. Pb	Zn-d-p(L12, K11, V7) Zn-n- γ (T2, L12) Ga-d- α (L12) Ga-n-p(L12)	L12, T2, K11, V7
	Zn ⁶⁶	A	β^-	57 m.(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) Zn ⁶⁶ (13.8 h.) β^- (K11)	L12, H8, T2, K11, V7
31	Ga ⁶⁷	B	β^+	48 m.(B13)			Zn-p-n(B13)	B13
	Ga ⁶⁸	A	K, e^-	15 m.(A4, L10)			Zn-d-n(A4, L10)	A4, L10
	Ga ⁶⁹	A	β^+	9.4 h.(B13, R3)	3.1(M7) abs.		Cu- α -n(M7, R3) Zn-p-n(B13)	M7, B13, R3
	Ga ⁷⁰	A	K, γ , e^-	83 h.(A4)		0.0925(V7, H25) spect. conv.; 0.1, 0.25(A4) abs. Cu, Pb	Zn-d-n(A4, G6, V7) Zn-n-p(M8) Zn-p-n(B13, V7)	A4, M8, B13, G6, V7, H25
	Ga ⁷¹	A	β^+	68 m.(R3)	1.9(R3, M7) abs.		Cu- α -n(R3, M7) Ga-n-2n(P2) Ga- γ -n(B20) Zn-p-n(D2, B13) Zn-p- γ (?) (D2) Zn-d-n(G6, V7)	R3, P2, B20, D2, M7, B13, G6, V7
	Ga ⁷²	A	β^- , e^- , γ	20 m.(B20, A1)	5.0(β^-)(M8) abs.	0.054, 0.117(V7) spect. conv.	Ga-n- γ (A1) Ga-n-2n(P2) Ga- γ -n(B20) Zn-p-n(D2, V7) Zn-n-p(M8) Ga-d-p(L20) Ga-n- γ (S6)	A1, P2, B20, D2, M8, B13, V7
32	Ga ⁷³	A	β^- , γ	14 h.(S6, L20)	2.6(L28) abs.	1.0(S7) abs. Pb	Ga-d-p(L20) Ga-n- γ (S6)	S6, S7, L20, L28
	Ge ⁶⁸	E	β^+	29 m.(S6)			Ge-n-2n(S6)	S6
	Ge ⁶⁹	B	β^+	37 h.(M8)	1.0(M8) abs.		Zn-n- α (M8) Ge-n- γ (S6) Ge-d-p(S6)	M8, S6, L28
	Ge ⁷⁰ , 49, 71	E	β^-	195 d.(M8)			Ge-d-2n(L28)	M8
	Ge ⁷¹ , 72	E	β^-	81 m.(S6)			Zn-n- α (M8) Ge-n- γ (S6) Ge-d-p(S6)	S6
	Ge ⁷² , 73	E	β^-	8 h.(S6)			Ge-n- γ (S6) Ge-n- γ (S6) Ga-d-2n(L28)	S6 S6, L28
33	As ⁷¹ , 72	F	β^+	50 h.(S6)			Ge-d-n(S6) Ge-d-n(S6)	S6
	As ⁷² , 73	F	β^+	88 m.(S6)			Ge-p-n(V4)	S6
	As ⁷³	E	β^+	26 h.(V4)			As-n-2n(S8, C11) Ge-d-n(S8)	V4 S8, C11, F8
	As ⁷⁴	A	β^- , β^+	17 d.(S8)	1.2(β^-), 0.9(β^+)(S8) cl. ch. K, U.		Se-d- α (F8)	
	As ⁷⁵	A	β^- , γ ; β^- ; K, γ (?) (S23)	26.8 h.(W9)	1.1, 1.7, 2.7 (β^-)(S23, W9); 0.7, 2.6(β^+) (S23) cl. ch.	3.2, 2.2, 1.5 (S23) cl. ch. pair	As-d-p(C11, T3) As-n- γ (C11) Br-n- α (C11) Ge-p-n(V4) Se-d- α (F8) Ge-d-n(S6, S8) Br-n- α (S9, C11)	C11, T3, S23, W9, V4, F8
	As ⁷⁶	D	β^- , γ (S6)	55 d.(S6)				S8, S6
34	As ⁷⁷	A	β^-	65 m.(S9)				S9, C11
	Se ⁷⁶	A	β^-	48 d.(D9)			As-p-n(D9) Se-d-p(S9, L32) Se-n- γ (S9, H10) Br-n-p(S9, L32) Se- γ -n(B20) Se-d-p(S9, L32) Se-n- γ (S9, H10) Se- γ -n(B20) Br-n-p(L32) Se ⁷⁶ , 4(57 m.) β^- (L32) Se-d-p(L32) Se-n- γ (L32) Th-n(B15) Th-n(B15)	D9 S9, H10, B20, L32
	Se ⁷⁸ , 41	C	β^-	57 m.(S9, L32)				
	Se ⁷⁹ , 41	C	β^-	19 m.(L32)	1.5(L32) abs.			B20, S9, H10, L32
	Se ⁸⁰	A	β^-	30 m.(L32)				L32
	Se	D		sev. h.(B15) sev. d.(B15)				B15 B15
35	Br ⁷⁸	A	β^- , e^- , γ	6.4 m.(S9)	2.3(β^+)(S9) abs.	0.046, 0.108 (V7) spect. conv.	Se-d-n(S9) As- α -n(S9) Br- γ -n(B20, C5) Br-n-2n(H10) Se-p-n(B13, V7) Br-n- γ (S9, S10, A2) Br-d-p(S9) Se-p-n(B13, V7) Br- γ -n(B20) Br-n-2n(P2)	S9, C5, B20, H10, B13, V7
	Br ⁸⁰	A	β^- , e^- (S10, V3, V7)	4.4 h.(B13)		0.049; 0.037 or 0.025(V7) spect. conv.		S9, S10, A2, B13, B20, P2, V7, D19

Z	A	CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
					PARTICLES	γ -RAYS		
35	Br ⁸⁰	A	β^- , γ	18 m.(S9, S10)	2.0(A2) spect.	<0.5 (B13, S9) abs.	Br-n- γ (S9) Br-d-p(S9) Se-p-n(B13) Br- γ -n(B20) Br-n-2n(P2) Br ⁸⁰ (4.4 h.) I.T.(S10) Br-n- γ (K5, S9) Br-d-p(S9) Se-p-n(B13) Se-d-2n(S9) Rb-n- α (S9, P2) Se-d-n(S9) Th-n(B15, L32) U-n(L32) U-n(D6, H22) Th-n(B15) U-n(H22)	S9, S10, V3, A2, B13, B20, P2
	Br ⁸¹	A	β^- , γ	34 h.(S9)	0.7(B13)	0.65(K5) cl. ch. recoil and abs.		S9, K5, B13, P2
	Br ⁸²	A	β^-	140 m.(L32)	1.05(L32) abs.	No γ (S9)	Se ⁸² β^- decay (S9, L32) Th-n(B15, L32) U-n(L32)	S9, B15, L32
	Br ⁸³ Br ⁸⁴ Br ⁸⁵	D F D		40 m.(D6) 22 h.(B15) 3.8 h.(H22)				D6, H22 B15 H22
36	Kr ⁷⁸ , ⁸¹ Kr ⁸⁰	E A	I.T., e^-	18 h.(S9) 113 m.(L32)		0.049(L32) abs. of e^-	Kr-d-p(S9) Br ⁸¹ β^- decay (L32)	S9 L32
	Kr ⁸⁴ , ⁸⁷	E E	β^-	74 m.(S9) 4.5 h.(S9)			Kr-d-p(S9) Se- α -n(?) (K3) Kr-d-p(S9) Se- α -n(?) (K3)	S9, K3 S9, K3
	Kr(?) Kr ⁸²	F A	β^-	1-2 m.(K3) 3 h.(L27)			Se- α -n(?) (K3) Th-n(A5, L27) U-n(H22, H11)	K3 H22, H11, A5, L27
	Rb ⁸³ , ⁸⁴ Rb ⁸⁵ , ⁸⁶ Rb ⁸⁸	F F A	β^+ β^+ β^-	1.5 m.(R3) 9.8 m.(R3) 18 m.(S9)			Br- α -n(?) (R3) Br- α -n(?) (R3) Rb-n- γ (S9, P2) Pa-n(G7) Kr ⁸⁸ β^- decay (L27, H11, A5) Rb-n- γ (S9)	R3 R3 S9, P2, H11, A5, L27, G7
	Rb ⁸⁶ , ⁸⁸	C	β^-	18 d.(S9)				S9
38	Sr ⁸⁴ Sr ⁸⁶ Sr ⁸⁷	B B A	K, γ (D9) K, γ (D9) I.T., e^- , γ (D18)	$\sim$ 60 d.(D18) 70 m.(D9) 2.7 h.(D18)		0.37(D18) spect. conv.	Rb-p-n(D18) Rb-p-n(D9) Rb-p-n(D18) Sr-d-p(D18) Sr-n- γ (D18) Y ⁸⁷ (85 h.) K decay Sr-d-p(S11, S28) Sr-n- γ (S11, S28) Y-n-p(S12) U-n(L26) U-n(L26) U-n(L26)	D18, D9 D9 D18 S11, S12, L26, S28 L26 L26
	Sr ⁸⁹	A	β^-	55 d.(S28)	1.50(S28) cl. ch.	No γ (S28)		S11, S12, L26, S28
	Sr ⁹⁰ Sr ⁹⁰	D D	β^- β^-	7 m.(L26) 6 h.(L26)				L26 L26
	Y ⁸⁸ Y ⁹¹	B B	K(D9) K(D9)	80 d.(D9) 14 h.(S28, D9)			Sr-p-n(D9) Sr-d-n(S28, D9) Sr-p-n(D9) Sr-p-n(D18) Sr-d-n(D18, S28) Sr-d-n(S11, S28) Y-n-2n(S11) Y-d-p(S11) Y-n- γ (S11, S12) Cb-n- α (S13) Zr-n-p(S12) Zr-d- α (S12) Sr ⁹⁰ (6 h.) β^- decay (L26) Sr-p-n(?) (D9)	D9 S28, D9 D18, S28 S11, S28 S11, S12, S13 S12 L26 D9
	Y ⁹² Y ⁹⁴ Y ⁹⁶	A A A	K, γ , e^- (D18) β^+ β^-	85 h.(D18) 2.0 h.(S28) 60 h.(S11)	1.2(S11) cl. ch. K. U. 2.6(S11) cl. ch. K. U.			
39	Y ⁹⁰ Y ⁹² Y ⁹⁴ Y ⁹⁶ Y ⁹⁸ Y ¹⁰⁰	D D D D D E	β^- β^- β^- β^- β^- β^-	70 h.(S12) 3.5 h.(L26) 80 d.(D9)	1.3(S12) cl. ch. K. U.			S12
	Zr ⁸⁸ Zr ⁹⁰ Zr ⁹² Zr ⁹⁴ Zr ⁹⁶ Zr ⁹⁸	A A D F F F	β^+ (S12, D9) γ ; I.T. or K(D9) β^- β^- β^- β^-	70 h.(S12, D9) 4 m.(D9) 17-40 h. (S12, H13) 10-30 m.(P2, S12) 2.5-5 h.(S12, P2) 90 m.(S12)	1.0(β^+)(S12) cl. ch. K. U. 1.25(S12) cl. ch. K. U.		Zr-n-2n(S12) Y-p-n(D9) Y-p-n(D9) Zr-n- γ (H13, S12) Zr-n- γ (P2, S12) Zr-n- γ (S12, P2) Zr-d- γ (S12) Zr-d- γ (S12)	S12, D9 D9 S12, H13 S12, P2 S12, P2 S12
	Cb ⁸⁸ Cb ⁹⁰ Cb ⁹² Cb ⁹⁴ Cb ⁹⁶ Cb ⁹⁸	E E E E E B	β^- β^- β^- β^- β^- β^-	4 m.(D9) 12 m.(D9) 38 m.(D9) 21 h.(D9) 96 h.(D9) 11 d.(S13)	1.0(S13) cl. ch. K. U.		Zr-p-n(?) (D9) Zr-p-n(?) (D9) Zr-p-n(?) (D9) Zr-p-n(?) (D9) Zr-p-n(?) (D9) Cb-n-2n(S13)	D9 D9 D9 D9 D9 S13
	Cb ⁹⁴	E	β^-	7.5 m.(S13)			Cb-n- γ (S13, P2)	S13, P2
	Mo ⁹² Mo ⁹¹ , ⁹³	F C	β^+ β^+	7 h.(D9) 17 m.(B20, S12)	1.8(S12) cl. ch. K. U.		Cb-p-n(?) (D9) Mo-n-2n(H10, S12) Mo- γ -n(B20)	D9 S12, B20, H10

* Radioactive isomer of stable nucleus.

Z	RADIO-ELEMENT	CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
					PARTICLES	γ -RAYS		
42	Mo ⁹³ , ¹⁰¹	C	β^+ , γ	67 h.(S14)	1.5(S14) abs.	0.4(S14) abs.	Mo-d-p(S14) Mo-n- γ (S14, S12) U-n(H23) Th-n(H24) Mo-n- γ (H10, S12)	S14, S12, H23, H24
	Mo ¹⁰¹	B	β^-	24 m.(S12)	1.3(S12) cl. ch. K, U.			S12, H10
43	43 ⁹⁶	B	β^+ (?)	2.7 h.(D4)			Cb- α -n(K3) Mo-p-n(D4) Mo-d-n(S14) Mo ⁹⁴ , ¹⁰¹ (67 h.) β^- decay (S14)	K3, D4, S14
	43 ⁹⁸ , ¹⁰¹	C	$I.T.$, e^- , γ (S14)	6.6 h.(S14)		~ 0.136 (S14) spect. conv. ~ 0.18 (S14) abs.		S14
	43	D	K , e^-	90 d.(C12)			Mo-d-n(C12, C24)	C12, C24
	43	D	K , γ	62 d.(C12)			Mo-d-n(C12, C24)	C12, C24
	43	D	K (?), e^- , γ (E5)	110 h.(E3)	0.6(E3)	0.05, 0.5(E5)	Mo-p-n(E3, E5)	E3, E5
	43	E	β^- , γ (E3)	55 m.(E5)	2.5(E5) abs.		Mo-p-n(E3, D4, E5)	E3, D4, E5
	43	E	β^-	36.5 h.(D4)			Mo-p-n(D4)	D4
	43	E	β^-	18 s.(D9)			Mo-p-n(D3, D9)	D3, D9
	43	D	K	~ 2 d.(S14)			Mo-d-n(S14)	S14
44	Ru ⁹⁸	F		20 m.(D7)			Ru-n-2n(?) (D7, P2)	D7, P2
	Ru ¹⁰⁰	B	β^-	4 h.(D7, L13)			Ru-n- γ (D7) Ru-n-2n(D7, P2) Ru-d-p(L13) Ru-n- γ (D7) Ru-d- γ (L13) Ru-d- γ (L13) Mo- α -n(K3)	D7, P2, L13
	Ru ¹⁰⁰	B	β^-	20 h.(D7)				D7
	Ru	F	β^-	39 h.(L13)				L13
	Ru	G		11 d.(L13)				L13
	Ru	E		90 m.(K3)				K3
45	Rh ¹⁰⁰	A	$I.T.$, e^- (P5)	4.2 m.(S29)		0.055-0.080(P5) abs. of e^-	Rh-n- γ (P5, A1, P2) Ru-p-n(D9)	P5, C13, A1, P2, D9, S29
	Rh ¹⁰⁰	A	β^-	44 s.(P5, A1)	2.3(C13) cl. ch.		Rh-n- γ (P5, A1) Rh ¹⁰⁰ (4.2 m.) $I.T.$ (P5) Ru-p-n(D9) Ag-n- α (G3) Ru ¹⁰⁰ β^- decay (D7) Ru-d-n(L13) Rh-n- γ (P2) Ru-p-n(?) (D9) Ru-p-n(?) (D9) Ru-p-n(?) (D9)	P5, C13, G3, A1, D9
	Rh ¹⁰⁰	B	β^-	46 d.(L13)				D7, L13
	Rh	G	β^-	1.1 h.(P2)				P2
	Rh	E		3 h.(D9)				D9
	Rh	E		10.7 h.(D9)				D9
	Rh	E		3 d.(D9)				D9
46	Pd ¹⁰⁷ , ¹⁰⁹	C	β^-	13 h.(K6)	1.03(K6) cl. ch.		Pd-d-p(K6) Pd-n- γ (A1, K6) Ag-n-p(E3) Pd-d-p(K6, A1) Pd-n- γ (K6, A1)	K6, A1, F5
	Pd ¹¹¹	A	β^-	17 m.(K6)				K6, A1
47	Ag ¹⁰⁷	E		73 m.(E6)		0.29, 0.42, 0.50, 0.62 (E6) spect.	Pd-p-n(E6) Pd-p-n(E6) Pd-p-n(E6)	E6
	Ag ¹⁰⁸	E		16.3 m.(E6)				E6
	Ag ¹⁰⁸	E		45 d.(E6)				E6
	Ag ¹⁰⁸	A	β^+	24.5 m.(P6, D2)	2.04(F5) abs.	No γ (F5)	Ag-n-2n(P6) Pd-d-n(P6) Cd-n-p(P6) Rh- α -n(P6, K3) Ag- γ -n(B20) Pd-p- γ (D2) Pd-p-n(D2, E6) Ag-n-2n(P6, K6) Pd-d-n(P6, K6) Rh- α -n(P6) Pd-p-n(D2, E6) Cd-n-p(P6) Ag-n- γ (A1) Ag- γ -n(B20) Pd-p-n(D2, E6) Cd-n-p(P6) Ag-d-p(K12) Ag-n- γ (A1) Cd-n-p(P6) Ag-n- γ (R10, L14, A8, M12) Ag-d-p(K12) Pd-d-n(K6, P6) Pd- α -p(P6) Cd-n-p(P6) Pd ¹¹¹ β^- decay (K6) Cd-n-p(P6) In-n- α (P6)	P6, B20, D2, F5, K3, E6
	Ag ¹⁰⁸	A	K (?), e^- , γ (P6, A4, F5)	8.2 d.(P6, K6)	1.2(e-), (F5) abs.	1.06, 0.69 E(6) spect.		P6, R2, D2, F5, K6, A4, E6
	Ag ¹⁰⁹	A	β^-	2.3 m.(A1, B20)	2.8(N4) cl. ch.			A1, B20, N4, D2, P6, E6, K12
	Ag ¹¹⁰	A	β^- , γ (P6)	22 s.(A1, P6)	2.8(G4) cl. ch. K, U.			A1, G4, P6
	Ag ¹⁰⁸ , ¹¹⁰	C	β^-	225 d.(L14, R10)				R10, L14, A8, M12, K12 *
	Ag ¹¹¹	A	β^-	7.5 d.(K6, P6)		No γ (K6, P6)		K6, P6
	Ag ¹¹²	A	β^- , γ	3.2 h.(P6)	2.3(P6) cl. ch.			P6
48	Cd ¹⁰⁷ , ¹⁰⁹	C	K , e^- , γ (D4, V7, W11)	6.7 h.(D4, R5)		0.093(V7) spect. conv. 0.53(V7) abs. Pb	Ag-p-n(D4, R5, V7, W11) Ag-d-n(K12)	D4, R5, V7, K12, W11

[illegible]

* Radioactive isomer of stable nucleus.

Z	A	CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MEV)		PRODUCED BY	OBSERVERS
					PARTICLES	γ -RAYS		
52	Te ¹¹⁸	A	β^-	70 m.(S15, A6)			Te-d-p(S15, T4) Te- γ -n(B20) Te-n-2n(H10, T4) Te ¹¹⁸ (30 d.) I.T. (S15) Sb ¹¹⁹ β^- decay (A6) Te-d-p(S15) U-n(A6, H22) Te-d-p(S15) Te-n- γ (S15) U-n(A6) Te ¹¹⁸ (30 h.) I.T. (S15) Sb ¹¹⁸ (<10 m.) β^- decay (A6, H22) Sb ¹¹⁸ (<10 m.) β^- decay (A6, H22) Sb ¹¹⁸ (5 m.) β^- decay (A6, H22) Th-n(H24) U-n(S21)	S15, B20, H10, A6, T4
	Te ¹¹¹	A	I.T.(S15)	30 h.(S15, A6)				S15, A6, H22
	Te ¹¹¹	A	β^-	25 m.(S15)				S15, A6
	Te ¹¹¹	D	β^-	43 m.(A6)				A6, H22
	Te ¹¹¹	D	β^-	60 m.(A6)				A6, H22
	Te ¹¹¹	D	β^-	77 h.(A6)				A6, H22, H24
	Te ¹¹¹	D	β^-	~0.5 h.(S21)				S21
	Te ¹¹¹	D	β^-	~0.5 h.(S21)				S21
	Te ¹¹¹	D	β^-	~0.5 h.(S21)				S21
	Te ¹¹¹	D	β^-	~0.5 h.(S21)				S21
53	I ¹¹⁴	A	β^+	4.0 d.(L19, D9)			Sb-a-n(L19) Te-p-n(D9) Sb-a-n(L19) I-n-2n(T4, L19) Te-d-n(L19) Te-p-n(D9) I-n- γ (A1, T4) Te-d-2n(L19) Te-p-n(D9) Te-d-2n(L19) Te-p-n(D9) Te-d-n(L19) Te ¹¹⁴ β^- decay (S15, A6, H22) Te ¹¹⁴ (77 h.) β^- decay (A6, H22) Te ¹¹⁴ (43 m.) β^- decay (H22, A6) Th-n(D6) Te ¹¹⁴ (~0.5 h.) β^- decay(S21) Te ¹¹⁴ (60 m.) β^- decay (H22, A6, S21)	L19, D9
	I ¹¹⁴	A	β^+ , γ	13.0 d.(L19, T4)	1.1(L19) abs.	0.5(L19) abs. Pb		L19, T4, D9
	I ¹¹⁸	A	β^+ , γ	25 m.(A1)	1.2, 2.1(B19) cl. ch.	0.4(L19) abs. Pb		A1, L19, B19, D9, T4
	I ¹²⁰	A	β^+ , γ	12.6 h.(L19)	0.83(T7) cl. ch.	0.6(L19) abs. Pb		L19, D9, T7
	I ¹²¹	A	β^+ , γ	8.0 d.(L19)	0.687(T7) cl. ch.	0.4(L19) abs. Pb		L19, S15, T7, A6, H22
	I ¹²¹	D	β^-	2.4 h.(A6)				A6, H22
	I ¹²¹	D	β^-	54 m.(A6)				H22, D6, A6
	I ¹²¹	D	β^-	6.6 h.(S21)				S21
	I ¹²¹	D	β^-	22 h.(A6)				A6, H22, S21
	I ¹²¹	D	β^-	22 h.(A6)				A6, H22, S21
54	Xe ¹²⁷	F		~100 s.(W11)			I-p-n(W11) U-n(H22, H11) Th-n(A5) U-n(H22, H11) Th-n(A5) I ¹²⁷ (22 h.) β^- decay (S21) I ¹²⁷ (6 h.) β^- decay (S21)	W11
	Xe ¹²⁹	A	β^-	<0.5 m.(H11, H12)				H11, H22, A5, H12
	Xe ¹²⁹	D	β^-	~15 m.(H22)				H11, A5, H22
	Xe ¹³¹	D		4.5 d.(S21)				S21
	Xe ¹³¹	D		9.4 h.(S21)				S21
55	Cs ¹³¹	A		1.5 h.(A1)			Cs-n- γ (A1, M16) Cs-n- γ (A8, S20) Xe ¹³¹ β^- decay (H22, H12, H11, A5) Xe ¹³¹ (~15 m.) β^- decay (H22, H11, H12, A5) Pa-n(G7)	A1, M16
	Cs ¹³¹	A		~1 y.(A8)				A8, S20
	Cs ¹³¹	A	β^-	6 m.(H22)				H22, H11, A5, H12
	Cs ¹³¹	D	β^-	33 m.(H22)				H22, H11, H12, A5, G7
56	Ba	D	e^+ , γ	30 h.(K10)		0.23(K10) abs.	Ba-n- γ (K10)	K10
	Ba ¹³³	A	β^-	86 m.(P8, H22)			Ba-d-p(P8) Ba-n- γ (A1, P2) La-n-p(P8) Cs ¹³³ β^- decay (H22, H11, A5, H12) Ba-n- γ (A1, P2) Cs ¹³³ (33 m.) β^- decay (H22, H11, H12, A5) Th-n(H24) U-n(H22, H12, H14) Th-n(H15, H14) U-n(H14)	P8, A1, P2, H22, H12, H11, A5
	Ba ¹³³	F		3 m.(A1, P2)				A1, P2
	Ba ¹³³	D	β^-	300 h.(H22)				H22, H14, H12, H11, A5, H24
	Ba ¹⁴⁰	D	β^-	14 m.(H22)				H22, H14, H12, H15
	Ba ¹⁴⁰	E	β^-	<1 m.(H14)				H14
57	La ¹³⁸	F		2.2 h.(P2)			La-n-2n(?) (P2) La-d-p(P8) La-n- γ (P9, M13) Ba ¹³⁸ (14 m.) β^- decay (H22, H14, H15) U-n(B15) Th-n(C16) Ba ¹³⁸ (<1 m.) β^- decay (H14, H15) Ba ¹³⁸ (300 h.) β^- decay (H22, H14, B15)	P2
	La ¹⁴⁰	A	β^-	31 h.(P9)	0.8(P9) cl. ch.			P8, P9, M13
	La ¹⁴⁰	D	β^-	~2.5 h.(H22)				H22, H14, H15, C16, B15
	La ¹⁴⁰	E	β^-	<30 m.(H14, H15)				H14, H15
	La ¹³⁹	D	β^-	36 h.(H22)				H22, H14, B15

Z	A	CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MeV)		PRODUCED BY	OBSERVERS
					PARTICLES	γ -RAYS		
58	Ce ¹³⁷ Ce ^{141, 143}	F C	β^+	2.1 m.(P9) 15 d.(R11)	0.12(R11) spect.		Ce-n-2n(?) (P9) Ce-n- γ (R11)	P9 R11
59	Pr ^{140, 143} Pr ¹⁴¹	C A	β^+ β^-	3.5 m.(P9) 18.7 h.(P9)			Pr-n-2n or Pr-n- γ (P9, A1) Pr-n- γ (P9, P2, M13, A1) Nd-n-p(P9, P2)	P9, A1 P9, P2, M13, A1
60	Nd ¹⁴⁷ Nd ¹⁴⁹ Nd ¹⁵¹	E E E	β^- β^- β^-	84 h.(P9) 2.0 h.(P9) 21 m.(P9)			Nd-d-p(P9) Nd-n- γ (P9) Nd-n-2n(?) (P9) Nd-d-p(P9) Nd-n- γ (P9) Nd-n-2n(?) (P9) Nd-n- γ (P9, M18)	P9 P9 P9, M18
61	61	F	β^-	12.5 h.(P9)			Nd-d-n(P9)	P9
62	Sm Sm	D D	β^- β^-	21 m.(P9) 46 h.(P9)			Sm-n- γ (P9, A1, M13, H17) Sm-n-2n(?) (P9) Sm-n- γ (P9, H20, R11, H17) Sm-n-2n(?) (P9)	P9, A1, H17, M13 P9, H20, H17, R11
63	Eu ¹⁵⁰ Eu ^{152, 154} Eu ^{157, 158} Eu ^{159, 160} Eu ^{161, 163}	E C C E E	β^+ β^+ , γ , ϵ^- (T6); K(?) (R2) β^- , γ (R11, F7) β^- β^-	27 h.(P9) 9.2 h.(P9) > 1 y.(F7, S20) 12 m.(F7) 105 m.(F7)	1.88(β^-)(T6) spect. 0.8(R11) spect.	0.123, 0.163, 0.725(T6) spect. conv.	Eu-n-2n(?) (P9, R11) Eu-n- γ (P9, M13, H17, H20) Eu-n-2n(?) (P9) Eu-d-p(F7) Eu-n- γ (S20, R11, F7) Eu-d-p(F7) Eu-d-p(F7)	P9, R11 P9, R2, H17, T6, M13, H20, F7 S20, R11, F7 F7 F7
64	Gd ^{155, 157}	E		8 h.(A1, H17)			Gd-n- γ (A1, H20, H17)	A1, H17, H20
65	Tb ¹⁵⁸	A	β^-	3.9 h.(H16, M13)			Tb-n- γ (H17, P9, M13, H20)	H17, P9, M13, H20
66	Dy ¹⁶⁰ Dy(?)	A F	β^- β^+	2.5 h.(H17, P9, M13) 2.2 m.(P9)	1.9(N4) cl. ch.		Dy-n- γ (H17, H20, P9, M13) Dy-n- γ (P9)	H17, H20, P9, M13, N4 P9
67	Ho ¹⁶⁴ Ho ¹⁶⁶	F E	β^- β^-	47 m.(P9) 35 h.(H17)	1.6(H20) abs.		Ho-n-2n(?) (P9) Ho-n- γ (H17, H20, P9)	P9 H17, H20, P9
68	Er ¹⁶² Er ^{164, 171} Er ^{169, 171}	F C C	β^+ β^- β^-	1.1 m.(P9) 7 m.(M13) 12 h.(H17, P9)			Er-n-2n(?) (P9) Er-n- γ (M13, M18) Er-n- γ (H17, H20, P9, R12)	P9 M13, M18 H17, P9, R12, H20
69	Tm ¹⁷⁰	A		105 d.(H20)			Tm-n- γ (H20, N7)	H20, N7
70	Yb ^{174, 177} Yb(?)	C G		3.5 h.(H17, M13) 41 h.(P9)			Yb-n- γ (H20, H17, M13, P9) Yb-n- γ (?) (P9)	H20, H17, M13, P9 P9
71	Lu ^{176, 177} Lu ^{178, 179} Rare Earth	C C F		4 h.(H17, H20, M13) 6 d. (H17, H20, F6) 2.3 d.(S4)			Lu-n- γ (H20, H17, M13, M18) Lu-n- γ (H17, H20, F6) U-n(M19, S4)	H20, H17, M13, M18 H20, H17, F6 M19, S4
72	Hf ¹⁸¹	A	β^-	55 d.(H19)			Hf-n- γ (H19)	H19
73	Ta ¹⁸⁰ Ta ¹⁸⁰ Ta ¹⁸²	A A A	β^- K ϵ^- , γ (O1); β^- (?) β^-	14-21 m. (B11, O1) 8.2 h.(O1) 97 d.(O1)	<0.5(ϵ^-)? (O1) abs.		Ta- γ -n(B11) (Ta-n-2n?) (O1) Ta-n-2n(O1, P2) Ta-n- γ (O1, F6) Ta-d-p(O1)	B11, O1 O1, P2 O1, F6
74	W ^{185, 187}	C		23 h.(M14)			W-n- γ (M14, A1)	A1, M14
75	Re Re Re ¹⁸⁶ Re ¹⁸⁸	E E B B	β^- β^- β^- β^-	55 m.(D9) 14 d.(D9) 90 h.(S16) 18 h.(P2)	1.2(S16) cl. ch. K. U. 2.5(S16) cl. ch. K. U.		W-p-n(D9) W-p-n(D9) Re-n- γ (S16, K7) Re-n-2n(S16) W-p-n(D9) Re-n- γ (P2, K7, S16)	D9 D9 S16, K7, D9 S16, K7, P2
76	Os ^{191, 192}	C	β^-	40 h.(K7)			Os-n- γ (K7)	K7
77	Ir ^{192, 194} Ir ^{192, 194} Ir ^{192, 194}	C C C	β^- β^- β^-	1.5 m.(M15) 19 h.(M15, A1) 60 d.(M15, F6)	2.2(A2) spect.		Ir-n- γ (M15) Ir-n- γ (M15, A1, P2, J1) Au-d- α , p(?) (C18) Ir-n- γ (M15, F6, J1)	M15 M15, A1, P2, C18, A2, J1 M15, F6, J1

RADIO-ELEMENT		CLASS	TYPE OF RADIATION	HALF-LIFE	ENERGY OF RADIATION (MeV)		PRODUCED BY	OBSERVERS
Z	A				PARTICLES	γ -RAYS		
78	Pt ¹⁹¹	B	β^-	18 h.(M15)			Pt-n- γ (M15) Pt-d-p(C19)	M15, C19
	Pt ¹⁹¹	B	β^-	3.3 d.(M15)			Pt-n- γ (M15, P2)	M15, P2
	Pt ¹⁹¹	A	β^-	31 m.(M15)			Pt-n- γ (M15, A1, M14) Pt-d-p(C19)	M15, A1, C19, M14
79	Au ¹⁹⁸	B	β^-	13 h.(M15)			Au-n-2 π (M15)	M15
	Au ¹⁹⁸	B	β^-	4-5 d.(M15)			Au-n-2 π (M15)	M15
	Au ¹⁹⁸	A	β^- , γ	2.7 d.(M15, A1)	0.8(M15, R2) abs. and cl. ch.	0.28, 0.44, 2.5(R2, S17) cl. ch. recoil	Au-n- γ (M15, A1, P2) Au-d-p(C18)	M15, A1, C18, R2, S17, P2
	Au ¹⁹⁹	A	β^-	3.3 d.(M15)			Pt ¹⁹¹ β^- decay (M15)	M15
	Au	G		17 m.(P2)			Pt-n- γ (P2)	P2
80	Hg ¹⁹⁷	B	K, e^- , γ (R11, A4)	43 m.(H10, M15)	<0.4(M15) abs.	<0.25(M15) abs.	Hg-n-2 π (M15, H10, P2)	M15, H10, P2, R11, A4
	Hg ^{201, 206}	C		25 h.(M15)			Hg-n- γ (M15, A9)	M15, A9
81	Tl ²⁰⁰	F		4 m.(K3)			Au- α -n(3)(K3)	K3
	Tl ²⁰⁰	C	β^-	3.8 h.(K3)			Au- α -n(2)(K3)	K3
	Tl ^{204, 206}	C	β^-	4 m.(P10, H10)			Tl-n- γ (P10, P2, H10)	P10, H10, P2
	Tl ^{204, 206}	C	β^-	97 m.(P10, M16)			Tl-n- γ (P10, M16, P2)	P10, M16, P2
82	Pb ²⁰³	B		80 m.(D10)			Pb-n-2 π (D10)	D10
	Pb ²⁰⁹	B	β^-	3.0 h.(T5)			Pb-d-p(T5)	T5
83	Bi ²¹⁰	A	β^-	5 d.(L13)			Bi-d-p(L13)	L13
84	Po ²¹⁰	A	α	136 d.(L13)			Bi ²¹⁰ β^- decay (L13)	L13, V4
	Po	F	α	7.5 h.(C23)	6, 7.5(C23) abs.		Bi-d-n(V4) Bi- α (32 Mev)	C23
90	U ²³¹	B	β^-	24.5 h.(N5)			Th-n-2 π (N5)	N5
	Th ²³¹	A	β^-	26 m.(M17)			Th-n- γ (M17)	M17
91	Pa ²³¹	B	β^-	25 d.(M17)			Th ²³¹ β^- decay (M17)	M17
92	U ²³⁸	F	β^-	23 m.(I1, S4)			U-n- γ (H18, H14, I1, S4, M19)	H18, H14, I1, M19, S4

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