SUPPLEMENT 2 to NBS CIRCULAR 499

Nuclear Data

UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

NUCLEAR DATA

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UNITED STATES DEPARTMENT OF COMMERCE, Charles Sawyer, Secretary
NATIONAL BUREAU OF STANDARDS, A. V. Astin, Acting Director

NUCLEAR DATA

A Collection of Experimental Values of Half-lives, Radiation Energies, Relative Isotopic Abundances, Nuclear Moments, and Cross Sections

Compiled by

Katharine Way, Gladys Fuller, Marion Wood,
Karin Thew and Alice Jurgens
With the Help of Abstracts Prepared by Special Readers

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Supplement 2 (July 1950 to January 1951) to
National Bureau of Standards Circular 499

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ACKNOWLEDGMENT

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Contents

EXPLANATION OF SUPPLEMENT 2

1. General Organization

The new data in *Supplement 2* to *National Bureau of Standards Circular 499* are presented in the same general form as were those in *Supplement 1*, and the same general explanation applies. Minor changes in style have been made and a few new notations have been added. These will be mentioned later in detail.

As in the case of *Supplement 1*, a list of "Additions to Old References" has been included. Any old reference key in either the *Table* or *Supplement 1* for which a newer and better reference is known is included in the list, the old key number being followed by the new reference. In addition, new references to data reported in *Supplement 1* are given in the body of *Supplement 2* as well as in the list of additions.

It is suggested that frequent users of the *Table* use the "Additions" list to insert the new reference under the old key in the main reference list. This job can be done in 11 minutes.

2. Special Details

The only major class of new information which is included in *Supplement 2* and not in *Supplement 1* is a year's list of fission and spallation papers, given at the back of the *Supplement*.

An addition to the compilation of W. F. Hornyak, T. Lauritsen P. Morrison, and W. A. Fowler, *Energy Levels of Light Nuclei, III*, Rev. Mod. Phys. **22**, 291 (1950), is in preparation. It was decided, therefore, to omit from this *Supplement* data on light element reactions pertaining to Q values, resonances, charged particle cross sections, etc., since they will be covered in the other paper. However, new data on neutron cross sections and β disintegrations are reported in *Supplement 2* as they were in *Supplement 1*.

Policies adopted in *Supplement 1* which are continued here are briefly summarized below.

Listing of Methods for Measuring γ and β Energies. The abbreviations sl, $s\pi$, and $s\pi\sqrt{2}$ are used to designate lens, 180°, and double focusing spectrometers, respectively. In the case of γ-rays the designations pe$^-$, ce$^-$, Compt indicate that the measurements were made by means of photo, conversion, or Compton electrons, respectively.

Inclusion of Spin and Parity Assignments. Authors' estimates of spins and parities are included in the decay schemes.

Listing of γ-rays Following β Decay under Parent Nucleus Only. The level information is provided by cross references in the *Table*.

Listing of Magnetic Moments. Results are based on the following values and are without diamagnetic corrections.

$\mu(H^1)$ = 2.7934 nuclear magnetons
$\nu(Na^{23})/\nu(H^1) = 0.26450$ 47B7
$\nu(D^2)/\nu(H^1) = 0.153506$* 47B29
$\nu(B^{11})/\nu(H^1) = 0.320827$ 49A12

*Note error in Explanation of *Supplement 1* where the value 0.307013 was given inadvertently.

Methods of Production. The lowest energy of the bombarding particle used is given when stated by the experimenter since it indicates an upper limit to the reaction threshold.

3. New Abbreviations

E2, M1, etc.	electric quadrupole, magnetic dipole, etc. radiation
Γ_n/Γ	resonance scattering fraction Γ_n = neutron width Γ = total width
osc	pile oscillator method
J	Spin of compound nucleus in a nuclear reaction. "I" is used to denote the spin of the target nucleus.

Alphabetical Index to Elements

0 NEUTRON n

1 0 1	I	**1/2**		50H67	Analysis of *n* reflection from magnetized mirror.	M.Hamermesh, E.Eisner, PR **79**, 888.
	β^-	**0.78**	sl	50R65	Allowed shape.	J.M.Robson, PR **81**, 297(A) (1951).

1 HYDROGEN H

H	σ_t (120 ev) (345 ev)	**20.3** **~19.7**		50H53	Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	(0.798 - 4.97 Mev)	**table**		50L54	Li(*p*,*n*) and D(*d*,*n*) sources. Values good to ±2%.	E.E.Lampi, et al., PR **80**, 853.
	(42 Mev)	**0.203**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	(270 Mev)	**0.038**		50D55	Be(350 Mev *p*,*n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	(280 Mev)	**0.033**		50F56	Be(340 Mev *p*,*n*). Scin; recoil *p*'s.	R.Fox, et al., PR **80**, 23.
1 1 0	μ	**2.79245** ± 0.0002		50B73	From ratio of nuclear resonance and cyclotron frequencies in same field.	F.Bloch, C.D.Jeffries, PR **80**, 305.
2 1 1	σ_t (120 ev) (345 ev)	**3.34** **3.32**		50H53	Co and Mn resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	(42 Mev)	**0.29**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	(270 Mev)	**0.057**		50D55	Be(350 Mev *p*,*n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	(280 Mev)	**0.049**		50F56	Be(340 Mev *p*,*n*). Scin; recoil *p*'s.	R.Fox, et al., PR **80**, 23.

2 HELIUM He

He	σ_s (thermal) (epi - Cd)	**1.4** **1.5**		50H60	Scattering detected in BF_3 annular pc.	S.P.Harris, PR **80**, 20.
3 2 1	μ	**negative**	S	50F51		M.Fred, et al., PR **79**, 212(A).
	σ(*n*,*p*) E_n = 0.4 - 3.0 Mev	**graph**		50C59	Results compared with those from inverse reaction.*	J.H.Coon, PR **80**, 488. *G.A.Jarvis, et al., PR **79**, 729.

3 LITHIUM Li

Li	σ_a (pile *n*)	65	osc	50C71	Based on σ_a (B) = 710. No self-screening correction.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) (345 ev)	2.24 1.65		50H53	Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (0.02 - 1.4 Mev) E_o = 0.27 Mev Γ = 0.045 Mev	graph		50A53	Concludes p-neutrons, J = 2 for level in Li^8.	R.K.Adair, PR **79**, 1018.
	σ_t (42 Mev)	0.68		50H71	Be (*d,n*). C^{12} (*n,2n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (280 Mev)	0.164		50F56	Be (340 Mev *p,n*). Scin; recoil *p*'s.	R.Fox, et al., PR **80**, 23.

4 BERYLLIUM Be

Be	σ_t (0.2 - 1.4 Mev) E_o	graph 0.62, 0.81		50B89	See 49A8 for analysis of 0.62 resonance.	C.K.Bockelman, PR **80**, 1011. New reference. Curve in 50Ad.
	σ_t (14 Mev)	1.5		50G67		L.S.Goodman, T.R.Robillard, ANL-4476, 62.
	σ_t (42 Mev)	0.85		50H71	Be (*d,n*). C^{12} (*n,2n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	0.229		50D55	Be (350 Mev *p,n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	0.225		50F56	Be (340 Mev *p,n*). Scin; recoil *p*'s.	R.Fox, et al., PR **80**, 23.
8 4 4	τ	5×10^{-14} s		50M80	From Be^8 displacement in O^{16} 4 - pronged stars.	C.H.Millar, A.G.W.Cameron, PR **81**, 316 (A).
	Mass difference in Mev $Be^8 - 2He^4$	0.09		50C75	From six forked pairs in cosmic ray stars.	J.Crussard, Nature **166**, 825.

5 BORON B

B	σ_s (epi-thermal)	3.5		50H90	B filtered *n*'s. Measured with scattering chamber.	C.T.Hibdon, C.O.Muehlhause, ANL-4552, 6.
	σ_t (2300 ev)	6.3		50H90	V resonance *n*'s.	See above.
	σ_t (0.2 - 1.0 Mev) E_o σ_o Γ J 0.43 6.7 0.045 2 or 3	graph		50B89	Resonance attributed to B^{11} because of abundance. O contamination negligible.	C.K.Bockelman, PR **80**, 1011. New reference. Curve in 50Ad.
	σ_t (42 Mev)	0.85		50H71	Be (*d,n*). C^{12} (*n,2n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	Relative isotopic abundances 10 19.57% 11 80.43%			50O53	B^{11}/B^{10} ratio for 6 minerals agreed to ±0.3%. Possible BF_3 source fractionation eliminated.	O.Osberghaus, Z. Phys. **128**, 366.

(B continued on next page)

5 BORON B (continued)

8 5 3	τ	0.65^s		50A57	B^{10}(21.2 Mev p,t); $Be^9(p,2p)$; C^{12}(~30 Mev $p,n\alpha$). Thresholds and E_β eliminate C^9 assignment.	L.W.Alvarez, PR **80**, 519.
	β^+	13.7	a			
	$\beta\alpha$ coincidences					
	E_α ~same as in Li^8 decay					
10 5 5	σ_s (epi-thermal)	2.43		50H90		See B, 50H90.
	σ_t (0.5 - 2.1 Mev)			50W74		H.B.Willard, et al., PR **81**, 329 (A).
	No resonances found					
11 5 6	σ_s (epi-thermal)	3.76		50H90		See B, 50H90.
	σ_t (0.5 - 2.1 Mev)			50W74		See B^{10}, 50W74.
	E_o	1.28				

6 CARBON C

C	σ_t (120 ev)	4.72		50H53	Co and Mn foils used as resonance scattering detectors	C.T.Hibdon, PR **79**, 747.
	(345 ev)	4.72				
	σ_t (0.798 - 4.97 Mev)	**table**		50L54	Li(p,n) and D(d,n) sources. Values good to ±2%.	E.E.Lampi, et al., PR **80**, 853.
	σ_t (2.5 - 3.8 Mev)	**graph**		50R60	D(d,n) source. Scin. Anisotropy of scattered n's observed. *	R.Ricamo, et al., HPA **23**, 508 and ***23**, 503.
	E_o	~2.9,3.7				
	σ_t (42 Mev)	1.09		50H71	Be(d,n). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	0.288		50D55	Be(350 Mev p,n). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	0.279		50F56	Be(340 Mev p,n). Scin; recoil p's.	R.Fox, et al., PR **80**, 23.
	Isotope shift			50B70	C^{13} shifted to lower frequency.	C.R.Burnett, PR **80**, 494.
14 6 8	β^-	0.155	sl	50W62	F-K plot slightly convex for 0.06 mg/cm^2 source in agreement with 48C10, 49A3.	S.D.Warshaw, PR **80**, 111.
15 6 9	2.4^s activity not found from $C^{14}(n,\gamma)$.			50Y51	σ(th n) <1 microbarn.	L.Yaffe, W.H.Stevens, PR **79**, 893.
	New reference for data reported in			50H10	C^{15}.	E.L.Hudspeth, et al., PR **80**, 643.

7 NITROGEN N

N	σ_a	1.76	osc	50C71	Chem. Cf. σ [$N^{14}(n,p)$]·	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) (345 ev)	~9.9 ~9.6		50H53	Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (42 Mev)	1.22		50H71	Be(d,n). $C^{12}(n,2n)$ detector. N_2 CH_2 used.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
$^{12}_{7}$ 5	β^+ to α emitting state of C^{12}			50A57	Delayed α's with τ of 13×10^{-3} s found.	L.W.Alvarez, PR **80**, 519.
$^{14}_{7}$ 7	q	0.01	Mic	50S51	J = 1→2 transition of $N^{14}F_3$.	J.Sheridan, W.Gordy, PR **79**, 513.

8 OXYGEN O

O	σ_t (0 - 1.44 Mev)	**graph**	50B89	Li(p,n). p - neutrons most likely for first two resonances and p or d for third.	C.K.Bockelman, PR **80**, 1011. New reference. Curve in 50Ad.
	σ_t (2.6 - 3.8 Mev) Double max.	**graph** ~3.6	50R60	D(d,n) source. Scin. Anistrophy of scattered n's observed.*	R.Ricamo, et al., HPA **23**, 508 and ***23**, 503.
	σ_t (42 Mev)	1.36	50H71	Be(d,n). $C^{12}(n,2n)$ detector. Derived from several molecular σ's.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	0.372	50D55	Be(350 Mev p,n). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	0.380	50F56	Be(340 Mev.p,n). Scin; recoil p's,	R.Fox, et al., PR **80**, 23.

E_o	σ_o	Γ	J
0.44	**14.0**	**0.045**	**3/2**
1.00	**7.9**	**0.100**	**3/2**
1.30	**6.7**	**0.040**	**3/2**

9 FLOURINE F

F	σ_t (0.01 - 0.7 Mev) **graph** E_o σ_o Γ J **0.10** **17.0** **0.015** **1**	50B89	Li(p,n). Six additional maxima observed.	C.K.Bockelman, PR **80**, 1011. New reference. Curve in 50Ad.
	σ_t (0.5 - 2.1 Mev) E_o **0.95** scattering **1.24** **1.66** } absorption **2.04**	50W74	Li(p,n). Distinction between scattering and absorption from the fact that BF_3 counter shows only last three resonances.	H.B.Willard, et al., PR **81**, 329(A)(1951).
	σ_t (42 Mev) **1.60**	50H71	Be(d,n). $C^{12}(n,2n)$ detector. LiF used.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	New reference for data reported in	50J4	F^{20}.	J.V.Jelley, Phil. Mag. **41**, 1199.
17 9 8	τ **70^s** β_1^+ 25% **0.78** sπ β_2^+ 75% **1.72** sπ γ **0.98** a	50P64	Produced by $O^{16}(d,n)$. Log ft_1 ~ 2.5. Log ft_2 ~ 3.5.	V.Perez-Mendez, P.Lindenfield, PR **80**, 1097.
19 9 10	σ(fast n,γ)12^sF **graph** E_o σ_o **0.27** **1.2 mb** 0.59 **1.0 mb**	50H70	Li(p,n). Based on σ(th n,γ) = 0.01. E_n = 0.225 - 0.370 and 0.510 - 0.625 Mev.	R.L.Henkel, H.H.Barschall, PR **80**, 145. New reference. Curve in 50Ad.
	μ **2.62805** I	50G65	From $\nu(H^1)/\nu(F)$ = 1.062917 ± 0.00001. [HFl]	E.W.Guptill, et al., Can. J. Res. **A28**, 359.
	Magnetic resonance frequency function of chemical compound	50G57	No temperature effect observed.	H.S.Gutowsky, C.J.Hoffman, PR **80**, 110.
20 9 11	β^- 96.5% **5.33** sl 3.5% **6.74** sl γ **1.64** sl;ce$^-$	50L57	Suggests that 2.45γ of 50J4 is due to impurity.	R.M.Littauer, Phil. Mag. **41**, 1214.

10 NEON Ne

Ne	σ_s (th n) **2.4**	50H60		S.P.Harris, PR **80**, 20.
	Relative isotopic abundances 20 **90.92 %** 21 **0.257 %** 22 **8.82 %**	50N51		A.O.Nier, PR **79**, 450.

11 SODIUM Na

Na	σ_a (pile n)	0.50 osc	50C71	Chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) σ_t (345 ev)	**4.16** **4.22**	50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (1 - 800 ev)	**3.3**	50S40	Used fast chopper.	W.Selove, et al., ANL-4397, 86.
	σ_t (42 Mev)	**1.67**	50H71	From σ(NaCl) = 3.777, $\sigma(CCl_4)$ = 9.516, and σ(C) = 1.092. $C^{12}(n,2n)C^{11}$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_s [I + ½] [I − ½]	**0.8** **8.8**	50S65	Calculated from resonance data of (50H9) and σ_t above (50S40).	W.Selove, PR **80**, 290.
	New reference for data reported in 50W6.			Na^{24}.	W.D.Whitehead, N.P.Heydenburg, PR **79**, 99.
20 11 9	τ β^+ Ne (p,n) threshold=16.9	~ **0.25**^{s} > **3.5***	50A57	Intense α's of >2 Mev follow β^+. *From energy considerations and intensity of α's observed.	L.W.Alvarez, PR **80**, 519.
24 11 13	τ	**15.04**^{h} ± 0.06	50S55	Ion exchange chemistry. Used windowless pc.	A.K.Solomon, PR **79**, 403.
	τ	**15.10**^{h} ± 0.04	50C69	Ion exchange chemistry. 4π ionization chamber.	J.W.Cobble, R.W.Atteberry, PR **80**, 917.
	γ	2.78 $\alpha_{pairs} = 8 \times 10^{-4}$	50M82	Observed annihilation radiation. Consistent with E2.	W.Mims, et al., Nature **166**, 1027.
	No $\beta\gamma$ angular correlation		50B60		J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.
	$\gamma\gamma$ angular correlation		50C77	Consistent with Γ = 4,2,0.	G.Charpak, F.Suzor, J. Phys. Rad. **11**, 633.
	Na (n,γ) Peaks at **2.8,3.0,3.2,3.6, 3.9,4.4,4.8,5.4**	γ **spectrum**	50M74	Dγp in deuterium loaded emulsions. γ peaks of comparable intensity.	C.H.Millar, et al., Can. J. Res., **28A**, 475.

12 MAGNESIUM Mg

Mg	σ_a (pile n)	0.057 osc	50C71	Based on σ_a (B) = 710. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (42 Mev)	**1.72**	50H71	Be (d,n). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
25 12 13	$Al^{27}(d,\alpha)$ Q	**6.58,6.01,5.62,4.95, 4.61,3.84,3.22,2.57, 1.77,1.10,0.63**	50S68	E_d = 11.1. Al absorption of α's; pc. Calibration with ThC' α's. Angular distribution curves given for different Q's.	A.D.Schelberg, et al., PR **80**, 574.
26 12 14	Al (γ,p)	threshold = 8.6	50D56		B.C.Diven, G.M.Almy, PR **80**, 407.

Al	σ_a (pile *n*)	**0.212**	osc	50C71	Based on σ_a (B) = 710. Chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (10 - 550 kev)	**curve**		50H70	Li (*p*,*n*). Many peaks.	R.L.Henkel, H.H.Barschall, PR **80**, 145.
	σ_t (42 Mev)	**1.78**		50H71	Be (*d*,*n*). C^{12} (*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	**0.555**		50D55	Be (350 Mev *p*,*n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	**0.566**		50F56	Be (340 Mev *p*,*n*). Scin; recoil *p*'s	R.Fox, et al., PR **80**, 23.
	Resonance Γ_n/Γ	$E_0 > 40$ kev $>$**0.99**		50H54	From measurement of Σ_a and Σ_s, resonance absorption and scattering integrals, in Argonne heavy water pile. $\Gamma_n/\Gamma = \Sigma_s/(\Sigma_s + \Sigma_a)$. Σ_a from cadmium ratio and σ_a (th *n*). Correction for 1/v absorption. Σ_s from comparison with C in annular counter. Correction for potential scattering.	S.P.Harris, et al., PR **79**, 11.
	Mg (*p*,γ) Peaks at **0.88,1.03,1.06,1.11, 1.22,1.26,1.35**			50C66	E_p = 0.35 - 1.5 Mev. Several peaks show evidence of more than one level.	J.N.Cooper, et al., PR **80**, 131 (A).
	Al (γ,*n*) 6.3^{s}Al Al (γ,*p*)	σ **curve** $\bar{\sigma}$ **table**		50D56	Angular distribution of *p*'s symmetrical. For the (γ,*p*) reaction, E_γ = 13.9, 17.1, 20.8.	B.C.Diven, G.M.Almy, PR **80**, 407.
	New reference for data reported in 50W6				Al^{28}.	W.D.Whitehead, N.P.Heydenburg, PR **79**, 99.
26 13 13	Mg^{25} (*d*,*n*) Q	**5.58,3.58,1.95,0.45**		50S53	E_d = 1.47. Separated isotopes. Ilford C2 photo plates.	C.P.Swann, et al., PR **79**, 598.
27 13 14	σ(10 - 550 kev *n*,γ) 2.30^{m}Al	**curve**		50H70	Li (*p*,*n*). Based on σ(th *n*,γ) = 0.22. Several resonances observed.	R.L.Henkel, H.H.Barschall, PR **80**, 145.
	σ($\sim$0.03 Mev *n*,γ) 2.30^{m}Al	**1.6 mb**		50H84	Based on σ(th *n*,γ) = 0.21 of 47S33. Sb - Be *n*'s.	V.Hummel, B.Hamermesh, ANL-4476 and PR **82**, 67.
	σ(*n*,*p*) 9.58^{m}Mg/σ(*n*,α) 14.90^{h}Na	**0.85**		50G67	14 Mev *n* from H^3 (*d*,*n*).	L.S.Goodman, T.R.Robillard, ANL-4476, 62.
	μ	**3.63938**	I	50G65	From ν_{Na}/ν_{Al} [$NaAlO_2$] = 1.015081 ± 0.00001.	E.W.Guptill, et al., Can. J. Res. **28A**, 359.
	Mg^{26} (*d*,*n*) Q	**5.68,4.80,3.76,2.93, 2.03,1.35,0.256,-0.13**		50S53	E_d = 1.47. Separated isotopes. Ilford C2 photo plates.	C.P.Swann, et al., PR **79**, 598.
28 13 15	Al (*n*,γ)	E_γ(max) = 8.0 - 8.5		50H51	Photo plates. Dγ*p*. Peaks at 5.3, 6.3.	B.Hamermesh, PR **80**, 415.
	Al (*d*,*p*) Angular distribution curves *p* spectrum			50H80	E_d = 4.6, 5.8, 7.5. Intensity max. in forward direction. Argon - filled ic.	J.R.Holt, C.T.Young, Proc. Phys. Soc., Lond., **A63**, 833.

14 SILICON Si

Si	σ_a (th *n*)	0.15		50T58	Si – H_2O mixture compared with C – H_2O mixture and with H_2O. H, O, C σ's taken as 0.313, 0.0016, 0.0045, respectively.	C.W.Tittle, H.Faul, PR **80**, 908.
	σ_a (pile *n*)	0.16	osc	50C71	Based on σ_a (B) = 710. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) (345 ev)	2.21 2.30		50H53	Thin foils of Co, Mn used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
28 14 14	$Al^{27}(p,p)Al^{27}$ $Al^{27}(p,\gamma)Si^{28}$ $Al^{27}(p,\alpha)Mg^{24}$	yield curves		50S54	E_p = 1.4 – 4.1. Many resonances observed.	F.C.Shoemaker, et al., PR **79**, 228(A).
	f	–5.07		50D52	From Δf(C_2H_4–Si^{28})=19.45 ± 0.06, f(C_2H_4)=14.37 ± 0.015; Δf(CO – Si^{28}) = 6.45 ± 0.03, f(CO) = 1.38 ± 0.07.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
29 14 15	$Si^{28}(d,p)$ Q	6.18, 4.89, 4.12, 3.75 3.10, 2.58, 2.09, 1.31		50M69	E_d = 3.8. Level values unchanged from 49AH.	H.T.Motz, R.F.Humphreys, PR **80**, 595.
	f	–4.94		50D52	From Δf(Si^{29} – Ni^{58}) = 3.07±0.02 and f(Ni^{58}) = – 8.01 ± 0.05.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
30 14 16	$Si^{29}(d,p)$ Q	8.36, 5.96 ?, 4.45, 3.36, 2.66		50M69	E_d = 3.8.	H.T.Motz, R.F.Humphreys, PR **80**, 595.
	f	–5.70		50D57	From Δf(CH_3 – Si^{30}) = 24.53 ± 0.05 and f(CH_3) = 18.83 ± 0.015.	H.E.Duckworth, et al., PR **79**, 188.
31 14 17	τ	2.59^h		50L56		E.Lüscher, et al., HPA **23**, 561.
	$Si^{30}(d,p)$ Q	4.33, 3.60, 3.10, 2.60, 2.00		50M69	E_d = 3.8. Q = 4.33 believed to be ground state Q.	H.T.Motz, R.F.Humphreys, PR **80**, 595.

15 PHOSPHORUS P

P	σ_a (pile *n*)	0.193	osc	50C71	Based on σ_a (B) = 710. Chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
31 15 16	σ(*n*,*p*) E_n = 1.9 – 3.75 Mev	σ curves		50L56	7 – 8 resonances.	E.Lüscher, et al., HPA **23**, 561.
32 15 17	τ	14.30^d		50B78	Rate of energy emission measured by calorimeter.	J.G.Bayly, Can. J. Res. **28A**, 520.
	Positive particles/e^-	~8×10^{-4}		50G56	E_e – ~0.19. sπ with path length of 4.4 cm. Ilford G5 plates.	G.Groetzinger, D.Kahn, PR **80**, 108.
	β^- Bump at ~H_ρ = 1000	1.708	sl	50W66	β shape constant over several half lives.	S.D.Warshaw, et al., PR **80**, 288.

Note abstracts in PR **83**, 215 (1951) which will be reported in *Supplement 3*.

16 SULPHUR S

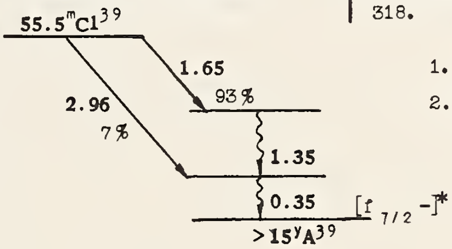
S	σ_a (pile *n*)	**0.49**	osc	50C71	Based on σ_a(B) = 710. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (0.015 - 1.45 Mev)		**σ curve**	50P53	Resonances at 0.111 (J = ½); 0.203, 0.274, 0.290 (½ or $\frac{3}{2}$); 0.375 (½); 0.585 (½); 0.700 (½); 0.725; 0.742.	R.E.Peterson, et al., PR **79**, 593.
	σ_t (42 Mev)	**1.97**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	New reference for data reported in 50G9				S^{35}.	L.Gross, D.R.Hamilton, PR **80**, 484.
$_{16}^{32}{}_{16}$	$P^{31}(p,\gamma)S^{32}$ 11 levels between (10.0 + 1.08) and (10.0 + 1.61) Mev		**γ yield curve**	50G55	~12 Mev γ observed at E_p = 1.270.	G.R.Grove, et al., PR **80**, 107.
	σ(*n*,*p*) E_r = 1.9 - 3.75 Mev		**σ curve**	50L56	6 resonances. Absolute values fixed from 48K28.	E.Lüscher, et al., HPA **23**, 561
	M	**31.9823** ± 0.0010		50S45	Absolute mass measurement.	L.G.Smith, PR **81**, 295(A).
$_{16}^{33}{}_{17}$	μ	**0.63**	Mic	50E51	Sample enriched to 5.54 % S^{33}. OCS^{33} J = 1 → 2 transition; g - factor taken as 0.421.	J.R.Eshbach, et al., PR **80**, 1106.
$_{16}^{35}{}_{19}$	$M(S^{35} - S^{32})/M(S^{34} - S^{32})$ $M(S^{35} - S^{32})/M(S^{33} - S^{32})$	**1.50156** ± 0.00015 **2.99882** ± 0.00030		50K46	J = 1 → 2 transition for OCS.	W.S.Koski, et al., PR **81**, 296(A).

17 CHLORINE Cl

Cl	σ_a (pile *n*)	**31.5**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_a (pile *n*)	**31.3**	osc	50C71	Based on σ_a(B) = 710. No self-screening correction; no chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	Resonance			50H55	From thermal σ_a, assumption of 1/v absorption, and new values of σ_t measured with Co, Mn, and V resonance scattering detectors.	C.T.Hibdon, C.O.Muehlhause, PR **79**, 44.
	E_0 (ev) **- 75**	Γ_γ **0.30**	Γ_n **2.63**	J **1 or 2**		
	σ_s (120 ev)	**5.12**				
	(345 ev)	**3.02**				
	(~2700 ev)	**1.60**				
	σ_t (42 Mev)	**2.11**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	q coupling ratio Cl^{35}/Cl^{37}	**1.277**	Mic	50S56	BrCl used.	D.F.Smith, et al., PR **79**, 1007.
	$M(Cl^{35})/M(Cl^{37})$	**0.945986** ± 0.000008	Mic	50S56	See above.	See above.

(Cl continued on next page)

17 CHLORINE Cl (continued)

34 17 17	β^+ **1.3, 2.58, 4.45** γ **0.145, 2.13, 3.30**	50R58	Cl^{35} (18 Mev *p,pn)* and S^{34} (18 Mev *p,n*). sl; ce^-, pe^-, Compt.	L. Ruby, J. R. Richardson, PR **80**, 760.
36 17 19	σ(3 - 3.7 Mev *n,α*) 14.3^dP shows monotonic increase	50L56	No σ values given. Possible peak at $E_n = 3.45$. D(*d,n*).	E. Lüscher, et al., HPA **23**, 561.
	Cl^{35} (*n*,γ) γ **spectrum** E_γ(max) = 8.5 Lines at 3.1, 3.4, 3.9, 4.5 - 5.0 No line at 8.5	50M74	Special D loaded C2 plates. $MgCl_2$ used. Two or more γ's in broad peak.	C. H. Millar, et al., Can. J. Res. **28A**, 475.
	E_γ(max) = 10.5 Some structure shown Line at 8.7 ?	50W61	D_2 in ionization chamber counter. CCl_4 used.	R. Wilson, PR **80**, 90.
	E_γ(max) = 9.2 Several peaks 4.2 - 7 Mev Intense line at 8.5	50H51	D_2O loaded Ilford C2 plates. C_2Cl_6 used.	B. Hamermesh, PR **80**, 415.
38 17 21	τ **37.29^m**	50C69	Produced by Cl(pile *n*); ion exchange. 4π ic.	J. W. Cobble, R. W. Atteberry, PR **80**, 917.
	γγ angular correlation indicates 2 E2 γ's with I = 3,2,0	50S62	1.1 β with log ft = 5.0 should then be 1^{st} forbidden.	R. M. Steffen, PR **80**, 115.
39 17 22	β^- 93% **1.65** a 7% **2.96** a γ **0.35** aβe^- α = 0.05 **1.35** a coin γγ, (0.35 e^-)β, (1.65 β)γ coincidences (2.96 β)γ coincidences could not have been observed A^{40} (*γ,p*) threshold = 14.2	50H61	Proposed decay scheme: 	R. N. H. Haslam, et al., PR **80**, 318. 1.65 β: [log ft ~ 4.8] 2.96 β: [log ft ~ 7.7] *See A^{39}, 50B66.

18 ARGON A

A	σ_a (pile *n*) **0.62** osc	50C71	Chem. Based on σ_a (B) = 710.	F. C. W. Colmer, D. J. Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	New reference for data reported in 50Z2		A^{37}.	A. Zucker, W. W. Watson, PR **80**, 966.
39 18 21	τ **$>15^y$** β^- **0.565** sl No γ > 0.3	50B66	K(pile *n*); eluted from charcoal column by He. Log ft > 8.7. ΔI = 2, yes shape makes ground state $f_{7/2}$.	A. R. Brosi, et al., PR **79**, 902.
	2.6^m activity with β^- ~2.1	50Z52	From A^{38} (*d,p*).	A. Zucker, W. W. Watson, PR **80**, 966.

19 POTASSIUM K

K	σ_a (pile *n*)	**1.89**	osc	50C71	No chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) σ_t (345 ev)	**1.92** **1.75**		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
39 19 20	μ	**0.39104**	I	50C65	$\nu(K^{39})/\nu(N^{14}) = 0.64580$. Used N^{14} values of 50P6.	T.L.Collins, PR **80**, 103.
40 19 21	β^-'s/sec (gm of K) γ/β^-	= **23** ~**0.05**		50S71	$\tau_\beta = 18.3 \times 10^{8\,y}$ *. From counts as function of KI crystal weight.	B.Smaller, et al., PR **79**, 940. *Based on K^{40}/K of 0.0119%.
	β^-'s/sec (gm of K) K/β^-	= **28** **0.14**		50S52	$\tau_\beta = 14.2 \times 10^{8\,y}$ *. Counted β's and Auger e^-'s **. Extrapolated to zero source and backing thickness.	G.A.Sawyer, M.L.Wiedenbeck, PR **79**, 490. ** Assumed $e^-/(e^- + X) = 0.88$.
	K's/sec (gm of K)	~**3**		50P74	From A content of Bugginger salts of known age.	M.Pahl, et al., Z. Naturforsch. **5a**, 404.
	K/β^-	**0.13**†	pc	50S44	K X-rays counted. $e^-/(e^- + X)$ used not given.	V.L.Sailor, et al., PR **81**, 298(A) (1951) and † verbal report.
	K/β^-	**0.126**	ms	50H83	Isotopic dilution method for A^{40} and Ca^{40} in ancient sylvite.	D.C.Hess, et al., PR **81**, 298(A) (1951) and PR **80**, 916.
	K/β^-	< **0.67**		50G53	From counting rate differences in G-M's with high and low efficiency for A X-rays **.	T. Gráf, PR **79**, 1014. **Assumed $e^-/(e^- + X) = 0.88$ and β/sec (gm of K) = 26.8.
	K/β^-	$\lesssim$ **0.07**		50C68	Special counter for X and X + β's. Approximate back-scattering correction used.	M.Ceccarelli, et al., PR **80**, 909.
	β^-	**1.33**	s	50F64	Enriched KCl. Shape fitted by C_3 factor of Greuling.	L.Feldman, C.S.Wu, PR **81**, 298(A) (1951).
	γ	**1.48**	scin	50H74	No other γ with intensity > 10% of 1.48 γ.	R.Hofstadter, J.A.McIntyre, PR **80**, 631.
	γ	**1.46**	scin	50B63		P.R.Bell, J.M.Cassidy, PR **79**, 173.
42 19 23	$\beta\gamma$ angular correlation b	 **0.062**		50B60	Consistent with I = 2−, 2+, 0+ of 49S41.	J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.

20 CALCIUM Ca

Ca	σ_a (pile *n*)	**0.40**	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (42 Mev)	**2.21**		50H71	Be(*d*,*n*). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith. PR **80**, 842.
45 20 25	β^-	**0.255**	scin	50K60	Split crystal technique. Kurie plot straight.	B.H.Ketelle, PR **80**, 758.

21 SCANDIUM Sc

Sc	σ_a (pile n)	**31.8**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
44 21 23 3.96^h	β^+	**1.54**	a	50C56	K^{41} (23 Mev α,n); chem. One β^+. $\beta\gamma$ coincidences indicate cascade.	W.H.Cuffey, PR **79**, 180.
	γ	**1.18**	a coin			
45 21 24	μ	**4.7508**	I	50S58	$\nu(Sc^{45})/\nu(Br^{79})$ [$ScCl_3$] = 0.96954 ± 0.00006, and $\nu(Br^{79})/\nu(H^1)$ [NaBr] = 0.25059 ± 0.00005.	R.E.Sheriff, D.Williams, PR **79**, 175.
46 21 25	β_2^- < 0.06%	**1.49**	sl	50M62	Both γ's E2 in agreement with angular correlation results.	M.L.Moon, et al., PR **79**, 905.
	γ_3	**0.88**	sl; ce^-			
		$\alpha = 1.74 \times 10^{-4}$				
	γ_2	**1.12**	sl; ce^-			
		$\alpha = 0.98 \times 10^{-4}$				
	β^- ~0.9%	**1.2**	sπ	50P71	No 1.49 β^- found*. Authors propose first excited Ti^{46} level at 1.12 Mev, with γ_3 preceding γ_2.	F.T.Porter, C.S.Cook, PR **81**, 298(A) (1951) and *verbal report.
	γ_3	**0.89**	sπ; ce^-			
		$\alpha = 1.36 \times 10^{-4}$				
	γ_2	**1.12**	sπ; ce^-			
		$\alpha = 0.607 \times 10^{-4}$				
	β_2^- < 0.05%			50S57	Study of $\beta\gamma$, $\gamma\gamma$ coincidences and electron tracks in cc.	B.N.Sorensen, et al., PR **79**, 1007.

22 TITANIUM Ti

Ti	σ_a (pile n)	**5.0**	osc	50C71	Based on σ_a(B) = 710. Self-screening correction; no chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev)	**4.69**		50H53	Thin foils of Co, Mn used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (345 ev)	~**4.8**				
	σ_s free	**4.0**		50L65	Sample outgassed at 1000° in vacuum furnace to remove H.	M.Levin, et al., CUD-53, 6.
	σ_s bound	**4.2**				
45 * 22 23	Reference number			[49K36]	Number should be 49K37.	*Correction to *Table*.
	τ	**3.09**^{h}		50K51	0.48 γ of 49K37 (see above) now attributed to annihilation radiation. Produced by Sc^{45} (5 Mev p,n); chem.	H.E.Kubitschek, PR **79**, 23.
	β^+	**1.00**	sπ			
	γ	**0.80**	sπ; pe^-, Compt			
	Sc K X-ray		crit a			
	τ	**3.05**^{h}		50T51	No 0.80 γ observed. Produced by Sc^{45} (10 Mev $d,2n$) and Sc^{45} (5 Mev p,n); chem. *2 - 3% of annihilation γ.	M.Ter-Pogossian, et al., PR **80**, 360.
	β^+ < 4%	**0.57**	sπ			
	≥96%	**1.02**	sπ			
	γ very weak*	**0.45**	sπ, pe^-			
	Sc^{45} (p,n)	threshold ~ 2.85		49H50		A.O.Hanson, et al., Rev. Mod. Phys. **21**, 635.

23 VANADIUM V

V	σ_a (pile n)	**4.93**	osc	50H62	Based on σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_a (pile n)	**4.4**	osc	50C71	Based on σ_a (B) = 710. Self-screening correction; no chemistry.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) σ_t (345 ev)	**5.35** **5.87**		50H53	Thin foils of Co and Mn used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (0.01 - 1 Mev)	**graph**		50B53	Li(p,n). BF$_3$ pc. Many rapid fluctuations.	J.M.Blair, J.R.Wallace, PR **79**, 28.
51 23 28	$\sigma(\sim 0.03$ Mev $n,\gamma)3.74^{m}$V	**59 mb**		50H84	Based on σ(th n,γ) = 4.50 of 47S33. Sb - Be n's.	V.Hummel, B.Hamermesh, ANL-4476, 54; PR **82**, 67 (1951).
	σ(fast $n,\gamma)3.74^{m}$V E_n = 0.120 0.400 0.650	 **16 mb** **6 mb** **3 mb**		50H70	Li(p,n). Based on σ(th n,γ) = 4.8. 10 maxima, not fully resolved, for E_n between 0.120 and 0.650.	R.L.Henkel, H.H.Barschall, PR **80**, 145.
52 23 29	τ_1 γ τ_2 β^- γ	**3.74^{m}** **0.25** α large **2.6^{m}** **~2.6** **~1.5**	 a a	50R67	No β e$^-$, no β(soft γ) coincidences. β(hard γ) coincidences. τ_2 from different irradiation times. Pure sample but no chem.	G.A.Renard, Ann. Phys., Paris, **5**, 385.
	V^{51} (d,p) Levels	 **0.72,1.31,1.65** **2.04,2.37,2.75**		50A62	E_d = 3.8 Mev. Wedge filter and photo plates.	A.Y.Abramov, Doklady Akad. Nauk, SSSR, **73**, #921; NSA **4**, #6435.

24 CHROMIUM Cr

Cr	σ_a (pile n)	**3.1**	osc	50C71	Based on σ_a (B) = 710. Self-screening correction. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
51 24 27	V(p,n) Q	 **-1.55,-2.33,-2.72** **-2.97,-3.08**		50S64	Levels at 0.78,1.17,1.42,1.53. Reaction can furnish mono-energetic n's up to E_n = 0.78.	P.H.Stelson, et al., PR **80**, 287.

25 MANGANESE Mn

Mn	σ_a (pile n)	**12.8**	osc	50C71	Based on σ_a (B) = 710. Self-screening correction. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	Resonances Γ_n/Γ	E_0 = 345,2400 ev **~0.99**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	Resonances E_0 (ev) Γ_γ Γ_n J **345** **~0.6** **21.6** **3** **~2400** **~0** **304** **2** E_n σ_s Scatterer 10.0 **2.26** Sm^{152} 19.5 **2.37** W^{186} 120 **6.01** Co^{59}			50H78	From measurements of Σ_s, Σ_a and σ_{self}. Γ values give σ_s (th) = 2.13, σ_a (th) = 12.1, σ_s coh = 2.03. They are consistent with σ_s (E_n) if two level Breit-Wigner formula is used with nuclear radius = 0.29×10^{-12} cm.	S.P.Harris, et al., PR **80**, 1014.
	New reference for data reported in 50W6				Mn^{56}.	W.D.Whitehead, N.P.Heydenburg, PR **79**, 99.
52 25 27 5.8^d	τ	**6.0^d**		50H48	Observed for 120^d in ic.	T.H.Handly, ORNL-867.
55 25 30	σ(~0.03 Mev n,γ)2.59^hMn	**78 mb**		50H84	Based on σ(th n,γ) = 10.7 of 47S33. Sb - Be n's.	V.Hummel, B.Hamermesh, ANL-4476, 54; PR **82**, 67 (1951).
56 25 31	Mn(d,p) Levels	**1.22,1.77,2.07, 2.45,2.82**		50A62	E_d = 3.8 Mev. Wedge filter and photo plates.	A.Y.Abramov, Doklady Akad. Nauk, SSSR, **73**, #921; NSA **4**, #6435.

26 IRON Fe

Fe	Incoherent scattering largely inelastic			50H69	Single crystal transmission and polarization studies.	D.J.Hughes, et al., PR **80**, 481.
	σ_a (pile n)	**2.4**	osc	50C71	Based on σ_a (B) = 710. Self-screening correction. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (120 ev) σ_t (345 ev)	**9.61** **8.65**		50H53	Co and Mn resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (42 Mev)	**2.44**		50H71	Be(d,n). C^{12} ($n,2n$) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
55 26 29	τ	**2.94^y**		50B76		G.L.Brownell, C.J.Maletskos, PR **80**, 1102.
56 26 30	f	**- 8.42**		50D52	From Δf(CO - Fe^{56}) = 9.80 and f(CO) = 1.38.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
57 26 31	Fe(th n,γ)	E_γ(max) ~7.8		50H51	Photo plates. Dyp.	B.Hamermesh, PR **80**, 415.

27 COBALT Co

Co	Resonance Γ_n/Γ	E_o = 115 ev **0.94**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	Resonance	E_o = **120 ev**		49R16	This value supersedes 115 ev.	L.J.Rainwater, PR **76**, 161.
	σ_a (pile *n*)	**38**	osc	50C71	Based on σ_a (B) = 710. No self-screening correction. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (0.080 - 1 Mev)	**curve**		50BB4	σ_t = 3 - 8 with ~20 peaks.	J.M.Blair, W.F.Stubbins, ANL-4437.
	New reference for data reported in			50W9	Co^{60}.	M.A.Waggoner, et al., PR **80**, 420.
58 27 31 9.3^h	τ_1	**9.2^h**		50C62	Produced by $Co^{59}(\gamma,n)$; Szilard-Chalmers separation.	D.Christian, D.S.Martin, Jr., PR **80**, 1110.
60 27 33	No $\beta\gamma$ angular correlation			50B60		J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.
5.2^y	τ_2	**5.26^y** ±0.17		50B76		G.L.Brownell, C.J.Maletskos, PR **80**, 1102.
	e^-	~**50 kev**	a	50D59	Intensity about 30% of principal mode of decay. 10.7^m activity had decayed.	M.Duquesne, et al., Compt Rend. **231**, 693.

28 NICKEL Ni

Ni	σ_a (pile *n*)	**4.8**	osc	50C71	Self screening correction; no chem. Used σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile *n*)	**4.37**	osc	50H62	Used σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (42 Mev)	**2.51**		50H71	Used $C^{12}(n,2n)C^{11}$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	New reference for data reported in			50F10	Ni^{57}.	G.Friedlander, et al., PR **80**, 30.
	New reference for data reported in			50S24	Ni^{58}, Ni^{60}, Ni^{62}.	W.C.Koehler, et al., PR **79**, 395.
58 28 30	f	**- 8.01**		50D52	Averaging f's from $\Delta f(C_2H_5-Ni^{58})$ and $\Delta f(COH-Ni^{58})$.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
59 28 31	τ Co K X-ray	**~8×10^{5y}**	 pc	50W58	Ni(pile n,γ); chem. τ based on $\sigma[Ni^{58}(\text{pile } n,\gamma)]$ = 4.6.	H.W.Wilson, PR **79**, 1032.
60 28 32	f	**- 8.60**		50D57	From $\Delta f(Si^{30}-Ni^{60})$ = 2.90 and a newer value of $f(Si^{30})$ = -5.70.	H.E.Duckworth, et al., PR **79**, 188.
61 28 33	μ	**<0.25**	S	50K55	From broadening in excess of Doppler effect.	K.G.Kessler, PR **79**, 167.
63 28 35	τ	**61^{y} ***		50W58	Ni(pile n,γ); chem. *Based on $\sigma[Ni^{62}(n,\gamma)]$ = 14.8 of 49P4.	H.W.Wilson, PR **79**, 1032.

Cu	Relative isotopic abundances 63 65	 **68.98%** **31.02%**		50H81		R.F.Hibbs, Y-648.
	Resonance Γ_n/Γ	$10^3 - 10^4$ ev **0.95**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	σ_a (pile *n*)	**3.6**	osc	50C71	Self-screening correction, no chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile *n*)	**3.71**	osc	50H62	Based on σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (42 Mev)	**2.540**		50H71	$C^{12}(n,2n)C^{11}$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	**1.145**		50D55	Be(350 Mev *p,n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	**1.19**		50F56	Be(340 Mev *p,n*). Scin, recoil *p*'s	R.Fox, et al., PR **80**, 23.
	σ(90 Mev *n,p* or *d*)	**curves**		50H63	Be(190 Mev *d,n*). Angular and energy distributions.	J.Hadley, H.York, PR **80**, 345.
	New reference for data reported in			50R12	Cu^{64}.	J.H.Reynolds, PR **79**, 789.
63,65 29 34,36	$\sigma[Cu^{63}(n,\gamma)]/\sigma[Cu^{65}(n,\gamma)]$	**2.3**	ms	50R51	Pile *n*'s. Products of Cu^{64} and Cu^{66} determined in ms.	J.H.Reynolds, PR **79**, 789.
64 29 35	τ	**12.80^h**		50R62	From different exposures for equal blackening of photoplate.	E.Rabinowitz, Proc. Phys. Soc., Lond., **A63**, 1040.
	γ	**1.38**	a	50K51	$\gamma/\beta^+ = 0.032$. Special technique for β^+ emitters.	H.E.Kubitschek, PR **79**, 23.
	$Cu(\gamma,n)12.88^h Cu$ threshold = 10.2			50J59	Based on 10.9 for Cu^{63}. $E_0 \sim 19.0$ Mev, $\Gamma \sim 6.0$ Mev.	H.E.Johns, et al., PR **80**, 1062.
65 29 36	$\sigma(\sim 0.03$ Mev $n,\gamma)5.05^m Cu$	**0.065**		50H84	Based on σ(th $n,\gamma)5.05^m Cu$ = 1.8 of 47S33. Sb-Be *n*'s.	V.Hummel, B.Hamermesh, ANL-4476, 54; PR **82**, 67 (1951).
	σ(fast $n,\gamma)5.05^m Cu$ E_n = 0.150 0.300 0.500	 **30 mb** **20 mb** **13 mb**		50H70	Li(*p,n*). Based on σ(th n,γ) = 2.05. Smooth curve using 20 kev resolution.	R.L.Henkel, H.H.Barschall, PR **80**, 145.
66 29 37	τ	**5.18^m**		50C67	Electrolytically pure Cu used.	A.G.W.Cameron, L.Katz, PR **80**, 904.

30 ZINC Zn

Zn	σ_a (pile n)		**1.09**	osc	50C71	No chem. No self-screening correction. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (42 Mev)		**2.62**		50H71	Be (d,n). C^{12} ($n,2n$) detector.	R.H.Hildebrand, C.E.Leith, PR **82**, 842.
62 30 32	τ		**9.33**^{h}		50H65	Other values as in 49H42. Log ft = 4.7 for β^+.	R.W.Hayward, PR **79**, 541.
	γ		0.0418	sl;ce$^-$			
			K/L > 6.4				
65 30 35	γ		**1.114**	sl;ce$^-$	50W59	α_K seems to indicate E2 and/or M1.	M.A.Waggoner, et al., PR **80**, 420.
			α_K = 2.28 x 10^{-4}				
68 30 38	σ(~0.03 Mev n,γ)52^mZn		**0.033**		50H84	Used σ(th n,γ) = 1.09 of 47S33. Sb - Be n's.	V.Hummel, B.Hamermesh, ANL-4476, 54; PR **82**, 67 (1951).

31 GALLIUM Ga

Ga	Resonance		$10^2 - 10^3$ ev		50H54		S.P.Harris, et al., PR **79**, 11.
	Γ_n/Γ		~**0.95**				
64 31 33	No 45^m β activity observed				50M70	Zn(p,n).	A.Mukerji, P.Preiswerk, Helv. Phys. Acta. **23**, 516.
66 31 35	τ		**9.2**^{h}		50M70	Zn(p,n). *Fermi plot straight, but log ft = 7.9. (1.05 γ) (2.76 γ) coincidences. No (4.20 β) (1.05 γ) coincidences. (Compare 50L55 below).	See above.
	β^+		**0.4**	s			
			0.9	s			
			1.44	s			
		40 %	**4.20** *	s			
	γ		**1.05**	s			
			2.76	s			
			3.3	s			
	τ		**9.45**^{h}		50L55	K capture to one or more levels. 4.144 β^+ has straight Fermi plot. No (4.144 β^+) (1.03 γ) coincidences. (Compare 50M70 above). *Relative intensities [$\gamma\gamma$ coincidences not discussed] Auger line at 7.34 kev but no conversion lines.	L.M.Langer, R.D.Moffat, PR **80**, 651.
	K	34 %					
	β^+	2 %	**0.403**	sπ			
		7 %	**0.878**	sπ			
		4 %	**1.4**	sπ			
		87 %	**4.144**	sπ			
		< 0.4 %	**5.17 ?**	sπ			
	γ	100 %*	**1.03**	s; pe$^-$, Compt			
		70 %*	**2.75**	s; pe$^-$			
			4.8	s; pe$^-$, Compt			
	γ		**1.06**	scin	50H74	1.06 γ and 2.75 γ of about equal intensity.	R.Hofstadter, J.A.McIntyre, PR **80**, 631.
			2.75	scin			
			3.25	scin			
			4.27	scin			

(Ga continued on next page)

31 GALLIUM Ga (continued)

68 31 37	τ	68^m		50M70	β's have allowed shape. Conclude spin for Ga^{68} = 1; parity same as Zn^{68}. K capture indicated by Auger electrons.	See Ga^{64}, 50M70.
	K					
	β^+	0.8	s			
		1.88	s			
	γ	1.10	s			

32 GERMANIUM Ge

Ge	σ_a (pile *n*)	2.64	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (120 ev)	14.0		50H59	Detected Co resonance *n*'s.	C.T.Hibdon, ANL-4552, 5.
70 32 38	σ(th *n*,γ) 11^dGe	4		50R66	Cd ratio of ~30.	S.A.Reynolds, ORNL-867, 24.
71 32 39	τ	11^d		50R66	Ge^{70}(*n*,γ) Ge^{71}. No isomer was found.	See above.
	K					
74 32 42	σ(th *n*,γ) 82^mGe	0.5		50R66	Enriched Ge^{74}. Cd ratio = 20.	See above.
75 32 43	τ	79^m		50R66	Ge^{74}(*n*,γ) Ge^{75}. Possible $\beta\gamma$ coincidences, but not certain due to short τ.	See above.
	β^-	1.3	a			
	γ? ~10%	~0.25				
76 32 44	σ(th *n*,γ)			50R66	Enriched Ge^{76}. Cd ratio of 3.2 for 12^h activity.	See above.
	59^sGe	0.015				
	12^hGe	0.30				
77 32 45 59^s	τ	57^s		50R66	p 40^hAs.	See above.
12^h	τ	12^h		50R66	p 40^hAs. Soft $\gamma\gamma$ coincidences. No (hard γ) (soft γ) coincidences. $\beta\gamma$ coincidences.	See above.
	β^-	1.8	a			
	γ weak	~0.3	a			
		~0.6	a			

33 ARSENIC As

As	σ_a (pile n)	**4.9**	osc	50C71	Self-screening correction; no chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	Resonance Γ_n/Γ	$E_0 = 10^2 - 10^3$ ev **~0.72**		50H54	See Al^{27}. Resonance in As^{75}.	S.P.Harris, et al., PR **79**, 11.
	Resonance	E_0 = **43** ev		50H88	Evidence of higher energy resonances.	S.P.Harris, ANL-4552, 5.
	New reference for data reported in			50M25	As^{71}.	J.Y.Mei, et al., PR **79**, 19.
72 33 39	β^+ 2% 5% 12% 62% 19%	**0.27** **0.67** **1.84** **2.50** **3.34**	sl sl sl sl sl	50M55	Spectrum of 3.34 β indicates $\Delta I = 2$, yes. Evidence for some γ's with $E > 1$ Mev. Other γ's same as in 50M25. Could not see any 0.637 γ.	J.Y.Mei, et al., PR **79**, 19.
73 33 40	τ γ	**~90**^{d} **0.052**	 sl;ce$^-$	50M55		See above.
74* 33 41	β^- intensity			42E4	Intensity of 1.40 β^-, as well as 0.72 β^-, should be 15%.	* Correction to *Table*.
	β^+ β^- 53% 47% γ	**0.96** **0.82** **1.45** **0.593**	sl sl sl sl;pe$^-$	50M55	β^-/β^+ ~2.	See As^{72}, 50M55.
75 33 42	σ(~0.03 Mev n,γ)26.8^{h}As	**1.2**		50H87	Based on σ(th n,γ) = 4.2 of 47S33. Sb - Be n's.	V.Hummel, B.Hamermesh, ANL-4515, 40; PR **82**, 67 (1951).
78 ? 33 45 ?	τ_2	**~40**^{m}		50B49	Fission. Probably d ~2^{h}Ge, but As^{79} assignment also possible.	R.A.Brightsen, et al., PR **81**, 298(A) (1951).

34 SELENIUM Se

Se	σ_a (pile n)	**12.2**	osc	50H62	Based on σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_a (pile n)	**11.4**	osc	50C71	No self-screening correction; no chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
75 34 41	τ γ	**128**^{d} **0.0247 0.1212 0.2801** **0.0662 0.1362 0.3050** **0.0808 0.1988 0.4019** **0.0968 0.2652**	 s;ce$^-$	50C57	No β^+ found using magnetic field and counters. The eleven γ's are fitted into five levels in As^{75}.	J.M.Cork, et al., PR **79**, 889.
77 34 43	τ e$^-$	**17.4**^{s} **0.165**	 a	50F62		A.Flammersfeld, C.Ythier, Z.Naturforsch., **5a**, 401.

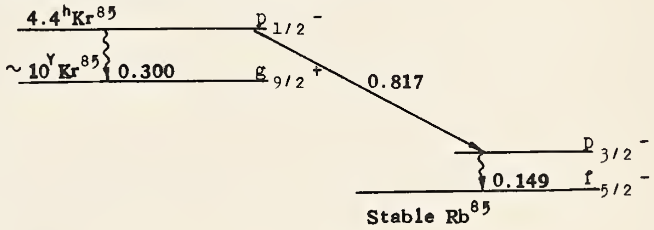
(Se continued on next page)

34 SELENIUM Se (continued)

79 ? 34 45 ?	τ e^- No γ	**3.9^m** **0.09**	 a	50F62	Se(fast and slow *n*). Activation σ too large for 6.6^mNb. Probably e^- not β^- since τ is so small.	A.Flammersfeld, C.Ythier, Z. Naturforsch., **5a**, 401.
$6.5 \times 10^{4\,y}$	β^- No γ	**0.160**	a	50P76		G.W.Parker, priv. comm., quoted in NNES Vol. **9**, 2020.
	β^-	**~0.150**	a	50K43		S.Katcoff, BNL 39, 59, quoted in NNES Vol. **9**, 2020.
81 34 47	τ	**18^m**		50F62	Discrepancies in previous results probably due to presence of 3.9^mSe$^{79\,?}$ activity.	A.Flammersfeld, C.Ythier, Z. Naturforsch., **5a**, 401.

35 BROMINE Br

Br	σ_a(pile *n*)	**8.7**	osc	50C71	Self-screening correction. No chem. Based on σ_a(B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a(pile *n*)	**8.83**	osc	50H62	Thick target. Based on σ_a(B)=710	S.P.Harris, et al., PR **80**, 342.
	σ_t(~0.006 - 10 ev)	**graph**		50E57	Best fit given by $\sigma_t = 6.2 + 1.1E^{-1/2}$.	P.A.Egelstaff, B.T.Taylor, Nature **166**, 825.
	σ_t(42 Mev)	**2.93**		50H71	From $\sigma(CH_2Br_2) = 7.361$, $\sigma(H) = 0.203$, $\sigma(C) = 1.089$. $C^{12}(n,2n)C^{11}$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	M(Br^{79})/M(Br^{81}) * M(Br^{79})/M(Br^{81}) **	**0.97522** **0.97521**	Mic Mic	50S56	*for Br^{79}Cl^{35}/Br^{81}Cl^{35} pair. **for Br^{79}Cl^{37}/Br^{81}Cl^{37} pair.	D.F.Smith, et al., PR **79**, 1007.
	New reference for data reported in 50R7				Br^{80}.	D.West, P.Rothwell, Phil. Mag. **41**, 873.
	New reference for data reported in 50R12				Br^{80}, Br^{82}.	J.H.Reynolds, PR **79**, 789.
79 * 35 44	σ's			49H5 47S33	*Table* should read: (th *n*,γ) 18^mBr 8.9 49H5 8.1 47S33 (th *n*,γ) 44^hBr 3.0 49H5 2.8 47S33	*Correction to *Table*.
79,81 35 44,46	$\sigma[Br^{79}(n,\gamma)]/\sigma[Br^{81}(n,\gamma)]$	**3.86**	ms	50R51	Pile *n*'s. Products of Br^{80} and Br^{82} determined in ms.	J.H.Reynolds, PR **79**, 789.
81 35 46	σ(pile *n*,γ)35.5^hBr	**4.3**		50C78	Based on σ(Co) = 34. Value used in 50C23 was σ(Co) = 22.	J.W.Cobble, ORNL-785, 45.
82 35 47	τ	**35.87^h**		50C69	Pile *n*. Ion-exchange column techniques.	J.W.Cobble, R.W.Atteberry, PR **80**, 917.

Kr	Relative isotopic abundances 78 **0.354 %** 80 **2.27 %** 82 **11.56 %** 83 **11.55 %** 84 **56.90 %** 86 **17.37 %**			50N51		A.O.Nier, PR **79**, 450.
	σ_a (pile n)	**30**		50M66	From sum of isotopic values listed below.	J.Macnamara, H.G.Thode, PR **80**, 296.
	σ_s (th n)	**7.2**		50H60	Boron absorption and self-absorption indicate resonance near thermal energies.	S.P.Harris, PR **80**, 20.
$^{80}_{36}{}_{44}$	σ(pile n,γ)	**95**		50M66	From relative abundance changes upon irradiation in Chalk River pile.	See Kr, 50M66.
	σ(pile n,γ) $2.1\times10^{5\,y}$ Kr	**12.5**		50R54	From ms peak found in Kr extracted from long irradiated Br.	J.H.Reynolds, PR **79**, 886.
$^{81}_{36}{}_{45}$	τ_1	**10^s**		50K62	See Rb^{81}, 50K62. d $5^h Rb^{81}$.	D.G.Karraker, D.H.Templeton, PR **80**, 646.
	γ	**0.193**	a			
	τ_2	**$2.1\times10^{5\,y}$**		50R54	Counting rate found as function of gas pressure.	See Kr^{80}, 50R54.
	K X-ray		a			
$^{82}_{36}{}_{46}$	σ(pile n,γ)	**45**		50M66	See Kr^{80}, 50M66.	See Kr, 50M66.
$^{83}_{36}{}_{47}$	σ(pile n,γ)	**205**		50M66	See Kr^{80}, 50M66.	See Kr, 50M66.
$^{84}_{36}{}_{48}$	σ(pile n,γ)	**0.1 – 2**		50M66	See Kr^{80}, 50M66.	See Kr, 50M66.
$^{85}_{36}{}_{49}$ 4.36^h	β^- 84 %	**0.817**	s	50B64	Log ft = 5. E2, M1 mixture for 0.149 γ. Decay scheme predicts 0.67 β^-, $\Delta I = 2$, yes.	I.Bergström, S.Thulin, PR **79**, 537.
	γ	**0.149** $\alpha_K = 0.051$	s;ce$^-$			
	16 %	**0.300**	s;ce$^-$			
	(0.149γ) β^- coincidences					
$\sim 10^y$	β^- 0.7 %	**0.15**	a$\beta\gamma$	50Z51	0.695 β^- spectrum indicates $\Delta I = 2$, yes; log ft = 9.	H.Zeldes, et al., PR **79**, 901.
		0.695	sl			
	γ	**0.54**	a,scin			
	σ(pile n,γ)	**0 – 15**		50M66	See Kr^{80}, 50M66.	See Kr, 50M66.
$^{86}_{36}{}_{50}$	σ(pile n,γ)	**0 – 2**		50M66	See Kr^{80}, 50M66.	See Kr, 50M66.

37 RUBIDIUM Rb

Rb	Relative isotopic abundances 85	 **72.15 %**	 87 **27.85 %**	50N51		A.O.Nier, Pr **79**, 450.
81 37 44	τ K β^+ γ	**4.7^h** **0.990** **0.95**	 $s\pi\sqrt{2}$ a	50K62	Br (40 Mev α); ms; chem. p 13^s Kr^{81} (0.193 γ). β^+ : K X-ray : γ = 0.1 : 1 : 0.6, assuming half the X-rays belong to daughter.	D.G.Karraker, D.H.Templeton, PR **80**, 646.
82 37 45	τ K β^+ γ strong	**6.3^h** **0.670** **0.7** **1.2**	 a, $s\pi\sqrt{2}$ a a	50K62	Br (18 Mev α); ms; chem. β^+ : K X-ray : γ = 0.12 : 1 : 0.9.	See above.
83 37 46	τ K	**107^d**		50K62	Br (40 Mev α,2n); ms; chem. Particles : K X-ray : γ ~0.3 : 1 : 2. No attempt to find 1.88^h Kr daughter.	See above.
84 37 47	τ K β^+ e^- γ	**34^d** **1.53** **~0.37** **0.85**	 $s\pi$ $s\pi$ a	50K62	Br (18 Mev α,n); ms; chem. β^+ : K X-ray : γ = 0.15 : 1 : ~0.6. Not sure if any e^-'s were β^-'s; if so β^- branch ~3% or less.	See above. Note also A.Flammersfeld, Z.Naturforsch. **5a**, 687.
	τ K β^+,β^- γ	**38^d** **1.3** **0.8**	 a	50B82	Kr (20 Mev α and 10 Mev d); chem; also Br (α,n). β^+/β^- = 6.2.	W.C.Beckham, M.L.Pool, PR **80**, 125 (A).
86 37 49	β_1^- β_2^- γ	**0.72** **1.80** **1.076**	sl; $\beta\gamma$ sl sl; pe^-	50M67	β_1^- shape ~allowed. β_2^- shape ΔI = 2, yes. Suggested spins 2−; 1,2,or3 +; 0 +.	H.R.Muether, S.L.Ridgway, PR **80**, 750.

38 STRONTIUM Sr

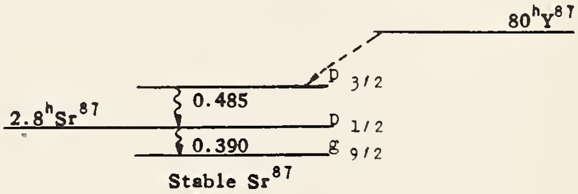
Sr	σ_t (120 ev) σ_t (345 ev)	**13.5** **13.0**		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (42 Mev)	**2.99**		50H71	From σ of $SrCO_3$ = 8.150, C = 1.092, and O = 1.353. C^{12} (n,2n) C^{11} detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_a (pile n)	**1.35**	osc	50C71	No chem.; no self-screening correction. Used σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.

(Sr continued next page)

38 STRONTIUM Sr (continued)

87 38 49	τ	2.80^h		50M68	See Y^{87}, 50M68.	L.G.Mann, P.Axel, PR **80**, 759.
	γ	0.390 $\alpha_K = 0.25$, K/L = 6.9				
90 38 52	τ	19.9^y		50P56	Fission product Sr.	R.I.Powers, A.F.Voigt, PR **79**, 175.
	β^-	0.54		50L52	Shape indicates $\Delta I = 2$, yes; additional correction Λ used. Log ft = 9.2.	L.J.Laslett, et al., PR **79**, 412.

39 YTTRIUM Y

87 39 48 14^h	τ	14^h		50M68	50% of 14^h activity goes to 80^h ground state. 0.374 ce^- in remainder.	L.G.Mann, P.Axel, PR **80**, 759.
	K					
	β^+ 2%	1.1	sl;scin			
	e^-	0.374				
80^h	τ	80.0^h		50M68	Proposed decay scheme: 	See above.
	K					
	β^+ <1%					
	γ	0.485 $\alpha_K = 0.0033$				
	$\gamma(2.8^h Sr)$	0.390				
89 39 50	I	1/2	S	50K69		H.Kuhn, G.K.Woodgate, Proc. Phys. Soc., Lond., **A63**, 830.
	μ	negative	S			
90 39 51	β^-	2.24		50L52	Log ft = 9.3 with Λ correction. See also Sr^{90}, 50L52.	L.J.Laslett, et al., PR **79**, 412.
95 39 56	τ	10.5^m		50K44	$Zr^{96}(\gamma,p)$.	J.D.Knight, priv. comm. quoted in NNES, Vol. **9**, 2028.

40 ZIRCONIUM Zr

Zr	σ_a (pile n,γ)	0.25	osc	50C71	Chem. Based on $\sigma_a(B) = 710$.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
90 40 50	f	-7.58		50D57	From $\Delta f(Si^{30}-Zr^{90}) = 1.88$ and $f(Si^{30}) = -5.70$.	H.E.Duckworth, et al., PR **79**, 188.
97 40 57	τ	17.0^h		50B54	$Zr^{96}(n,\gamma)$, and fission. Log ft = 7.1. No $\beta\gamma$ coincidences; γ assigned to $60^s Nb^{97}$, q.v.	W.H.Burgess, et al., PR **79**, 104.
	β^-	1.91	sl			
	γ	0.749 $\alpha = 0.015$	sl;pe^-			
	β^-	1.9	a	49S50	Fission.	F.Suzor, Ann. Phys., Paris, **4**, 269.

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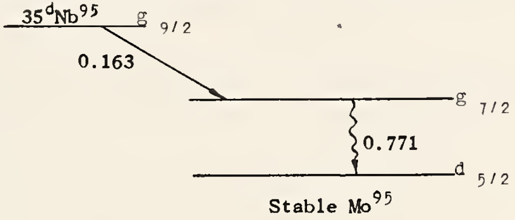
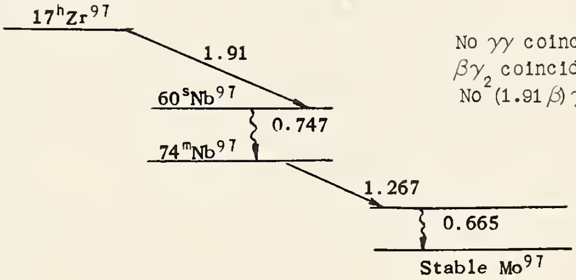
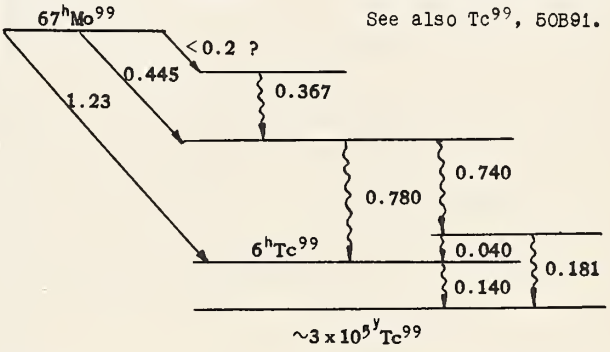
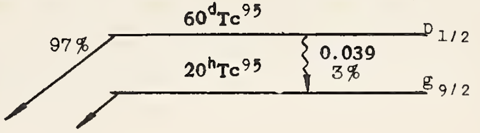
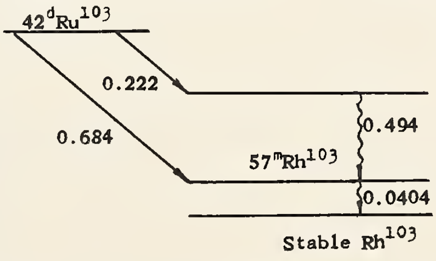
Nb	σ_a (pile n)	1.26	osc	50C71	No chem. No self-screening correction. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile n)	1.51	osc	50H62	Based on σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (120 ev) σ_t (345 ev)	7.24 7.16		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
95 41 54 35^d	β^- γ	0.163 0.771	sl sl; ce$^-$ α = 0.0018, K/L ~ 2.3	50F65	Proposed decay scheme:  	C.Y.Fan, PR **81**, 300(A)(1951).
96 41 55	τ β^-	22.9^h 0.75	 sl	50B43	$\beta\gamma$ coincidences indicate β followed by 3 γ's in cascade.	G.E.Boyd, B.H.Ketelle, ORNL-795, 44; ORNL-870, 37.
	No 1.119 γ			50BB2	See Tc^{96}, 50M21.	G.E.Boyd, priv. comm.
97 41 56 60^s	τ_1 γ_1	60^s 0.747	 sl; pe$^-$ α = 0.015	50B54	d 17^hZr, p 74^mNb; chem. Proposed decay scheme:  	W.H.Burgus, et al., PR **79**, 104. No $\gamma\gamma$ coincidences. $\beta\gamma_2$ coincidences. No (1.91 β) γ coincidences.
76^m	τ_2 β^- γ_2	74^m 1.267 0.665	 sl log ft = 5.4 sl; pe$^-$ α ~ 0.0015	50B54		
	β^-	1.35	a	49S50	Fission.	F.Suzor, Ann. Phys., Paris, **4**, 269.
99 41 58	τ β^-	2.5^m 3.2	 a	50D54	Mo^{100} ($\leqslant$23 Mev γ,p); chem.	R.B.Duffield, et al., PR **79**, 1011.

Mo	σ_a (pile n)		**3.04**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_a (pile n)		**2.95**	osc	50C71	No chem. Self-screening correction. Based on σ_a(B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (0.0025 – 10 ev)		**graph**		50E57	Results from 0.25 to 10 ev fitted by $\sigma_t = 6.4 + 0.43E^{-1/2}$.	P.A.Egelstaff, B.T.Taylor, Nature **166**, 825.
	σ_t (120 ev) σ_t (345 ev)		**6.78** **5.55**		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (0.01 – 1.15 Mev)		**graph**		50S42		W.F.Stubbins, ANL-4515, 8.
	σ_t (42 Mev n)		**3.11**		50H71	$C^{12}(n,2n)C^{11}$ detector. Be(d,n).	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
96 42 54	f		**- 6.67**		50D57	From $\Delta f(C_2 - Mo^{96}) = 9.88$ and $f(C_2) = 3.213$.	H.E.Duckworth, et al., PR **79**, 188.
99 42 57	β_1^-	~20 %	**0.445**	sl	50B91	Mo(d,p). Proposed decay scheme: 	M.E.Bunker, R.Canada, PR **80**, 961 and PR **81**, 299(A) (1951). See also Tc^{99}, 50B91.
	β_2^-	~80 %	**1.23**	sl			
	β_3^- ?	weak	**< 0.2**	sl			
	γ_1		**0.040**	sl; ce⁻			
	γ_2		**0.140** K/L = 9	sl; ce⁻, pe⁻			
	γ_3		**0.181** K/L = 5	sl; ce⁻, pe⁻			
	γ_4	10 %*	**0.367**	sl; pe⁻			
	γ_5	100 %*	**0.741**	sl; pe⁻			
	γ_6	14 %*	**0.780**	sl; pe⁻			
	*Relative values						
	β^-		**1.25**	a	49S50	Fission.	F.Suzor, Ann. Phys., Paris, **4**, 269.
100 42 58	f		**- 6.14**		50D57	From $\Delta f(C_2H - Mo^{100}) = 12.47$ and $f(C_2H) = 6.336$.	H.E.Duckworth, et al., PR **79**, 188.
	σ(~0.03 Mev n,γ)14^mMo		**1.4**		50H87	Based on σ(th n,γ) = 0.5 of 47S33. Sb – Be neutrons.	V.Hummel, B.Hamermesh, ANL-4515, 4; PR **82**, 67 (1951).
	$\sigma(\gamma,n)$ maximum at E_γ ~17 Mev $\sigma(\gamma,p)$ increased up to $E_\gamma = 23$ Mev				50D54	$\sigma(\gamma,p)/\sigma(\gamma,n)$ ~100 times greater than statistical theory of nuclear reactions predicts.	R.B.Duffield, et al., PR **79**, 1011.

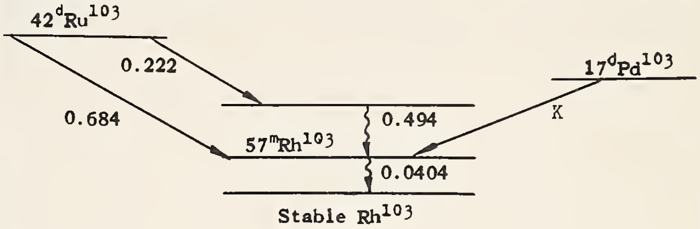
43 TECHNETIUM Tc

95 43 52 62^{d}	τ		60^{d}		50BB2		G.E.Boyd, priv. comm.
	γ		0.0390	sl;ce$^-$	50M73	Proposed decay scheme: 	H.A.Medicus, P.Preiswerk, PR **80**, 1101.
96 43 53	τ		4.25^{d}		50B43	Same decay scheme as 50M21 (See Tc^{96}) except for these crossovers. 0.312 γ practically completely converted.	G.E.Boyd, B.H.Ketelle, ORNL-870, 37; also G.E.Boyd, priv. comm.
	γ		1.65	scin			
			1.89	scin			
			2.39	scin			
	τ		4.20^{d}		50C69	4π ic. Ion exchange separation.	J.W.Cobble, R.W.Atteberry, PR **80**, 917.
99 43 56 5.9^{h}	γ		0.140 K/L = 9	 sl;pe$^-$,ce$^-$	50B91	See Mo^{99}, 50B91.	M.E.Bunker, R.Canada, PR **80**, 961.
$\sim 3 \times 10^{5\,y}$	τ		$2.12 \times 10^{5\,y}$		50J61	NH_4TcO_4 solution used.	A.H.Jaffey, et al., PR **81**, 299(A) and PR **81**, 741.
	τ		$2.2 \times 10^{5\,y}$		50P73	Used pertechnetate compound with tetraphenyl arsonium chloride.	G.W.Parker, ORNL-870, 45.
	I		9/2	S	50K66		K.G.Kessler, W.F.Meggers, PR **80**, 905.

44 RUTHENIUM Ru

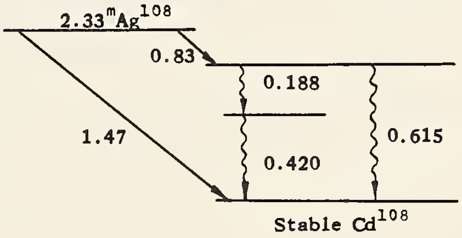
Ru *	Relative abundances				[44E1]	Reference should be 43E6 not 44E1	*Correction to *Table*.
	σ_a (pile *n*)		6.30	osc	50H62	Sample $\sim$150 mg/cm^2.	S.P.Harris, et al., PR **80**, 342.
	σ_t (120 ev)		6.51		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t (345 ev)		6.70				
	New reference for data reported in 50M26					Ru^{97}.	J.Y.Mei, et al., PR **79**, 429.
103 44 59	τ		39.8^{d}		50K56	Ru(pile n,γ); chem. β spectra do not yield straight-line Fermi plots. No $\gamma\gamma$ coincidences. No $\beta\gamma_1$ coincidences. γ_2 follows β_1. See decay scheme below.	E.Kondaiah, PR **79**, 891.
	β_1^-		0.217	sl			
	β_2^-		0.698	sl			
	γ_1		0.0400 K/L + M = 0.20	sl;ce$^-$,pe$^-$			
	γ_2		0.498	sl;ce$^-$,pe$^-$			
	β_1^-	94 %	0.222	sl	50M53	Suggested decay scheme: 	J.Y.Mei, et al., PR **79**, 429. log ft (β_1) = 8.3 log ft (β_2) = 5.6
	β_2^-	6 %	0.684	sl			
	γ_1		0.0404	sl;ce$^-$			
	γ_2		0.494 $\alpha_K = 5.5 \times 10^{-3}$ K/L = 6.5	sl;ce$^-$,pe$^-$			

45 RHODIUM Rh

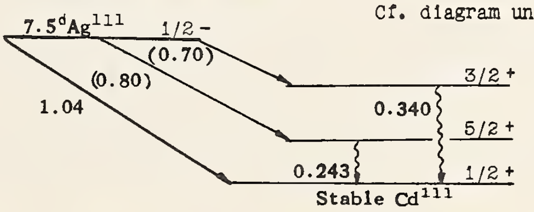
Rh	Resonance Γ_n/Γ	E_0 = 1.28 ev 0.043	50H54	See Al^{27}, 50H54.	S.P.Harris, et al., PR **79**, 11.
103 45 58 57^m	τ γ e^-	**56^m** **0.0404** sl;ce^- K/L < 1 **0.0369**	50M53	Decay of Pd^{103}; chem. Proposed decay scheme: 	J.Y.Mei, PR **79**, 429.
Stable	I μ	**1/2** S **- 0.11***	50K45	* Assuming perfect L-S coupling. Sign doubtful.	H.Kuhn, G.K.Woodgate, Nature 166, 906.
	σ(~0.03 Mev n,γ)4.34^mRh	**0.20**	50H84	Based on σ(th n,γ) = 12 of 47S33. Sb-Be n's.	V.Hummel, B.Hamermesh, ANL-4476, 54;. PR **82**, 67 (1951).
105 45 60	τ β^- γ	**36.8^h** **~0.6** a **0.3** a	50M77	Ru(pile $n,\gamma\beta$); chem. No $\beta\beta$ or $\gamma\gamma$ coincidences. Very few β's coincident with 0.3 γ.	C.E.Mandeville, E.Shapiro, PR **80**, 125(A).
106 45 61	γ_1 γ_2	$\alpha_K = 5.4 \times 10^{-3}$ $\alpha_K < 2.5 \times 10^{-3}$	50M86	Conversion coefficients suggest E2 for γ_1 and γ_2.	F.Metzger, PR **79**, 398.
	$\gamma\gamma$ angular correlation curve		50B59	Curve not analyzed.	J.R.Beyster, M.L.Wiedenbeck, PR **79**, 411.

46 PALLADIUM Pd

Pd	σ_a (pile n)	**10.3** osc	50H62	Thick target. Based on σ_a(B)=710.	S.P.Harris, et al., PR **80**, 342.
	σ_a (pile n)	**10.0** osc	50C71	Self-screening correction; no chem. Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys., Soc., Lond., **A63**, 1175.
	σ_t (120 ev) σ_t (345 ev)	**5.95** **5.78**	50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	Resonances E_0	 **80** ev **180** ev	50H88	Evidence of higher energy resonances.	S.P.Harris, ANL-4552, 5.
108 46 62	σ(~0.03 Mev n,γ)13.1^hPd	**1.3**	50H87	Based on σ(th n,γ) = 11 of 47S33. Sb-Be n's.	V.Hummel, B.Hamermesh, ANL-4515, 40; PR **82**, 67 (1951).
110 46 64	f	**- 5.40**	50D52	From Δ f ($Pd^{110} - Mn^{55}$) = 2.70 and f (Mn^{55}) = - 8.10.	H.E.Duckworth, R.S.Preston, PR **79**, 402.

Ag	σ_t(42 Mev) 3.23	50H71	Be(d,n). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	$\sigma(\gamma,n)$ curve for $E_\gamma = 10-22$ $p/n = 0.023$ for $E_\gamma = 10-20.8$	50D56	Angular distribution of photo-protons given.	B.C.Diven, G.M.Almy, PR **80**, 407.
	Resonances E_o — Γ_n/Γ 5.1 — 0.038 ~15 — ~0.071	50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	New reference for data reported in	49G24	Ag^{105}, Ag^{110}.	J.R.Gum, M.L.Pool, PR **80**, 315.
105 47 58	K, no β^+ Pd K X-ray	50G54	γ/X-ray ~2.	J.R.Gum, M.L.Pool, PR **80**, 315.
	γ 0.064 weak 0.220 0.278 0.340 weak 0.437	50M61	Rh($\alpha,2n$), Pd(d); chem. Two weak lines maybe in another K capture branch.	J.Y.Mei, et al., PR **79**, 1010.
106 47 59	γ 0.515 0.722 1.04 1.54	50M61	Rh(α,n), Pd(d); chem.	See above.
107 47 60 44.3^s	τ 44^s	50W73	$Ag^{107}(\gamma,\gamma)$. Followed seven half-lives.	E.J.Wolicki, et al., PR **81**, 319(A) (1951).
Stable	Level for 44^sAg by $Ag^{107}(\gamma,\gamma)$ 1.28	50W73	Threshold < 0.8.	See above.
	σ(~0.03 Mev n,γ)2.3^mAg 2.1	50H84	Based on σ(th n,γ) = 44 of 47S33. Sb-Be n's.	V.Hummel, B.Hamermesh, ANL-4476, 54; PR **82**, 67 (1951).
108 47 61	τ 2.4^m β^- ~40% 0.83 scin ~60% 1.47 scin γ ~20% 0.188 scin ~20% 0.420 scin ~80% 0.615 scin	50G63	Proposed decay scheme: 	M.Goodrich, ORNL-940, 22.
109 47 62 39.2^s	τ 40^s	50W73	$Ag^{109}(\gamma,\gamma)$. Followed seven half-lives.	See Ag^{107}, 50W73.
Stable	Level for 40^sAg by $Ag^{109}(\gamma,\gamma)$ 1.21	50W73	Threshold < 0.8.	See Ag^{107}, 50W73.
	σ(0.12 - 0.60 Mev n,γ)24^sAg	50H70	Results ~twice those in 50Ad. **(Ag continued on next page)**	R.L.Henkel, H.H.Barschall, PR **80**, 145.

47 SILVER Ag (continued)

110 47 63 270^d	270^d activity is upper level leading to 24.5^s ground state	50M59	21 - 30^s activity extracted from solution of 270^dAg.	J.Miskel, PR **79**, 403.
	γ S** **0.1161*** M **0.6770** W **0.4375** M **0.7052** M **0.4460** W **0.7226** W **0.4710** M **0.7637** W **0.4989** W **0.8174** s;pe^-,ce^- W **0.5415** S **0.8841** W **0.5752** M **0.937** M **0.6190** W **1.384** S **0.6570** W **1.504**	50C61	* In Ag^{110}. Other γ's are fitted into 10 levels in Cd^{110}. ** S = Strong M = Medium W = Weak	J.M.Cork, et al., PR **80**, 286.
	$\gamma\gamma$ angular correlation curve	50B59	No discussion.	J.R.Beyster, M.L.Wiedenbeck, PR **79**, 411.
	E_γ — Intensity 2.21 or 1.8 — 3×10^{-4} photons/dis. 2.3 or 2.9 — $< 10^{-4}$ photons/dis.	50W55	Detected Be and D photo *n*'s by Szilard-Chalmers reaction in C_2H_5I.	R.Wilson, PR **79**, 1004.
111 47 64	τ **7.5^d** β^- 91% **1.04** sl complex γ 1% **0.243** sl; pe^- $\alpha < 0.08$ 8% **0.340** sl; pe^- $\alpha \sim 0.015$ No $\gamma\gamma$ coincidences Few $\beta\gamma$ coincidences	50J53	Pd(slow *n*,$\gamma\beta$). Proposed decay scheme: 	S.Johansson, PR **79**, 896. Cf. diagram under Cd^{111} in *Table*. 0.70 β: log ft = 7.8 0.80 β: log ft = 8.8 1.04 β: log ft = 7.3
	τ **7.5^{d*}** β^- 6.5% **0.73** a$\beta\gamma$ 93.5% [1.06] γ **0.33** a	50S60	* Same for γ and β^-'s. Soft $\beta\gamma$ coincidences. No $\gamma\gamma$ coincidences.	A.Storruste, PR **79**, 193.
	β^- **1.06** s	50M61	Pd(*d*,*n*); chem.	J.Y.Mei, et al., PR **79**, 1010.

48 CADMIUM Cd

Cd,Cd^{113} *	Reference	[47D2]	47D2 should read 47D12.	* Correction to table.
Cd	New reference for data reported in 49P24		Cd^{111}, Cd^{113}.	W.G.Proctor, PR **79**, 35.
105 48 57	β^+ **1.5** a K γ	50G54	57^m activity produced by Pd(α), Cd(fast *n*); chem; not by Ag(*d*), Cd(slow *n*). γ/K $\sim$1.	J.R.Gum, M.L.Pool, PR **80**, 315.
109 48 61	τ **470^d** K, X-rays No β, no γ	50G54	Ag(*d*), Pd(α); chem.	See above.
	τ **$\sim 250^d$** K	50C60	Cd^{108} (pile *n*,γ).	J.M.Cork, et al., PR **79**, 938.

(Cd continued on next page)

110 48 62	f	- **5.57**		50D52	From $\Delta f(Cd^{110} - Mn^{55}) = 2.53$ and $f(Mn^{55}) = -8.10$.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
112 48 64	σ(pile n,γ)$5^y Cd^{113}$	**0.020**		50BB6	Based on σ(pile n,γ)$43^d Cd^{115} = 0.14$. Enriched Cd^{112}.	P.R.Bell, et al., ORNL-940, 30.
	f	- **5.36**		50D52	From $\Delta f(Cd^{112} - Fe^{56}) = 3.06$ and $f(Fe^{56}) = -8.42$.	See Cd^{110}, 50D52.
113 48 65	τ	**5.1**^{y}		50C63	Cd^{112}(*d,p*); chem.	W.L.Carss, et al., PR **80**, 1028.
	β^-	**0.5**	a			
	X-rays ~10%					
	τ	**3.5**^{y}		50BB6	$Cd^{112}(n,\gamma)Cd^{113}$.	P.R.Bell, et al., ORNL-940, 30.
	β^- 80%	**0.580**	scin	50BB5	Cd^{112}(pile n,γ).	P.R.Bell, et al., ORNL-865, 21 and PR **79**, 418(A).
	20%	**0.350**	scin			
	γ 2-3%	**0.270**	scin			
114 48 66	Cd(n,γ) E_γ(max)	~**8.0**		50H51	No line structure. Curve still rising below 3 Mev. D_2O loaded emulsions.	B.Hamermesh, PR **80**, 415 and ANL-4447.
	Cd(n,γ) E_γ(max)	~**8.5**		50W61	Peak ~5 Mev may be due to several levels. Dγp in ic.	R.Wilson, PR **80**, 90.
	Cd(th n,γ) E_γ(max)	**7.5**		50M74	Organic D loaded emulsions. Broad peak ~5 Mev. Some indication of peak ~3 Mev.	C.H.Millar, et al., Can. J. Res., **28A**, 475.
115 48 67 43^d	τ	**42.6**^{d}		50C60	Enriched Cd^{114}(pile n,γ).	J.M.Cork, et al., PR **79**, 938.
	β^-	**1.46**	a			
	β^- 1%*	**0.38**	a$\beta\gamma$	50G59	Cd(pile n); chem. after one month. *Assuming 0.38β followed by 1.10γ.	P.S.Gill, et al., PR **80**, 284.
	99%	**1.41**	a			
	γ	**1.10**	a$\beta\gamma$			
	$\gamma\gamma$ coincidences					
	β^- ~1.4%	**0.8**	a$\beta\gamma$	50E58	Some $300^d Cd^{109}$ was present. ~0.007% of the disintegrations lead to $4.5^h In^{115}$.	D.Engelkemeir, ANL-4526, 92.
	γ weak	**0.48**	scin			
	strong	**0.94**	scin			
	weak	**1.28**	scin			
	No (1.67β)γ coincidences					
	β^-	**1.59**	scin	50BB5	$Cd^{114}(n,\gamma)$.	P.R.Bell, et al., ORNL-865.
	No $\beta\gamma$ angular correlation			49G21		R.L.Garwin, PR **76**, 1876.
	No $\beta\gamma$ angular correlation			50B60		J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.

(Cd continued on next page)

48 CADMIUM Cd (continued)

115 48 67 2.33^d	τ	**2.35**^{d}		50C60	Cd^{114}(pile n,γ). The ten γ's (reported here and in 50C22) are fitted into six levels in In^{115}.	J.M.Cork, et al., PR **79**, 938.
	γ	**0.3625** **0.4237** **0.5254**	s;ce$^-$ s;ce$^-$ s;ce$^-$			
	γ	**0.336** **0.522**	sl;pe$^-$ sl;pe$^-$	50D60	Cd(pile n,γ). Less intense pe$^-$'s found with $E < 0.5$.	E.B.Dale, J.D.Kurbatov, PR **80**, 126(A).
116 48 68	f	**-5.00**		50D52	From $\Delta f(Cd^{116} - Ni^{58}) = 3.01$ and $f(Ni^{58}) = -8.01$.	H.E.Duckworth, R.S.Preston, PR **79**, 402.

49 INDIUM In

? 49 ?	τ γ In K X-ray	**2.5**^{s} **0.152**	 scin pc	50C72	In (pile n).	E.C.Campbell, J.H.Kahn, ORNL-865, 16.
112 49 63 23^m	τ γ	**21.5**^{m} **0.154** $\alpha \sim 9$		50C76		S.A.Chowdary, unpublished Thesis, Purdue University, 1949. Quoted in 50G66 below.
9^m	τ	**10**^{m}		50C76		See above.
	Confirm 21.5^m activity to excited state, 10^m activity to ground state.			50G66	Transition formed ions separated in electric field.	G.J.Goldsmith, E.Bleuler, J. Phys. Coll. Chem., **54**, 717.
114 49 65	Confirm 72^s activity to ground state.			50G66	See above.	See above.
115 49 66 4.5^h	γ	**0.336**	sl;pe$^-$	50D60	Cd(pile n,γ).	E.B.Dale, J.D.Kurbatov, PR **80**, 126(A).
~stable	τ β^-	**6 x 10**^{14y} **0.63**	 a	50M76		E.A.Martell, W.F.Libby, PR **80**, 977.
	Levels for 4.5^{h}In by In(γ,γ)	**1.08, 1.47, 1.60**		50S46		E.J.Schillinger, èt al., PR **81**, 318(A)(1951).
	σ($\sim$0.03 Mev n,γ)54.31^{m}In	**1.05**		50H84	Based on σ(th n,γ) = 145 of 47S33. Sb-Be n's.	V.Hummel, B.Hamermesh, PR **82**, 67(1951).
	σ(0.015 - 1 Mev n,γ)13^{s}In	**0.14 - 0.09**		50H70	Li(p,n).	R.L.Henkel, H.H.Barschall, PR **80**, 145.
116 49 67 54.31^m	γ	**0.1374** **0.1712**	s s	50K48	In(pile n).	H.B.Keller, ANL-4437.

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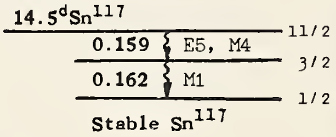
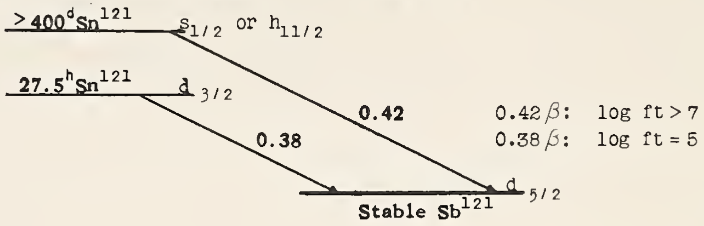
Sn	σ_a (pile *n*)	0.70	osc	50C71	Based on σ_a (B) = 710. No chemical analysis of sample.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (270 Mev)	**1.87**		50D55	Be(350 Mev *p,n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev)	**1.83**		50F56	Be(340 Mev *p,n*). Recoils *p*'s, scin.	R.Fox, et al., PR **80**, 23.
112 50 62	σ(pile *n*,γ) 30^mSn 112^dSn	 0.02 1.3		50N52		C.M.Nelson, et al., ORNL-828.
113 50 63 112^d	No β^+ with $E_\beta > 0.05$ No γ			50N52		See above.
115 50 65	μ	**- 0.9134**	I	50P51	$\nu(Sn^{115})/\nu(Na^{23})$ [$SnCl_2$] = 1.2362 ± 0.0001.	W.G.Proctor, PR **79**, 35.
116 50 66	σ(pile *n*,γ) 14.5^dSn	**6 mb**		50N52		See Sn^{112}, 50N52.
	f	**- 5.35**		50D52	From $\Delta f(Sn^{116} - Ni^{58}) = 2.66$ and $f(Ni^{58}) = -8.01$.	H.E.Duckworth, R.S.Preston, PR **79**, 402.
117 50 67 14.5^d	γ	**0.157** K/L = 2.2	sl; ce$^-$	50H66		R.W.Hayward, PR **79**, 542.
	γ	**0.159** K/L = 2.2 **0.162** α_K = 0.1	s; ce$^-$ s; ce$^-$	50M52	Proposed decay scheme:  	J.W.Mihelich, R.D.Hill, PR **79**, 781.
	γ	**0.152** K/L = 2.4	sl; ce$^-$	50N52		See Sn^{112}, 50N52.
stable	μ	**- 0.9951**	I	50P51	$\nu(Sn^{117})/\nu(Na^{23})$ [$SnCl_2$] = 1.3468 ± 0.0001.	See Sn^{115}, 50P51.
119 50 69 $\gtrsim 100^d$	τ γ	$\sim$**250**^{d} **0.069** K/L = 1.5	 s; ce$^-$	50M52	Propose second γ of low conversion to explain probable M4 of 0.069 γ. See Sn^{117}.	J.W.Mihelich, R.D.Hill, PR **79**, 781.
	τ γ	**245**^{d} **0.064** K/L = 0.82 *		50N52	Energy may be low due to source thickness. *Corrected for self-absorption in source.	See Sn^{112}, 50N52.
stable	μ	**- 1.0411**	I	50P51	$\nu(Sn^{119})/\nu(Na^{23})$ [$SnCl_2$] = 1.4090 ± 0.0001.	See Sn^{115}, 50P51.
120 50 70	σ(pile *n*,γ) 27^hSn long Sn	 0.03 0.001		50N52		See Sn^{112}, 50N52.

(Sn continued on next page)

50 TIN Sn (continued)

121 50 71 27^h	τ No ce^-, no γ	**27.5^h**		50N52	Used enriched Sn^{120}.	C.M.Nelson, et al., ORNL-828.
long	τ β^-	$>400^d$ **0.42**	 sl	50N52	Proposed decay scheme:	See above.



123 50 73 39.5^m	γ	**0.153**	scin	50B47	No 0.76 γ-ray observed.	G.E.Boyd, ORNL-870.
124 50 74	σ(pile n,γ) 9.5^mSn 10.0^dSn	 0.5 0.002		50N52		See Sn^{121}, 50N52.
	No β^- with $\tau < 3.7 \times 10^{17\,y}$			50L61		C.Levine, G.T.Seaborg, UCRL-635.
	No β^- with $\tau < 10^{16\,y}$		cc	50L60	Used 83% Sn^{124}.	J.S.Lawson, PR **81**, 299(A) (1951).
125 50 75 9.5^m	β^-_1 β^-_3 γ_1	**2.06** **~0.5** **0.326**	a a a	50N52	Coincidences observed between β_1 and γ_1.	See Sn^{121}, 50N52.
	γ_3 weak	**1.37**	s	50B47	1.86γ does not appear.	G.E.Boyd, ORNL-870.
10.0^d	τ β^-	**9.4^d** **2.33**	 sl	50N52	Assignment based on growth of $2.7^y Sb^{125}$ and $58^d Te^{125}$.	See Sn^{121}, 50N52.
	β^-_1 95% β^-_2 5%	**2.37** **0.40**	sl sl	50H58	β^-_1 shape indicates $\Delta I = 2$, yes.	R.W.Hayward, PR **79**, 409.
	γ	**~1.9**		50B45		G.E.Boyd, priv. comm.

51 ANTIMONY Sb

Sb	σ_a (pile n)	**8.15**	osc	50H62	Based on $\sigma_a(B) = 710$. Sample ~400 mg/cm^2.	S.P.Harris, et al., PR **80**, 342.
	σ_a(pile n)	**7.6**	osc	50C71	Based on $\sigma_a(B) = 710$. Self-screening correction applied. No chem.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	Resonance Γ_n/Γ	$E_0 \sim 10$ ev **~0.21**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
120 51 69 16.6^m	τ Sb(γ,n)	**16.4^m** threshold = 9.3		50J59		H.E.Johns, et al., PR **80**, 1062.

(Sb continued on next page)

121 51 70	σ(~0.03 Mev n,γ)2.8^dSb	**2.8**		50H87	Based on σ(th n,γ) = 6.8 of 47S33. Sb-Be n's.	V.Hummel, B.Hamermesh, ANL-4515, 39; PR **82**, 67.
	μ	**3.3422**	I	50C57	$\nu(Sb^{121})/\nu(Na^{23})$ [$HSbCl_6$] = 0.90469 ± 0.00004.	V.W.Cohen, et al., PR **79**, 191.
	μ	**3.7094**	I	50C70	$\nu(Sb^{121})/\nu(Na^{23})$ [$SbCl_3$] = 1.0041 ± 0.0003.	T.L.Collins, PR **79**, 226(A).
122 51 71	Sb(γ,n)	threshold = 9.3		50J59		H.E.Johns, et al., PR **80**, 1062.
123 51 72	μ	**2.5335**	I	50C57	$\nu(Sb^{123})/\nu(Na^{23})$ [$HSbCl_6$] = 0.8442 ± 0.0001.	See Sb^{121}, 50C57.
124 51 73 60^d	β_5^- β_4^- β_3^- γ_7 γ_5 γ_4	**0.95** **1.69** **2.291** **0.607** $\alpha = 0.0016$* **0.653** **0.730**	sl sl sl sl; pe^-, ce^- sl; pe^- sl; pe^-	50L51	Spectral shape of β_3^- indicates $\Delta I = 2$ yes. No β^+ or K capture found. Auger electrons could be attributed to ce^- of γ_7. *If assume γ_7 follows all β's. α indicates E1.	L.M.Langer, et al., PR **79**, 808 and **80**, 126(A).
	$\beta_3\gamma_7$ coincidences			50B62	Graph of angular correlation; b = − 0.27.	J.R.Beyster, M.L.Wiedenbeck, PR **79**, 169.
131 51 80	τ	**23.2^m***		50P72	p $25^m Te^{131}$. Fission; chem.	A.C.Pappas, PR **81**, 299(A)(1951) and *verbal report.
132 ? 51 81	τ	**2.2^m***		50P72	Probable identification by energy considerations. Fission; chem.	See above.
133 51 82	τ	**4.5^m***		50P72	p $60^m Te^{133}$. Fission; chem.	See above.
134,135 ? 51 83,84	τ	**~50^s**		50P72	Probable identification by energy considerations. Fission; chem.	See above.

52 TELLURIUM Te

Te	σ_a (pile *n*)	**5.82**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
123* 52 71	μ			49M47	$\mu(Te^{123})/\mu(Te^{125})$ in *Table* should read $\mu(Te^{125})/\mu(Te^{123})$.	*Correction to *Table*.
125* 52 73	γ_1			49H27	$\alpha \sim 1$ in *Table* should read $\alpha > 100$.	*Correction to *Table*.
	γ_2	**0.0354** $\alpha_K = 7-11$	pc	50F60	Measured relative heights of K X-rays and γ's with pc. E2,M1.	G.Friedlander, et al., PR **80**, 1103.
128* 52 76	Relative abundance			48W9	31.78% in *Table* should read 31.72%.	*Correction to *Table*.
132 52 80	τ	**77.7**^{h}		50P70	Fission; chem; yield.	A.C.Pappas, C.D.Coryell, PR **81**, 329(A) (1951).
133 52 81	τ	**66**^{m}		50P70	Fission; chem; yield.	See above and PR **81**, 299(A).
134 52 82	τ	**44**^{m}		50P70	Fission; chem; yield.	See Te^{132}, 50P70.

53 IODINE I

I	New reference for data reported in			50R12	I^{128}.	J.H.Reynolds, PR **79**, 789.
	σ_a (pile *n*)	**7.4**	osc	50C71	Based on σ_a(B) = 710. No chem. Self-screening correction.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile *n*)	**9.23**	osc	50H62	Sample ~250 mg/cm^2. Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (42 Mev)	**3.51**		50H71	Derived from $\sigma_t(CH_2I_2)$ = 8.52. C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	Resonances Γ_n/Γ	E_0 ~20-30 ev ~**0.31**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
127 53 74	σ(~0.03 Mev *n*,γ)24.99^{m}I	**2.2**		50H87	Based on σ(th *n*,γ) = 6.3 of 47S33. Sb-Be *n*'s.	V.Hummel, B.Hamermesh, ANL-4515, 40; PR **82**, 67.
131 53 78	β_1^- 15% β_2^- 85% γ_6 .1% $\gamma_1\gamma_2$ coincidences No $\gamma_1\gamma_3$ coincidences	**0.315** **0.600** **0.73**	sl sl sl;scin	50B44	γ_1 does not follow β_1^-. $\tau(\gamma_1) < 10^{-3}$ μs. $\tau(\gamma_2$ and $\gamma_3) < 2 \times 10^{-4}$ μs.	R.E.Bell, PR-P-7, 22, Chalk River.
	No $\beta\gamma$ angular correlation			50B60		J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.
132 53 79	β^-	**1.50**	a	49S50	Fission product.	F.Suzor, Ann. Phys., Paris, **4**, 269.

(I continued on next page)

133 53 80	τ	**22.4^h**	50P70	Fission; chem; yield.	A.C.Pappas, C.D.Coryell, PR **81**, 329(A) (1951).
134 53 81	τ	**52.5^m**	50P70	Fission; chem; yield.	See above.

54 XENON Xe

Xe	σ_a (pile n)	**37**	50M66	From sum of isotopic values listed below.	J.Macnamara, H.G.Thode, PR **80**, 296.
	σ_s (th n)	**4.3**	50H60	Boron absorption and self absorption indicate resonance about 11ev	S.P.Harris, PR **80**, 20.
	Relative isotopic abundances 124 **0.096 %** 131 **21.18 %** 126 **0.090 %** 132 **26.89 %** 128 **1.919 %** 134 **10.44 %** 129 **26.44 %** 136 **8.87 %** 130 **4.08 %**		50N51		A.O.Nier, PR **79**, 450.
128 54 74	σ(pile n,γ)	**0-5**	50M66	From relative abundance changes on irradiation in Chalk River pile.	See Xe, 50M66.
129 54 75	σ(pile n,γ)	**40**	50M66	See above.	See Xe, 50M66.
130 54 76	σ(pile n,γ)	**0-5**	50M66	See above.	See Xe, 50M66.
131 54 77 12^d	τ γ	**12.0^d** **0.1629** $s\pi\sqrt{2}$; ce^- K/L = 2.34, L/M = 3.4	50B67	No lines for γ's of 0.80, 0.284, 0.364. **0.177** γ of 49C13 may be due to $1.25^d Te^{131}$.	I.Bergström, PR **80**, 114.
stable	σ(pile n,γ)	**120**	50M66	See Xe^{128}, 50M66.	See Xe, 50M66.
132 54 78	σ(pile n,γ)	**0-5**	50M66	See above.	See above.
133 54 79 $\sim 2^d$	τ_1 γ	**$\sim 2^d$** **0.232**	50K58	Fission product Xe was highly purified from other gases including Kr.	B.H.Kettle, et al., PR **80**, 485.
5.27^d	β^- γ_1 γ_2	**0.345** **0.081** α_K = 2.9, K/L = 5.9 **0.232** K/L = 2.2	50B65	Fission product Xe. Log ft = 5.6. [See above.] [Only one γ of ~0.081. Values of 0.0824 and 0.0836 from 49T4 in *Suppl. 1* were from K and L lines of same γ.]	I.Bergström, S.Thulin, PR **79**, 538.
134 54 80	σ(pile n,γ)	**0-5**	50M66	See Xe^{128}, 50M66.	See Xe, 50M66.
136 54 82	σ(pile n,γ)	**0-5**	50M66	See above.	See above.

55 CESIUM Cs

Cs	σ_a(pile *n*)	35.8	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
134 55 79	Crossover 1.96 γ intensity $<10^{-4}$ photons/disintegration			50W55	Detected Be(γ,*n*) by Szilard-Chalmers in ethyl iodide.	R.Wilson, PR **79**, 1004.
	β_2^-	0.651	sl	50W59	$\beta_3\gamma_4$ coincidences observed. *Assuming β_3/β_2 = 26.5/73.5. γ_6 and γ_7 may be in a K-capture branch or due to an impurity.	M.A.Waggoner, et al., PR **80**, 420.
	γ_2	0.560 α_K=0.0082*	sl;ce⁻			
	γ_3	0.602 α_K=0.0053*				
	γ_4	1.363 α_K=0.00062				
	γ_5	0.799 α_K=0.00255*				
	γ_6	1.03				
	γ_7	1.17				
	No $\beta\gamma$ angular correlation			50S27		R.Stump, S.Frankel, PR **79**, 243(A).
	No $\beta\gamma$ angular correlation			50B60		J.R.Beyster, M.L.Wiedenbeck, PR **79**, 728.
	$\gamma\gamma$ angular correlation indicates I = ?*,4,2,0			50B59	*Suggest I for highest level is 4,5, or 6.	J.R.Beyster, M.L.Wiedenbeck, PR **79**, 411.
135 55 80	τ	2.9×10^{6} y		50Z55	Fission product. τ from assay and counting rate.	H.Zeldes, et al., ORNL-286.
	β^-	0.19				
	No γ, no X-ray					
137 55 82	β_2^-	0.518		50W63	β spectrum indicates ΔI=2, yes. α_K determined by two methods, and indicates M4.	M.A.Waggoner, PR **80**, 489.
	γ	0.663 α_K = 0.097				

56 BARIUM. Ba

Ba	New reference for data reported in 50D4				Ba^{131}.	E.L.Zimmerman, et al., PR **80**, 908.
	σ_a(pile *n*)	1.25	osc	50C71	No self-screening correction. No chem. Based on σ_a(B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t(120 ev)	5.76		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_t(345 ev)	6.05				
	σ_t(40 Mev)	3.6		50H71	Derived from $\sigma_t(BaCO_3)$ = 8.73. C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
131 56 75	γ	0.213	sl;pe⁻	50D58	Pile activated $Ba(NO_3)_2$ was purified and Cs removed chemically. Ba^{133} allowed to decay.	E.B.Dale, et al., PR **80**, 763. See also PR **80**, 908.
	Other γ's 0.18 - 0.22 ?					
135 56 79	I	3/2	S	50A51	Used 3 different enriched samples and natural Ba. Linear isotope shift for even masses. Great even-odd shift; different for Ba I and Ba II.	O.H.Arroe, PR **79**, 836.
137 56 81	I	3/2	S	50A51	See above.	See above.

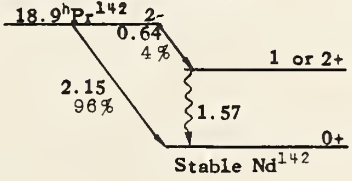
57 LANTHANUM La

La	σ_a (pile *n*)	**9.0**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (120 ev) (345 ev)	**5.86** **4.94**		50H53	Co and Mn resonant scattering detectors; thin foils.	C.T.Hibdon, PR **79**, 747.
138 57 81	γ	**0.545** **1.06**	scin scin	50B50	Very pure sample. No γ's with $E_\gamma > 0.1$ in natural Pr or Ce.	P.R.Bell, J.M.Cassidy, ORNL-782.
140 57 83	La(th *n*,γ)	E_γ(max) = 8.0	Dγp	50H51	γ intensity max. at 4.6.	B.Hamermesh, PR **80**, 415.

58 CERIUM Ce

Ce	σ_a (pile *n*)	**< 0.92**		50C71	Impure sample; partial chem. Based on σ_a(B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	No $E_\gamma > 0.1$ in natural Ce			50B50		P.R.Bell, J.M.Cassidy, ORNL-782.
141 58 83	τ β_2^- 66% β_3^- 33% γ	**32.5**^{d} **0.442** **0.581** **0.145** α = 0.25 - 0.7	 sl sl sl; pe$^-$, ce$^-$	50F58	β's have allowed shapes, but log ft_2 = 7.0, log ft_3 = 7.7. No 0.137γ; 0.316γ due to Pa^{233} impurity. $\beta_2\gamma$ coincidences.	M.S.Freedman, D.W.Engelkemeir, PR **79**, 897.
144 58 86	τ γ	**290**^{d} **0.0340 0.0537** **0.0413 0.0809 0.1005** **0.0468 0.0950 0.1345**	s; ce$^-$	50K50		H.Keller, ANL-4515, 6.

59 PRASEODYMIUM Pr

Pr	Resonance Γ_n/Γ	E_0 = 10 ? **~0.94**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	No $E_\gamma > 0.1$ in natural Pr			50B50		P.R.Bell, J.M.Cassidy, ORNL-782.
140 59 81	τ	**3.5**^{m}		49P5		M.L.Perlman, PR **75**, 988.
	Little or no K			50F66		G.Friedlander, priv. comm.
142 59 83	τ β^- 4% 96% γ No low energy γ's found	**19.1**^{h} **0.636** **2.154** **1.576**	 sl sl sl; pe$^-$	50J56	Proposed decay scheme: 	E.N.Jensen, et al., PR **80**, 862. Spectral shape of 2.15 β indicates $\Delta I = 2$, yes. Λ correction made.
	$(K+\beta^+)/\beta^-$	< 0.0052		50R64		J.R.Reynolds, ANL-4515, 23.

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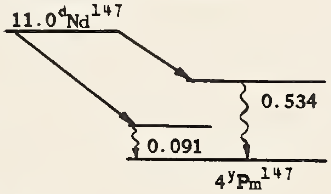
59 PRASEODYMIUM Pr (continued)

144 59 85	τ	17^m		50K50		H.Keller, ANL-4515, 5.
	γ	0.061	s;ce$^-$			
	β^-	2.87	a	50M78	2% of β's of ~0.42 Mev in coincidence with 2.60γ.	C.E.Mandeville, E.Shapiro, PR **79**, 243(A).
	γ	2.60	a/$\beta\gamma$			

60 NEODYMIUM Nd

Nd	σ_a (pile n)	52	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	No $E_\gamma > 0.1$ in natural Nd			50B50		P.R.Bell, J.M.Cassidy, ORNL-782
147 60 87	γ	0.0915 K/L = 2.5 0.534 *	s;ce$^-$ s;ce$^-$	50E55	Proposed decay scheme: * 	W.S.Emmerich, J.D.Kurbatov, PR **81**, 300(A) (1951) and *verbal report. Observed βe$^-$ coincidences; no γX or $\gamma\gamma$ coincidences.
	New reference for data in 50M7				Nd^{147}.	C.E.Mandeville, E.Shapiro, PR **79**, 391.

61 PROMETHIUM Pm

62 SAMARIUM Sm

Sm	Relative isotopic abundances 144 **2.87%** 150 **7.36%** 147 **14.94%** 152 **26.90%** 148 **11.24%** 154 **22.84%** 149 **13.85%**		50H81		R.F.Hibbs, Y-648.
	Resonance Γ_n/Γ	E_0 = 10 ev **0.66**	50H54	See Al^{27}. Resonance assigned to Sm^{152}.	S.P.Harris, et al., PR **79**, 11.
	α activity assigned to Sm^{147}		49D32		A.J.Dempster, ANL-4355.
	α activity assigned to Sm^{147}		50W65	From α counts in Sm samples enriched in Sm^{147}.	B.Weaver, PR **80**, 301.
	Sm α found in Sm^{147} separated from Pm^{147}		50R56	E_α ~2. Ion exchange separation.	J.O.Rasmussen, et al., PR **80**, 475.
153 62 91	$\beta\gamma$ delay of $3.0 \times 10^{-3\,\mu s}$ γ_2 and γ_3 follow delay		50M64	K/L ~1 for γ_3 suggests it precedes γ_2.	F.K.McGowan, PR **80**, 482.

63 EUROPIUM Eu

147 63 84	τ	54^d		50W64	Produced by Sm(10 Mev *p*); ion exchange chem. *% relative to K X-ray.	G.Wilkinson, H.G.Hicks, PR **80**, 491.
	e^- 5%*	~0.4	s			
	γ 30%*	0.4	a			
	30%*	1.0	a			
	K,L X-rays					
149 63 86	τ	14^d		50W64	Produced by Sm(10 Mev *p*); ion exchange.	See above.
	e^-	~0.1	s			
	γ	~1	a			
	K,L X-rays					
150 63 87	τ	15^h		50W64	See above. No $E_\gamma > 0.5$. Yield ~1/3 that of 9.2^h Eu^{152}.	See above.
	β^+	1.8	s			
152,154 63 89,91	τ	$\sim 7.5^y$		50H82	Observed activity for 560 days.	R.E.Hein, ISC-110, 7.

64 GADOLINIUM Gd

Gd	σ_a (pile *n*)	**37,600**	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	New reference for data reported in			50H18	Gd^{151}, Gd^{153}.	R.E.Hein, A.F.Voigt, PR **79**, 783.

65 TERBIUM Tb

Tb	4^h α activity assigned to Tb^{149}		ms	50R56	Produced by Gd(150 Mev *p*); ion exchange.	J.O.Rasmussen, et al., PR **80**, 475.
161 65 96	τ	7.2^d		50H18	Produced by Gd(*n*,γ); ion exchange.	R.E.Hein, A.F.Voigt, PR **79**, 783.
	β^-	0.50	a			

66 DYSPROSIUM Dy

67 HOLMIUM Ho

Ho	σ_t (0.026-0.5 ev)	**graph**		50S50	Paramagnetic scattering observed. Bent crystal spect.	T.E.Stephenson, T.Arnette, ORNL-782, 48.
166 67 99	γ	**0.0812**	s	50K48		H.B.Keller, ANL-4437, 22.
	$\beta\gamma$ delay of 1.7×10^{-3} μs $E_\beta > 0.6$			50M79	0.080 γ follows delay.	F.K.McGowan, PR **80**, 923.

68 ERBIUM Er

165 68 97	τ **10.0**^{h} 50B85 K 100% Ho K,L X-rays	Produced by Ho^{165}(10 Mev p,n); ion exchange. No β^- or β^+.	F.D.S.Butement, Proc. Phys. Soc., Lond., **A63**, 775.
171 68 103	γ **0.1126** s 50K48 **0.1176** s **0.1253** s		H.B.Keller, ANL-4437, 22.

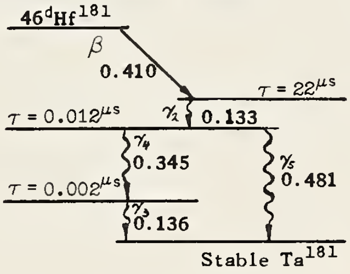
69 THULIUM Tm

169 69 100	Relative isotopic abundance 50L53 **100%**	Upper limit for other isotopes is 0.04%.	C.R.Lagergren, M.E.Kettner, PR **80**, 102.
170 69 101	β^- 8% ? ~**0.460** sl 50E54 18% **0.893** sl 74% **0.972** sl γ **0.084** sl;ce$^-$ $\alpha_K = 1.8$ K/L = 0.22	Measured K X-ray and γ peak with pc. K:L:M = 0.22:1:0.22.	L.G.Elliott, PR-P-7, 20, Chalk River.
	No evidence for γ's of 0.198, 0.360, 0.550 found by 50G16 50E52	Upper limits 6×10^{-4}, 1×10^{-3}, 2×10^{-3} quanta/disintegration.	L.G.Elliott, R.E.Bell, PR-P-8, 17, Chalk River

70 YTTERBIUM Yb

? 70 ?	τ **0.5**^{s} 50C72 γ **0.45** scin Yb K X-ray		E.C.Campbell, J.H.Kahn, ORNL-865, 16.
169 70 99	γ **0.023** scin **0.130** s 50S49 [**0.064** scin **0.177** s [**0.063** s **0.198** s **0.093** s **0.307** s **0.109** s Tm K,L X-rays Xγ delay of 0.60$^{\mu s}$	0.023 γ interpreted as 0.021 γ and 0.024 γ combined. Only X-rays precede delay.	A.W.Sunyar, J.W.Mihelich, PR **81**, 300(A) (1951) and verbal report.
	γ delay of 0.658$^{\mu s}$ 50F63		E.W.Fuller, Proc. Phys. Soc., **A63**, 1044.

71 LUTETIUM Lu

Hf	σ_a (pile n)	**110**	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile n)	**171**	osc	50H62	Based on σ_a (B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (120 ev) (345 + 2400 ev) (2300 ev)	**15.0** **15.8** **14.9**		50H89	Used Co, Mn, and V resonance scattering detectors.	C.T.Hibdon, ANL-4552, 5.
	Resonance Γ_n/Γ	E_0 =< 10 ev **0.17**		50H54	See Al^{27}. $\Gamma_n \sim \Gamma_\gamma$ at 7.7 ev.	S.P.Harris, et al., PR **79**, 11.
174 72 102	σ(pile n,γ)	**~2000**	osc	50M81	Enriched material used.	C.O.Muehlhause, ANL-4552, 7.
177 72 105	σ(pile n,γ)	**~500**	osc	50M81	Enriched material used.	See above.
179 72 107	19^s activity assigned to Hf^{179}			50M81	Enriched material used.	See above.
181 72 109	τ	**45^d**		50R66	Followed 270 days with ic.	S.A.Reynolds, ORNL-867, 30.
	Hf^{175} suggested as source of 0.345 γ			50D51	γ_2, γ_3, γ_5 follow $20^{\mu s}$ delay; < 10% of ~ 0.345 γ does.	M.Deutsch, A.Hedgran, PR **79**, 400.
	γ_2, γ_5 follow $20^{\mu s}$ delay in cascade			50P62	Coincidence spectrometer studies.	W.W.Pratt, PR **80**, 289.
	β^- γ_2 γ_3 γ_4 γ_5 γ_6	**0.410** **0.133** **0.136** **0.345** * **0.481** **0.615**	sl sl;ce$^-$ sl;ce$^-$ sl;ce$^-$ sl;ce$^-$ sl;ce$^-$	50E56	Proposed decay scheme:  	L.G.Elliott, R.E.Bell, PR-P-7, 22. Coincidences observed with two sl's. * Also observed 0.342 γ which is converted in Lu.
	0.481 γ delayed $11 \times 10^{-3\,\mu s}$			50B61	Above decay scheme proposed with γ_3 and γ_4 interchanged.	W.C.Barber, PR **80**, 332.

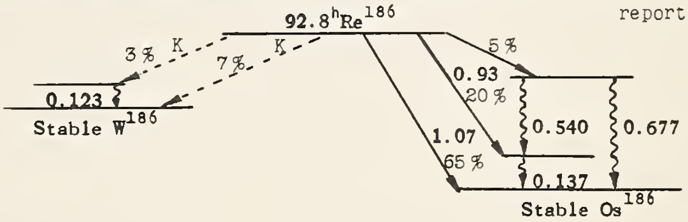
Ta	σ_a (pile n)	21	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (42 Mev)	4.20		50H71	Be(d,n). C^{12} ($n,2n$) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	Resonance Γ_n/Γ	E_0 = 4.0 ev 0.12		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
176 73 103	γ	~1.3	a	50W67	Only new values or those differing from 49W13 are listed. d 80^mW, q.v.	G.Wilkinson, PR **80**, 495.
177 73 104	τ	2.2^d		50W67	See above.	See above.
178 73 105	9.35^m activity assigned to Ta^{178}			50W67	d 21^dW, q.v. See also 50W1.	See above.
	τ_2	2.1^h		50W67	Produced by Lu(19 Mev α,n), Hf(10 Mev p,n); chem. Assignment from yields. Not d 21^dW. [No mention of previously reported $15.4^d Ta^{178}$.]	See above.
	K					
	β^+ 3%	~1	s;a			
	e^-	0.1	s;a			
	γ	1.3-1.5	a			
179 73 106	τ	~600^d		50W67	Produced by Lu(19 Mev α,n), Hf(10 Mev p,n); chem. W parent has $\tau < 1^h$.	See above.
	e^-	0.1	s;a			
	γ weak	0.7	a			
180 73 107	τ	8.15^h		50B48	Produced by Ta (22 Mev γ,n). β^+ in less than 10^{-3}% of disintegrations. 0.092 γ converted in Hf. $\gamma\gamma$, $\beta\gamma$, $e^-\gamma$ coincidences.	W.L.Bendel, et al., PR **81**, 300(A) (1951).
	β^- strong	0.60	sπ			
	weak	0.70	sπ			
	γ strong	0.092	sπ			
	weak	0.103	sπ			
	X-rays		crit a			
	Ta(γ,n)	threshold = 8.0		50J59	σ curve for E_γ = 8 - 20 Mev.	H.E.Johns, et al., PR **80**, 1062.
182 ? 73 109	τ	0.33^s		50G60	Suggest low energy IT with α_L large. Ta(pile n's).	M.Goodrich, E.C.Campbell, PR **79**, 418.
	X or γ	8 - 11 kev	scin			
182 73 109 117^d	τ	115^d		50S18	σ for Ta(d,p) reported in Supplement I.	K.H.Sun, et al., PR **78**, 338(A).
	β^-	0.52 1.1				
	β^-	0.525	s	50J62	At least three β components present.	S.Jnanananda, J. Sci. Industr. Res. **8B**, 147, (1949).
	"					
	γ spectrum from ~0.22 to ~1.23 Mev			50051	24 γ's found, mostly from K conversion lines only.	F.E.O'Meara, PR **79**, 1032.
185 73 112	τ	46^m		50D54	Produced by W^{186} (23 Mev γ,p). 0.075 e^- line also found in $1.85^m W^{185}$, q.v.	R.B.Duffield, et al., PR **79**, 1011.
	β^-	1.7				
	e^-	~0.075	pc			

Ta	σ_a (pile *n*)	**21**	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (42 Mev)	**4.20**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	Resonance Γ_n/Γ	E_0 = 4.0 ev **0.12**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
176 73 103	γ	**~1.3**	a	50W67	Only new values or those differing from 49W13 are listed. d 80^mW, q.v.	G.Wilkinson, PR **80**, 495.
177 73 104	τ	**2.2^d**		50W67	See above.	See above.
178 73 105	9.35^m activity assigned to Ta^{178}			50W67	d 21^dW, q.v. See also 50W1.	See above.
	τ_2 K β^+ 3% e^- γ	**2.1^h** **~1** **0.1** **1.3-1.5**	 s;a s;a a	50W67	Produced by Lu(19 Mev α,*n*), Hf(10 Mev *p*,*n*); chem. Assignment from yields. Not d 21^dW. [No mention of previously reported $15.4^d Ta^{178}$.]	See above.
179 73 106	τ e^- γ weak	**~600^d** **0.1** **0.7**	 s;a a	50W67	Produced by Lu(19 Mev α,*n*), Hf(10 Mev *p*,*n*); chem. W parent has $\tau < 1^h$.	See above.
180 73 107	τ β^- strong weak γ strong weak X-rays	**8.15^h** **0.60** **0.70** **0.092** **0.103** 	 sπ sπ sπ sπ crit a	50B48	Produced by Ta (22 Mev γ,*n*). β^+ in less than 10^{-3}% of disintegrations. 0.092 γ converted in Hf. $\gamma\gamma$, $\beta\gamma$, $e^-\gamma$ coincidences.	W.L.Bendel, et al., PR **81**, 300(A) (1951).
	Ta(γ,*n*)	threshold = 8.0		50J59	σ curve for E_γ = 8 - 20 Mev.	H.E.Johns, et al., PR **80**, 1062.
182 ? 73 109	τ X or γ	**0.33^s** **8 - 11** kev	 scin	50G60	Suggest low energy IT with α_L large. Ta(pile *n*'s).	M.Goodrich, E.C.Campbell, PR **79**, 418.
182 73 109 117^d	τ β^-	**115^d** **0.52** **1.1**		50S18	σ for Ta(*d*,*p*) reported in Supplement I.	K.H.Sun, et al., PR **78**, 338(A).
	β^-	**0.525**	s	50J62	At least three β components present.	S.Jnanananda, J. Sci. Industr. Res. **8B**, 147, (1949).
	γ spectrum from ~0.22 to ~1.23 Mev			50O51	24 γ's found, mostly from K conversion lines only.	F.E.O'Meara, PR **79**, 1032.
185 73 112	τ β^- e^-	**46^m** **1.7** **~0.075**	 pc	50D54	Produced by W^{186} (23 Mev γ,*p*). 0.075 e^- line also found in $1.85^m W^{185}$, q.v.	R.B.Duffield, et al., PR **79**, 1011.

W	σ_a (pile *n*)	**20**	osc	50C71	Based on σ_a(B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_a (pile *n*)	**24**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t (42 Mev)	**4.31**		50H71	Be(*d*,*n*). C^{12}(*n*,2*n*) detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
	σ_t (270 Mev)	**2.61**		50D55	Be(350 Mev *p*,*n*). Bi-f detector.	J.DeJuren, PR **80**, 27.
	Resonance Γ_n/Γ	E_o = ~15 **~0.81**	ev	50H54	See Al^{27}. Resonance in W^{186}, q.v.	S.P.Harris, et al., PR **79**, 11.
176 74 102	τ	**80^m**		50W67	Produced by Ta(50 Mev *p*,6*n*); chem.	G.Wilkinson, PR **80**, 495.
	β^+ ~0.5 %	**~2**	a		p 8.0^hTa.	
	e^-	**~0.1**	a		[Bohr-Wheeler E_{dis} ~1]	
		~0.2	a			
	γ	**~1.3**	a			
	K,L X-rays					
178 74 104	τ	**21.5^d**		50W67	Produced by Ta(25 Mev *p*,4*n*); chem.	See above.
	Other properties as in 50W1				Previously assigned to $Ta^{178,179}$.	
179 74 105	τ_2	**5.2^m**		50W67	Produced by Ta(20 Mev *p*,3*n*).	See above.
	e^-				Ratio of 5.2^m and 30^m activities in various bombardments same.	
	K,L X-rays					
182 74 108	Resonances E_o	**4.2,14, 21.5,88,124**	ev	50S43	*n* transmission curves. Many resonances above 200 ev. Fast chopper.	W.Selove, W.E.Woolf, ANL-4437, 69; PR **82**, 345 (1951).
183 74 109	Resonances E_o	**7.8,28,49**	ev	50S43	*n* transmission curves. Many resonances above 100 ev.	See above.
184 74 110	Resonances E_o	**190,2600 ?**	ev	50H88	*n* transmission curves.	S.P.Harris, ANL-4552, 5.
185 74 111	τ_1	**1.85^m**		50D54	Produced by W^{186}(23 Mev γ,*n*).	R.B.Duffield, et al., PR **79**, 1011.
	e^-	**~0.075**	pc		γ highly converted. See Ta^{185}.	
186 74 112	Resonances E_o	**19.5,225**	ev	50S43	*n* transmission curves. More resonances above 1 kev. [See also W, 50H54 above.]	See W^{182}, 50S43.
187 74 113	W(th *n*,γ)	E_γ(max) = 9.0	D*yp*	50H51	Max. at 4.8 and three lesser peaks at 5.4, 6.0, 6.6.	B.Hamermesh, PR **80**, 415.

75 RHENIUM Re

Re	σ_a(pile *n*)	**120**	osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	Resonance	E_0 = 2.3 ev		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
	Γ_n/Γ	**0.11**				
182 75 107 12.7^h	τ	**14^h**		50D61	Produced by W^{182}(*d*,2*n*); chem.	H.T.Dybvig, M.L.Pool, PR **80**, 128(A).
	K					
	γ	**0.92**				
183 75 108	τ	**67^h**		50D61	W^{183}(*d*,2*n*); chem. [This activity formerly assigned to Re^{182}.]	See above.
	K					
	γ	**1.75**				
186 75 111	β^+(< 10^{-7} per disintegration)			50M87	$\beta\gamma$, Xγ, XX coincidences. Proposed decay scheme: *	F.R.Metzger, R.D.Hill, PR **81**, 300(A) (1951) and * verbal report.
	β^-	**0.933**	sl			
		1.066	sl			
	γ	**0.123**	sl;ce$^-$			
		$\alpha_K \sim 0.45$, K/L ~ 0.6				
		0.137	sl;ce$^-$			
		$\alpha_K = 0.35$, K/L = 0.6				
		0.540	sl;ce$^-$			
		0.677	sl;ce$^-$			



76 OSMIUM Os

185 76 109	K			50B51	No $\gamma\gamma$ coincidences. Produced by Os(pile *n*). No β^+.	M.E.Bunker, et al., PR **79**, 610 and **80**, 128(A).
	γ ~85 %	**0.648**	sl; pe$^-$,ce$^-$			
	~15 %	**0.878**	sl; pe$^-$,ce$^-$			
191 76 115	β^-	~**0.14**	sl	50B51	Produced by Os(pile *n*). γ's highly converted. [Authors assign activity to Os^{193}].	See above.
	γ	**0.041**	sl;ce$^-$			
		0.128	sl; pe$^-$,ce$^-$			
193 76 117	β^-	**1.10**	sl	50B51	Produced by Os(pile *n*). [Authors assign activity to Os^{191}].	See above.
	No γ					
	β^-	**1.05**	s	50M60	[Author assigns activity to Os^{191}].	F.K.McGowan, PR **79**, 404.
	γ	**0.065**	s;ce$^-$			
	$\beta\gamma$ delay of 5.7 x 10^{-3} μs					

77 IRIDIUM Ir

191 77 114	I	**3/2**	S	50B75	Most probable value; possibly 5/2; not 1/2. $\lvert\mu\rvert$ small.	P.Brix, et al., Naturwiss. **37**, 397.
	μ	**positive**	S			
193 77 116	I	**3/2**	S	50B75	Value of μ is a few tenths of a nuclear magneton.	See above.
	μ	**positive**	S			
194 77 117	γ_3 0.14 %	$1.67 < E_\gamma < 2.23$		50W55	γ_3 result shows γ_1 follows γ_2 if γ_1 and γ_2 are E2 and γ_3 is E4.	R.Wilson, PR **79**, 1004.
	γ_4 2 x 10^{-4}%	$2.23 < E_\gamma$				

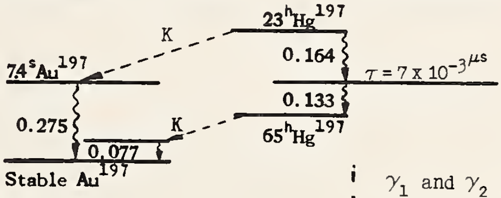
78 PLATINUM Pt

Pt	σ_t (120 ev) (345 ev)	**12.6** **11.9**		50H53	Thin Co and Mn foils used as resonance scattering detectors.	C.T.Hibdon, PR **79**, 747.
	σ_a (pile *n*)	**15**	osc	50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
194 ? 78 116	Pt(γ,*n*)	threshold = 6.1		50P67	See Tl^{205}, 50P67.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
198 78 120	σ(~0.03 Mev *n*,γ)29^mPt	**0.280**		50H84	Relative to σ(th *n*,γ) value of 47S33. Sb-Be *n*'s.	V.Hummel, B.Hamermesh, ANL-4476; PR **82**, 67.

79 GOLD Au

Au	Resonances E_0 $\sigma_0\Gamma^2$ Γ_n/Γ	**4.87** **638**		50T57	Data suggest J = 1.	J.Tittman, et al., PR **80**, 903.
		4.8 **0.14** >345 >**0.9**		50H54	See Al^{27}.	S.P.Harris, et al., PR **79**, 11.
196 79 117	Au(γ,*n*)	threshold = 8.1		50P67	See Tl^{205}, 50P67.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
197 79 118	σ(~0.03 Mev *n*,γ)2.69^dAu	**1.5**		50H84	Relative to σ(th *n*,γ) value of 47S33. Sb-Be *n*'s.	V.Hummel, B.Hamermesh, ANL-4476; PR **82**, 67.
198 79 119	σ(slow *n*,γ)3.3^dAu	**1.6×10^4**		50H59		R.D.Hill, PR **79**, 413.
	τ γ 50-100% E_γ	**2.7^d** << 0.411 s		50M71	<< 0.411 γ delayed by 3.5×10^{-2} μs; follows 0.411 γ.	K.P.Meyer, et al., HPA **23**, 517.
	γ	**0.690** **1.100**	scin scin	50P63		R.W.Pringle, S.Standil, PR **80**, 762.
	β^- γ	**0.961** **0.411** α_K = 0.029 α_L = 0.012	sl	50F65		C.Y.Fan, PR **81**, 300(A) (1951).
		K/L = 2.1		50H56		R.D.Hill, J.W.Mihelich, PR **79**, 275.
	Au(th *n*,γ)	E_γ(max)= 9.2	Dγp	50H51		B.Hamermesh, PR **80**, 415.
199 79 120	τ	**3.3^d**		50H56	Produced by successive thermal *n* capture.	R.D.Hill, J.W.Mihelich, PR **79**, 275.
	γ_2 γ_4 ~67% γ_5 ~33%	**0.050** **0.1585** K/L = 0.37 **0.2085** K/L~5		50H59	No 0.230 γ_6 found. Other lines are Auger e^-'s. γ_4 probably follows 0.050 γ_2.	R.D.Hill, PR **79**, 413.

80 MERCURY Hg

Hg	Relative isotopic abundances 198 **10.03%** 201 **13.24%** 199 **16.86%** 202 **29.84%** 200 **23.16%** 204 **6.86%**		50N51		A.O.Nier, PR **79**, 450.
	σ_a(pile *n*)	~**380** osc	50H62	Based on σ_a(B) = 710.	S.P.Harris, et al., PR **80**, 342.
	σ_t(280 Mev)	**2.80**	50F56	Be(340 Mev *p,n*). Scin; recoil *p*'s.	R.Fox, et al., PR **80**, 23.
	σ_a(Rn-α-F *n*'s) $\sigma_{n,2n}$(Ra-α-Be *n*'s)	**0.25** **0.07**	50L63	See B1, 50L63, for method.	K.Lintner, Acta Physica Austriaca **3**, 352.
197 80 117 65^h	γ	**0.077**	50F55	Proposed decay scheme:	H.Frauenfelder, et al., PR **79**, 1029.
25^h	γ_1	**0.164** sl; ce$^-$ α~20, K/L = 0.45			
	γ_2	**0.133** sl; ce$^-$ α~ 2, K/L = 0.39			
	γ_3	**0.275** sl; ce$^-$ K/L = 3.4			γ_1 and γ_2 converted in Hg.
200 ? 80 120	Hg(th *n*,γ)	E_γ(max) = 8.0 Dγ*p*	50H51		B.Hamermesh, PR **80**, 415.
	Hg(γ,*n*)	threshold = 6.6	50P67	See Tl^{205}, 50P67.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
202 80 122	σ(pile *n*,γ)43.5^dHg	**3.8**	50L62	Hg^{202} enriched to 97%.	W.S.Lyon, ORNL-788, 24.
204 80 124	σ(pile *n*,γ)5.5^mHg	**0.47**	50L62	Hg^{204} enriched to 89%.	See above.
205 80 125	τ β^-	**5.66^m** **1.75** a	50L62		See above.

81 THALLIUM Tl

Tl	Resonance Γ_n/Γ	E_0 = 260 ev **0.52**	50H54	See Al^{27}. Probably resonance in Tl^{203}.	S.P.Harris, et al., PR **79**, 11.
	σ_a(Rn-α-F *n*'s) $\sigma_{n,2n}$(Ra-α-Be *n*'s)	**0.22** **0.59**	50L63	See B1, 50L63, for method.	K.Lintner, Acta Physica Austriaca **3**, 352.
204 81 123	β^-	**0.762** sl	50E52	Shape indicates $\Delta I = 2$, yes.	L.G.Elliott, R.E.Bell, PR-P-8, 16, Chalk River.
	Tl(*n*,γ)	E_γ(max) = 6.54	50K49	Pair spectrometer.	B.B.Kinsey, PR-P-7-GP, 41, Chalk River.

(Tl continued on next page)

81 THALLIUM Tl (continued)

204 ? 81 123	Tl(γ,n) threshold = 7.3 50P67	n's detected by activity induced in ethyl iodide.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
206 81 125	Tl(n,γ) E_γ(max) = 6.23 50K49	Pair spectrometer.	See Tl^{204}, 50K49.
208 81 127	Angular correlation between 0.58 and 2.62 γ's gives spins 4,2,0 50P59	Disagrees with conversion coeff. results of 50M27.	H.E.Petch, M.W.Johns, PR **80**, 478.

82 LEAD Pb

Pb	New reference for data reported in 50H16	$Pb^{206,207,208}$.	J.A.Harvey, PR **81**, 353.
	σ_a (pile n) **0.28** osc 50C71	Based on σ_a (B) = 710.	F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
	σ_t (300-750 kev) **graph** 50P60 E_o (kev) σ_o J Γ(kev) **350** **4** **1/2** ~10 **525** **3/2** ~10 **720** **3.7** **3/2** ~10	Better resolution than in 49B31. P-neutrons probably responsible for all three resonances which are attributed to levels in Pb^{209}.	R.E.Peterson, et al., PR **79**, 935.
	σ_t (270 Mev) **2.84** 50D55	Be(350 Mev p,n). Bi-f detector.	J.DeJuren, PR **80**, 27.
	σ_t (280 Mev) **2.89** 50F56	Be(340 Mev p,n). Recoil p's.	R.Fox, et al., PR **80**, 23.
	σ_a (Rn-α-F n's) **0.04** 50L63 $\sigma_{n,2n}$ (Ra-α-Be n's) **0.25**	See Bi, 50L63, for method.	K.Lintner, Acta Physica Austriaca **3**, 352.
204 82 122	$\gamma\gamma$ angular correlation 50S59	Shows spin memory for $0.3^{\mu s}$.	A.W.Sunyar, et al., PR **79**, 181.
68^m	Mass assignment questioned 66^m activity from Pb + n 50G64	Paraffin slowed n's. Activity decreased 10% by Cd shield.	K.Geiger, Z.Naturforsch. **5a**, 401.
206 82 124	σ_t (15-750 kev) **graph** 50P60	Radio-lead used. Many peaks.	See Pb, 50P60.
	Pb^{207}(γ,n) threshold = 6.9 50P67	See Tl^{204} ?. Natural Pb used.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
207 82 125	μ **0.5837** I 50P51	$\nu(Pb^{207})/\nu(Na^{23})$ $[Pb(C_2H_3O_2)_2]$ = 0.7901 ± 0.0001.	W.G.Proctor, PR **79**, 35.
	Levels 50P60	Spacing ~50 kev above 7 Mev.	See Pb, 50P60.
	Pb^{208}(γ,n) threshold = 8.1 50P68	Pb^{208} extracted by Soddy.	R.W.Parsons, et al., Proc. Phys. Soc., Lond., **A63**, 915.
	Pb^{206}(n,γ) E_γ(max) = 6.74 50K49	Natural Pb used.	B.B.Kinsey, PR-P-7-GP, 41, Chalk River.
209 82 127	Levels from Pb(n,γ) resonances 50P60	Effect of Pb^{206} subtracted. $\sigma_t(Pb^{207})$ assumed smooth.	See Pb, 50P60.
210 82 128	τ **25^y** 50W72	Followed 250 days with ic.	F.Wagner, Jr., ANL-4490, 5.

(Pb continued on next page)

82 LEAD Pb (continued)

212 82 130	β^-	**0.590**	s	50Z54		A.S.Zavelskii, et al., Izv. Akad. Nauk, SSSR, Ser. Fiz. **12**, 673; Chem. Abst. **44**, 4343a.

83 BISMUTH Bi

Bi	σ_a	**0.033**		50E53	Danger coeff. method and osc.	C.Eggler, D.J.Hughes, ANL-4476,40
	σ_a (Rn-α-F *n*'s) $\sigma_{n,2n}$ (Ra-α-Be *n*'s)	**0.06** **0.26**		50L63	E_n (max) $\simeq$3.7 and ~13, resp. Sources placed at center of Bi sphere and *n* densities measured in surrounding water.	K.Lintner, Acta Physica Austriaca **3**, 352.
208 83 125	$Bi^{209}(\gamma,n)$	threshold = 7.2		50P67	See Tl^{205}.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
209 83 126	μ	**4.10**	S	50K59		F.M.Kelly, et al., PR **80**, 295.
	σ(th n,γ) 5^dBi	**0.016**		50E53	Disagreement with absorption value felt to be real.	See Bi, 50E53.
	σ(th $n,\gamma\beta$) 138^dPo	**0.021**		50C71		F.C.W.Colmer, D.J.Littler, Proc. Phys. Soc., Lond., **A63**, 1175.
214 83 131	No fine structure found in conversion lines			50L58	In old apparatus lines had "individual plateaus which we took for unresolved lines".	G.D.Latyshev, J. Exp. Theor. Phys. USSR **20**, 192; Guide to Russ. Sci. Lit. **3**, 288.

84 POLONIUM Po

211 ? 84 127	Long range α 3×10^{-5} α's per dis. of AcC'	**9.1**		50A61	Suggests possibility of assignment to AcA, AcC', or Rn^{215}.	P.Avignon, J. Phys. Radium, (8) **11**, 521.
213 84 129	α	**8.34**	ic	50H52	Details of work reported in 47H2.	F.Hagemann, et al., PR **79**, 435.
214 84 130	τ	**1.637×10^{-4}**	s	50D53	20 channel time analyzer.	G.von Dardel, PR **79**, 734.

85 ASTATINE At

215 85 130	α 2.3×10^{-6} α's per dis. of AcA	**8.04**	ic	50A61	Range = 7.40 cm.	P.Avignon, J. Phys. Radium, (8) **11**, 521.

86 RADON Rn

87 FRANCIUM Fr

88 RADIUM Ra

89 ACTINIUM Ac

227 89 138	τ	**22.0^y**	50H79	Sample produced by Ra(n,γ) compared to Ra standard.	J.M.Hollander, R.F.Leininger, PR **80**, 915.
	τ	**27.7^y**	50W72	Followed for 250 days with ic.	F.Wagner, Jr., ANL-4490, 5.

90 THORIUM Th

Th	σ_t (42 Mev)	**5.03**	50H71	Be(d,n). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith, PR **80**, 842.
229 90 139	τ	**7340^y** ± 160	50H52	Produced by U^{233} decay; chem. α's same as in 46H20.	F.Hagemann, et al., PR **79**, 435.
231 90 141	$Th^{232}(\gamma,n)$	threshold = 6.0	50P67	n's detected by activity induced in ethyl iodide.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., **A63**, 839.
233 90 143	β^- No γ, no pe^-	**1.23** sl	50B68	Falling off in Fermi plot below 500 kev; above that, linear. Secondary e^- found; attributed to bremsstrahlung.	M.E.Bunker, et al., PR **80**, 468.
234 90 144	σ(pile $n,\gamma\beta$) 23.7^mPa	**1.7 - 1.8**	50H76		B.G.Harvey, B.I.Parsons, PR **80**, 1098.

91 PROTACTINIUM Pa

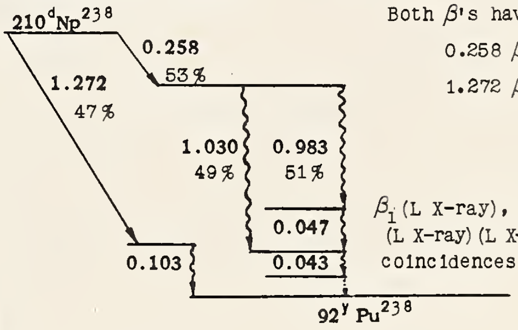
Pa	New reference for data reported in		48J10	Pa^{232}.	A.H.Jaffey, E.K.Hyde, PR **79**, 280.
231* 91 140	γ	**27 kev**	49S35	Reported as e^- in *Table*.	*Correction to *Table*.
233 91 142	γ Auger e^-'s	**0.0289, 0.0406, 0.0581, 0.0757, 0.0871, 0.1045, 0.2726, 0.3015, 0.3131, 0.3420, 0.3765, 0.3999, 0.4164** s, ce$^-$	50K54	γ's fitted into five levels in U^{233} with energy $\lesssim 0.16$. These levels are not the same as those proposed in 50E1.	H.B.Keller, J.M.Cork, PR **79**, 1030.
	β^-	**~0.530** sl	50F58	Conversion lines at 0.050, 0.061, 0.0775, 0.192, 0.221, 0.288.	M.S.Freedman, D.W.Engelkemeir, PR **79**, 897.
235 91 144	τ	**23^m**	50H76	Produced by Th^{234} (pile n); 12 minute chem. separation.	B.G.Harvey, B.I.Parsons, PR **80**, 1098.

92 URANIUM U

Isotope	Property	Value	Class	Ref.	Remarks	Reference
U	σ_t (42 Mev)	5.12		50H71	Be(d,n). $C^{12}(n,2n)$ detector.	R.H.Hildebrand, C.E.Leith, PR 80, 842.
	σ_t (270 Mev)	3.29		50D55	Be(350 Mev p,n). Bi-f detector.	J.DeJuren, PR 80, 27.
	σ_t (280 Mev)	3.14		50F56	Be(340 Mev p,n). Scin, recoil p's	R.Fox, et al., PR 80, 23.
233 92 141	α	4.80		50H52		A.H.Jaffey, priv. comm. quoted by F.Hagemann, et al., PR 79, 435.
235 92 143	I	5/2	s	50S10	Enriched U^{235}. I = 5/2 fits data considerably better than I = 7/2.	G.L.Stukenbroeker, J.R.McNally, Jr., AECD-2797.
238 92 146	Resonance E_0: 11 ev σ_0: 9200	Γ: < 0.20 ev	Γ_n: < 0.0086 ev	50A58	B absorption, resonance activation experiments. Evidence for higher levels.	H.L.Anderson, PR 80, 499. Work done in 1940.
	U(γ,n)	threshold = 5.8		50P67	n's detected by activity induced in ethyl iodide.	R.W.Parsons, C.H.Collie, Proc. Phys. Soc., Lond., A63, 839.

93 NEPTUNIUM Np

Isotope	Property	Value	Class	Ref.	Remarks	Reference
238 93 145	β^-_1 53%	0.258	sl	50F53	Produced by Np^{237} (pile n); chem. Proposed decay scheme:	M.S.Freedman, et al., PR 79, 410.
	β^-_2 47%	1.272	sl			Both β's have allowed shape 0.258 β: log ft = 6 1.272 β: log ft = 8.4
	No K					
	$\beta^+/\beta^- \leqslant 10^{-3}$					
	γ	0.043 $\alpha_L = 2.5, \alpha_M = 0.37$	sl; ce$^-$			
		0.047 $\alpha_L = 2.8, \alpha_M = 0.14$	sl; ce$^-$			
		0.103 $\alpha_L = 0.041, \alpha_M = 0.026$	sl; ce$^-$			β_1 (L X-ray), β_2 (L X-ray), (L X-ray) (L X-ray), β_1 (1.03γ) coincidences.
	51%	0.983 $\alpha_K = 0.012$	sl; pe$^-$			
	49%	1.030 $\alpha_K = 0.012$	sl; pe$^-$			



94 PLUTONIUM Pu

Isotope	Property	Value	Class	Ref.	Remarks	Reference
240 94 146	α	5.16	lc	50T54	$Pu^{239}(n,\gamma)$; chem.	S.Thompson, et al., PR 80, 1108.
241 94 147	τ	$14^{y\,*}$		50T54	$Pu^{239}(n,\gamma;n,\gamma)$, chem. * Estimated from growth of Am^{241}.	See above.
	α ~3 x 10^{-3}%	4.91	lc			
	$\sigma(n,\gamma)Pu^{242}$	~250				
242 94 148	τ_α	~5 x 10^{5y}		50T54	n bombardment of Pu^{239} and Am^{241}; ms, chem.	See above.
	α	4.88	lc			

95 AMERICIUM Am

238 ? 95 143	τ	$\sim 1.2^h$		50S61	Pu^{239} (17 Mev *d,3n* ?).	K.Street, Jr., et al., PR **79**, 530.
	ce^-		a			
	X-rays		a			
239 95 144	α ~0.01%	5.77	ic	50S61	Former value was 0.1%	See above.
240 95 145	Confirm 50^h assignment to Am^{240} No α's			50S61	Pu^{239} (10 Mev *d,n*), not from Pu^{239} (9 Mev *p*,γ).	See above.
241 95 146	τ	475^y *		50S61	* Unpublished value of Cunningham, Thompson, Lohr.	See above.
	$\sigma(n,\gamma)Am^{242}$	~100				
242 95 147 16^h	β^-	0.628	$s\pi\sqrt{2}$	50052	Am(n,γ). Pu^{242} found by ms in long irradiation of Am. Tentative branching ratio: β^-: L capture: IT = 60 : 20 : 20. Bent crystal spec, for X-rays.	G.D.O'Kelley, et al., PR **80**, 293.
	γ	0.038	$s\pi\sqrt{2}$; ce^-			
		0.052	$s\pi\sqrt{2}$; ce^-			
		α ~1				
	Pu, Am, Cm L X-rays					
$\sim 400^y$	τ	$\sim 100^y$		50S61	From ms analysis of Am and growth of Cm^{242} and Np^{238}.	See Am^{238} ?, 50S61.
	α ~1%					
	$\sigma(n,\gamma)Am^{243}$	~4000				
	β^-	0.580	$s\pi\sqrt{2}$	50052		See Am^{242}, 50052.
243 95 148	τ_α	$\sim 10^{4y}$		50S61	Am($n,\gamma;n,\gamma$); ms. p of Np^{239}. No Cm^{243} found in aged Am^{243}; therefore $\tau_\beta > 10^{3y}$.	K.Street, Jr., et al., PR **79**, 530.
	α	5.21	ic			
	$\sigma(n,\gamma)Am^{244}$?	~50				
244 ? 95 149?	τ	$\sim 25^m$		50S61	Am^{243} (n,γ) ?	See above.

96 CURIUM Cm

243 96 147	τ	$\sim 100^y$		50T52	Daughter of 4.6^h Bk. Differential pulse analysis of α's.	S.G.Thompson, et al., PR **80**, 781.
	α 85%	5.79	ic			
	15%	5.89	ic			
	ms identification of isotope			50R55	Am^{241} ($n,\gamma\beta$) Cm^{242} (n,γ); chem.	F.L.Reynolds, et al., PR **80**, 467.
244 96 148	ms identification of isotope			50R55	Am^{241} (successive *n* capture,$\gamma\beta$) and Cm^{243} (n,γ); chem.	See above.

97 BERKELIUM Bk

98 CALIFORNIUM Cf

List of Fission and Spallation Papers

Fission Yields

G.B.Cook, AERE - C/R - 424.	$Sn^{121,123}$ *from* U^{235}.
L.E.Glendenin, ANL - 4526, 91.	Cs^{136} *from* U^{233}.
R.H.Goeckermann, I.Perlman, Phys. Rev. **76**, 628.	*Yield curve for Bi(190 Mev d,f).* Mo^{99} *from* $Pb^{204,208}(d,f)$.
M.G.Inghram, D.C.Hess, Jr., J.H.Reynolds, Phys. Rev. **76**, 1717.	*Cs from* U^{235}.
M.G.Inghram, R.J.Hayden, D.C.Hess, Jr., Phys. Rev. **79**, 271.	*Rare earths from* U^{235}.
J.Macnamara, H.G.Thode, Phys. Rev. **80**, 471.	*Xe, Kr from spontaneous fission of* U^{238}.
J.Macnamara, C.B.Collins, H.G.Thode, Phys. Rev. **78**, 129.	Xe^{133} *from* U^{235}.
J.Niday, A.Turkevich, Phys. Rev. **80**, 136.	*Yield curve for Th(fast n,f).*
A.C.Pappas, C.D.Coryell, Phys. Rev. **81**, 329(A).	*Masses 129 to 134 from* U^{235}.
K.Way, N.Dismuke, AECD - 2817.	*Summary of data as of June 1949.*

Fission Yields: Theoretical

D.L.Hill, Phys. Rev. **80**, 330(A).

J.Jungerman, Phys. Rev. **80**, 285.

T.Yasaki, O.Miyatake, Phys. Rev. **79**, 740 and **80**, 754.

Fission Fragments: Ranges and Energies

J.K.Bøggild, L.Minnhagen, O.B.Nielsen, Phys. Rev. **76**, 988.	*Mean ranges in air for* $U^{235}(th\ n,f)$.
D.C.Brunton, W.B.Thompson, Phys. Rev. **76**, 848.	*Energy distribution for* $Pu^{239}(th\ n,f)$.
D.C.Brunton, G.C.Hanna, Phys. Rev. **75**, 990; Can. J. Res. **28A**, 190.	*Energy distribution for* U^{233}, $U^{235}(th\ n,f)$.
S.S.Friedland, AECU - 929.	*Energy distribution for* U^{235}*(2.5 and 14 Mev n,f).*
J.Jungerman, S.C.Wright, Phys. Rev. **76**, 1112.	*Energy distribution for* U^{235}, U^{238}, Th^{232}, Bi^{209} *(45 Mev and 90 Mev n,f).*
J.K.Knipp, R.B.Leachman, R.C.Ling, Phys. Rev. **80**, 478 and **79**, 197(A).	*Estimate of fragment energies not producing ionization.*
N.O.Lassen, Kgl. Danske Vid. Sels, **25**, #11.	*Energy loss by fragments along range.*
F.Suzor, Ann. Phys., Paris, **4**, 269.	*Ranges in Al, Cu, Ag, Au for* U^{235}*(th n and fast n,f).*
W.J.Whitehouse, W.Galbraith, Phil. Mag. **41**, 429.	*Energy distribution for spontaneous fission of* U^{238}.

Fission Cross Sections

S.Biswas, A.P.Patro, Ind. J. Phys. **23**, 97.	$\sigma[U^{235}(0.025\ ev\ n,f)] = 526$.
U.Facchini, E.Gatti, Nuovo Cim. **7**, 589; Helv. Phys. Acta **23**, 556.	$\sigma[U^{235}(0.025\ ev\ n,f)] = 551$.
C.Haenny, P.Lerch, O.Rochat, Helv. Phys. Acta **21**, 186 and **22**, 609.	$\sigma[U^{235}(0.025\ ev\ n,f)] = 580$.
Office of Classification, AEC, TID - 235.	$\sigma[U^{235}(0.025\ ev\ n,f)] = 545$.
J.Jungerman, Phys. Rev. **79**, 632 and **79**, 198(A).	*Excitation functions for* α,f *and* d,f *for Au, Bi,* Th^{232}, $U^{235,238}$.

(Continued on next page)

List of Fission and Spallation Papers - Continued

Ternary Fission and Long Range α's

K.W.Allen, J.T.Dewan, Phys. Rev. **76**, 181.	Three particles from U(slow n, f).
K.W.Allen, J.T.Dewan, Phys. Rev. **80**, 181.	Long range α's from $U^{233,235}$, Pu^{239}(slow n, f).
F.K.Goward, E.W.Titterton, J.J.Wilkins, Nature **164**, 661.	Three particles from $U^{238}(\gamma, f)$.
L.Rosen, A.M.Hudson, Phys. Rev. **78**, 533.	Three particles from U^{235}(slow n, f).
E.W.Titterton, F.K.Goward, Phys. Rev. **76**, 142.	Long range α's from $U^{238}(\gamma, f)$.
E.W.Titterton, T.A.Brinkley, Phil. Mag. **41**, 500.	Long range α's from U^{238}, $Th^{232}(\gamma, f)$.

Fission: Delayed n's

L.G.Creveling, J.R.Hood, M.L.Pool, Phys. Rev. **76**, 946.	Th^{232}.
K.H.Sun, R.A.Charpie, F.A.Pecjak, B.Jennings, J.F.Nechaj, A.J.Allen, Phys. Rev. **79**, 197 and **79**, 3.	U^{238}, Th^{232}.

Fission: Miscellaneous and General

R.Batzel, G.T.Seaborg, Phys. Rev. **79**, 528.	Fission of medium weight elements.
T.W.Bonner, AECD-3110.	Prompt n spectrum from U^{235}(th n, f) from 0.05 to 0.7 Mev.
Office of Classification, AEC, TID-235.	Prompt n spectrum from U^{235}(th n, f) is given by $\sinh\sqrt{2E}\,e^{-E}$. E in Mev in laboratory system.
H.W.Koch, J.McElhinney, E.L.Gasteiger, Phys. Rev. **79**, 329.	Photofission thresholds for $U^{233,235,238}$, Pu^{239}, Th^{232}.
N.O.Lassen, Phys. Rev. **79**, 1016.	Total charges of fragments in gaseous and solid media.
N.Sugarman, Phys. Rev. **79**, 532.	Photofission of Bi.
J.M.C.Scott, E.W.Titterton, Phil. Mag. **41**, 918.	Search for p^-.

Spallation: Reactions, Products, and Yields

F.O.Bartell, A.C.Helmholz, S.D.Softky, D.B.Stewart, Phys. Rev. **80**, 1006.	Yields from Cu(190 Mev d).
H.H.Hopkins, Phys. Rev. **77**, 717.	Yields from As(190 Mev d).
M.Lindner, I.Perlman, Phys. Rev. **78**, 499.	Yields from Sb(380 Mev α) and Sb(190 Mev d).
C.H.Millar, A.G.W.Cameron, Phys. Rev. **79**, 182.	Li^8 found from $\leqslant 27$ Mev γ on Br, Ag, I.
S.C.Wright, Phys. Rev. **79**, 838 and **77**, 742(A).	σ's for Li^8 production from 340 Mev p and 190 Mev d on C, N, Ne, A, Kr, Xe.

List of Journals, Volumes and Numbers, Surveyed for Supplement 2, July 1950 to January 1951

Journal	*Abbreviation Used*	*Volume, Numbers*
Annalen der Physik	Ann. Phys., Lpz.	**7**, Nos. 7,8.
Annales de Physique	Ann. Phys., Paris	**5**, July - Dec.
Australian Journal of Scientific Research	Australian J. Sci. Res.	**3**, March - Sept.
Canadian Journal of Research	Can. J. Research	**28A**, Nos. 4 - 6
Comptes rendus hebdomadaires des séances de l'academie des sciences	Comptes rendus	**231**, Nos. 1 - 24
Experientia	Experientia	**6**, Nos. 1 - 6
Guide to Russian Scientific Periodical Literature	Guide to Russ. Sci. Lit.	**3**, Nos. 7 - 12
Helvetica Physica Acta	Helv. Phys. Acta HPA **	**23**, Nos. 5
Indian Journal of Physics	Indian J. Phys.	**33**, Nos. 5 - 12
Journal of American Chemical Society	J. Am. Chem. Soc.	**72**, Nos. 7 - 12
Journal de physique et le radium	J. de phys. et rad.	Series (8), **11**, Nos. 7 - 12
Journal of Chemical Physics	J. Chem. Phys.	**18**, Nos. 7 - 12
Journal de chimie physique et de physico-chimie biologique	J. Chimie Physique	**47**, Nos. 7 - 10
Nature	Nature	**166**, Nos. 4209 - 4235
Die Naturwissenschaften	Naturwiss.	**37**, Nos 13 - 22
Nuclear Science Abstracts	NSA	**4**, Nos. 13 - 24
Nuovo Cimento	Nuovo Cim.	**7**, Nos. 4 - 6
Philosophical Magazine	Phil. Mag.	**41**, Nos. 318 - 323
Physica	Physica	**16**, Nos. 6 - 9
Physical Review	Phys. Rev. PR **	**79**, Nos. 1 - 6 **80**, Nos. 1 - 6
Proceedings of the Cambridge Philosophical Society	Proc. Camb. Phil. Soc.	**46**, Nos. 3,4
Proceedings of the Physical Society	Proc. Phys. Soc., Lond.	**A63**, Nos. 367 - 371
Proceedings of the Royal Society of London	Proc. Roy. Soc.	**A202**, Nos. 1068 - 1071 **A203**, Nos. 1072 - 1075 **A204**, No. 1076
Research	Research	**3**, Nos. 7 - 12
Zeitschrift für Naturforschung	Z. Naturforsch.	**5a**, Nos. 7 - 9
Zeitschrift für Physik	Z. Phys.	**128**, Nos. 2,3

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[*] All numbers are inclusive.
All dates are 1950

[**] These abbreviations are used in the body of the supplement

Additions to Old References

Supplement 2

The following is a list of better references for data already reported in either the *Table* or in *Supplement 1*. It is recommended that the new reference be written into the appropriate reference list under the old key number.

For convenience, all 1950 reference numbers were included in the *Supplement 1* table of references. Thus additions to 1950 references need only be inserted by the reader into *Supplement 1*.

Reference Key Used Previously	New Reference
1946	
46H10	E. K. Hyde, NNES 14B. Paper 19.15; AECD-2457.
1947	
47H2	F. Hagemann, L. I. Katzin, M. H. Studier, G. T. Seaborg, A. Ghiorso, Phys. Rev. **79**, 435.
1948	
48H10	F. Hagemann, L. I. Katzin, M. H. Studier, G. T. Seaborg, A. Ghiorso, Phys. Rev. **79**, 435 and **79**, 534.
48J10	A. H. Jaffey, E. K. Hyde, Phys. Rev. **79**, 280.
48R10 48S29	H. T. Richards, R. V. Smith, C. P. Browne, Phys. Rev. **80**, 524.
1949	
49C3	M. F. Crawford, A. L. Schawlow, F. M. Kelly, W. M. Gray, Can. J. Res. **28A**, 558.
49D11	J. A. Miskel, E. der Mateosian, M. Goldhaber, Phys. Rev. **79**, 193.
49D30	E. der Mateosian, M. Goldhaber, Phys. Rev. **79**, 192.
49H42	R. W. Hayward, Phys. Rev. **79**, 541.
49J4	G. H. Jenks, F. H. Sweeton, J. A. Ghormley, Phys. Rev. **80**, 990.
49M49	C. H. Millar, A. G. W. Cameron, M. Glicksman, Can. J. Res. **28A**, 475.
49N10	C. N. Nelson, B. H. Ketelle, G. E. Boyd, ORNL-828.
49P4	H. S. Pomerance, Phys. Rev. **76**, 195.
49P7	W. G. Proctor, Phys. Rev. **79**, 35.
49W13	G. Wilkinson, Phys. Rev. **80**, 495.
1950	
50D4	E. L. Zimmerman, E. B. Dale, D. G. Thomas, J. D. Kurbatov, Phys. Rev. **80**, 908.
50F10	G. Friedlander, M. L. Perlman, D. Alburger, A. W. Sunyar, Phys. Rev. **80**, 30.
50G9	L. Gross, D. R. Hamilton, Phys. Rev. **80**, 484.
50G22	L. S. Germain, Phys. Rev. **80**, 937.

Additions to Old References - Continued

Supplement 2

Reference Key Used Previously	New Reference
1950	
50H5	S. P. Harris, Phys. Rev. **80**, 20.
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