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ISOMERIC-YIELD RATIOS IN NUCLEAR REACTIONS
(With a Compilation of Experimental Data)

by

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ABSTRACT

Experimental procedures are briefly described for the determination of the ratios of cross sections for the formation of isomeric states in nuclear reactions. Available experimental data on isomeric yield ratios in nuclear reactions are compiled. Some of the collected data are discussed in terms of angular-momentum effects in nuclear reactions.

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The tables on the following pages which precede the body of the report became available prior to issuance of this report but after printing had been done. It is inserted at this time to make the information as complete as possible at this date. Reference should be made to the text for the symbols and format used.

Additional Experimental Data of Isomeric Yield Ratios for Chapter III

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Co}^{59}(\gamma, n)\text{Co}^{58}$	$\underline{7/2-}$	30 max			0.79 ± 0.04	Scint count γ with NaI. Electron synchrotron.	62CC
$\text{Ge}^{76}(\gamma, n)\text{Ge}^{75}$	0+	30 max			0.92 ± 0.13	Same as above.	62CC
$\text{Br}^{81}(\gamma, n)\text{Br}^{80}$	$\underline{3/2-}$	30 max			0.47 ± 0.03	Same as above.	62CC
$\text{Sr}^{86}(\gamma, n)\text{Sr}^{85}$	0+	30 max			1.77 ± 0.35	Same as above.	62CC
$\text{Zr}^{90}(\gamma, n)\text{Zr}^{89}$	0+	30 max			2.0 ± 0.6	Same as above.	62CC
$\text{Mo}^{92}(\gamma, n)\text{Mo}^{91}$	0+	30 max			1.17 ± 0.10	Same as above.	62CC
$\text{Ag}^{107}(\gamma, n)\text{Ag}^{106}$	$\underline{1/2-}$	30 max			0.042 ± 0.021	Same as above.	62CC
$\text{Cd}^{116}(\gamma, n)\text{Cd}^{115}$	0+	30 max			≤ 0.25	Same as above.	62CC
$\text{In}^{113}(\gamma, n)\text{In}^{112}$	$\underline{9/2+}$	30 max			4.0 ± 0.5	Same as above.	62CC
$\text{Ce}^{140}(\gamma, n)\text{Ce}^{139}$	0+	30 max			0.087 ± 0.011	Same as above.	62CC
$\text{Hg}^{198}(\gamma, n)\text{Hg}^{197}$	0+	30 max			0.053 ± 0.011	Same as above.	62CC
$\text{K}^{39}(\gamma, n)\text{K}^{38}$	$\underline{3/2+}$	15.5	0.8	1.5	0.53^*	Scint count annihilation radiations with NaI.	62GP
		16.0	1.05	1.9	0.55^*		
		16.5	1.5	2.4	0.62^*		
		17.0	2.2	3.5	0.63^*		
		17.5	3.5	5.0	0.70^*		
		18.0	6.7	6.7	1.0^*		
		18.5	11.0	9.0	1.2^*		
		19.0	14.8	11.0	1.35^*		
		19.5	18.4	11.3	1.63^*		
		20.0	19.3	10.6	1.82^*		
		20.5	17.9	9.6	1.86^*		

Additional Experimental Data of Isomeric Yield Ratios for Chapter III (Cont'd.)

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$K^{39}(\gamma, n)K^{38}$ (Cont'd.)		21.0	14.0	8.0	1.75*		
		21.5	10.5	5.9	1.78*		
		22.0	6.0	3.9	1.54*		
		22.5	2.3	2.3	1.0*		
		22.7	1.0	1.9	0.53*		
$Y^{89}(\gamma, 2n)Y^{87}$	$1/2^-$	47 Brem			0.32	Scint count γ with NaI.	62MN
$Sm^{144}(n, 2n)Sm^{143}$	0+	14			(0.5)	σ_m count 0.75-Mev γ ; σ_g count annihilation radiations.	62AK
$Te^{120}(n, \gamma)Te^{121}$	0+	Thermal	340	2000	(0.16 $\pm$ 0.04)	Scint count γ with NaI.	62SE
$Te^{130}(n, \gamma)Te^{131}$	0+	Thermal	40	270	0.15 $\pm$ 0.03	18% IT. 145-keV $\gamma/\beta = 1$ for Te^{131g} .	62SE
$Ce^{138}(n, \gamma)Ce^{139}$	0+	Thermal	18	650	0.028 $\pm$ 0.012	σ_m scint count γ with NaI, compared with $\sigma(n, \gamma)$ of Al^{27} . σ_g coinc count k x-ray and 166-keV γ with NaI, compared with $\sigma(n, \gamma)$ of Ce^{140} and Sn^{116} .	62SE
$Pt^{196}(n, \gamma)Pt^{197}$	0+	Thermal			0.071 $\pm$ 0.013	σ_m scint count k x-ray from 343-keV γ conversion. σ_g scint count 77-keV γ with NaI. Also β count with anthracene.	62SE
$Hg^{196}(n, \gamma)Hg^{197}$	0+	Thermal			0.028 $\pm$ 0.005	σ_m scint count 133- and 164-keV γ ; σ_g count K x-ray ($L/K = 0.15$) with NaI.	62SE

Additional Experimental Data of Isomeric Yield Ratios for Chapter III (Cont'd.)

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Se}^{82}(\gamma, n)\text{Se}^{81}$	0+	10			0.34 #	Betatron max. energy.	57SG
		11			0.44 #		
		12			0.63 #		
		13			0.72 #		
		14			0.73 #		
		15			0.65 #		
		16			0.73 #		
		17			1.15 #		
		18			1.25 #		
		19			1.25 #		
		20			1.35 #		
		21			1.55 #		

Corrections and additions of references.

- (1) Reference 62CC should read: J. H. Carver, G. E. Coote, and T. R. Sherwood, Nuclear Phys., 37, 449 (1962).
- (2) Reference 61V should read: H. Vonach, Sitzber. Öst. Akad. Wiss., Mitt. Inst. Rad. Nr. 524 (1961).
- (3) Add reference 57SG E. Silva and J. Goldemberg, An Acad. Brasil Cience, 28, 275 (1957).
- (4) Add reference 62GP D. Goldman, A. F. T. Piza, and E. Silva, Nuovo cimento (10), 25, 41 (1962).
- (5) Add reference 62AK W. L. Alford and D. R. Koehler, Bull. Am. Phys. Soc., II, 7, 577 (1962).
- (6) Add reference 62MN H. A. Medicus and M. R. van Nieuwenhuysen, Bull. Am. Phys. Soc., II, 7, 550 (1962).
- (7) Add reference 62SE M. L. Sehgal, Phys. Rev., 128, 761 (1962).

ISOMERIC-YIELD RATIOS IN NUCLEAR REACTIONS

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CHAPTER I. INTRODUCTION

In the study of angular momentum effects in nuclear reactions, attempts have been made to compare excitation functions (reaction cross sections as a function of bombarding energy) of different nuclear reactions forming the same compound nucleus and the same product nuclide. If we assume that some excitation energy is tied up in rotation of the compound nucleus in a reaction, then the energy available for the emission of particles would be equal to the maximum excitation energy of the compound nucleus minus the rotational energy of the compound nucleus. An energy displacement of the matched excitation functions would indicate the difference of the rotational energies of the compound nuclei in proportion to the relative amount of angular momenta brought in by the projectiles.

In order to make this kind of comparison possible, the bombarding energies of the projectiles must be known very accurately. Difficulties have been encountered in matching excitation functions in which the experimental uncertainty of the projectile energy was quite large (50G, 54CR, 56J, 60TF).^{*} In addition, the assumption of a mechanism for compound nucleus formation in some nuclear reactions is questionable.

Another application of excitation functions in the study of angular momentum effects in nuclear reactions is in the study of relative cross sections for the formation of the metastable and ground states of nuclides, the so-called isomeric yield ratios. The metastable state of a nuclide differs from the ground state in spin value (and sometimes parity assignment) and only slightly in excitation energy. The ratio of their formation cross sections represents the net result of angular momentum effects in the processes taking place during the nuclear reaction. Specifically, in this study, one investigates the variation of isomeric yield ratios as a function of bombarding energy. One may compare the ratios of cross sections for the formation of a given isomeric pair produced in different reactions. In this way, the different effects of angular momenta brought in by various projectiles may be observed. One may also compare the yield ratios of different isomeric pairs which are produced in the same type of nuclear reaction. For example, it was found that the isomeric yield ratios (high spin to low spin states) in (p,n) reactions at low energies increase with increasing projectile energy (62WH, 62HJ, 51BB, 59LJ, 52F).

^{*}References are listed in Appendix.

Recently, on the basis of a statistical model, Vandenbosch and Huizenga (60VH), and, later, other workers (61BH, 61F, 62WG, 62VH) have calculated the angular momentum distributions in the processes (compound nucleus formation, neutron evaporations, and gamma cascades) which take place in reactions proceeding through compound nucleus formation. From the analyses of these calculations, they have obtained information about the spin dependence of the nuclear level-density parameter. They showed that the calculated ratios of isomeric yield are very sensitive to the assumed values of the parameter σ in the level-density formula

$$\rho(J) \propto \rho(J=0) (2J+1) \exp \left\{ -(J - \frac{1}{2})^2 / 2\sigma^2 \right\} ,$$

where ρ is the relative level density of levels with spin J . The calculated ratios of isomeric yield are also dependent to a smaller extent on the assumed number and multipolarity of the gamma cascades following neutron evaporations.

In this report, experimental techniques and mathematical treatments for the determination of isomeric yields are described briefly in Chapter II. Existing experimental data about isomeric yield ratios are compiled in Chapter III. Some of these data are discussed in Chapter IV. No theoretical analysis of experimental data is made in this report.

The author of this compilation is aware of the possibility that some experimental data on isomeric yield ratios may have been overlooked or unavailable to him. The author wishes that readers would kindly point out valuable data which have been overlooked and submit additional data to him. Corrections, suggestions, and comments to this compilation will always be appreciated.

It may be mentioned here that experimental cross sections for the formation of only one state of a given isomeric pair are not included in this report, as these data may be available elsewhere. Excitation functions with neutron as the projectile are compiled by Hughes and Schwartz (58HS) and by Howerton (58H); and those with charged particles as the projectiles are collected by Jarmie and Seagrave (56JS) and Smith (61S). Bibliographies on photonuclear reactions are compiled by Toms (60TO).

General references on nuclear isomerism:

E. Segre and A. C. Helmholz, *Revs. Modern Phys.*, 21, 217 (1949).

M. I. Korsunski, "Izomeriia Atomnykh Iader," State Publishing House of Technical-Theoretical Literature, Moscow, 1954. Translated to German, "Isomerie der Atomkerne," VEB Deutscher Verlag der Wissenschaften, Berlin, 1957.

CHAPTER II. EXPERIMENTAL DETERMINATION OF ISOMERIC YIELD RATIOS

Section A. Experimental Procedure

Since the decay half-life of a metastable state is usually different from that of its ground state, the yields or formation cross sections for the metastable state and the unstable ground state may be determined by the activation method. After their formation in a nuclear reaction, the radiations of the metastable and the ground states are measured. In a few cases, the radiations from the decay of the daughters of the isomeric states have been measured (58GH, 56AF, 60R, 57DL, 61BH). If the metastable state decays entirely to its ground state, then one may either simply follow the activities of the ground state or follow the gamma activities of the isomeric transition and the activities of the ground state. For isomers whose metastable states do not decay to their ground states, the radiations from both states may be followed. If both the metastable and ground states decay to a common excited level of the daughter nuclide, then the radiation from this excited state may be measured.

More complicated decay schemes have been found in the disintegration of some isomers in which the metastable states decay partially to the ground states and partially to the daughter nuclides. With proper mathematical analyses, as shown in the next section, the relative yields of the isomeric states may be calculated.

Sometimes the yield of an isomeric state does not represent direct formation (independent yield) in the nuclear reaction. Instead, it represents the sum (cumulative yield) of direct formation of the isomeric state and decay from its precursor, as in fission and some spallation reactions. The independent yield of this isomeric state can be calculated only if the yield and decay branchings of its precursor are known.

In some isomers, there exist very short-lived excited states between the metastable and the ground states. If these very short-lived states decay solely by isomeric transition, then the cross section for the formation of the ground state will include the formation of these very short-lived states.

A number of isomers have stable or long-lived states. Formation cross sections for stable and long-lived nuclides have been determined with mass-spectrometric and isotope-dilution techniques (54B, 59WR). It is possible, although this has not yet been done, to determine the sum of formation cross sections for the metastable and the ground states of these isomers by mass spectrometry, and to determine the formation cross sections for the short-lived states by the activation method. From these data one obtains the relative isomeric yields.

The total cross sections for some simple reactions, such as (p,n) and (n, α) reactions, can be determined by counting the particles emitted. Cross sections for radiative capture processes can be determined by the beam-attenuation method. Both of these methods give the sum of cross sections for the formation of the metastable and the ground states.

Experimental errors in isomeric yield ratios may be minimized by counting the same irradiated sample with the same radiation detector in an identical geometric arrangement. In many cases, it is possible to reduce further the experimental uncertainty of the ratios by counting the same radiations emitted from the decay of both the metastable and the

ground states. The experimental accuracy of the isomeric yields, however, depends greatly on a knowledge of the decay schemes of the isomers.

Section B. Mathematical Treatments

We may assume a generalized decay scheme of beta-unstable isomers in which the metastable state decays by isomeric transition, beta emission, and/or electron capture, and the ground state decays by beta emission and/or electron capture. The beta emission and electron capture lead to excited levels in the daughter nuclide, and the excited levels decay by gamma cascades. Figure 1 shows this generalized decay scheme, with the percents of radiations in total disintegration

Fig. 1. A Generalized Decay Scheme of Isomers

given in parentheses. For some isomers, some of these decay branchings are absent.

The following symbols will be used in the present discussion:

- b percentage of beta emission in the total disintegration.
- c percentage of electron capture in the total disintegration.
- p percentage of isomeric transition in the total disintegration.
- g percentage of a gamma transition in the total disintegration.
- α internal conversion coefficient, the ratio of the number of converted electrons to the number of unconverted photons.

- C observed counting rate.
 F a factor to convert the observed counting rate into disintegration rate.
 N number of radioactive nuclei at time t .
 N^0 number of radioactive nuclei at the end of irradiation.
 λ decay constant.
 t time interval between the end of irradiation and time of sample counting.
 T duration of irradiation or bombardment.
 R rate of reaction during irradiation or bombardment.
 σ formation cross section.
 W number of target nuclei.
 ϕ current or flux of the projectile.

Subscripts m and g refer to metastable and ground states, respectively.

The production rates of the isomers are:

$$\frac{dN_m}{dT} = R_m - \lambda_m N_m \quad (1)$$

and

$$\frac{dN_g}{dT} = R_g - \lambda_g N_g + p\lambda_m N_m \quad , \quad (2)$$

where

$$R_m = W\phi\sigma_m \quad (3a)$$

and

$$R_g = W\phi\sigma_g \quad (3b)$$

if the isomers were produced in the same sample in the same irradiation. Since at time $T = 0$, $N_m = N_g = 0$, the activity of each isomer at the end of the irradiation is given by

$$\lambda_m N_m^0 = R_m(1 - e^{-\lambda_m T}) \quad (4)$$

and

$$\lambda_g N_g^0 = (pR_m + R_g)(1 - e^{-\lambda_g T}) + \frac{p\lambda_g R_m}{\lambda_m - \lambda_g} (e^{-\lambda_m T} - e^{-\lambda_g T}) \quad (5)$$

The cross-section ratio is

$$\frac{\sigma_g}{\sigma_m} = \frac{\lambda_g N_g^0}{\lambda_m N_m^0} \frac{1 - e^{-\lambda_m T}}{1 - e^{-\lambda_g T}} - \frac{p\lambda_g}{\lambda_m - \lambda_g} \frac{e^{-\lambda_m T} - e^{-\lambda_g T}}{1 - e^{-\lambda_g T}} - p \quad (6)$$

If only β particles are counted, with no absorbers to stop the converted electrons, then the counting rates are

$$F_m C_m + F_g C_g = \left[\frac{p\alpha'_m}{1 + \alpha'_m} + b_m + \frac{g_m \alpha_m}{1 + \alpha_m} \right] \lambda_m N_m^0 e^{-\lambda_m t} + \left[b_g + \frac{g_g \alpha_g}{1 + \alpha_g} \right] \left\{ \lambda_g N_g^0 e^{-\lambda_g t} + \frac{p\lambda_m N_m^0 \lambda_g}{\lambda_m - \lambda_g} [e^{-\lambda_g t} - e^{-\lambda_m t}] \right\} \quad (7)$$

If the isomeric states decay by β^+ emission and the annihilation radiations are counted, then

$$F_m C_m + F_g C_g = b_m \lambda_m N_m^0 e^{-\lambda_m t} + b_g \left\{ \lambda_g N_g^0 e^{-\lambda_g t} + \frac{p\lambda_m N_m^0 \lambda_g}{\lambda_m - \lambda_g} [e^{-\lambda_g t} - e^{-\lambda_m t}] \right\} \quad (8)$$

If gamma radiations are detected, then

$$F_m C_m = p \left(\frac{1}{1 + \alpha'_m} \right) \lambda_m N_m^0 e^{-\lambda_m t} \quad (\text{isomeric transition}) \quad (9)$$

or

$$F_m C_m = g_m \left(\frac{1}{1 + \alpha_m} \right) \lambda_m N_m^0 e^{-\lambda_m t} \quad (10)$$

and

$$F_g C_g = g_g \left(\frac{1}{1 + \alpha_g} \right) \left\{ \lambda_g N_g^0 e^{-\lambda_g t} + \frac{p\lambda_m N_m^0 \lambda_g}{\lambda_m - \lambda_g} [e^{-\lambda_g t} - e^{-\lambda_m t}] \right\} \quad (11)$$

Similar treatments may be made for alpha emitters.

CHAPTER III. COLLECTED EXPERIMENTAL DATA ON ISOMERIC YIELD RATIOS

In this chapter are compiled experimental data for the ratios of cross sections for the formation of isomeric states in nuclear reactions. All data involving the production of the same isomeric pair are grouped together. The isomers are arranged in the order of increasing atomic number and then the mass number. The nuclear properties and decay schemes of the isomers, taken from references 58SH and 61W are given first, followed by the nuclear reaction data.

In the TABLES OF NUCLEAR PROPERTIES AND DECAY SCHEMES, the contents are as follows:

- Column 1: Nuclear symbols of the isomeric states.
- Column 2: Decay half-life: s = second; m = minute; h = hour; d = day; y = year.
- Column 3: Spin (total angular momentum), in units of Planck's constant divided by 2π , and parity of the isomeric state. Spins which have been measured directly are underlined. Spins that are determined uniquely by other methods are given without any modification. Probable spins are placed in parentheses.
- Column 4: Energy (in Mev) of the metastable state relative to the ground state of the isomer. Levels between the metastable and the ground states are also given.
- Column 5: Decay schemes. Modes of decay: IT = isomeric transition; β^- = negative beta-particle emission; β^+ = positive beta-particle (positron) emission; α = alpha-particle emission; EC = orbital electron capture.

The mode of decay is followed by energy of radiation (in Mev). The absolute percentage of total decay is given in parentheses; relative abundances are marked by R. The energy level (above the ground state of the daughter nuclide) to which this decay proceeds is indicated. For example, β^- 1.39 (99+%) to 4.12 level means that this isomeric state decays more than 99% by emission of β^- particles (having a maximum beta energy of 1.39 Mev), leading to the 4.12-Mev excited level of the daughter nuclide.

γ transitions are indicated by a dashed line between the two energy levels, energy (in Mev) of levels being measured above the ground state. Absolute and relative abundances of the γ transitions are given in parentheses, as mentioned above. For

example, 4.00--2.50(100R)--0.50(60R)--0(7R) means three γ cascades with energies of 1.50, 2.00, and 0.50 Mev and relative intensities of 100, 60, and 7, respectively. Internal conversion coefficients, if significantly large, are given as the ratio of the number of converted electrons emitted to the number of unconverted γ quanta emitted, and are expressed as e/γ . When the γ transition scheme is not known, the energies of the γ radiations will be given.

Column 6: Reference to the source of information not yet available in the compilations of 58SH and 61W. (The latter compilation gives references to more recently reported decay schemes which have not yet been presented in that compilation.)

In the TABLES OF ISOMERIC YIELD RATIOS, the contents are as follows:

Column 1: Nuclear reactions forming the isomeric states. Nuclear reactions are represented by $\underline{X}(\underline{a}, \underline{b},)$, where $\underline{X}$ denotes the target nuclide; $\underline{a}$ the projectile; and $\underline{b}$ the emitted particle(s), nuclear species, or reaction mechanism (f = fission, frag. = fragmentation, sp = spallation). In many cases, $\underline{b}$ represents the expected species emitted in the reactions, as $\underline{b}$ is usually not detected in the experiments. In some cases, $\underline{b}$ may represent the sum of all possible components of the emitted species. For example, (d,t) is written to mean the sum of (d,t), (d,dn), and (d,p2n) reactions forming the same product. Reactions are arranged according to the atomic number and the mass number of first the projectiles and then the emitted particles.

Column 2: Spin and parity of the target nuclide, with the same designations as mentioned above.

Column 3: Bombarding energy (kinetic energy of the projectile) in units of Mev, in the laboratory system. "10 to 15" means energy region between 10 and 15 Mev; "10-15" means a 5-Mev energy spread of the projectile with a minimum of 10 Mev and a maximum of 15 Mev. Brem = bremsstrahlung X rays. For neutrons, "thermal" means thermalized neutrons, and "pile" refers to neutrons that are generated in fissions. It must be pointed out that "thermal" and "pile" energies of neutrons and bremsstrahlung γ energies are not well-defined quantities.

Columns 4 and 5: Cross sections (in millibarns, or 10^{-27}cm^2), σ_m and σ_g , for the formation of the metastable and the ground states, respectively. Sometimes the sum ($\sigma_m + \sigma_g$) and either σ_m or σ_g have been determined experimentally. The undetermined

quantity is obtained by subtraction. For some isomers, it is not certain which state is the metastable state and which is the ground state. In these cases, the states are identified by their decay half-lives. In some isomers, there exist very short-lived states between the metastable and the ground states. If these very short-lived states decay solely by isomeric transitions, then σ_g will include the cross sections for the formation of these states. These cases are so indicated in the tables.

Column 6: Isomeric cross-section ratios, always given in the ratio of the metastable state to the ground state, i.e., σ_m/σ_g . Whenever possible, the collected isomeric-yield ratios have been corrected for the decay schemes as given here. Many reports do not reveal experimental conditions sufficient for making this correction. Data which cannot be corrected to the accepted decay scheme are rejected. Probable values and some unpublished results are given in parentheses. Reported data with no mention of the decay schemes and counting method are also placed in parentheses.

Values of isomeric-yield ratios that are obtained by interpolation from curves of excitation functions are indicated by *, and those obtained by direct reading of points in the graphs are marked by #. In fission and some spallation reactions, the cross sections for the formation of the unshielded nuclides (nuclides which can be formed from both direct production and beta decays of their precursors) may represent the cumulative yields of the nuclides. Cumulative yields are indicated by c. Approximate values of experimental data are preceded with ~, and uncertain and unreliable values are marked with ?. Experimental errors are either taken directly from the original references or estimated from the errors stated in the original references.

Column 7: Author's comments or remarks on the experimental values or procedures. The readers should consult the original references for complete information. Abbreviations used: scint = scintillation; prop = proportional counter; Geiger = Geiger counter; NaI = NaI(Tl) scintillator; coinc = coincidence; Geiger count β means counting betas with Geiger tube; i = independent yield.

Column 8: Reference of the experimental data cited.

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{Cl}^{34\text{m}}$	32.4m	3+	0.145	IT (31%, e/ γ 0.13). $\beta^+\text{EC}$ 0.43 (0.3% β^+ , 0.3% EC) to 4.11 level; 1.24 (32.2% β^+ , 1.0% EC) to 3.30 level; 2.41 (35.1% β^+ , 0.2% EC) to 2.13 level. γ 4.11--0(1R); 3.30--2.13(32R)--0(100R); 3.30--0(32R).
Cl^{34}	1.53s	0+		$\beta^+\text{EC}$ 4.40(~100% β^+ , 0.08% EC) to 0 level.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Cl}^{35}(\gamma, n)$	<u>3/2+</u>	15			~1.02	Scint count annihilation radiations with NaI. X rays from 31-Mev betatron.	59FF
		16			1.0		
		17			1.0		
		18			1.0		
		19			0.8		
		20			0.68		
		21			0.62		
		22			0.65		
		23			0.75		
		24			0.98		
		25			1.16		
		26			1.20		
		27			1.22		
		28			1.24		
		29			1.24		
		30			1.22		
$\text{Cl}^{35}(n, 2n)$	<u>3/2+</u>	14.8	5.6	2.8	(2.0 $\pm$ 0.8)	Geiger count β .	58SF
$\text{Cu}(p, sp)$	3/2-	5700	0.73	~0.92	~0.79	σ_m scint count annihilation radiations. σ_g estimated.	57B

Isomer	Half-life	Spin, parity	Level	Decay scheme	
K^{38m}	0.95s	(0+)	0.123	β^+	5.03 (~100%) to 0 level.
K^{38}	7.7m	(3+)		β^+	2.68 (100%) to 2.16 level.
				γ	2.16--0

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$Ca^{40}(\gamma, pn)$	0+	29(max)			$> 4,$ < 12	Scint count annihilation radiations with NaI. Brem.	60LS

Isomer	Half-life	Spin, parity	Level	Decay scheme
Sc ^{44m}	2.44 d	(6,7+)	0.271	IT (e/ γ 0.14).
	1.8 x 10 ⁻⁷ s	(0,1+)	0.147	IT
		(2+)	0.069	IT
Sc ⁴⁴	3.92h	(3+,2+)	0	EC (~1%) to 2.66 level; (~3%) to 2.28 level. β^+ EC 1.47 (91.5% β^+ , 4.5% EC) to 1.16 level. γ 2.66--0(0.2R); 2.66--1.16(1R)--0(100R); 2.28--0(0.2R); 2.28--1.16(3R).

Reaction	Target spin	E	$\sigma_m(2.4 \text{ d})$	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Sc ⁴⁵ (n,2n)	<u>7/2-</u>	10 to 20			~1?	No mention of counting method.	38CT
Sc ⁴⁵ (n,2n)	<u>7/2-</u>	14.4 $\pm$ 0.3	149	198	0.754 $\pm$ 0.080	Coinc count annihilation radiations.	61R
Sc ⁴⁵ (n,2n)	<u>7/2-</u>	14.8	5.6	2.8	2.0 $\pm$ 0.8	Geiger and plastic scint count β .	58SF
Sc ⁴⁵ (n,2n)	<u>7/2-</u>	14.8	149	179	0.83 $\pm$ 0.18	Geiger count β .	61MG
Sc ⁴⁵ (n,2n)	<u>7/2-</u>	11.97 $\pm$ 0.08	2.5	6.5	(0.385 $\pm$ 0.023)	Prop count β .	61PB
		13.40 $\pm$ 0.20	74.0	87.0	(0.850 $\pm$ 0.043)		
		13.69 $\pm$ 0.10	91.9	111.9	(0.820 $\pm$ 0.041)		
		14.01 $\pm$ 0.10	107.4	138.5	(0.775 $\pm$ 0.039)		
		14.09 $\pm$ 0.10	116.2	150.0	(0.775 $\pm$ 0.038)		
		14.31 $\pm$ 0.13	127.3	169.0	(0.753 $\pm$ 0.037)		
		14.50 $\pm$ 0.20	134.3	181.4	(0.740 $\pm$ 0.037)		
		14.68 $\pm$ 0.26	144.7	204.3	(0.708 $\pm$ 0.036)		
		16.50 $\pm$ 0.30	170.3	283.7	(0.600 $\pm$ 0.044)		
		17.95 $\pm$ 0.32	189.6	318.3	(0.596 $\pm$ 0.043)		
		19.76 $\pm$ 0.43	185.7	322.2	(0.576 $\pm$ 0.042)		
Ca ⁴⁴ (p,n)	0+	6.7			(0.077 $\pm$ 0.010)	No experimental method given.	52BM
Ca ⁴⁴ (p,n)	0+	40			(0.30 $\pm$ 0.03)		62S

Reaction	Target spin	E	$\sigma_m(2.4 \text{ d})$	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Sc ⁴⁵ (p,pn)	<u>7/2-</u>	13			0.52#	Scint cont E _γ 0.9 Mev with NaI.	56MD
		13			0.53#		
		18			0.54#		
		18.5			0.55#		
		19			0.53#		
		22			0.52#		
		23			0.51#		
		26			0.53#		
		29			0.52#		
		35			0.50#		
		37			0.50#		
		41			0.46#		
		43			0.47#		
		47			0.45#		
		48			0.46#		
		50			0.46#		
		51			0.45#		
		53			0.42#		
		55			0.45#		
		58			0.43#		
		61			0.44#		
		62			0.42#		
		63			0.41#		
		68			0.43#		
		69			0.42#		
		69			0.40#		
		74			0.41#		
		81			0.40#		
		88			0.43#		
		93			0.42#		
		98			0.41#		
Cu(p,sp)	<u>3/2-</u>	480	3.7	4.8	(0.77)		55VA
Cu(p,sp)		2400	2.4	2.4	(1.0 ± 0.2)	Count β and/or γ.	62RB
Cu(p,sp)	<u>3/2-</u>	5700	4.7	4.6	1.0 ± 0.3	σ_m scint count 270-kev γ; σ_g scint count 511-kev annihilation radiations with NaI.	57V

Reaction	Target spin	E	$\sigma_m(2.4 \text{ d})$	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
As ⁷⁵ (p,sp)	<u>3/2-</u>	590	0.55	0.22	(2.5 ± 1.2)	Prop count β or scint count γ .	61RB
Ti ⁴⁶ (d, α)	0+	7.71 ± 0.05			~0.05	Estimated value. Prop count β .	60AM
K ⁴¹ (He ⁴ ,n)	<u>3/2+</u>	5-7	20	70	0.30	Scint count 1.16-Mev γ with NaI.	61MS, 60S
		8.5-13	250	740	0.34		
		15-18	610	820	0.74		
		19.8-20.8	590	540	1.10		
		19.5-21	560	560	1.00		
		19.5-22	470	300	1.56		
		22.9-24.9	480	300	1.60		
		25.0			(1.7)#		
		25-26.5	280	140	2.00		
		27			(2.0)#		
		26.8-28.5	150	80	1.83		
		28			(1.5)#		
		29.5-30.2	50	40	1.45		
		31.5			(1.3)#		
		32.0			(1.1)#		
		34.2			(1.0)#		
		37			(1.06)#		
		39			(0.90)#		
		40			(0.82)#		
K ⁴¹ (He ⁴ ,n)	<u>3/2+</u>	10			0.3 ± 0.1	Scint count 1.16-Mev γ .	61B
		43			0.9 ± 0.1		
Sc ⁴⁵ (He ⁴ , α n)	<u>7/2-</u>	20.4			1.7	Scint count 1.16-Mev γ with NaI.	61B
		25.2			1.3		
		33.7			1.5		
		43			1.4		
		320			0.62		
S ³² (N ¹⁴ ,2p)	0+	26	25	43	0.58*	Geiger count β . Sum of $\sigma(\text{Sc}^{44g})$ and $\sigma(\text{Sc}^{43})$ was determined. σ_g obtained by subtracting interpolated values of $\sigma(\text{Sc}^{43})$.	59FZ
		27	44	57	0.77*		

$^\dagger \sigma_g$ includes $\sigma_m(0,1+)$ and $\sigma_m(2+)$.

Isomer	Half-life	Spin, parity	Level	Decay scheme
Sc ^{50m}	23m		0.493	IT
Sc ⁵⁰	1.74m	≥ (4+)		β^- 3.5 (~100%) to 2.76 level. γ 2.76--1.56--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ti ⁵⁰ (n,p)	0+	14.8	48	27	(1.8±0.7)	Prop count β .	59PF

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Mn ^{52m}	21.3m	(2+)	0.39	IT β^+ γ	(0.05%). 2.63(99+%) to 3.67 and 1.44 levels. all to 1.44--0(100%).
Mn ⁵²	5.6d	(6+)		β^+ EC γ	0.58(29%) to 3.11 level. (71%) to 3.11, 3.61 and 3.83 levels. all to 1.44--0(100%).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Fe ⁵⁴ (γ ,pn)	0+	70 Brem			(2.2±0.4)	Geiger count β . Not sure what β^+ branching was used.	57HM
Cr ⁵² (p,n)	0+	6.6			4.1?	Ionization chamber. 5% β^+ of Mn ^{52g} .	40H
Cr ⁵² (p,n)	0+	5.8 ± 0.5	4.2	0.22	19 ± 3	Scint count 1.44-Mev γ and prop count β .	60WH 62WH
		5.8 ± 0.5	7.7	0.39	20 ± 3		
		5.9 ± 0.5	20	1.3	15 ± 2		
		6.0 ± 0.5	28	1.1	26 ± 3		
		6.4 ± 0.5	158	11	14 ± 2		
		7.0 ± 0.4	210	23	9.2 ± 0.9		
		7.0 ± 0.4	220	23	9.6 ± 0.9		
		7.4 ± 0.4	224	31	7.3 ± 0.6		
		8.0 ± 0.4	260	41	6.3 ± 0.5		
		8.0 ± 0.4	250	44	5.7 ± 0.5		
		8.4 ± 0.3	281	51	5.5 ± 0.5		
		8.9 ± 0.3	296	60	4.9 ± 0.4		
		9.0 ± 0.3	288	65	4.4 ± 0.4		
		9.1 ± 0.3	344	84	4.1 ± 0.3		
		9.2 ± 0.3	350	69	5.0 ± 0.4		
		9.9 ± 0.2	326	79	4.1 ± 0.3		
		10.1 ± 0.2			3.6 ± 0.3		
		10.1 ± 0.2	365	88	4.2 ± 0.3		
		10.5 ± 0.2	370	98	3.8 ± 0.3		

Reaction	Target spin	E	C m	τ_g	σ_m/σ_g	Comments	Reference
Cr ⁵² (p,n)	0+	7.4			(9.8)#		59T
		8.3			(8.4)#		
		8.9			(4.4)#		
		9.3			(4.7)#		
		9.6			(4.8)#		
		10.1			(4.4)#		
		10.4			(3.8)#		
		10.8			(3.5)#		
		11.1			(3.4)#		
		11.7			(3.5)#		
		11.9			(3.3)#		
		12.3			(3.0)#		
		12.5			(3.1)#		
		13.1			(2.7)#		
		13.2			(2.5)#		
		13.8			(2.4)#		
		14.0			(2.0)#		
Cr ⁵² (p,n)	0+	12	210	90	2.3 ± 0.7	Geiger count μ . 35% μ^+ for Mn ^{52g}	55BH
Cr ⁵² (p,n)	0+	7.5	128	25.4	5.00	Geiger count μ . 35% μ^+ for Mn ^{52g} .	59LJ
		10	358	140	2.56		
		10	312	125	2.49		
		12.5	410	244	1.67		
		16	265	236	1.12		
		20			0.66±		
Cr ⁵² (p,n)		5.91	2.5	2	(1.2*)	Geiger count μ . No μ^+ branching was given.	52BM
		5.95	20	1.1	(18*)		
		6.0	30	2.3	(13*)		
		6.1	60	3.5	(17*)		
		6.3	105	10	(10.5*)		
		6.7			(12 ± 3)		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Mn ⁵⁵ (p,sp)	<u>5/2-</u>	49 ± 7 75 ± 8 103 ± 8 133 ± 8 153 ± 8			(0.593±0.039) (0.720±0.088) (0.633±0.056) (0.715±0.061) (0.545±0.065)	Geiger and prop count β . β^+ branching not given.	61HR
Mn ⁵⁵ (p,sp)	<u>5/2-</u>	170	10	16	(0.61±0.23)	Geiger count β . β^+ branching not given.	56R
Co ⁵⁹ (p,sp)	<u>7/2-</u>	49 ± 7 103 ± 8 133 ± 8	0.8 4.2	2.0 10	(0.40±0.09) (0.39±0.06) (0.42±0.04)	Geiger and prop count β . β^+ branching not given.	61HR
Co ⁵⁹ (p,sp)	<u>7/2-</u>	170	12	31	(0.37±0.06)	Geiger count β . β^+ branching not given.	56R
Co ⁵⁹ (p,sp)	<u>7/2-</u>	370	5.6	17	0.33±0.15	Geiger count β . 35% β^+ of Mn ^{52g} .	54BM
Cu(p,sp)	<u>3/2-</u>	153 ± 8	0.9	2.6	(0.35±0.12)	Geiger and prop count β . β^+ branching not given.	61HR
Cu(p,sp)	<u>3/2-</u>	680	2.1	6.5	(0.32)		55VA
Cu(p,sp)	<u>3/2-</u>	2200	1.6	5.4	(0.34)	Geiger and prop count β . β^+ branching not given.	54FM
Cu(p,sp)	<u>3/2-</u>	2400	0.8	4.0	(0.2 ± 0.06)	Count β and/or γ .	62RB
Cu(p,sp)	<u>3/2-</u>	5700	1.87	5.9	0.32±0.10	Prop count β . Mn ^{52m} 98.5% β^+ ; Mn ^{52g} 33% β^+ ; also scint count 730- and 940-kev γ .	57B
Ga(p,sp)	<u>3/2-</u>	153 ± 8	0.031	0.27	(0.12±0.06)	Geiger and prop count β . β^+ branching not given.	61HR
As ⁷⁵ (p,sp)	<u>3/2-</u>	378	0.24	0.85	(0.28±0.03)		54C

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
As ⁷⁵ (p,sp)	<u>3/2-</u>	590	2.6	4.3	(0.60±0.21)	Prop count β or scint count γ . No β^+ branching given.	61RB
Cr ⁵² (d,2n)	0+	8.5 ± 0.5			0.45 ± 0.07	Scint count 1.43-Mev γ with NaI. Above 16 Mev, Cr ⁵³ (d,3n) reaction is energetically possible.	60WH
		9.1 ± 0.4			0.71 ± 0.08		
		9.8 ± 0.4			1.08 ± 0.13		
		9.9 ± 0.4			0.89 ± 0.18		
		10.7 ± 0.4			1.14 ± 0.16		
		11.0 ± 0.4			1.19 ± 0.20		
		12.4 ± 0.3			1.20 ± 0.17		
		12.5 ± 0.3			1.25 ± 0.17		
		12.9 ± 0.3			1.29 ± 0.21		
		14.0 ± 0.3			1.21 ± 0.17		
		14.9 ± 0.3			1.14 ± 0.23		
		15.9 ± 0.2			1.22 ± 0.17		
		16.6 ± 0.2			1.19 ± 0.16		
		16.9 ± 0.2			1.12 ± 0.22		
		18.9 ± 0.2			1.05 ± 0.17		
		20.8 ± 0.2			1.07 ± 0.17		
		21.2 ± 0.2			1.08 ± 0.15		
V ⁵⁰ (He ⁴ ,2n)	6-	14.7 ± 0.4			0.115±0.023	Scint count 1.43-Mev γ with NaI.	60WH, 62WZ
		15.2 ± 0.3			0.105±0.014		
		15.9 ± 0.3			0.170±0.034		
		16.3 ± 0.3			0.171±0.024		
		16.6 ± 0.3			0.175±0.035		
		16.6 ± 0.3			0.188±0.030		
		17.6 ± 0.3			0.189±0.026		
		17.8 ± 0.3			0.202±0.040		
		18.7 ± 0.3			0.207±0.022		
		19.4 ± 0.3			0.219±0.029		
		19.5 ± 0.3			0.216±0.043		
		20.7 ± 0.3			0.222±0.044		
		21.5 ± 0.3			0.210±0.040		
		21.6 ± 0.3			0.229±0.044		
		22.9 ± 0.3			0.20 ± 0.04		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
V ⁵⁰ (He ⁴ ,2n)		23.3 ± 0.3			0.172 ± 0.024		
(Cont'd.)		23.7 ± 0.3			0.193 ± 0.040		
		25.1 ± 0.3			0.07 ± 0.01		
V ⁵¹ (He ⁴ ,3n)	<u>7/2-</u>	28.3 ± 0.3			0.105 ± 0.021	Scint count 1.44-Mev γ with NaI.	60WH 62 WZ
		28.8 ± 0.3			0.102 ± 0.015		
		29.6 ± 0.3			0.127 ± 0.016		
		29.7 ± 0.3			0.126 ± 0.025		
		32.1 ± 0.3			0.138 ± 0.027		
		33.2 ± 0.3			0.151 ± 0.020		
		34.4 ± 0.2			0.145 ± 0.029		
		35.3 ± 0.2			0.159 ± 0.020		
		36.1 ± 0.2			0.163 ± 0.032		
		37.7 ± 0.2			0.149 ± 0.022		
		37.9 ± 0.2			0.147 ± 0.029		
		41.0 ± 0.2			0.146 ± 0.021		
		41.3 ± 0.2			0.132 ± 0.026		
Cr ⁵⁰ (He ⁴ ,pn)	0+	33			(0.44)	No mention of what radiations were measured.	55MF
K ³⁹ (N ¹⁴ ,P)	<u>3/2+</u>	25.5	0.35	0.62	(0.57 ± 0.17)	Geiger count β . β^+ branching not given.	59PH
		26.5	0.66	1.5	(0.44 ± 0.13)		
		27.5	0.95	3.1	(0.31 ± 0.10)		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Co ^{58m}	9.2h	5 (+)	0.025	IT	(e ⁻ /γ large).
Co ⁵⁸	71.3d	<u>2</u> (+)		β ⁺	0.485 (14.8%) to 0.800 level.
				EC	(2.1%) to 1.66 level; (83.1%) to 0.800 level.
				γ	1.66--0.800(1.6%)--0(99+%); 1.66--0(0.5%).

Reaction	Target spin	E	σ _m	σ _g	σ _m /σ _g	Comments	Reference
Co ⁵⁹ (γ,n)	<u>7/2-</u>	68			1.6 ± 0.1	Electron synchrotron. Geiger count .	51CM
Co ⁵⁹ (γ,n)	<u>7/2-</u>	30			(0.79 ± 0.04)	Electron synchrotron.	62CC
Co ⁵⁹ (n,2n)	<u>7/2-</u>	14.5			(2.3 ± 0.3)	Count β.	62WG
Co ⁵⁹ (n,2n)	<u>7/2-</u>	14.5			0.82 ± 0.58	Scint count 850-kev γ.	60W
Co ⁵⁹ (n,2n)	<u>7/2-</u>	14.8 ± 0.9	4	145	0.028 ± 0.014?	Scint count 850-kev γ. σ _g incorrect.	60PF
Ni ⁵⁸ (n,p)	0+	Pile	28	61	0.46 ± 0.06	Scint count 850-kev γ.	61PH
Ni ⁵⁸ (n,p)	0+	14.8 ± 0.9	40	237	0.17 ± 0.06	Scint count 850-kev γ.	60PF
Cu(n,sp)	<u>3/2-</u>	300 to 440	~49	23.2	~2.1 ± 1.3	Geiger count β. Contributions from Co ⁵⁶ estimated.	52M
Fe ⁵⁸ (p,n)	0+	6.3			(0.13)	Count X-rays. No mention of EC branching.	52AK
Co ⁵⁹ (p,pn)	<u>7/2-</u>	13.2 14 15 15.5 16 16.2			4.0# 5.8# 2.5# 1.9# 2.5# 1.6#	Geiger count β. Only relative σ _m and σ _g were determined. σ _m /σ _g calculated from relative σ _m and σ _g and from max. σ _m = 403 mb and max. (σ _g +σ _m) = 675 mb.	56SD

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Co ⁵⁹ (p,pn) (Cont'd.)		17			1.55#		
		18 to 40			1.48#*		
		45			1.38*		
		50			1.39*		
		60			1.35*		
		70			1.35*		
		80			1.35*		
		90			1.45*		
		100			1.48*		
Co ⁵⁹ (p,pn)	<u>7/2-</u>	13			4.0#	Geiger count β . Only a few representative points in the energy region 16 to 30 Mev are included here.	56MD
		14			2.3-4.9#		
		15			1.2-1.9#		
		16			1.4-2.1#		
		17			1.5#		
		18			1.4#		
		19			1.4#		
		20			1.3#		
		20.5			1.3-1.6#		
		21			1.4-1.9#		
		22			1.4-1.7#		
		23			1.2-1.6#		
		24			1.3#		
		24.5			1.2-1.8#		
		25			1.4#		
		26			1.5#		
		27			1.6#		
		28			1.0, 1.7#		
		29			1.5#		
		30			1.8, 1.6#		
		31			1.4#		
		32			1.5#		
		36			1.35#		
		37			1.4#		
		38			1.5#		
		42			1.4#		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Co ⁵⁹ (p,pn) (Cont'd.)		46			1.45#		
		50			1.3#		
		53			1.5#		
		57			1.55#		
		60			1.25#		
		62			1.4#		
		70			1.4#		
		74			1.3#		
		77			1.3#		
		80			1.25#		
		83			1.25#		
		86			1.45#		
		88			1.5#		
		91			1.3#		
		94			1.25#		
		96			1.7#		
As ⁷⁵ (p,sp)	<u>3/2-</u>	590	3.8	10	(0.38±0.24)	Prop count β or scint count γ .	61RB
Mn ⁵⁵ (He ⁴ ,n)	<u>5/2-</u>	5.7 ± 0.6	1.2	1.5	0.80 ± 0.10	Scint count 800-kev γ with NaI.	60WH
		6.2 ± 0.6			0.96 ± 0.10		
		6.2 ± 0.6	3.7	3.7	1.0 ± 0.1		
		7.5 ± 0.5	9	8	1.1 ± 0.1		
		7.8 ± 0.5	22	18	1.24 ± 0.12		
		9.2 ± 0.5			0.94 ± 0.10		
		9.5 ± 0.5	250	200	1.3 ± 0.1		
		10.4 ± 0.4			1.50 ± 0.15		
		12.3 ± 0.4	322	172	1.87 ± 0.19		
		13.0 ± 0.4			2.14 ± 0.22		
		14.7 ± 0.3	342	138	2.47 ± 0.30		
		15.7 ± 0.3	270	102	2.70 ± 0.35		
		16.4 ± 0.3	228	64	3.6 ± 0.5		
		17.8 ± 0.3	200	50	4.0 ± 0.6		
		19.2 ± 0.3	169	44	3.8 ± 0.6		
		21.6 ± 0.3	76	18	4.3 ± 0.6		
		23.6 ± 0.3	41	9.7	4.2 ± 0.6		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Mn ⁵⁵ (He ⁴ ,n)	<u>5/2</u> -	17			(1.7)	Spectrometric count β . Used thick target.	50S
Mn ⁵⁵ (He ⁴ ,n)	<u>5/2</u> -	23.7-11 23.9-19 23.7-23			2.3 $\pm$ 0.1 2.9 $\pm$ 0.2 3.7 $\pm$ 0.3	Scint count 800-kev γ . Used thick target	53L
Mn ⁵⁵ (He ⁴ ,n)	<u>5/2</u> -	29.8-30.3			(0.63+0.06)	No experimental details given.	60S
Mn ⁵⁵ (He ⁴ ,n)	<u>5/2</u> -	10.0 12.4 16.0 18.4 20.9 23.0 25.4 29.4 31.4			1.22 $\pm$ 0.10# 1.45 $\pm$ 0.10# 3.20 $\pm$ 0.50# 3.90 $\pm$ 0.50# 4.25 $\pm$ 0.60# 3.95 $\pm$ 0.50# 3.90 $\pm$ 0.50# 2.55 $\pm$ 0.20# 2.40 $\pm$ 0.20#	Sint count 800-kev γ with NaI.	59T 62I
Fe ⁵⁶ (He ⁴ ,pn)	0+	15 + 1 17.4 18.6 19.0 20.5 21.1 $\pm$ 0.8 22.6 23.0 24.5 $\pm$ 0.6 25.0 26.0 $\pm$ 0.5 26.4 27.5			0.3 $\pm$ 0.2# 1.9 # 2.1 $\pm$ 0.2# 2.4 # 2.7 $\pm$ 0.3# 3.1 $\pm$ 0.3# 2.8 $\pm$ 0.3# 2.9 # 3.1 $\pm$ 0.3# 2.8 # 3.0 $\pm$ 0.3# 2.7 $\pm$ 0.3# 3.05 #	Sint count 800-kev γ with NaI.	59T 62I

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Fe ⁵⁶ (He ⁴ ,pn) (Cont'd.)		28.0			2.93 #		
		28.2			2.95 ± 0.2#		
		29.8			2.6 ± 0.3#		
		30.4			2.65 #		
		32.0			3.1 ± 0.4#		
		32.5			3.0 #		
		24.2			2.8 ± 0.3#		
		36.5			2.75 #		
		37.5			2.65 ± 0.5#		
		39.0			2.6 #		
		40.0			2.0 ± 0.5#		
Co ⁵⁹ (He ⁴ ,pn)	<u>7/2-</u>	11.6 ± 0.4	0.28	0.14	2.0 ± 0.3	Scint count 800-kev γ with NaI.	60WH
		12.6 ± 0.4	0.29	0.15	2.0 ± 0.3		
		14.0 ± 0.4	2.7	1.1	2.4 ± 0.4		
		17.6 ± 0.3	9.4	2.0	4.7 ± 0.7		
		20.4 ± 0.3	42	8.7	4.8 ± 0.7		
		23.2 ± 0.3	82	21	3.9 ± 0.6		
		26.6 ± 0.2	103	28	3.7 ± 0.6		
		29.5 ± 0.2	139	30	4.6 ± 0.7		
		32.4 ± 0.2	119	36	3.4 ± 0.5		
		35.6 ± 0.2	109	28	3.9 ± 0.6		
		41.0 ± 0.2	83	32	2.6 ± 0.4		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Co ^{60m}	10.5m	<u>2+</u>	0.058	IT β^-	(99.72%, e/ γ 45). 1.54 (0.28%) to 1.33 level.
Co ⁶⁰	5.24y	<u>5+</u>		β^- γ	0.313 (~100%) to 2.51 level; 1.48 (0.01%) to 1.33 level. 2.51--1.33--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal	660	21,700	0.030?	σ_m thermal; σ_g pile neutrons. Geiger count β .	47SF
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal	720	30,000	0.024	Geiger count β .	49HS
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal?			0.71 $\pm$ 0.31	Counting γ .	51DS
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Pile	95,000	6,000	16 $\pm$ 8	Scint count β with anthracene.	53BW
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal	14,000	20,000	0.7	Geiger count β .	53HG
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal	20,000		(1.19 $\pm$ 0.16)	σ_m count 58-kev γ .	60KB3
Co ⁵⁹ (n, γ)	<u>7/2-</u>	Thermal			0.025	Geiger count β . Assumed the 11-min Co activity was Co ^{60m} Corrected in 42NP.	41SY
Co ⁵⁹ (d, p)	<u>7/2-</u>				0.005	Count β and/or γ .	42NP

Isomer	Half-life	Spin, parity	Level	Decay scheme
Co ^{62m}	1.9m			β^-
Co ⁶⁰	13.9m	(5+)		β^- 0.88 (25%) to 4.35 level; 2.88 (75%) to 2.34 level. γ 4.35--2.34 (7R)--1.17 (75R)--0 (92R); 4.35--2.88 (18R)--1.17 (18R).

Reaction	Target spin	E	J_m	G_g	J_m/G_g	Comments	Reference
Ni ⁶² (n,p)	0+	14.8 ± 0.9	2.0	3.3	0.6	Prop count β .	60PF

Isomer	Half-life	Spin, parity	Level	Decay scheme
Co ^{64m}	2.0m			β^- γ energies: 0.39; 0.66; 0.70; 0.97; 1.37; 2.34.
Co ⁶⁴	7.8m			β^- γ energies: 0.39; 0.66; 0.70; 0.97; 1.37; 2.34.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ni ⁶⁴ (n,p)	0+	14.8 $\pm$ 0.9	>0.43	4.1	>0.11	Prop count β .	60PF

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Zn ^{69m}	13.8h	(9/2+)	0.435	IT	(e/ γ 0.05).
Zn ⁶⁹	55m	(1/2-)		β^-	0.90 (100%) to 0 level.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ga ⁷¹ (γ ,pn)	<u>3/2-</u>	70 Brem			0.67 $\pm$ 0.05	Geiger count β ; yield ratio.	59SC
As ⁷⁵ (γ ,sp)	<u>3/2-</u>	70 Brem			1.4 $\pm$ 0.2	Geiger count β .	59SC
Zn ⁶⁸ (n, γ)	0+	Thermal	310	1090	0.28 $\pm$ 0.08	σ_m pile, σ_g thermal neutrons; Geiger count β .	47SF
Zn ⁶⁸ (n, γ)	0+	Thermal	85	890	0.095	Geiger count β .	49HS
		1	13	7.1	1.84		
Zn ⁶⁸ (n, γ)	0+	Thermal	100	1000	0.1	Geiger count β .	53HG
		1	15.2	8.0	1.9	See 49HS.	
Zn ⁶⁸ (n, γ)	0+	Thermal			0.0736	Reported in 59SC.	54CC
		0.0052			0.164		
		1			0.42		
Zn ⁶⁸ (n, γ)	0+	0.025 $\pm$ 0.005	5.6	26	(0.22 $\pm$ 0.12)		58BB
Zn ⁶⁸ (n, γ)	0+	Thermal	97	1000	(0.097 $\pm$ 0.022)		58HS
Zn ⁶⁸ (n, γ)	0+	Thermal	83	1116	0.074 $\pm$ 0.015	Count β .	62MG
Ga ⁶⁹ (n,p)	<u>3/2-</u>	14			2.4	Geiger count β .	57L
Ga ⁶⁹ (n,p)	<u>3/2-</u>	14			1.4	Geiger count β .	58ZM
Ge ⁷² (n, α)	0+	14			1.1	Geiger count β .	57L
Ga ⁷¹ (p,He ³)	<u>3/2-</u>	22.4	$\sim$ 0.05	$\sim$ 0.05	$\sim$ 1 $^{+3}_{-0.3}$	End-window count β .	56MB

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Zn(p,sp)		20 $\pm$ 6			0.77 $\pm$ 0.05	Geiger and prop count β .	61HR
		49 $\pm$ 7			0.77 $\pm$ 0.05		
		75 $\pm$ 8			0.67 $\pm$ 0.03		
		103 $\pm$ 8			0.74 $\pm$ 0.08		
		133 $\pm$ 8			1.06 $\pm$ 0.07		
		153 $\pm$ 8			0.70 $\pm$ 0.04		
As ⁷⁵ (p,sp)	<u>3/2-</u>	75 $\pm$ 8			1.90 $\pm$ 0.10	Geiger and prop count β .	61HR
		133 $\pm$ 8			0.91 $\pm$ 0.09		
As ⁷⁵ (p,sp)	<u>3/2-</u>	49	0.31	0.11	2.8 $\pm$ 0.2	Geiger count β .	56R
		103	0.34	0.25	1.4 $\pm$ 0.1		
		170	1.1	1.3	0.85 $\pm$ 0.03		
Ga(p,sp)	<u>3/2-</u>	20 $\pm$ 6			1.11 $\pm$ 0.10	Geiger and prop count β .	61HR
		49 $\pm$ 7			1.49 $\pm$ 0.13		
		75 $\pm$ 8			1.71 $\pm$ 0.17		
		103 $\pm$ 8			1.42 $\pm$ 0.24		
		153 $\pm$ 8			1.31 $\pm$ 0.21		
Br(p,sp)	<u>3/2-</u>	153 $\pm$ 8			2.67 $\pm$ 0.22	Geiger and prop count β .	61HR
Rb(p,sp)	<u>3/2</u> , <u>5/2-</u>	153 $\pm$ 8			5.9 $\pm$ 1.1	Geiger and prop count β .	61HR
Zn ⁶⁸ (d,p)	0+	8			0.53	Quart-fiber electroscope.	39LS
Zn ⁶⁸ (d,p)	0+	2.3			0.40#	Geiger count β .	58ZM
		2.8			0.38#		
		3.2			0.40#		
		3.8			0.52#		
		4.0			0.46#		
		4.3			0.47#		
		4.8			0.51#		
		5.0			0.55#		
		6.0			0.51#		
		7.0			0.61#		
		8.2			0.58#		
		9.0			0.55#		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$Zn^{68}(d,p)$	$0+$	3			(0.40)#	No experimental details given.	52F
		4			(0.43)#		
		5			(0.46)#		
		6			(0.50)#		
		7			(0.53)#		
		8			(0.55)#		
		9			(0.57)#		
		10			(0.59)#		
		11			(0.60)#		
		12			(0.61)#		
		13			(0.62)#		
		14			(0.625)#		
		15			(0.63)#		
$Ga^{71}(d,\alpha)$	<u>$3/2-$</u>	3.4			$0.7 \pm 0.1\#$	Geiger count β .	58ZM
		4.9			$0.6 \pm 0.1\#$		
		5.6			$0.8 \pm 0.1\#$		
		8.0			$0.68 \pm 0.10\#$		
$Ga^{71}(d,t)$	<u>$3/2-$</u>	8			0.50	Quart-fiber electroscope.	39LS

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Zn ^{71m}	4.0h	(9/2+)	0.34	β^- 1.46 (100%) to 1.49 level. γ 1.49--1.00--0.39--0; 1.49--0.88--0.39.	61TP
Zn ⁷¹	2.45m	(1/2-)		β^- 2.61 (82%) to 0 level; 2.10 (14%) to 0.51 level; 1.69 (3%) to 0.92 level; 0.99 (1.7%) to 1.63 level. γ 1.63--0.92--0; 1.63--0; 1.63--0.51--0; 0.51--0.39--0.	61TP

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Zn ⁷⁰ (n, γ)	0+	Thermal			0.20 $\pm$ 0.02	σ_m scint count 390-kev γ ; σ_g scint count 510-kev γ with NaI.	61TP
Zn ⁷⁰ (n, γ)	0+	Thermal	9	111	0.081 $\pm$ 0.017	Count β .	62MG
Ga ⁷¹ (n,p)	<u>3/2-</u>	14			2.3	Geiger count β .	57L
Ge ⁷⁴ (n, α)	0+	14			2.3	Geiger count β . JETP gave $\sigma_m/\sigma_g = 1.3$.	57L

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Ge ^{75m}	49s	(7/2+)	0.139	IT	(e/ γ ~ 2).
Ge ⁷⁵	82m	(1/2-)		β^-	0.55 (0.41%) to 0.628 level; 0.72 (0.29%) to 0.477 level; 0.92 (11.4%) to 0.265 level; 0.98 (1.4%) to 0.199 level; 1.19 (86.5%) to 0 level.
				γ	0.628--0.199 (2.5R)--0 (12R); 0.628--0 (1.8R); 0.477--0 (2.3R); 0.265--0.199 (2.2R); 0.265--0 (100R).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ge ⁷⁴ (n, γ)	0+	Pile Thermal			0.23 0.22 $\pm$ 0.03	Scint count β with anthracene.	57MG
As ⁷⁵ (n,p)	<u>3/2-</u>	14.1 $\pm$ 0.2	10	25	0.40 $\pm$ 0.11	Coinc count γ with plastic scintillator.	61F

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Ge ^{77m}	54s	(1/2-)	0.159	IT	(36%).
				β^-	2.7 (18%) to 0.215 level; 2.90 (46%) to 0 level.
				γ	0.215--0.
Ge ⁷⁷	11.3h	(7/2+)		β^-	0.38 (3%) to 2.37 level; 0.76 (15%) to 1.99 level; 1.20 (11%) to 1.55 level; 1.30 (4%) to 1.45 level; 1.56 (24%) to 1.19 level; 2.12 (29%) to 0.632 level; 2.27 (14%) to 0.475 level.
				γ	2.37--0; 2.37--0.475--0.265--0; 2.37--1.55--0.475; 1.55--0.632--0; 2.37--0.632--0.215--0; 1.99--0; 1.99--0.475; 1.99--0.632--0.265; 1.99--1.19--0.475; 1.45--0.265; 1.19--0.632--0.475.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ge ⁷⁶ (n, γ)	0+	Thermal			1.1?	Count β . Assumed 100% IT	47AS
Ge ⁷⁶ (n, γ)	0+	Pile	53	24	(2.2)	σ_m prop. count β and scint count 156-kev γ , assume $e/\gamma \sim 1$. σ_g prop count β .	57LE
Ge ⁷⁶ (n, γ)	0+	Pile Thermal			(1.11) (1.14 $\pm$ 0.30)	Scint count β with anthracene. No mention of β branching of Ge ^{77m}	57MG
Ge ⁷⁶ (n, γ)	0+	Thermal	62	58	(1.07 $\pm$ 0.28)	Assumed 50% IT	58HS

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Se ^{73m}	42m	(1/2-)		β^+ EC 1.72 (63% β^+ , 12% EC) to 0 level; 1.47 (~7% β^+ , ~2% EC) to 0.251 level; 0.89 (~2% β^+ , ~3% EC) to 0.83 level. γ 0.83--0.251--0.	60RL
Se ⁷³	7.1h	(9/2+)		β^+ EC 1.32 (70% β^+ , 29% EC) to 0.425 level; 1.68 ($\leq 0.7\%$ β^+ , $\leq 0.4\%$ EC) to 0.065 level. γ 0.425--0.065 (e/ γ 0.014)--0 (e/ γ 0.29).	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Se ⁷⁴ (n,2n)	0+	14.4 $\pm$ 0.3	48.7	383	(0.127 $\pm$ 0.043)	Coinc count annihilation radiations. Se ^{73m} 100% β^+ ; Se ^{73g} 70.6% β^+ .	61R
Ge(He ⁴ ,xn)		52			0.2?	Count β . Intensity ratio was reported.	53HA

Isomer	Half-life	Spin, parity	Level	Decay scheme
Se ^{81m}	62m	7/2+	0.103	IT (e/ γ 11).
Se ⁸¹	18.6m	1/2-		β^- 1.38 (100%) to 0.280 level. γ 0.280--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Se ⁸² (γ ,n)	0+	17			(1.7)	Assumed the 57-m and 17-m activities were Se ^{81m} and Se ^{81g} .	39BG
Se ⁸⁰ (n, γ)	0+	Thermal	34	440	0.074?	σ_m pile, σ_g thermal neutrons. Count β . Assumed the 57m activity was Se ^{81m}	47SF
Se ⁸⁰ (n, γ)	0+	"Slow"			0.13 $\pm$ 0.003	Geiger count β .	57AC
Se ⁸⁰ (n, γ)	0+	Thermal			(0.21 $\pm$ 0.02)	Count β .	60KB2
Se ⁸⁰ (n, γ)	0+	Thermal Epi-Cd			0.130 $\pm$ 0.013 0.192 $\pm$ 0.019	Scint count β with anthracene	61BH
Br ⁸¹ (n,p)	<u>3/2-</u>	14.6 $\pm$ 0.3	32	25	1.28 $\pm$ 0.45	Geiger count β .	62SC
Br ⁸¹ (n,p)	<u>3/2-</u>	Be + d Li + d			(0.63) (0.69)		50FH
U ²³³ (n,f)	<u>5/2+</u>	Thermal			0.043 $\pm$ 0.008C	Geiger count β . As ⁸¹ decays 97% to Se ^{81g} and 3% to Se ^{81m}	62CW
U ²³⁵ (n,f)	<u>7/2-</u>	14.7			$\sim$ 0.17C	β counting.	62VT
U ²³⁵ (n,f)	<u>7/2-</u>	Thermal			0.036 $\pm$ 0.006C	Geiger count β . As ⁸¹ decays 97% to Se ^{81g} and 3% to Se ^{81m}	62CW

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$U^{235}(n,f)$	<u>7/2-</u>	Thermal			(0.064)C		51CS
$U^{235}(n,f)$	<u>7/2-</u>	Pile			(0.064)C		46S
$U^{235}(p,f)$	<u>7/2-</u>	20			(0.572)	Quoting Croall and Willis' value, no reference given.	62VT
$Se^{80}(d,p)$	0+	3			(0.31)#	No experimental details given.	52F
		5.2			(0.40)#		
		8			(0.62)#		
		15.4			(0.63)#		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Se ^{83m}	70s	(1/2-)	0.40	β^-	1.75 (if 10%) to 2.02 level; 3.75 (if 90%) to 0 level.
				γ	2.02--1.00 (100R)--0 (100R); 2.02--0 (40R); 1.00--0.35 (20R)--0 (16R).
Se ⁸³	25m	(9/2+)		β^-	0.45 to 2.87 level; 1.0 to 2.47 level; 1.7 to 1.89 level.
				γ	2.87--0.58 (3R)--0.35 (14R)--0 (22R); 2.41--1.89 (19R)--1.06 (13R)--0.35 (8R); 1.89--0 (5R); 1.89--0.58 (8R); 1.06--0 (5R).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Se ⁸² (n, γ)	0+	Thermal	4.3	~0.4	~11	Count β .	47AS
U ²³⁵ (n, f)	<u>7/2-</u>	Thermal			1.55 $\pm$ 0.18C	Geiger and prop count β of Br ⁸³ .	62CW

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Br ^{80m}	4.38h	<u>5</u> -	0.085	IT 0.085--0.037 ($e/\gamma \geq 400$).	
		2-	0.037	IT 0.037--0 ($e/\gamma \approx 1.3$).	
Br ⁸⁰	17.6m	<u>1</u> +		β^- 0.67 (0.17%) to 1.33 level; 0.74 (0.3%) to 1.26 level; 1.38 (6.9%) to 0.618 level; 2.00 (84.3%) to 0 level. β^+ 1.33--0; 1.33--0.618--0; 1.258--0.618; 1.258--0. β^+ 0.87 (2.6%) to 0 level. EC (1.1%) to 0.667 level; (4.6%) to 0 level. γ 0.667--0.	62TV

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Br ⁸¹ (γ ,n)	<u>3/2</u> -	12 17			0.36 1.0	Production ratios were determined	39BG
Br ⁸¹ (γ ,n)	<u>3/2</u> -	11.3 11.6 12 12.5 13 14 15 15.5 16 16.5 17			(0.14#) (0.15#) (0.16#) (0.167#) (0.17#) (0.185#) (0.22#) (0.25#) (0.31#) (0.48#) (0.91#)	Experimental details not given	52F
Br ⁸¹ (γ ,n)	<u>3/2</u> -	11 12 13 14 15			0.07* 0.21* 0.35* 0.40* 0.47*	Geiger count β . Betatron γ .	52KP

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Br ⁸¹ (γ , n) (cont'd.)		16			0.50*		
		17			0.51*		
		18			0.48*		
		19			0.45*		
		20			0.43*		
		21			0.40*		
Br ⁸¹ (γ , n)	<u>3/2-</u>	10.5			(0.072)	γ energies are maximum energies. Bremsstrahlungs from 22-Mev betatron.	52H
		10.7			(0.056)		
		10.8			(0.036)		
		11.0			(0.056)		
		11.2			(0.077)		
		11.7			(0.117)		
		14.2			(0.24)		
		18.3			(0.45)		
Br ⁸¹ (γ , n)	<u>3/2-</u>	22.2			(0.56)		
		15.7 $\pm$ 1			0.290 $\pm$ 0.069	γ energies are maximum brems- strahlung energies. Yield ratios were determined. Geiger count p. 70-Mev synchrotron.	57KV
		25 $\pm$ 5			0.404 $\pm$ 0.019		
		25 $\pm$ 5			0.420 $\pm$ 0.037		
		27.4 $\pm$ 1			0.434 $\pm$ 0.058		
		68 $\pm$ 1			0.400 $\pm$ 0.013		
		70 $\pm$ 1			0.399 $\pm$ 0.027		
		70 $\pm$ 1			0.424 $\pm$ 0.012		
Br ⁷⁹ (n, γ)	<u>3/2-</u>	Thermal	1,400	4,300	0.32	Geiger count p.	41SY
Br ⁷⁹ (n, γ)	<u>3/2-</u>	fast(Ra-Be)			(0.40)	Relative initial activities were reported. Geiger count p.	36JH
Br ⁷⁹ (n, γ)	<u>3/2-</u>	Thermal			(0.42)	Computed in 52KP from ratio of saturation activities.	37F
Br ⁷⁹ (n, γ)	<u>3/2-</u>	Thermal			(0.40)	Computed in 52KP.	37S
Br ⁷⁹ (n, γ)	<u>3/2-</u>	Slow			(~0.45)	Geiger count p. Calculated from saturation activity ratio.	38SW

Reaction	Target spin	E	σ_m	σ_g^+	c_m/σ_g	Comments	Reference
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal	2760	8100	0.34 ± 0.10	Geiger count β .	47SF
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal?			(0.34)	Geiger count β .	49CC
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal 1	3000 14	8900 30	0.34 0.47	Geiger count β .	49HS
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal			(0.31)	Calculated from saturation activity ratios. Geiger count β .	51CV
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal 1	2, 900 13.5	8, 500 29	0.34 0.47	Geiger count β . See 49HS	53HG
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal Fast			0.0385 0.0395	Geiger count β . Ratios of activities were measured.	56AC
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	0.18 0.25 0.33 0.40 0.48 0.53 0.60 0.80 1.00 1.30 1.6 2.0 2.6 Thermal	115 100 42 41 32 32 26 40 25 19 14 13.5 12 2900	220 194 120 100 60.5 53 45 35 34 24 20 14 12 8500	$0.52 \pm 0.07\#$ $0.51 \pm 0.10\#$ $0.35 \pm 0.22\#$ $0.41 \pm 0.10\#$ $0.53 \pm 0.11\#$ $0.60 \pm 0.11\#$ $0.58 \pm 0.10\#$ $1.14 \pm 0.17\#$ $0.73 \pm 0.16\#$ $0.79 \pm 0.18\#$ $0.70 \pm 0.39\#$ $0.96 \pm 0.30\#$ $1.0 \pm 0.31\#$ 0.34 ± 0.08	Scint count x-rays with NaI.	59JS
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal (Godiva)	31.1	57.1	0.54 ± 0.06	Prop count β .	60B
$\text{Br}^{79}(\text{n}, \gamma)$	<u>3/2-</u>	Thermal			(0.31 ± 0.02)		60KB2

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Br ⁸¹ (n,2n)	<u>3/2</u> -	Ra + Be			(0.54)	Geiger count β .	36JH
Br ⁸¹ (n,2n)	<u>3/2</u> -	≤ 14			(1.1)	Computed in 52KP	37S
Br ⁸¹ (n,2n)	<u>3/2</u> -	≤ 14			(1.4)	Computed in 52KP. Geiger count β .	38SW
Br ⁸¹ (n,2n)	<u>3/2</u> -	14.1 ± 0.2	510	470	1.1 ± 0.2	Coinc count γ with plastic scintillator	61F
Br ⁸¹ (n,2n)	<u>3/2</u> -	14.6 ± 0.3	610	437	1.4 ± 0.2	Geiger count β .	62SC
Se ⁸⁰ (p,n)	0+	4			(0.063)	Computed in 52KP.	38DB
Se ⁸⁰ (p,n)	0+	3.6	0.7	12	0.06#	Geiger count β . Br ^{80g} 13% KC, 3% β^+ .	51BB
		3.8	1.8	20	0.09#		
		4.0	3	31	0.14#		
		4.2	6	42	0.143#		
		4.4	10	62	0.16#		
		4.6	14	79	0.18#		
		4.8	20	99	0.20#		
		5.0	30	120	0.25#		
		5.2	38	150	0.25#		
		5.3	38	150	0.25#		
		5.5	50	180	0.28#		
		5.6	60	200	0.30#		
		5.7	65	200	0.33#		
		5.9	80	245	0.33#		
		6.1	85	250	0.34#		
		6.2	92	280	0.33#		
		6.3	100	300	0.33#		
		6.7	115	330	0.35 ± 0.05		

Reaction	Target spin	E	γ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Se ⁸⁰ (p,n)	0+	3.7			(0.077)#	No experimental details given.	52F
		3.8			(0.095)#		
		4.0			(0.12)#		
		4.1			(0.14)#		
		4.2			(0.16)#		
		4.4			(0.19)#		
		4.7			(0.21)#		
		5.2			(0.26)#		
		5.7			(0.30)#		
		6.2			(0.35)#		
		6.7			(0.40)#		
		7.2			(0.45)#		
		7.7			(0.50)#		
Br ⁸¹ (p,pn)	<u>3/2-</u>	15.5			1.15#	Geiger count $\dagger$.	56MD
		16			1.08#		
		18.5			1.19#		
		19			1.23#		
		23			1.45#		
		30			1.62#		
		33			1.58#		
		40			1.49#		
		45			1.38#		
		50			1.43#		
		56			1.38#		
		64			1.35#		
		65			1.29#		
		71			1.36#		
		73			1.30#		
		73.5			1.35#		
		82.5			1.25#		
		88			1.32#		
		94			1.21#		
		100			1.25#		

Reaction	Target spin	E	σ_m	σ_g^1	σ_m/σ_g	Comments	Reference
Br ⁸¹ (p,pn)	<u>3/2-</u>	85			1.30 ± 0.03	Prop count β .	61HA
		130			1.30 ± 0.13		
		160			1.28 ± 0.09		
Br ⁸¹ (p,pn)	<u>3/2-</u>	250 ± 13	34.4	31.2	1.10 ± 0.04	Geiger count β .	61SC
		300	35.0	31.0	1.13 ± 0.03		
		350	34.5	30.8	1.12 ± 0.04		
		400	34.2	30.0	1.14 ± 0.04		
		440 ± 9	33.4	28.6	1.16 ± 0.05		
Y ⁸⁹ (p,sp)	<u>1/2-</u>	70			5.2 ± 1.0	Prop count β .	61HA
		100			4.7 ± 0.6		
		130			4.25 ± 0.44		
		160			3.10 ± 0.40		
U ²³⁸ (p,f)	0+	70			1.44 ± 0.25	Prop count β .	61HA
		100			2.49 ± 0.45		
		130			2.96 ± 0.36		
		160			2.94 ± 0.70		
Se ⁸⁰ (d,2n)	0+	5.4			(0.078)#	No experimental details given.	52F
		5.5			(0.11)#		
		5.6			(0.17)#		
		5.75			(0.20)#		
		5.9			(0.23)#		
		6.0			(0.26)#		
		6.25			(0.33)#		
		6.5			(0.37)#		
		6.75			(0.43)#		
		7.0			(0.48)#		
		7.5			(0.57)#		
		8			(0.68)#		
		8.5			(0.77)#		
		9			(0.91)#		
		9.5			(1.0)#		
		10			(1.05)#		

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Se ⁸⁰ (d,2n) (Cont'd.)	0+	10.5			(1.1)#		
		11			(1.33)#		
		11.5			(1.4)#		
		12			(1.47)#		
		12.5			(1.6)#		
		13			(1.67)#		
		13.5			(1.8)#		
		14			(2.0)#		
		15			(2.0)#		
Br ⁷⁹ (d,p)	<u>3/2-</u>	5			(0.43)	Computed in 52KP.	37S
Br ⁷⁹ (d,p)	<u>3/2-</u>	3			(0.37)#	No experimental details given.	52F
		4			(0.39)#		
		5			(0.43)#		
		6			(0.50)#		
		7			(0.58)#		
		8			(0.63)#		
		9			(0.66)#		
		10			(0.665)#		
		11			(0.67)#		
		12			(0.68)#		
		13			(0.69)#		
		14			(0.70)#		
		15			(0.72)#		

[†] σ_g includes σ_m (2-).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Br ^{84m}	6.0m		~0.5	β^- γ	0.8(20%); 1.9(72%); 3.2(8%). energies 0.44(60%); 0.88(70%); 1.46(60%); 1.89(20%).
Br ⁸⁴	31.8m	(2-)		β^- γ	0.5(~3%) to 4.18 level; 0.83(19%) to 3.91 level; 0.98(~2%) to 3.70 level; 1.39(14%) to 3.35 level; 1.81(~1.5%) to 2.91 level; 2.80(15%) to 1.90 level; 3.83(14%) to 0.88 level; 4.68(32%) to 0 level. complex. Simplified scheme: 3.91--0(25R); 3.91--0.88(8R)--0(100R); 3.35--2.71(5R)--1.90(18R)-- 0(36R); 1.90--0.88(20R); 3.91--2.71(8R); 3.35--0.88(16R).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comment	Reference
Rb ⁸⁷ (n, α)	<u>3/2</u> -	14			2.83	Prop count β . Activity ratios.	60SK
U ²³⁵ (n,f)	<u>7/2</u> -	Thermal			0.021c	σ_m scint count 0.44-Mev γ . σ_g prop count β .	60SK
Au ¹⁹⁷ (C ¹² ,f)	<u>3/2</u> +	112	5.5c	2c	2.8 $\pm$ 0.8	Prop count β .	61BL

Isomer	Half-life	Spin, parity	Level	Decay scheme
Kr ^{79m}	55s	7/2+	0.127	IT
Kr ⁷⁹	34.5h	1/2-		EC (20%) to 0.833, 0.606, 0.398, 0.307 levels; (7.9%) to 0.261 level; (63.4%) to 0 level. β^+ 0.34(0.11%) to 0.261 level; 0.598(7.6%) to 0 level. γ complex.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Br ⁷⁹ (p,n)	<u>3/2-</u>	6.7			(0.5 ± 0.2)	No mention of experimental method of measurement.	52BM

Isomer	Half-life	Spin, parity	Level	Decay scheme		Reference
Kr ^{85m}	4.36h	1/2-	0.305	IT β^- γ	(19%, e^+/γ 0.47). 0.824(81%) to 0.150 level. 0.150--0 (e^-/γ 0.04).	
Kr ⁸⁵	10.6y	<u>9/2+</u>		β^- γ	0.16(~0.46%) to 0.514 level; 0.67(99%) to 0 level. 0.514--0.	61G, 61L

Reaction	Target spin	E	σ_m	σ_g	σ_m σ_g	Comments	Reference
Kr ⁸⁴ (n, γ)	0+	Thermal	91	68	(1.3)?	Assumed 23% IT was used.	51CS
Kr ⁸⁴ (n, γ)	0+	Thermal 1	95 1.8	65 8.1	(1.5) (0.22)?	Assumed 23% IT was used.	53HG, 58HS

Isomer	Half-life	Spin, parity	Level	Decay scheme
Rb ^{86m}	1.02m	(6-)	0.56	IT
Rb ⁸⁶	18.7d	<u>2</u> -		β^- 1.78 (91%) to 0 level; 0.70 (9%) to 1.08 level. γ 1.08--0.

Reaction	Target spin	E	σ_m	σ_g	σ_{m+g}	Comments	Reference
Rb ⁸⁵ (n, γ)	<u>5/2</u> -	Thermal			(7.7 $\pm$ 0.8)	Scint count 560-kev γ .	61KB

Isomer	Half-life	Spin, parity	Level	Decay scheme	
$\text{Sr}^{85\text{m}}$	70m	(1/2-)	0.233	IT	0.233--0.225 (e/γ very large)--0 (84.7%, e/γ 0.031); 0.233--0 (1.3%, $e/\gamma \sim 0.04$).
				EC γ	(14%) to 0.150 level. 0.150--0.
Sr^{85}	64d	(7/2+)	0.225	IT	
		(9/2+)		EC γ	(100%) to 0.514 level. 0.514--0.

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
$\text{Sr}^{84}(\text{n}, \gamma)$	0+	Thermal	1000	1000	(1)	80% IT	58HS
$\text{Sr}^{84}(\text{n}, \gamma)$	0+	Thermal	600	400	1.5 ± 0.9	Scint count 514-kev γ .	60HS
$\text{Sr}^{86}(\text{n}, 2\text{n})$	0+	14.6 ± 0.3	312	280	1.12 ± 0.18	Scint count γ with NaI.	62SC
$\text{Rb}^{85}(\text{p}, \text{n})$	<u>5/2-</u>				(0.25 ± 0.15)	No experimental method given.	52BM

$^\dagger \sigma_g$ includes σ_m (7/2+).

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Υ^{86m}	49m		0.242	IT	61HV, 61HC
Υ^{86}	14.6h	(4-)		f^+EC 0.76(6% f^+ , 30%EC) to 3.59 level; 0.90(3% β^+ , 7%EC) to 3.46 level; 1.32(15% β^+ , 11%EC) to 3.02 level; 1.41(5% f^+ , 4%EC) to 2.95 level; 2.09(6% β^+ , 1%EC) to 2.25 level; 3.28(0.8% β^+ , 0.06%EC) to 1.08 level. EC (9%) to 4.76 level; (10%) to 4.23 level. γ all cascades to 1.08 level; 1.08--0(100%).	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$Rb^{85}(He^4, 3n)$	<u>5/2-</u>	42			(0.85 $\pm$ 0.20)	Scint count γ of Υ^{86g} with NaJ.	61HV

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Y^{87m}	14h	(9/2+)	0.381	IT	(e/ γ 0.28).
Y^{87}	80h	(1/2-)		EC β^+ γ	(97.7%) to 0.871 level; (2%) to 0.388 level. ~0.7(0.3%) to 0.388 level. 0.871--0.388--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$Sr^{87}(p,n)$	<u>9/2+</u>	6.7	95	230	0.42 $\pm$ 0.06	Geiger count conversion electrons of Sr^{87m} .	51BB
$Ag(p,sp)$	<u>1/2-</u>	340	1.8	1.3	1.4	Beta ray spectrographic count conversion electrons.	53K
$Sr^{86}(d,n)$	0+	10			(~1)?	No mention what radiations were measured. $N_m = N_g$.	51MA
$Sr^{86}(d,n)$	0+	4.3 6.6 9.1 11.4 13.4 15.2			0.55 $\pm$ 0.02 1.04 $\pm$ 0.04 1.44 $\pm$ 0.06 1.44 $\pm$ 0.06 1.31 $\pm$ 0.06 1.04 $\pm$ 0.15	Scint count 483-kev γ with NaI.	62VH
$Sr^{87}(d,2n)$	<u>9/2+</u>	4.7 7.5 10.2 12.3 15.4 17.3 19.1			2.2 $\pm$ 0.3 2.6 $\pm$ 0.1 2.8 $\pm$ 0.1 3.4 $\pm$ 0.2 3.8 $\pm$ 0.1 4.4 $\pm$ 0.1 4.9 $\pm$ 0.2	Scint count 483-kev γ with NaI.	62VH
$Sr^{88}(d,3n)$	0+	17.8 20.2			2.3 $\pm$ 0.1 2.7 $\pm$ 0.1	Scint count 483-kev γ with NaI.	62VH

Reaction	Target spin	E	σ_m	J_g	σ_m/σ_g	Comments	Reference
Rb ⁸⁵ (He ⁴ ,2n)	<u>5/2-</u>	13.0			0.35 ± 0.05	Scint count 483-kev γ with NaI.	62VH
		13.8			1.8 ± 0.1		
		15.3			2.6 ± 0.1		
		16.8			3.1 ± 0.1		
		19.2			4.9 ± 0.3		
		21.6			5.5 ± 0.4		
		22.2			6.3 ± 0.2		
		24.4			6.4 ± 0.1		
		24.9			4.9 ± 0.1		
		26.2			8.9 ± 0.5		
		28.6			10.5 ± 0.5		
Sr ⁸⁶ (He ⁴ ,t)	0+	29.9-30.3			0.18 ± 0.01	Scint count 483-kev γ with NaI.	60S

Isomer	Half-life	Spin, parity	Level	Decay scheme		Reference
Y ^{90m}	3.19h	(7+)	0.676	IT	0.676--0.203--0	61HV, 61HC
		(3-)	0.203	IT		
Y ⁹⁰	64.2h	<u>2</u> -		β^-	2.27 (99+%) to 0 level; 0.52 (0.017%) to 1.73 level.	
				γ	1.73--0 (e/ γ >30).	

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Nb ⁹³ (n, α)	<u>9/2+</u>	14.5	5.9	8.6	(0.68 $\pm$ 0.30)		62BF

[†] σ_g includes σ_m (3-).

Isomer	Half-life	Spin, parity	Level	Decay scheme
Y^{91m}	50.3m	$9/2+$	0.551	IT (e^- , 0.053).
Y^{91}	57.5d	$1/2-$		β^- 1.54 (99.7%) to 0 level; 0.33 (0.3%) to 1.21 level. β^- 1.21--0

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$Zr^{91}(n,p)$	<u>5/2+</u>	14.09	0.12	17.5	14.2	1.23 ± 0.14 σ_m scint count 551-keV γ ; σ_g prop count ϵ .	60R

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Zr ^{89m}	4.4m	(1/2-)	0.588	IT β^+EC γ	(93%, e/ γ 0.076). ~0.85 (1.2% β^+ , 5.7% EC) to 1.53 level; 2.43 (0.5% β^+ , 0.07% EC) to 0 level. 1.53--0.
Zr ⁸⁹	79.3h	(9/2+)		β^+EC γ	0.90 (30% β^+ , 70% EC) to 0.915 level. 0.915--0 (e/ γ 0.01).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Zr ⁹⁰ (γ ,n)	0+	13	1.3	0.4	3.2*	σ_m scint count 588-keV γ ; σ_g scint count 915-keV γ . σ_m and σ_g relative. Betatron x-rays.	56AF
		14	2.6	1.2	2.2*		
		15	4.2	2.5	1.7*		
		16	7.1	5.0	1.4*		
		17	7.5	6.8	1.1*		
Zr ⁹¹ (γ ,2n)	<u>5/2+</u>	18	5.7	1.0	5.7*	Same as above	56AF
		19	4.2	1.2	3.5*		
		20	3.1	2.9	1.1*		
		21	2.3	4.0	0.57*		
		22	1.8	5.0	0.36*		
		22.8			0.615 $\pm$ 0.038		
Zr ⁹⁰ (n,2n)	0+	14.09 $\pm$ 0.12	74	470	0.16 $\pm$ 0.01	σ_m scint count 588-keV γ ; σ_g scint count 915-keV γ .	60R
Y ⁸⁹ (p,n)	<u>1/2-</u>	6.7	130	240	(0.54 $\pm$ 0.10)	Geiger count β . 25% β^+ and 75% EC for Zr ^{89g} ; 100% IT.	51BB

Isomer	Half-life	Spin, parity	Level	Decay scheme
Nb ^{95m}	90h	(1/2-)	0.235	IT (e ₊ , very large).
Nb ⁹⁵	35d	(9/2+)		0.160 (99%) to 0.768 level; 0.93 (1%) to 0 level. 0.768--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	68	0.014	0.005	2.8 ± 1.2	Geiger count β .	55JS
		108	0.079	0.061	1.3 ± 0.5		
		166	0.55	0.55	1.0 ± 0.4		
		218	0.75	0.45	1.7 ± 0.7		
		273	0.86	0.24	3.6 ± 1.5		
		320	0.71	1.29	0.55 ± 0.23		
		336	0.81	1.89	0.43 ± 0.18		
		405	0.83	0.57	1.5 ± 0.6		
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	340	0.22	9.9	0.022 ± 0.005	Geiger count β .	53B
Mo ⁹⁷ (d, γ)	<u>5/2+</u>	7.71 ± 0.05	0.98	2.35	0.42 ± 0.05	Prop count β .	60AM
U ²³⁸ (d,f)	0+	19 to 23			2.3 to ∞	σ_m scint count 235-kev γ with $e/\gamma = 3.32$; σ_g scint count 768-kev γ .	59B
U ²³⁸ (d,f)	0+	13.6			(0.60)	Scint count γ . e/γ for IT = 3.34. σ_m i, σ_g i.	61MI

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Mo ^{91m}	66s	(1/2-)	0.658	IT β^+EC γ	(57%, e/ γ 0.055). 2.48 (19% β^+ , 3% EC) to 1.62 level; 2.78 (14% β^+ , 2% EC) to 1.31 level; 3.99 (5% β^+ , 0.2% EC) to 0.104 level. 1.62--0.104--0; 1.31--0.104 (Nb ^{91m})--0.
Mo ⁹¹	15.5m	(9/2+)		β^+EC	3.44 (94% β^+ , 6% EC) to 0 level.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Mo ⁹² (γ, n)	0+	18 to 67				Constant relative intensities	52S
Mo ⁹² (γ, n)	0+	13.1			0.95*	σ_m scint count 658-kev γ ; σ_g coinc count annihilation radiation with NaI.	60AF
		13.2			2.2*		
		13.3			2.55*		
		13.5			2.6*		
		13.7			2.5*		
		13.8			2.26*		
		13.9			2.1*		
		14.0			1.9*		
		14.2			1.4*		
		14.4			1.2*		
		14.6			1.13*		
		14.8			1.04*		
		15.0			1.0*		
		16.0			0.96*		
		17.0			0.96*		
		18.0			0.96*		
		19.0			0.96*		
		20.0			1.0*		
		21.0			1.2*		
		22.0			1.4*		
		22.5			1.55*		

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Tc^{94m}	52.5m	2+	0.03	IT (24%). EC (1%) to 3.27 level; (11%) to 2.73 level; (9%) to 0.874 level. β^+ 0.56(1%) to 2.73 level; 2.41(54%) to 0.874 level. γ 3.27--0(1%); 2.73--0(1%); 2.73--0.874(11%)--0(73%).	62S
Tc^{94}	293m	5+		β^- EC 0.9(2% β^+ , 70%EC) to 2.43 level; 1.7(5% β^+ , 23%EC) to 1.58 level. γ 2.43--1.58(72%)--0.874(100%)--0(100%).	62S

Reaction	Target spin	E	σ_m	σ_g	σ_m, σ_g	Comments	Reference
$Nb^{93}(He^4, n)$	<u>9/2+</u>	26.6 $\pm$ 0.3 29.1 $\pm$ 0.3 29.9 $\pm$ 0.3 33.2 $\pm$ 0.2 33.8 $\pm$ 0.2 36.1 $\pm$ 0.2 38.0 $\pm$ 0.2 40.8 $\pm$ 0.1 41.0 $\pm$ 0.1 41.8 $\pm$ 0.1 41.8 $\pm$ 0.1			0.57 $\pm$ 0.08# 0.31 $\pm$ 0.02# 0.30 $\pm$ 0.02# 0.17 $\pm$ 0.02# 0.22 $\pm$ 0.01# 0.14 $\pm$ 0.02# 0.14 $\pm$ 0.01# 0.12 $\pm$ 0.02# 0.12 $\pm$ 0.01# 0.115 $\pm$ 0.013# 0.10 $\pm$ 0.01#	Scint count γ with NaI.	62S

Isomer	Half-life	Spin, parity	Level	Decay scheme		Reference
Tc ^{95m}	60d	(1/2-)	0.039	IT EC β^+ γ	(3%). (31%) to 1.04 level; (10%) to 0.82 level; (49%) to 0.78 level; (~8%) to 0.203 level; (~2%) to 0 level. 0.46(0.05%) to 0.203 level; 0.68(0.05%) to 0 level. 1.04--0(5R); 1.04--0.203(38R)--0(100R, e/ γ 0.036); 0.82--0(13R); 0.78--0(17R); 0.78--0.203(50R).	61CR
Tc ⁹⁵	20h	(9/2+)		EC γ	(84.5%) to 0.768 level; (6.5%) to 0.93 level; (9%) to 1.07 level. 1.07--0; 0.93--0; 0.768--0.	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Mo ⁹⁵ (p,n)	<u>5/2+</u>	6.7	60	110	(0.55±0.15)	Geiger count γ , not sure what radiations were detected.	51BB
Nb ⁹³ (He ⁴ ,2n)	<u>9/2+</u>	18.9			(0.25±0.05)	Count γ . Not sure which radia- tions were counted.	61SM
		20.5			(0.26±0.03)		
		24.0			(0.16±0.02)		
		25.4			(0.15±0.02)		
		26.9			(0.14±0.02)		
		28.0			(0.13±0.02)		
		28.2			(0.12±0.01)		
		26.4-23.9			(0.16)		
Nb ⁹³ (He ⁴ ,2n)	<u>9/2+</u>	27.3-24.8			(0.15)	Scint count γ with NaI. Not sure which radiations were measured.	62S
		14.0 ± 0.2			(0.59 ± 0.31#)		
		16.2			(0.83 ± 0.83#)		
		17.1			(0.63 ± 0.31#)		
		18.2			(0.17 ± 0.08#)		
		19.0			(0.17 ± 0.02#)		
		21.9			(0.15 ± 0.004#)		
		22.1			(0.14 ± 0.004#)		
		22.2			(0.15 ± 0.004#)		

Reaction	Target spin	E	σ_m	g	σ_m, σ_g	Comments	Reference
Nb ⁹³ (He ⁴ ,2n) (Cont'd.)		24.0			(0.14 + 0.004#)		
		25.5			(0.125 + 0.001#)		
		26.0			(0.13 + 0.01#)		
		26.0			(0.12 + 0.003#)		
		27.0			(0.114 + 0.001#)		
		27.1			(0.112 + 0.003#)		
		28.0			(0.110 + 0.003#)		
		28.1			(0.102 + 0.002#)		
		29.3			(0.089 + 0.002#)		
		30.0			(0.098 + 0.003#)		
		30.2			(0.097 + 0.003#)		
		30.5			(0.089 + 0.002#)		
		33.0			(0.094 + 0.005#)		
		33.0			(0.087 + 0.005#)		
		33.2			(0.085 + 0.003#)		
		33.9			(0.082 + 0.002#)		
		34.0			(0.098 + 0.004#)		
		35.1			(0.091 + 0.009#)		
		35.2			(0.105 + 0.007#)		
		35.7			(0.100 + 0.003#)		
		36.1			(0.116 + 0.007#)		
		37.9			(0.122 + 0.005#)		
		38.2			(0.128 + 0.005#)		
		38.7			(0.14 + 0.01#)		
		39.7			(0.17 + 0.08#)		
		41.8			(0.20 + 0.12#)		
		41.8			(0.25 + 0.20#)		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Tc ^{96m}	51.5m	(4+)	0.0344	IT (99+%). β^+ (0.01%) to 1.61 level. γ 1.61--0.77--0.	
Tc ⁹⁶	4.3d	(7+)		EC (20%) to 2.73 level; (80%) to 2.41 level. γ 2.73--2.41 (0.52%)--1.61 (82%)--0.77 (100%)--0 (100%); 2.73--1.61 (17%).	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Nb ⁹³ (He ⁴ ,n)	<u>9/2+</u>	14.7-10.2			(1.0)	Scint count 771, 806 and 842-kev γ .	61SM
Nb ⁹³ (He ⁴ ,n)	<u>9/2+</u>	10.6 $\pm$ 0.3 11.2 12.1 $\pm$ 0.5 13.0 13.8 14.2 14.2 14.8 15.0 15.5 16.2 $\pm$ 0.2 18.0 19.0 19.5 $\pm$ 0.2 19.8 22.0 22.9 23.0 $\pm$ 0.2 23.8 26.1 26.2 28.0			(5.6 $\pm$ 0.6#) (2.4#) (3.3#) (3.7#) (3.6#) (3.4#) (2.5#) (1.8#) (2.3#) (1.7#) (1.7#) (1.0#) (0.80#) (0.63 $\pm$ 0.04#) (0.685#) (0.31 $\pm$ 0.02#) (0.57#) (0.67 $\pm$ 0.09#) (0.78 $\pm$ 0.13#) (2.0 $\pm$ 0.4#) (1.4 $\pm$ 0.01#) (2.1 $\pm$ 0.8#)	Scint count γ with NaI. Not sure which radiations were measured.	62S

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Rh ^{104m}	4.4m	5+	0.128	IT	0.128--0.051 (99.86%).
				β^-	0.30 (0.026%) to 2.27 level; 0.48 (0.12%) to 2.09 level.
		2+	0.096	γ	2.27--1.34--0; 2.09--0.556--0; 2.09--1.34--0.556.
		2-	0.051	IT	0.096--0. (e_K/γ 1.9).
Rh ¹⁰⁴	44s	1+		β^-	2.44 (98.5%) to 0 level; 1.88 (1.4%) to 0.556 level; 0.64 (0.08%) to 1.80 level.
				γ	1.80--0.556 (5.8R)--0 (100R).

Reaction	Target spin	E	τ_m	$g^\dagger$	σ_m/σ_g	Comments	Reference
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	2.4			1.5?	Computed from saturation intensity ratio.	38R
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal 0.1			(0.074)? (0.135)?	Calculated from saturation intensity ratios. Geiger count β .	38PO
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal	11,600	137,000	0.085 $\pm$ 0.012	Geiger count β .	47SF
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal 1	12,800 16.5	150,000 103	0.0855 0.16	Geiger count β .	49HS
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal			(0.74)	Calculated from saturation activity ratios. Geiger count β .	51CV
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal 1	12,000 15.4	137,000 94	0.088 0.16	Geiger count β . See 49HS.	53HG
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal 0.0011 Epi-Cd			(0.075 $\pm$ 0.002) (0.081 $\pm$ 0.001) (0.080 $\pm$ 0.001)		60KB1

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal			0.0736 $\pm$ 0.0074	Scint count 556-kev γ with NaI.	61BH
		Thermal			0.0786 $\pm$ 0.0079		
		Epi-Cd			0.0739 $\pm$ 0.0074		
Rh ¹⁰³ (n, γ)	<u>1/2-</u>	Thermal	8,800	140,000	0.063	Geiger count β .	41SY
Ru ¹⁰⁴ (p,n)	0+	6.7	60	130	0.45 $\pm$ 0.08	Geiger count β .	51BB

$^\dagger \sigma_g$ includes $\sigma_m(2+)$ and $\sigma_m(2-)$.

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{Pd}^{109\text{m}}$	4.75m	$11/2^-$	0.188	IT ($e^+/\gamma \sim 0.6$).
Pd^{109}	13.5h	$5/2^+$		γ^- 1.03 (99.97%) to 0.088 ($\text{Ag}^{109\text{m}}$) level; others (0.03%). γ 0.088--0 (99+%, e^+/γ 11); all others (1%).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Pd}^{108}(\text{n}, \gamma)$	0+	Thermal	260	14,000	0.0186 ± 0.0039	σ_m scint count 188-kev γ , with NaI; σ_g β and γ counting.	59SH
$\text{Pd}^{108}(\text{n}, \gamma)$	0+	Thermal Epi-Cd			0.0221 ± 0.0044 0.0224 ± 0.0045	σ_m scint count 188-kev γ ; σ_g scint count 88-kev γ , with NaI.	61BH

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{Pd}^{111\text{m}}$	5.5h	(11/2-)	0.17	IT (68%). β^- 0.61 (4%) to 1.75 level; (28%) to higher level. γ 1.75--0.065 ($\text{Ag}^{111\text{m}}$)--0
Pd^{111}	22m	(5/2+)		β^- 2.13 (if 100%) to 0.065 ($\text{Ag}^{111\text{m}}$) level.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Pd}^{110}(\text{n}, \gamma)$	0+	Thermal	50	190	(< 0.26)	σ_m scint count 170-kev γ ; σ_g β and γ counting. Decay scheme not given.	59SH
$\text{Pd}^{110}(\text{n}, \gamma)$	0+	Pile			0.045	Geiger count β of Ag^{111} at various time intervals.	57DL
$\text{U}^{238}(\text{p}, \text{f})$	0+	5700	1.6	6.2	0.26 ± 0.12	Prop count β . 75% IT.	56S

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Ag ^{104m}	29m	<u>2</u> ⁺	0.020	β^- EC 2.71(8.4% β^- , 16% EC) to 0.556 level. γ 0.556--0.	60NG
Ag ¹⁰⁴	66m	<u>5</u> ⁺		β^- 0.99 to 2.26 level. γ 2.26--1.33(37R)--0.556(82R)--0(100R); 2.26--1.81(3.4R)--1.33(1.9R)--0(14.3R); 2.18--0.556(5.5R); 2.18--1.33(18R); 2.18--1.81(1.9R)--0(9R); 2.08--0.556(7.5R); 2.08--1.33(2.2R); 2.08--1.81(2.5R)--0.556(7.2R).	60NG

Reaction	Target spin	E	ϵ_m	ϵ_g	ϵ_m, ϵ_g	Comments	Reference
Rh ¹⁰³ (He ⁴ ,3n)	<u>1/2</u> ⁻	38			~(0.083)	Did not mention what radiations were measured.	60NG

Isomer	Half-life	Spin, parity	Level	Decay scheme
Ag ^{106m}	8.3d	6	~0.3	EC (~95%) to 2.78 level; (~5%) to 1.88 level. γ complex. Most cascade to 0.513 level. 0.513--0(86%).
Ag ¹⁰⁶	24m	<u>1+</u>		β ⁺ EC 1.45(7% ⁺ , 11%EC) to 0.513 level; 1.96(54% ⁺ , 28%EC) to 0 level. γ 0.513--0(e _K /, 0.0027).

Reaction	Target spin	E	σ _m	σ _g	σ _m /σ _g	Comments	Reference
Ag ¹⁰⁷ (γ,n)	<u>1/2-</u>	34			0.07±0.02	Scint count 513- and 511-keV γ. Ag ^{106m} 75% γ per decay.	62FK
Ag ¹⁰⁷ (γ,n)	<u>1/2-</u>	22	2.2	1.44	1.6±0.5?	Scint count 511-keV γ by NaI. Fractions of products recoiled from target were determined.	59SL
Ag ¹⁰⁷ (n,2n)	<u>1/2-</u>	20			~20?	Ionization chamber. Ag ^{106m} γ/β = 35. Ag ^{106g} 100% β ⁺ .	38P
Ag ¹⁰⁷ (n,2n)	<u>1/2-</u>	14.8	6500	662	(~9.8)?	Geiger count β. σ _m impossibly high.	61MG
Ag ¹⁰⁷ (n,2n)	<u>1/2-</u>	14	0.60	0.74	0.81±0.19	NaI scint count K-X rays and K-γ coinc for σ _m ; ann. rad. and 4π β count for σ _g .	61V
Pd ¹⁰⁶ (p,n)	0+	6.7	110	220	0.50?	σ _m count γ, assuming 1 γ/decay. σ _g Geiger count β(70% β ⁺).	51BB
Ag ¹⁰⁷ (p,pn)	<u>1/2-</u>	20.0 20.0 20.0 20.0 20.0 19.0 19.0 18.0 18.0			1.09±0.46# 1.18±0.50# 1.25±0.53# 1.28* 1.41±0.60# 0.92±0.41# 1.0* 0.92±0.41# 0.79*	σ _m scint count 1.55 and 0.511- MeV γ; sum of (c/m) of 1.55 and 0.511-MeV γ = (d/m). σ _g Geiger count β(63%).	59LJ

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ag ¹⁰⁷ (p,pn) (Cont'd.)		17.0			0.68*		
		16.0			0.64 ± 0.30#		
		16.0			0.56*		
Rh ¹⁰³ (He ⁴ ,n)	<u>1/2-</u>	12	0.022	0.0186	1.2#?	σ_m count γ (assumed 513-keV γ was counted). σ_g count annihilation radiations (assumed including 513-keV γ).	47BT
		12.5	0.043	0.036	1.2#?		
		13	0.068	0.076	0.90#?		
		13.5	0.082	0.14	0.59#?		
		14	0.14	0.21	0.66#?		
		14.6	0.23	0.33	0.70#?		
		15	0.24	0.42	0.57#?		
		16	0.55	0.70	0.78#?		
		16.5	0.70	0.72	0.97#?		
		17	0.81	0.86	0.94#?		
		17.8	1.16	0.95	1.2#?		
		18	1.3	1.14	1.14#?		
		18.5	1.1	1.13	1.0#?		

Isomer	Half-life	Spin, parity	Level	Decay schemes	
Ag ^{110m}	253d	<u>6</u> -	0.116	IT	(2%) 0.116--0.03--0; 0.116--0 (e/ γ > 90).
				β^-	0.085 (65%) to 2.92 level; 0.53 (33%) to 2.48 level.
		2+	0.03	γ	most cascade to 0.656 level; 0.656--0.
Ag ¹¹⁰	24.2s	1+		IT	
				β^-	2.87 (~95%) to 0 level; 2.21 (~5%) to 0.656 level; ~1.40 to 1.47 level.
				γ	1.47--0; 1.47--0.656--0.

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Ag ¹⁰⁹ (n, γ)	<u>1/2</u> -	Thermal	2300	97,000	(0.028 $\pm$ 0.008)	Geiger count β . σ_m pile, σ_g thermal neutrons.	47SF
Ag ¹⁰⁹ (n, γ)	<u>1/2</u> -	Thermal	2200	84,000	(0.026)	Geiger count β .	53HG
Ag ¹⁰⁹ (n, γ)	<u>1/2</u> -	Thermal	3200	113,000	(0.028 $\pm$ 0.005)	Assumed 5% IT.	58HS
Pd ¹¹⁰ (p,n)	0+	6.7	91	106	0.85 $\pm$ 0.15	Geiger count β .	51BB

$^\dagger \sigma_g$ includes σ_m (2+).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Cd ^{115m}	43d	(11/2-)	0.18	β^-	1.63 (96.7%) to 0 level; 0.687 (2%) to 0.935 level; 0.335 (1%) to 1.30 level; 0.20 (0.3%) to 1.42 level.
				γ	1.42--0.935 (0.3%)--0 (2.3%); 1.30--0 (1%).
Cd ¹¹⁵	2.33d	(1/2+)		β^-	0.59 (24.4%) to 0.858 level; 0.63 (12.6%) to 0.825 level; 0.85 (0.9%) to 0.595 level; 1.11 (62.1%) to 0.335 level.
				γ	0.858--0.335 (24R)--0 (100%) 0.858--0.595 (0.2R)--0.335 (1.7R); 0.858--0.825 (0.2R)--0.335 (12R); 0.825--0.595 (6.6R).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Cd ¹¹⁶ (γ, n)	0+	20			~0.25	Betatron x-rays. Prop count β .	52WB
U(γ, f)		15.5 $\pm$ 0.1	0.013	0.16	0.081 $\pm$ 0.008c	Geiger count β with 91 mg/cm ² Al absorber.	54SS
		21.3 $\pm$ 0.1	0.018	0.25	0.072 $\pm$ 0.005c		
		48 $\pm$ 1	0.041	0.47	0.087 $\pm$ 0.006c		
		100 $\pm$ 1	0.048	0.67	0.072 $\pm$ 0.004c		
		300	0.20	1.15	0.17 $\pm$ 0.018c		
Cd ¹¹⁴ (n, γ)	0+	Pile	140	1100	0.13 $\pm$ 0.03	Geiger count β .	47SF
Cd ¹¹⁴ (n, γ)	0+	Thermal			0.13	Prop count β .	52WB
Cd ¹¹⁶ (n, 2n)	0+	14.8	490	690	0.71 $\pm$ 0.15	Geiger count β .	61KH
Cd ¹¹⁶ (n, 2n)	0+	12.06 $\pm$ 0.11	721	721	1.00 $\pm$ 0.14	Prop count β .	61PB
		13.40 $\pm$ 0.20	780	821	0.95 $\pm$ 0.13		
		13.69 $\pm$ 0.10	795	830	0.958 $\pm$ 0.13		
		14.01 $\pm$ 0.10	840	850	0.988 $\pm$ 0.12		
		14.09 $\pm$ 0.10	769	835	0.921 $\pm$ 0.13		
		14.31 $\pm$ 0.13	885	863	1.03 $\pm$ 0.14		
		14.50 $\pm$ 0.20	808	826	0.978 $\pm$ 0.14		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Cd ¹¹⁶ (n,2n) (Cont'd.)		14.68 ± 0.26	825	817	1.01 ± 0.14		
		14.81 ± 0.31	807	781	1.03 ± 0.14		
		14.91 ± 0.36	836	798	1.05 ± 0.15		
		16.50 ± 0.30	822	658	1.25 ± 0.17		
		17.95 ± 0.32	666	488	1.36 ± 0.19		
		19.76 ± 0.43	566	355	1.59 ± 0.22		
In ¹¹⁵ (n,p)	<u>9/2+</u>	10			1.0 ± 0.3	Geiger count β .	59SP
		15			0.90 ± 0.21		
		20			0.60 ± 0.10		
		25			0.53 ± 0.06		
Sn ¹¹⁸ (n, α)	0+	15			1.24 ± 0.17	Geiger count β .	59SP
		20			0.60 ± 0.07		
		25			0.75 ± 0.11		
Th ²³² (n,f)	0+	Pile			0.042 ± 0.023	Geiger count β . σ_m i; σ_g c.	51TN
U ²³³ (n,f)	<u>5/2+</u>	Thermal	0.001	0.19c	(0.0053)		55SG
U ²³³ (n,f)	<u>5/2+</u>	Thermal			(0.063)c		51CS
U ²³⁵ (n,f)	<u>7/2-</u>	Pile			(0.073)	σ_m i; σ_g c.	46S
U ²³⁵ (n,f)	<u>7/2-</u>	Thermal			0.072 ± 0.010	σ_m c; σ_g c.	52WB
		Thermal 14			< 7 × 10 ⁻⁵ 0.070 ± 0.010	σ_m i; σ_g c. σ_m c; σ_g c. Prop count β .	
U ²³⁸ (n,f)	0+	Pile			(0.105)	σ_m i; σ_g c.	51CS
U ²³⁸ (n,f)	0+	2.8			0.078 ± 0.017	Geiger count β . σ_m i; σ_g c.	54KS
U ²³⁸ (n,f)	0+	14			0.10 ± 0.02c	σ_m estimated. σ_g prop count β .	57C

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Pu ²³⁹ (n,f)	<u>1/2+</u>	Thermal			(0.067)	σ_m i; σ_g c.	51CS
Pr ¹⁴¹ (p,sp)	<u>5/2+</u>	450			2.1c	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
I ¹²⁷ (p,sp)	<u>5/2+</u>	450			2.6c	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
In ¹¹⁵ (p,p τ^+)	<u>9/2+</u>	1000 2000 4100 4100 6200 6200	0.13 0.145 0.15 0.06 0.147 0.24	0.03 0.06 0.066 0.05 0.071 0.13	4.3 2.4 $\pm$ 0.4 2.3 $\pm$ 0.3 1.2 2.1 $\pm$ 0.14 1.8	Prop count β . ~25% contribution from secondary (n,p) reactions.	60NW
Ho ¹⁶⁵ (p,f)	<u>7/2-</u>	450	0.0079	0.0145c	0.55	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
Ta ¹⁸¹ (p,f)	<u>7/2+</u>	340	0.0027	0.0016c	1.7	Geiger count β .	55NS
Ta ¹⁸¹ (p,f)	<u>7/2+</u>	450	0.0044	0.0016c	2.8	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
Re(p,f)	<u>5/2+</u>	450	0.012	0.0041c	2.9	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
Au ¹⁹⁷ (p,f)	<u>3/2+</u>	450	0.11	0.042c	2.6	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
Pb(p,f)		54	0.0 ^a	0.36c	0.25	Geiger count β .	61VP
Pb(p,f)		600 1000 1600 2200 3000	0.55 0.5 0.33 0.35 ~0.24	0.32c 0.25c 0.16c 0.14c 0.11c	1.7 2.0 2.1 2.5 ~2.2	Prop count β .	56WB
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	340	0.83	(0.62)c	(1.3)	Geiger count β .	53B

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	450			1.64	Prop count β . σ_m i; σ_g c.	57P
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	450	1.0	0.61c	1.6	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
Th ²³² (p,f)	0+	13.3 to 21.1			0.066 to 0.057	Geiger count β . σ_m i; σ_g c.	52TJ
Th ²³² (p,f)	0+	450	7.8	15c	0.52	Geiger and prop count β . σ_g corrected for In ^{115m} decay.	55KS
U ²³⁸ (p,f)	0+	12 50 90 150 250 350			<0.032 0.054 0.13 0.26 0.29 0.36	Geiger count β . σ_m i; σ_g c.	59B
U ²³⁸ (p,f)	0+	50 75 100 125 150 200 250 300 350	1 3 6 7.5 9 11 12 11 13	18c 25c 30c 24c 23c 22c 21c 22c 21c	0.056# 0.12# 0.20# 0.31# 0.40# 0.50# 0.57# 0.50# 0.62#	Count β .	55HG
U ²³⁸ (p,f)	0+	340	12	33.6c	0.36	Geiger count β .	55FS
U ²³⁸ (p,f)	0+	480	93	87	1.1c		55VA
U ²³⁸ (p,f)	0+	2200 5700	8.5 7.5	19c 22c	0.45 $\pm$ 0.12 0.34 $\pm$ 0.10	Prop count β .	56S

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Cd}^{114}(\text{d},\text{p})$	0+	10			0.69 ± 0.07	Geiger count β .	59SP
		15			0.29 ± 0.03		
		20			0.23 ± 0.02		
		25			0.109 ± 0.011		
$\text{In}^{115}(\text{d},2\text{p})$	<u>9/2+</u>	15			3.19 ± 0.23	Geiger count β .	59SP
		20			2.40 ± 0.35		
		25			1.08 ± 0.15		
$\text{Sn}^{118}(\text{d},\alpha\text{p})$	0+	25			1.31 ± 0.22	Geiger count β .	59SP
$\text{Sb}(\text{d},\text{sp})$		50	0.0041	0.0017	>2.4	Geiger count β .	50LP
		75	0.0088	0.0041	2.2		
		100	0.11	0.026	4.3		
		190	0.68	0.15	4.5		
$\text{Bi}^{209}(\text{d},\text{f})$	<u>9/2-</u>	190			0.7c	Geiger count β .	49GP
$\text{U}^{233}(\text{d},\text{f})$	<u>5/2+</u>	12.1 ± 0.5	1.55	8.43c	<0.184	Geiger count β .	59FG
		14.0 ± 0.5	1.97	14.7c	<0.134		
		15.4 ± 0.5	3.92	22.9c	<0.171		
		19.6 ± 0.5	5.58	44.0c	<0.127		
		21.5 ± 0.5	8.5	47.3c	0.18		
		23.4 ± 0.5	4.8	63.9c	<0.075		
$\text{U}^{238}(\text{d},\text{f})$	0+	5	≤ 0.0004	0.0048c	≤ 0.083	Geiger count β .	57SD
		10	0.046	0.73c	0.063 ± 0.006		
		13.6	0.30	4.2c	0.071 ± 0.005		
$\text{U}^{238}(\text{d},\text{f})$	0+	10			0.30 ± 0.08	Geiger count β . σ_m i; σ_g c.	59SP
		15			0.15 ± 0.02		
		20			0.071 ± 0.008		
		25			0.025 ± 0.003		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
U ²³⁸ (d,f)	0+	50	1	19c	0.05#	Count β .	55HG
		75	5	33c	0.15#		
		100	9	35c	0.26#		
		150	14	36c	0.39#		
		190	16	37c	0.43#		
Pu ²³⁹ (d,f)	<u>1/2+</u>	12.3 $\pm$ 0.5	$\leq$ 1.12	6.55c	$\leq$ 0.171	Geiger count β .	56G
		15.0 $\pm$ 0.5	$\leq$ 1.57	18.4c	$\leq$ 0.085		
		16.1 $\pm$ 0.5	$\leq$ 2.23	20.8c	$\leq$ 0.107		
		17.9 $\pm$ 0.5	$\leq$ 5.89	26.3c	$\leq$ 0.224		
		20.2 $\pm$ 0.5	$\leq$ 5.54	39.2c	$\leq$ 0.141		
		20.6 $\pm$ 0.5	$\leq$ 4.64	42.3c	$\leq$ 0.110		
		23.4 $\pm$ 0.5	$\leq$ 7.18	53.5c	$\leq$ 0.134		
Sb(He ⁴ ,sp)		380	1.1	0.35	3.2	Geiger count β .	50LP
Th ²³² (He ⁴ ,f)	0+	25.7-28.9	0.79c	12c	0.066 $\pm$ 0.022	Geiger count β .	59FG
		34.9-37.7	1.4c	24c	0.058 $\pm$ 0.012		
		43.4-45.9	7.8c	54c	0.145 $\pm$ 0.073		
Th ²³² (He ⁴ ,f)	0+	37.5			($\sim$ 0.083c)	Probably β count. σ_g corrected for In ^{115m} decay.	49N
U ²³³ (He ⁴ ,f)	<u>5/2+</u>	25.3	0.8c	8.0c	(0.10)		61CSC
		29.0	1.6c	16.0c	(0.10)		
		34.5	4.0c	33.2c	(0.12)		
		40.5	5.3c	42.1c	(0.13)		
U ²³⁵ (He ⁴ ,f)	<u>7/2-</u>	39.9	5.0c	41.0c	0.12 $\pm$ 0.004	Prop count β .	59GC
U ²³⁵ (He ⁴ ,f)	<u>7/2-</u>	21.9	0.073	0.80c	0.091 $\pm$ 0.026	Count β .	57V
		23.6	0.25	3.27c	0.076 $\pm$ 0.021		
		25.2	0.423	5.43c	0.078 $\pm$ 0.022		
		26.8	1.29	10.3c	0.125 $\pm$ 0.035		
		27.3	1.0	9.06c	0.11 $\pm$ 0.03		
		29.7	1.2	12.5c	0.096 $\pm$ 0.027		
		30.6	1.65	16.6c	0.099 $\pm$ 0.028		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
U ²³⁵ (He ⁴ ,f) (Cont'd.)		32.8	3.7	32.7c	0.113 ± 0.032		
		34.1	3.17	35.2c	0.090 ± 0.025		
		37.1	3.86	43.8c	0.088 ± 0.025		
		39.5	4.3	51.3c	0.084 ± 0.024		
		42.8	4.4	46.5c	0.095 ± 0.027		
		45	10.1	49.6c	0.204 ± 0.058		
		45.5	10.9	61.5c	0.177 ± 0.050		
U ²³⁸ (He ⁴ ,f)	0+	380			~ 0.5c	Geiger count β .	48OS
Np ²³⁷ (He ⁴ ,f)	<u>5/2+</u>	19.8 ± 0.5	< 0.02	0.14c	< 0.14	Geiger count β .	56G
		22.7 ± 0.5	< 0.23	2.55c	< 0.090		
		24.2 ± 0.5	< 0.29	3.21c	< 0.090		
		28.1 ± 0.5	< 2.08	19.0c	< 0.110		
		31.5 ± 0.5	< 2.71	19.8c	< 0.137		
		35.0 ± 0.5	< 5.10	22.4c	< 0.228		
		38.1 ± 0.5	< 3.35	39.2c	< 0.0855		
		44.9 ± 0.5	< 8.17	37.6c	< 0.218		
		45.7 ± 0.5	< 8.5	49.7c	< 0.17		
Au ¹⁹⁷ (C ¹² ,f)	<u>3/2+</u>	64			1.56c	Geiger count β . Ag ¹¹⁵ decay included.	60PC
		78			1.82c		
Au ¹⁹⁷ (N ¹⁴ ,f)	<u>3/2+</u>	89			2.1c	Geiger count β . Ag ¹¹⁵ decay included	60PC
Au ¹⁹⁷ (N ¹⁴ ,f)	<u>3/2+</u>	115			1.9 ± 0.7c	Geiger count β .	58TG
U ²³⁸ (N ¹⁴ ,f)	0+	115			0.88 ± 0.35c	Geiger count β .	58TG
Au ¹⁹⁷ (O ¹⁶ ,f)	<u>3/2+</u>	85			2.0c	Geiger count β . Ag ¹¹⁵ decay included	60PC
		102			2.33c		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
In ^{110m}	4.9h	<u>7</u>	0.120	IT EC γ	(0.6%). ($\sim$ 100%) to 2.48 level; others to higher levels. all cascade to 1.54 level; 1.54--0.656--0.
In ¹¹⁰	66m	2+		β^+ EC γ	2.25(72% β^+ , 28%EC) to 0.656 level. 0.656--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Ag ¹⁰⁷ (He ⁴ ,n)	<u>1/2-</u>	10.6-11.0	0.30	1.99	0.15 $\pm$ 0.016	σ_m scint count sum peak of 3.15-Mev γ ; σ_g scint count 656-keV γ with NaI.	61BH
		11.9-12.3	6.63	33.2	0.200 $\pm$ 0.022		
		13.4-13.7	21.5	78.1	0.275 $\pm$ 0.028		
		14.85-15.15	69.0	159	0.434 $\pm$ 0.042		
		16.8-17.1	123	187	0.658 $\pm$ 0.050		
		18.5-18.8	188	157	1.20 $\pm$ 0.10		
		20.1-20.35	178	59.7	2.98 $\pm$ 0.28		
		20.3-20.55	214	74.9	2.86 $\pm$ 0.30		
		21.8-22.1	128	30.6	4.18 $\pm$ 0.42		
Ag ¹⁰⁹ (He ⁴ ,3n)	<u>1/2-</u>	27.5-27.8	68.5	33	2.08 $\pm$ 0.21	σ_m scint count sum peak of 3.15-Mev γ ; σ_g scint count 656-keV γ with NaI.	61BH
		29.2-29.5	193	72.9	2.66 $\pm$ 0.27		
		31.0-31.3	363	103	3.52 $\pm$ 0.32		
		33.1-33.4	487	116	4.20 $\pm$ 0.34		
		35.1-35.3	672	136	4.95 $\pm$ 0.45		
		36.8-37.0	811	141	5.75 $\pm$ 0.55		
		38.6-38.75	799	115	6.95 $\pm$ 0.70		
Ag ¹⁰⁹ (He ⁴ ,3n)	<u>1/2-</u>	$\sim$ 28			(2.4)	σ_m count 656-keV γ . σ_g β spectrometric count β (100%?)	56P

Isomer	Half-life	Spin, parity	Level	Decay scheme	
In ^{112m}	0.042s	(7-)	0.466	IT	0.466--0.155.
In ^{112m}	20.7m	(4+)	0.155	IT	
In ¹¹²	14.5m	1+		μ^+ EC EC γ β^-	0.99 (0.8% β^+ , 4.9% EC) to 0.615 level; 1.62 (21% β^+ , 29% EC) to 0 level. (1.3%) to 1.31 level. 1.31--0.615--0; 1.31--0. 0.656 (41%) to 0 level.

Reaction	Target spin	E	$\sigma_m^\dagger$	σ_g	σ_m/σ_g	Comments	Reference
Cd ¹¹² (p,n)	0+	6.7	67	45	1.5?	$t_{1/2}$ of In ^{112g} was 9m. Geiger count converted electrons of In ^{112m} (e/ γ 9).	51BB

$^\dagger\sigma_m$ is sum of σ_m (7-) and σ_m (4+).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
In ^{114m}	2.5s	(8 _±)	0.34	IT	0.34--0.192.
In ^{114m}	50.0d	<u>5</u> +	0.192	IT EC γ	(96.5%). (3.5%) to 1.28 level. 1.28--0.556--0.
In ¹¹⁴	72s	1+		β ⁻ γ β ⁺ EC γ	0.67(0.15%) to 1.30 level; 1.98(98.9%) to 0 level. 1.30--0. 0.397(0.0035% β ⁺ , 0.7%EC) to 0 level; (0.25%EC) to 1.21 level. 1.21--0; 1.21--0.556--0.

Reaction	Target spin	E	σ _m [†]	σ _g	σ _m /σ _g	Comments	Reference
In ¹¹⁵ (γ,n)	<u>9/2</u> +	10.2			6.9#	Ionization chamber count β, used 100% IT and 97% β ⁻ of In ^{114g} .	53GK
		10.7			8.2#		
		11.3			8.3#		
		11.8			8.4#		
		12.3			8.2#		
		12.8			8.3#		
		13.3			7.7#		
		13.8			7.2#		
		14.3			6.7#		
		14.8			6.5#		
		15.3			6.0#		
		15.8			6.1#		
		16.3			6.0#		
		16.8			6.0#		
		17.3			6.1#		
		17.8			6.0#		
		18.2			6.0#		
In ¹¹³ (n,γ)	<u>9/2</u> +	Thermal	56,000	2,000	(28±10)	σ _g 3% of total capture.	48GM, 58HS

Reaction	Target spin	E	$\sigma_m^\dagger$	σ_g	σ_m/σ_g	Comments	Reference
Cd ¹¹⁴ (p,n)	0+	6.7	68	85	0.80	Geiger count β . 100% IT, 97% β of In ^{114g} .	51BB
Cd ¹¹⁴ (p,n)	0+	5.0			0.26 $\pm$ 0.15*	Prop count β and scint count 556-kev γ with NaI.	62WH
		5.5			0.27 $\pm$ 0.16*		
		6.0			0.34 $\pm$ 0.14*		
		6.5			0.42 $\pm$ 0.16*		
		7.0			0.52 $\pm$ 0.17*		
		7.5			0.62 $\pm$ 0.18*		
		8.0			0.72 $\pm$ 0.22*		
		8.5			0.85 $\pm$ 0.25*		
		9.0			1.00 $\pm$ 0.30*		
		9.5			1.15 $\pm$ 0.35*		
		10.0			1.24 $\pm$ 0.38*		

$^\dagger\sigma_m$ is sum of $\sigma_m(8\pm)$ and $\sigma_m(5+)$.

Isomer	Half-life	Spin, parity	Level	Decay scheme	
In ^{116m}	2.5s	(8-)	0.22	IT	0.22--0.07 (e/ γ $\sim$ 1).
In ^{116m}	54m	<u>5</u> (+)	0.07	β^-	0.34 (2%) to 3.04 level; 0.60 (18%) to 2.76 level; 0.87 (38%) to 2.49 level; 1.00 (42%) to 2.35 level.
				γ	3.04--1.27 (2R)--0 (83R); 2.76--1.27 (10R); 2.76--2.35 (8R)--1.27 (57R); 2.49--2.09 (32R)--0 (17R); 2.49-- 2.35 (6R); 2.09--1.27 (15R).
In ¹¹⁶	12.5s	(0,1)+		β^-	3.29 (100%) to 0 level.

Reaction	Target spin	E	$\sigma_m^\dagger$	σ_g	σ_m/σ_g	Comments	Reference
In ¹¹⁵ (n, γ)	<u>9/2+</u>	Thermal	144,600	51,800	2.80 $\pm$ 0.39	Geiger count β .	47SF
In ¹¹⁵ (n, γ)	<u>9/2+</u>	Thermal 1	157,000 180	57,000 63	2.76 2.9	Geiger count β .	49HS
In ¹¹⁵ (n, γ)	<u>9/2+</u>	Thermal 1	145,000 166	52,000 57	2.8 2.9	Geiger count β . See 49HS.	53HG
In ¹¹⁵ (n, γ)	<u>9/2+</u>	3.86 ev 2.66 ev 1.45 ev 0.10 ev Pile Pile			1.20 $\pm$ 0.07 2.23 $\pm$ 0.21 2.45 $\pm$ 0.12 2.05 $\pm$ 0.25 2.48 $\pm$ 0.15 2.40 $\pm$ 0.15	Prop count β . Data of 60DS cor- rected by 61GK.	61GK, 60DS

$^\dagger \sigma_m$ here is sum of $\sigma_m(2.5s)$ and $\sigma_m(54m)$.

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
In ^{117m}	1.9h	1/2-	0.311	IT (28%). β^- 1.62 (21%) to 0.161 level; 1.77 (51%) to 0 level. γ 0.161--0.	61WH
In ¹¹⁷	43m	9/2+		β^- 0.74 (100%) to 0.726 level. γ 0.726--0.161--0.	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Sn ¹¹⁸ (γ ,p)	0+	24 Brem			15.4 $\pm$ 0.36	NaI scint count 161-keV γ .	61H
Sb ¹²¹ (γ , α)	<u>5/2+</u>	16	0.003	0.011	0.27*	Scint count 161-keV γ with NaI. Brem.	61WH
		17	0.006	0.022	0.27*		
		18	0.0125	0.037	0.33*		
		19	0.020	0.055	0.36*		
		20	0.027	0.075	0.36*		
		21	0.040	0.107	0.38*		
		22	0.060	0.150	0.40*		
		23	0.078	0.208	0.38*		
In ¹¹⁵ (He ⁴ ,2p)	<u>9/2+</u>	22.8			(0.43 $\pm$ 0.04)	Scint count 565-keV γ .	61SD
		24.4			(0.40 $\pm$ 0.04)		
		25.7			(0.46 $\pm$ 0.08)		
		25.9			(0.39 $\pm$ 0.06)		
		26.4			(0.44 $\pm$ 0.06)		
		27.2			(0.25 $\pm$ 0.03)		
		27.4			(0.35 $\pm$ 0.04)		
In ¹¹⁵ (He ⁴ ,2p)	<u>9/2+</u>	21.7-20.6			5.3 $\pm$ 0.3	Scint count 0.565-keV γ with NaI.	62S
		23.2-22.0			5.9 $\pm$ 0.3		
		24.6-23.5			4.35 $\pm$ 0.19		
		25.7-25.0			3.6 $\pm$ 0.3		
		26.1-25.2			4.4 $\pm$ 0.2		
		26.6-26.2			4.0 $\pm$ 0.2		
		27.2-26.6			2.5 $\pm$ 0.1		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
In ¹¹⁵ (He ⁴ ,2p) (Cont'd.)		27.4-26.7			1.9 ± 0.1		
		27.4-26.9			2.04 ± 0.12		
		31.1-30.4			0.366 ± 0.021		
		31.9-31.4			0.312 ± 0.018		
		32.7-32.2			0.281 ± 0.017		
		38.8-38.2			0.351 ± 0.038		
		40.1-39.7			0.333 ± 0.033		
		41.5-41.2			0.345 ± 0.038		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
$\text{In}^{119\text{m}}$	17.5m	(1/2-)	0.3	IT (4%). β^- 1.8 (if 6%) to 0.907 level; 2.7 (if 90%) to 0.024 level. γ 0.907--0; 0.024--0.	
In^{119}	2.3m	(9/2+)		β^- 1.6 (if 100%) to 0.84 level. γ 0.84--0.024--0.	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Sn}^{120}(\gamma, p)$	0+	18.5			~2.9#	Maximum γ energies. σ_m end-window count β . σ_g scint count with NaI. Assuming no IT.	60KR
		18.5			~3.4#		
		19			~3.3#		
		19			~3.8#		
		20			~11.5#		
		21			~9.5#		
		22			~10.5#		
		23			~8.3#		
		23			~8.9#		
		24			~8.5#		
		25			~8.7#		
		26			~8.7#		
		28.5			~7.8#		
$\text{Sn}^{120}(\gamma, p)$	0+	25 Brem			4.0 ± 1.0	Geiger count β and NaI scint count 0.77 (0.82?)-Mev γ . Assuming no IT.	60YM

Isomer	Half-life	Spin, parity	Level	Decay scheme
In ¹²⁰	50s			β^- 2.2. γ energies 0.73; 0.85; 1.02; 1.18.
In ¹²⁰	3.0s			β^-

Reaction	Target spin	E	$\sigma(50s)$	$\sigma(3s)$	$\sigma(50s)/ (3s)$	Comments	Reference
Sn ¹²⁰ (n,p)	0+	14.8	2.8	~1	(~2.8)	Not sure how cross sections were determined.	60PCM

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{In}^{121\text{m}}$	3.1m	(1/2-)	β^-	3.7 (if 100%) to 0.05 and 0 levels.
In^{121}	30s	(9/2+)	β^- γ	2.9 (if 100%) to 0.94 level. 0.94--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m, σ_g	Comments	Reference
$\text{Sn}^{122}(\gamma, p)$	0+	25 Brem			5.8 ± 2.0	σ_m count β σ_g scint count 0.94-Mev γ by NaI.	60YM

Isomer	Half-life	Spin, parity	Level	Decay scheme
In ^{123m}	36s	(1/2-)	β^-	4.6 (~100%) to 0 level (41m Sn ¹²³).
In ¹²³	10s	(9/2+)	β^- γ	~3.3 (~100%) to 1.10 level. 1.10--0 (41m Sn ¹²³).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Sn ¹²⁴ (γ ,p)	0+	25 Brem			13 $\pm$ 7	σ_m count β σ_g scint count 1.10-Mev γ .	60YM

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
$\text{Sn}^{113\text{m}}$	20m	(7/2+)	0.079	IT (91%). EC (9%) to 0 level.	61SE
Sn^{113}	118d	(1/2+)		EC (98%) to 0.393 level; (2%) to 0.648 level. γ 0.648--0.393 (e/ γ 0.044)--0.	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Sn}^{112}(\text{n}, \gamma)$	0+	Thermal			0.41 ± 0.06	σ_m scint count 79-kev γ ; σ_g scint count 393-kev γ with NaI.	61SE

Isomer	Half-life	Spin, parity	Level	Decay scheme	
$\text{Sn}^{121\text{m}}$	>5y	(11/2-)	~0.05	β^- γ	0.42(100%) to 0.01 level. 0.01--0.
Sn^{121}	27.5h	(3/2+)		β^-	0.383(100%) to 0 level.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Sn}^{120}(\text{n},\gamma)$	0+	Pile	54.5	218	0.25?	Geiger count β . Assuming the 400d activities were $\text{Sn}^{121\text{m}}$.	47SF
$\text{Sn}^{120}(\text{n},\gamma)$	0+	Thermal	1	140	(0.007 $\pm$ 0.007)		58HS

Isomer	Half-life	Spin, parity	Level	Decay scheme
Sn^{123}	41.5m	(3/2+)		β^- 1.26 (100%) to 0.16 level. γ 0.16--0 (e/ γ 0.13).
Sn^{123}	125d	11/2-		β^- 0.34 (2%) to 1.08 level; 1.42 (98%) to 0 level. γ 1.08--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Sn}^{124}(\gamma, n)$	0+	19(max)			(4.2 $\pm$ 0.2)		61KR
$\text{Sn}^{124}(\gamma, n)$	0+	25 Brem			1.5 $\pm$ 0.4	Geiger count β .	60YM
$\text{Sn}^{122}(n, \gamma)$	0+	Thermal	160	1.0	(160 $\pm$ 80)		58HS
$\text{Sn}^{124}(\text{He}^4, \alpha n)$	0+	27	0.4	2.7	0.15*	σ_m scint count 160-kev γ with NaI. σ_g count β .	61HM
		28	0.9	4.2	0.21*		
		29	1.6	6.2	0.26*		
		30	2.5	8.4	0.30*		
		31	3.5	10.5	0.33*		
		32	4.8	13	0.37*		
		33	6.5	15	0.43*		
		34	8.4	18	0.47*		
		35	11	21	0.53*		
		36	14	23	0.60*		
		37	18	27	0.66*		
		38	21	29	0.72*		
		39	23	30	0.77*		
		40	24	30	0.80*		
		41	25	27	0.92*		

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Sn ^{125m}	9.7m	(3/2+)	~0.03	β^-	0.65(2.2%) to 1.71 level; 2.04(97.8%) to 0.326 level.		
				γ	1.71--1.07--0; 1.71--0.326--0(99.7%).		
Sn ¹²⁵	9.4d	11/2-		β^-	0.23 to 2.11 level; 0.37(2.1%) to 1.97 level; 0.47(1.5%) to 1.88 level; ~1.3(1.3%) to 1.07 level; 2.33(95%) to 0 level.		
				γ	2.11--1.88--1.07--0(3.9%); 1.88--1.41--0; 1.97--0; 1.97--1.07; 1.41--1.07.		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Sn ¹²⁴ (n, γ)	0+	Pile	650	150	4.3 $\pm$ 1.2?	Geiger count β . Assumed the 10d activities were Sn ^{125g} .	47SF
Sn ¹²⁴ (n, γ)	0+	Thermal	150	5	30	Geiger count β .	53HG
		1	15	4	4		
Sn ¹²⁴ (n, γ)	0+	Thermal	200	4	(50+35)		58HS
Sn ¹²⁴ (He ⁴ , 2pn)	0+	31	0.04	0.32	0.013*	σ_m scint count 3.26-keV γ with NaI and β count. σ_g count β .	61HM
		32	0.09	0.44	0.20*		
		33	0.17	0.58	0.29*		
		34	0.28	0.70	0.40*		
		35	0.44	0.83	0.53*		
		36	0.66	0.95	0.70*		
		37	0.94	1.07	0.88*		
		38	1.30	1.19	1.10*		
		39	1.62	1.30	1.24*		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Sb ^{122m}	3.5m	(7-)	0.136	IT	0.136--0.061.
		(4-)	0.061	IT.	
Sb ¹²²	2.8d	<u>2-</u>		EC	(0.7%) to 1.14 level.
				β^+EC	0.57 (0.0063% β^+ , 2.3% EC) to 0 level.
				γ	1.14--0.
				β^-	0.74 (4%) to 1.25 level; 1.40 (62.9%) to 0.564 level;
					1.97 (30%) to 0 level.
				γ	1.25--0; 1.25--0.564--0.

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Sb ¹²¹ (n, γ)	<u>5/2+</u>	Thermal	57	6000	(0.0095)	Did not mention what radiations were measured.	62MS

[†] σ_g includes σ_m (4-).

Isomer	Half-life	Spin, parity	Level	Decay scheme
Sb ^{126m}	18.8m			IT (99%). β^- (1%).
Sb ¹²⁶	12.5d			β^- ~1.9($\leq 100\%$) to 1.78 level. γ 1.78--1.36($\sim 100R$)--0.665($\sim 100R$)--0($\sim 100R$).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Sn ¹²⁴ (He ⁴ ,pn)	0+	21	0.31	0.05	~6*	Scint count 0.68-Mev γ with NaI.	61HM
		22	0.42	0.15	~2.8*		
		23	0.55	0.26	2.10*		
		24	0.70	0.45	1.55*		
		25	0.90	0.87	1.04*		
		26	1.08	1.3	0.83*		
		27	1.3	2.0	0.65*		
		28	1.55	2.9	0.53*		
		29	1.85	4.0	0.47*		
		30	2.2	5.0	0.44*		
		31	2.6	6.4	0.41*		
		32	3.0	7.5	0.40*		
		33	3.5	8.7	0.40*		
		34	3.9	10	0.39*		
		35	4.4	11	0.40*		
		36	5.0	12.5	0.40*		
		37	5.5	13.5	0.41*		
		38	6.0	14.5	0.42*		
		39	6.5	15	0.43*		
		40	6.7	15.5	0.43*		

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{Te}^{119\text{m}}$	4.7d	(11/2-)	~0.3	EC (23%) to 2.39 level; (77%) to 1.37 level. γ 2.39--0.27 (5.5%)--0; 2.39--1.37 (17%)-- 0.153 (78%)--0; 1.37--0.27 (16%).
Te^{119}	16h	(1/2+)		EC (5%) to 1.76 level; (93%) to 0.645 level. β^+ 0.627 (2%) to 0.645 level. γ 1.76--0; 0.645--0.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{I}^{127}(\text{p}, \text{sp})$	<u>5/2+</u>	250			(0.33 $\pm$ 0.03)		60ZK
$\text{Ta}^{181}(\text{p}, \text{sp})$	<u>7/2+</u>	5700	< 0.6	8.7	($\sim$ 0.069) $\pm$ 0.025	σ_m scint count 0.64-Mev γ (90% ?); σ_g scint count K x-rays (86%) and 0.64-Mev γ (90% ?) with NaI.	57G 62G

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Te ^{121m}	154d	(11/2-)	0.296	IT	0.296--0.214 (95%)--0 (e/γ 0.16).
				EC	(5%).
	<5 x 10 ⁻⁹ s	(3/2+)	0.214	γ	energy 1.13.
				IT	
Te ¹²¹	17d	(1/2+)		EC	(100%) to 0.575 level.
				γ	0.575--0 (87%, e/γ ~0.01); 0.575--0.070 (13%, e/γ 0.018)--0.

Reaction	Target spin	E	σ _m	σ _g [†]	σ _m /σ _g	Comments	Reference
Sb ¹²¹ (p,n)	<u>5/2+</u>	6.7	105	70	1.33 ± 0.30	Geiger count γ.	51BB
Bi ²⁰⁹ (p,f)	<u>9/2-</u>	405	>5.8	1.9	>3c	Geiger count with unknown counting efficiency for σ _m .	55JS
Ta ¹⁸¹ (p,f)	<u>7/2+</u>	5700	0.52	12.4	0.042 ± 0.015	σ _m and σ _g scint count 0.21-Mev γ (91%) and k x-rays (73%), resp.	57G 62G
Sb ¹²¹ (d,2n)	<u>5/2+</u>	9.2 ± 0.2			0.560 ± 0.095	Scint count 214- and 575-keV γ with NaI.	62NA
		11.7 ± 0.3			0.470 ± 0.025		
		14.3 ± 0.3			0.560 ± 0.015		
		16.6 ± 0.2			0.603 ± 0.009		
		18.7 ± 0.3			0.653 ± 0.032		
		20.3 ± 0.1			0.623 ± 0.024		
		21.5 ± 0.1			0.720 ± 0.060		
		22.8 ± 0.2			0.720 ± 0.093		
		24.2 ± 0.2			0.653 ± 0.079		
		25.8 ± 0.2			0.747 ± 0.064		
		27.3 ± 0.1			0.793 ± 0.087		

[†]σ_g includes σ_m (3/2+).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Te^{127m}	105d	(11, 2-)	0.0887	IT β^- γ	(98.5%), 0.73(1.5%) to 0.059 level. 0.059--0.
Te^{127}	9.35h	(3, 2+)		β^- γ	0.27(1%) to 0.418 level; 0.695(99%) to 0 level. 0.418--0; 0.418--0.059 0.418--0.203--0; 0.203--0.059--0 (e/ γ 1.95).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Te}^{126}(n, \gamma)$	0+	Pile	73	780	0.094 $\pm$ 0.026	Geiger count f	47SF
$\text{Te}^{126}(n, \gamma)$	0+	Thermal			(0.15 $\pm$ 0.02)		60KB3
$\text{I}^{127}(p, p_n^+)$	<u>5/2+</u>	250 500 720 1000 2000 6200	0.5 0.06 0.6 0.1 0.6 0.4	1.5 1.7 2.6 1.2 2.6 1.3	$\sim$ 0.3 $\sim$ 0.035 $\sim$ 0.23 $\sim$ 0.084 $\sim$ 0.23 $\sim$ 0.31	Prop count β^- . Possible contamination from secondary (n,p) reactions.	60LW
$\text{Sn}^{124}(\text{He}^4, n)$	0+	13.47 14.68 16.44 17.60 17.70 19.43 20.53 20.80 22.44 23.39 23.67 26.41	9.77 18.0 51.0 87.3 88.8 94.0 106 67.8 66.8 57.5 35.0 40.0	11.8 20.5 39.0 71.3 70.9 37.1 41.9 41.9 20.6 21.0 24.4 17.5	0.83 $\pm$ 0.16 0.88 $\pm$ 0.17 1.31 $\pm$ 0.26 1.22 $\pm$ 0.25 1.25 $\pm$ 0.25 2.53 $\pm$ 0.64 2.53 $\pm$ 0.64 1.62 $\pm$ 0.40 3.24 $\pm$ 0.80 2.74 $\pm$ 0.68 1.43 $\pm$ 0.22 2.29 $\pm$ 0.57	Count 0.7-Mev β^- and k - X rays.	61HM

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Te ^{129m}	33.3d	(11/2-)	0.106	IT β^-	(e/ γ very large). 1.59 (if 5%) to 0 level.		
Te ¹²⁹	67.3m	(3/2+)		β^- γ	0.3(1%) to 1.15 level; 0.7(3%) to 0.72 level; 0.99(16%) to 0.502 level; 1.45(80%) to 0.027 level. 1.15--0.027--0; 0.72--0; 0.72--0.502--0.027.		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Te ¹²⁸ (n, γ)	0+	Pile	15.4	133	0.116 ± 0.033	Geiger count β .	47SF
Te ¹²⁸ (n, γ)	0+	Thermal Epi-Cd			0.079 ± 0.016 0.075 ± 0.015	Scint count 1.12-Mev γ with NaI.	61BH
Te ¹³⁰ (p,pn)	0+	45 60 80 100			1.27 ± 0.10 1.23 ± 0.10 1.38 ± 0.20 1.41 ± 0.20	Prop. count β and scint count γ with NaI.	62S

Isomer	Half-life	Spin, parity	Level	Decay scheme	
$\text{Te}^{131\text{m}}$	28.8h	(11/2-)	0.182	IT (19%). β^- 0.22 (3.6%) to 2.24 level; 0.42 (43%) to 2.00 level; 0.57 (31%) to 1.92 level; 2.46 (3.8%) to 0 level. γ 2.24--0 (0.6R); 2.24--2.00 (3R)--0 (4R); 2.00--0.78 (17R)--0 (80R); 2.00--1.92 (4R)--0 (2R); 2.00--0.92 (5R)--0 (5R); 1.92--1.82(8R)--1.62 (8R)--0 (3R); 1.92--0.78 (25R); 1.62--0.78 (40R); 1.97--1.62 (16R).	
Te^{131}	24.8m	(3/2+)		β^- 1.36 (~5%) to 0.92 level; 1.68 (25%) to 0.60 level; 1.15 (~10%) to 1.13 level; 2.14 (60%) to 0.15 level. γ 0.92--0 (5R); 0.60--0 (5R); 0.60--0.15 (20R)--0 (80R, e_K/γ 0.26); 1.13--0 (10R); 1.13--0.15 (1R).	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Te}^{130}(\text{n},\gamma)$	0+	Thermal	8	222	(<0.036)	σ_m pile neutrons; σ_g thermal neutrons. Geiger count β and I^{131} .	47SF
$\text{U}^{235}(\text{n},\text{f})$	<u>7/2-</u>	Thermal			4.2 ± 1.0	Prop count β of I^{131} .	62TG
$\text{U}^{235}(\text{n},\text{f})$	<u>7/2-</u>	Thermal 14			$\sim 1.7\text{c?}$ $>1.1\text{c?}$	Scint count γ .	55W
$\text{U}(\text{p},\text{sp})$		170	3	7.9	(0.38 ± 0.18)		62AP
$\text{Te}^{130}(\text{d},\text{p})$	0+	7 15.4			$(0.28)\#$ $(0.48)\#$	No experimental details given.	52F

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Xe ^{127m}	75s	(11/2-)	0.125	IT	(100%) to (5/2+) level.		
		(5/2+)		IT	(100%) to 0.125 level.		
		(3/2+)		IT			
Xe ¹²⁷	36.4d	(1/2+)		EC	(46%) to 0.375 level; (54%) to 0.203 level.		
				γ	0.375--0(21R); 0.375--0.203(25R)--0(73R, e/γ 0.1); 0.203--0.059(6R)--0(6R).		

Reaction	Target spin	E	σ _m	σ _g [†]	σ _m /σ _g	Comments	Reference
I ¹²⁷ (p,n)	<u>5/2+</u>	6.7	53	44	(1.2±0.2)	Geiger count.	51BB

[†]σ_g includes σ_m(5/2+) and σ_m(3/2+).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Xe ^{135m}	15.3m	(11/2-)	0.528	IT	(e _k /γ 0.2).
Xe ¹³⁵	9.13h	(3/2+)		β ⁻	0.55 (~3%) to 0.604 level; 0.91 (97%) to 0.250 level.
				γ	0.604--0 (3R); 0.604--0.250 (0.09R)--0 (97R; e/γ 0.063).

Reaction	Target spin	E	σ _m	σ _g	σ _m /σ _g	Comments	Reference
Ba ¹³⁸ (n, α)	0+	14.1 ± 0.2	13	13	1.0 ± 0.2	Coinc count γ with plastic scintillator.	61F

Isomer	Half-life	Spin, parity	Level	Decay scheme	
$\text{Cs}^{134\text{m}}$	2.9h	<u>8</u> (-)	0.137	IT	0.137--0.010(~100%, e/γ 6.1)--0; 0.137--0(0.8%).
			0.063	IT	0.063--0.
		(5+)	0.010	IT	
Cs^{134}	2.19y	<u>4</u> (+)		β^-	0.086(27%) to 1.97 level; 0.282(0.5%) to 1.77 level; 0.41(9%) to 1.64 level; 0.658(61%) to 1.40 level; 0.892(1.5%) to 1.17 level; 1.45(0.2%) to 0.60 level.
				γ	1.97--0.60(5R)--0(98%); 1.97--1.17(11R)--0(2R); 1.97--1.40(12R)--0.60(73R); 1.77--0.60(0.5R); 1.64--0.60(5R); 1.64--1.17(4R)--0.60(14R).

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
$\text{Cs}^{133}(\text{n},\gamma)$	<u>7/2</u> +	Pile	16	25,600	6.2×10^{-4}	Geiger count β .	47SF
$\text{Cs}^{133}(\text{n},\gamma)$	<u>7/2</u> +	Thermal	2,820	30,400	0.093 ± 0.003	Count β and γ (0.47 to 1.17 Mev) coincidences.	60BB
		Epi-Cd	34,400	461,000	0.075 ± 0.006		
$\text{Cs}^{133}(\text{n},\gamma)$	<u>7/2</u> +	Thermal			0.102 ± 0.015	Scint count 796- and 801-kev γ with NaI.	61BH
		Thermal			0.086 ± 0.013		
		Epi-Cd			0.082 ± 0.012		
		Epi-Cd			0.078 ± 0.012		
		Epi-Cd			0.074 ± 0.011		
		Epi-Cd			0.081 ± 0.012		
$\text{Cs}^{133}(\text{n},\gamma)$	<u>7/2</u> +	0.025 ± 0.005	0.6	900	(0.00067 ± 0.00039)	No mention of what radiations were measured.	58BB

$^\dagger \sigma_g$ includes $\sigma_m(5+)$ and $\sigma_m(0.063 \text{ Mev})$.

Isomer	Half-life	Spin, parity	Level	Decay scheme
Ce ^{137m}	34.4h	(11/2-)	0.254	IT (99.4%, e/γ ~6.9). EC (0.6%).
Ce ¹³⁷	8.7h	(3/2+)		EC (3%) to 0.455 level; (97%) to 0.010 level. γ 0.455--0.010 (e/γ 0.014)--0 (e/γ ~140).

Reaction	Target spin	E	σ _m	σ _g	σ _m /σ _g	Comments	Reference
Ce ¹³⁶ (n, γ)	0+	Pile	2000	20,000	(0.1 ^{+0.1} _{-0.05})	Not sure what radiations were measured.	55BK
Ce ¹³⁶ (n, γ)	0+	Thermal	630	6300	0.1	Prop count La x-rays.	56BK
Ce ¹³⁶ (n, γ)	0+	Thermal	600	6300	(0.095 ± 0.04)		58HS
Cs ¹³⁶ (n, γ)	0+	Thermal			(0.15 ± 0.01)	Count 455-kev γ.	60KB3
La ¹³⁹ (d, 4n)	<u>7/2+</u>	18.8 ± 0.2 21.8 ± 0.3 22.7 ± 0.3 23.5 ± 0.2 24.4 ± 0.3 25.1 ± 0.2 25.9 ± 0.2 26.9 ± 0.3 27.7 ± 0.3 27.9 ± 0.2			0.03 ± 0.006 0.09 ± 0.02 0.15 ± 0.03 0.34 ± 0.07 0.38 ± 0.08 0.59 ± 0.12 0.46 ± 0.09 0.76 ± 0.15 0.67 ± 0.13 0.68 ± 0.13	Scint count 255-kev and 445-kev γ with NaI.	61VN

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Ce ^{139m}	55s	11/2-	0.74	IT	(e _K /γ 0.08).
Ce ¹³⁹	140d	<u>3/2+</u>		EC γ	(100%) to 0.166 level. 0.166--0 (e/γ 0.25).

Reaction	Target spin	E	σ _m	σ _g	σ _m /σ _g	Comments	Reference
Ce ¹⁴⁰ (γ,n)	0+	31			0.16 ± 0.01	Scint count 740 and 166-keV γ with NaI. One γ per decay.	62FK
Ce ¹³⁸ (n,γ)	0+	Thermal	7	1000	0.007 ^{+0.007} _{-0.004}	σ _m compared X-ray intensities with Ce ^{137g} . σ _g compared 166-keV γ with 145-keV γ of Ce ¹⁴¹ .	56KT
Ce ¹⁴⁰ (n,2n)	0+	14.7 ± 0.7	805	1075	0.745	Scint count γ.	62KA
Nd ¹⁴² (n,α)	0+	14.8 ± 0.8	10	2	(5 ± 3)	Prop count.	60WF

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Nd ^{141m}	63.9s	(11/2-)	0.76	IT.			
Nd ¹⁴¹	2.42h	<u>3/2+</u>		β^+	0.78 (2.2%) to 0 level.		
				EC	(95%) to 0 level; (2%) to 1.30 level; (0.3%) to 0.88 level.		
				γ	1.30--0 (0.7R); 1.30--0.145 (1R)--0 (1R); 1.30--0.88 (0.3R)--0 (0.6R).		
Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Nd ¹⁴² (n,2n)	0+	14.7 $\pm$ 0.7	618	1862	0.333	Scint count γ and annihilation radiations, 1.9% β^+ .	62KA

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
Pm ^{148m}	41d	(5,6,7-)	0.135	IT. 0.135--0.075 (6.5%)--0. β^- 0.5 (37%) to 2.19 level; 0.6 (19%) to 2.09 level; 0.68 (8%) to 2.02 level; 0.8 (24%) to 1.90 level.	62SB, 62SF, 62RS
		(2,3-)	0.075	γ all cascade to 1.18 level; 1.18--0.55 (93.5%)--0 (93.5%). IT	
Pm ¹⁴⁸	5.4d	(1,2-)		β^- 1.1 (41%) to 1.46 level; 2.0 (14%) to 0.55 level; 2.6 (45%) to 0 level. γ 1.46--0 (24%); 1.46--0.55 (17%)--0 (31%).	

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Pm ¹⁴⁷ (n, γ)		Thermal Resonance Integral	111,000 1.52 x 10 ⁶	124,000 1.70 x 10 ⁶	0.89 $\pm$ 0.10 0.89 $\pm$ 0.16	σ_m scint count 550- and 627-kev γ ; σ_g scint count 1.46-Mev γ with NaI.	62SB
U ²³⁸ (He ⁴ ,f)	0+	45			>0.5	Geiger count β .	59B

[†] σ_g includes σ_m (0.075 Mev).

Isomer	Half-life	Spin, parity	Level	Decay scheme
$\text{Sm}^{141\text{m}}$	60s	(11/2-)	0.68	IT.
Sm^{141}	8.5m	(3/2+)		β^+ 2.5(,50%). EC (,50%).

Reaction	Target spin	E	σ_{m}	σ_{g}	$\sigma_{\text{m}}/\sigma_{\text{g}}$	Comments	Reference
$\text{Sm}^{144}(\text{n},2\text{n})$	0+	14.7 ± 0.7	673	922	0.729	Scint count γ . 43% β^+ for $\text{Sm}^{143\text{g}}$ and $t_{1/2} = 73\text{s}$ for $\text{Sm}^{143\text{m}}$	62KA

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Eu ^{152m}	9.35h	0-	0.055	β^-	1.87 (74%) to 0 level; 1.55 (2%) to 0.344 level; 0.56 (1.6%) to 1.32 level.
				γ	1.32--0 (1%); 1.32--0.344 (0.5%)--0 (2.6%).
				EC	(1%) to 1.51 level; (20%) to 0.963 level; (0.24%) to 0.685 level; (1%) to 0.122 level; (0.25%) to 0 level.
				γ	1.51--0.122 (1%)--0 (13.2%); 0.963--0 (9%); 0.963--0.122 (11%); 0.685--0.122 (24%).
Eu ¹⁵²	12.2y	<u>3-</u>		β^-	0.22 (2%) to 1.58 level; 0.36 (2.7%) to 1.45 level; 0.71 (12%) to 1.12 level; 1.04 (1.8%) to 0.755 level; 1.47 (7.5%) to 0.344 level.
				γ	1.58--0.344 (2%)--0 (26%); 1.45--0.344 (2.5%); 1.45--0.755 (0.2%)--0.344 (2%); 1.12--0.344 (12%).
				EC	(2%) to 1.58 level; (30%) to 1.53 level; (17%) to 1.23 level; (22%) to 1.09 level; (2%) to 0.366 level; (1%) to 0.122 level.
				γ	1.58--0.366 (2%)--0.122 (8%)--0 (62%); 1.53--0.122 (25%); 1.53--1.09 (5%)--0 (12%); 1.23--0.122 (13%); 1.23--0.366 (4%); 1.09--0.122 (15%).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Eu ¹⁵¹ (n, γ)	<u>5/2-</u>	Thermal			0.26?	Eu ^{152m} 82% β ; Eu ^{152g} 26% β .	49HR
Eu ¹⁵¹ (n, γ)	<u>5/2-</u>	-0.011 ev 0.327 ev 0.461 ev 1.055 ev 3.35 ev 7.36 ev			0.24 $\pm$ 0.03 0.19 $\pm$ 0.02 0.11 $\pm$ 0.01 0.08 $\pm$ 0.03 ~0.06 ~0.06	Geiger count β . These are relative population ratios and are not absolute yield ratios.	54WO
Eu ¹⁵¹ (n, γ)	<u>5/2-</u>	Thermal			(0.48 $\pm$ 0.09)		58J
Eu ¹⁵¹ (n, γ)	<u>5/2-</u>	Thermal Thermal			(0.64 $\pm$ 0.11) (0.48 $\pm$ 0.08)	Scint count 344-kev γ . Did not give % 344-kev γ .	59ME
Eu ¹⁵¹ (n, γ)	<u>5/2-</u>	Thermal			(0.56 $\pm$ 0.04)	Scint count 344- and 210-kev γ .	60KB2

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Dy ^{165m}	1.25m	1/2-	0.108	IT β^- γ	(97.6%, e/ γ ~30). 1.02(0.3%) to 0.356 level; 0.89(2.1%) to 0.515 level. 0.515--0; 0.515--0.356--0.
Dy ¹⁶⁵	2.3h	7/2-		β^- γ	1.22(16%) to 0.095 level; 1.0(0.6%) to 0.275 level; 1.31(80%) to 0 level; 0.31(2%) to 0.985 level. 0.985--0; 0.985--0.275--0; 0.985--0.356--0(e/ γ 0.25); 0.555--0; 0.095--0(e/ γ 4).

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Dy ¹⁶⁴ (n, γ)	0+	Thermal	215,000	270,000	~0.80	Count β .	46F
Dy ¹⁶⁴ (n, γ)	0+	Thermal			~2.0	Count β with β spectrometer. e/ γ = 50.	54W
Dy ¹⁶⁴ (n, γ)	0+	Thermal	2.49 x 10 ⁶	<8.4 x 10 ⁵	(>3.0)	No mention of what radiations were measured.	59SH
Dy ¹⁶⁴ (n, γ)	0+	Thermal			1.9 $\pm$ 0.05	Scint count β with plastic detector.	60T
Dy ¹⁶⁴ (n, γ)	0+	14.8 $\pm$ 0.08	1.5	8	0.19 $\pm$ 0.09	Prop count β .	60WF
Ho ¹⁶⁵ (n,p)	<u>7/2-</u>	14.1 $\pm$ 0.2	<1	40	<0.025	Coinc count γ with plastic scintillator.	61F
Er ¹⁶⁸ (n, α)	0+	14.8 $\pm$ 0.8	1.0	0.5	2 $\pm$ 0.9	Prop count β .	60WF

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Ta ^{182m}	16.3m	(8,9+)	0.503	IT	0.503--0.147 (2.1%, e/γ ~5.6)--0 (94.4%, e/γ 1.0); 0.503--0.319 (97.9%, e/γ >1.74)--0 (5.6%); 0.319--0.147 (92.3%, e/γ 0.75). 0.319--0.		
		(5,6-)	0.319	IT			
		(4,5-)	0.147	IT.			
Ta ¹⁸²	115d	(3,4-)		β ⁻	0.18 (38%) to 1.55 level; 0.25 (~5%) to 1.49 level; 0.33 (~2%) to 1.41 level; 0.363 (20%) to 1.37 level; 0.443 (23%) to 1.29 level; 0.48 (~4%) to 1.26 level; 0.514 (~8%) to 1.22 level. Energies: 0.100 (56R); 1.122 (33R); 1.222 (28R); 0.068 (34R); others (<15R each).		
				γ			
Reaction	Target spin	E	σ _m	σ _g [†]	σ _m /σ _g	Comments	Reference
Ta ¹⁸¹ (n,γ)	<u>7/2+</u>	Thermal	34	20,600	0.00165?	Geiger count β.	47SF
Ta ¹⁸¹ (n,γ)	<u>7/2+</u>	Thermal	20	21,000	(0.001)	Geiger count β.	53HG
Ta ¹⁸¹ (n,γ)	<u>7/2+</u>	Thermal (Godiva)	1.8	150	0.012	Prop count β.	60B
Ta ¹⁸¹ (n,γ)	<u>7/2+</u>	Pile			0.00043 ± 0.00011	σ _m scint count k-x ray (88% decay); σ _g scint count 100-keV γ (14.2% decay).	61SA

[†]σ_g includes σ_m (5,6-) and σ_m (4,5-).

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Ir ^{190m}	3.2h	(9,10,11-)	2.8	β^+ EC	2.04(12% β^+ , 88%EC) to 1.70(10m Os ^{190m}) level.
				γ	1.70--1.66--1.05--0.546--0.187--0.
Ir ¹⁹⁰	10.7d	3-		EC	(1.4%) to 1.88 level; (38%) to 1.68 level; (1.7%) to 1.57 level; (3.7%) to 1.38 level; (31%) to 1.16 level; (10%) to 0.954 level; (11%) to 0.754 level; (~3.2%) to 0.546 level.
				γ	1.68--1.16(90%)--0.557(63%)--0(55%); 1.68--0.954(7.5%)--0.187 (14%)--0; 1.68--1.38(2.5%)--0.557--0.187(45%); 0.954--0.557 (47%); 1.16--0.754(36%)--0.557(28%); 0.754--0.187(71%); 0.954--0.546(39%)--0.187.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Re ¹⁸⁷ (He ⁴ ,n)	<u>5/2</u> +	22	10	240	0.041?	Geiger count. Not sure what radiations were measured.	50C
		32	6	150	0.04?		

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Ir ^{192m2}	>5y	9 $\overline{+}$	0.161	IT	0.161--0.
Ir ^{192m1}	1.45m	1 $\overline{+}$	0.058	IT	(99.9%, e/ γ $\geq$ 1000).
				β^-	0.898 to 0.613 level; 1.18 to 0.317 level; 1.51 to 0 level.
				γ	0.613--0; 0.613--0.317--0.
Ir ¹⁹²	74.3d	4 $\pm$		β^-	0.26 (15%) to 1.20 level; 0.535 (38%) to 0.92 level; 0.67 (41%) to 0.785 level.
				γ	1.20--0.317--0; 1.20--0.613--0; 1.20--0.785--0.613--0.317; 1.20--0.92--0; 1.20--0; 0.92--0.317; 0.92--0.613; 0.92--0.785--0.317.
				EC	(4%) to 0.69 level; (1.5%) to 0.58 level.
				γ	0.69--0.206--0; 0.69--0.49--0; 0.58--0.206; 0.49--0.206.

Reaction	Target spin	E	$\sigma_m(1.45m)$	σ_g	σ_m/σ_g	Comments	Reference
Ir ¹⁹¹ (n, γ)	<u>3/2+</u>	Thermal	260,000	740,000	0.35 $\pm$ 0.17	Geiger count β .	47SF
Ir ¹⁹¹ (n, γ)	<u>3/2+</u>	Thermal			0.84	Scint count 468-kev γ .	59GM
Ir ¹⁹¹ (n, γ)	<u>3/2+</u>	Thermal			1.3 $\pm$ 0.2	Scint count 470-kev γ .	61KB

Isomer	Half-life	Spin, parity	Level	Decay scheme		Reference
Au ^{196m}	9.5h	(11+)	0.598	IT	0.598--0.422.	60K
				EC	($\sim 10\%$).	
		(7-)	0.422	IT	0.422--0.233.	
		(6-)	0.233	IT	0.233--0.085.	
		(4-)	0.085	IT.		
Au ¹⁹⁶	5.5d	2-		β^-	0.27(12%) to 0.425 level.	
				γ	0.425--0.	
				EC	(24.5%) to 0.685 level; (63.5%) to 0.354 level.	
				γ	0.685--0.354(e/ γ 0.089)--0(e/ γ 0.062).	

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Au ¹⁹⁷ (n,2n)	<u>3/2+</u>	14.5			$>0.05 \pm 0.01$	Geiger count conversion electrons, assuming 1.4 k-x ray per decay.	60AB
Au ¹⁹⁷ (n,2n)	<u>3/2+</u>	12.13 $\pm$ 0.15	68.3	2013	(0.0339 $\pm$ 0.0024)	Prop count β . Did not give β branching.	61PB
		13.40 $\pm$ 0.20	118.8	2211	(0.0537 $\pm$ 0.0038)		
		13.69 $\pm$ 0.10	128.1	2241	(0.0572 $\pm$ 0.0040)		
		14.01 $\pm$ 0.10	134.3	2269	(0.0592 $\pm$ 0.0041)		
		14.31 $\pm$ 0.13	137.1	2283	(0.0600 $\pm$ 0.0042)		
		14.50 $\pm$ 0.20	142.1	2261	(0.0628 $\pm$ 0.0045)		
		14.81 $\pm$ 0.31	145.1	2211	(0.0656 $\pm$ 0.0046)		
		16.50 $\pm$ 0.30	166.8	1693	(0.0985 $\pm$ 0.014)		
		17.95 $\pm$ 0.32	164.1	1234	(0.133 $\pm$ 0.019)		
		19.76 $\pm$ 0.43	136.2	975	(0.140 $\pm$ 0.020)		

$^\dagger\sigma_g$ includes $\sigma_m(7-)$, $\sigma_m(6-)$, and $\sigma_m(4-)$.

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Hg ^{197m}	24h	<u>13/2+</u>	0.299	IT	0.299--0.134 (96.5%, e/ γ 350).
				EC	(3.5%) to 0.409 level.
				γ	0.409--0.279 (e/ γ 2.1)--0; 0.409--0.
	7×10^{-9} s	(3/2-)	0.152	IT	0.152--0.
		5/2-	0.134	IT	e/ γ 2.1.
Hg ¹⁹⁷	65h	<u>1/2-</u>		EC	(1.2%) to 0.268 level; (98.8%) to 0.077 level.
				γ	0.268--0.077 (e/ γ 1.05)--0 (e/ γ 2.3).

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Hg ¹⁹⁶ (n, γ)	0+	Thermal	420,000	880,000	(0.48 $\pm$ 0.13)	σ_m scint count sum of 133 and 164-keV γ ; σ_g scint count sum of x-rays and 77-keV γ . 97% IT.	59SH
Hg ¹⁹⁶ (n, γ)	0+	Thermal			0.044 $\pm$ 0.008	σ_m scint count 133-keV γ ; σ_g scint count 77-keV γ , with NaI.	60VH
Hg ¹⁹⁸ (n, 2n)	0+	14.1			0.8 $\pm$ 0.1	See above.	60VH
Au ¹⁹⁷ (p, n)	<u>3/2+</u>	7.3 $\pm$ 0.5	0.4	1.8	0.22 $\pm$ 0.02	See above.	60VH
		8.5 $\pm$ 0.5	3.3	14.2	0.23 $\pm$ 0.02		
		9.4 $\pm$ 0.5	10.7	41.1	0.26 $\pm$ 0.02		
		9.9 $\pm$ 0.5	19.9	64.3	0.31 $\pm$ 0.03		
		10.4 $\pm$ 0.5	26.8	74.9	0.36 $\pm$ 0.03		
Au ¹⁹⁷ (p, n)	<u>3/2+</u>	7.0 $\pm$ 0.4	1.2	3.6	0.33 $\pm$ 0.07	σ_m scint count 133-keV γ . σ_g scint count k-x rays and 77-keV γ with NaI, 79% K-capture.	62HJ
		8.6 $\pm$ 0.3	12	31	0.39 $\pm$ 0.09		
		9.3 $\pm$ 0.2	26	48	0.54 $\pm$ 0.11		
		10.0 $\pm$ 0.2	38	52	0.73 $\pm$ 0.16		
		11.3 $\pm$ 0.2	53	40	1.3 $\pm$ 0.3		
		11.7 $\pm$ 0.2	51	34	1.5 $\pm$ 0.3		
		12.3 $\pm$ 0.2	46	30	1.5 $\pm$ 0.3		
		12.7 $\pm$ 0.2	40	23	1.7 $\pm$ 0.4		

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
$\text{Au}^{197}(\text{p},\text{n})$	<u>3/2+</u>	10 20			~ 0.22 ~ 0.24	σ_m scint count 133-keV γ . σ_g scint count 77-keV γ and k-x rays. Did not correct for 3.5% EC of $\text{Hg}^{197\text{m}}$	53L
$\text{Au}^{197}(\text{p},\text{n})$	<u>3/2+</u>	6.7			(0.27 ± 0.06)	No mention on method of measurement.	52BM
$\text{Au}^{197}(\text{d},2\text{n})$	<u>3/2+</u>	7.2 ± 0.5 8.4 ± 0.5 9.5 ± 0.5 10.8 ± 0.5 11.1 ± 0.5 12.0 ± 0.5 12.3 ± 0.5 13.9 ± 0.5 14.3 ± 0.5 14.7 ± 0.5 15.6 ± 0.5 16.5 ± 0.5 16.5 ± 0.5 17.9 ± 0.5 18.4 ± 0.5 19.4 ± 0.5 19.7 ± 0.5 21.0 ± 0.5 21.1 ± 0.5 21.4 ± 0.5	0.3 3.0 17.6 66 102 125 205 278 250 296 286 251 241 200 156 134 120 92 94	0.9 8.6 44.3 129 207 202 344 339 242 303 262 203 196 160 104 119 89 68 90	0.33 ± 0.03 0.35 ± 0.03 0.40 ± 0.04 0.51 ± 0.05 0.49 ± 0.05 0.62 ± 0.06 0.60 ± 0.06 0.82 ± 0.08 1.03 ± 0.10 0.98 ± 0.10 1.09 ± 0.10 1.24 ± 0.15 1.23 ± 0.15 1.25 ± 0.15 1.50 ± 0.15 1.13 ± 0.15 1.35 ± 0.15 1.15 ± 0.10 1.35 ± 0.15 1.04 ± 0.15	σ_m scint count 133-keV γ . σ_g scint count 77-keV γ with NaI.	60VH
$\text{Au}^{197}(\text{d},2\text{n})$	<u>3/2+</u>	8.8 ± 0.5 11.1 ± 0.3 14.7 ± 0.3 17.9 ± 0.2 20.8 ± 0.3 23.5 ± 0.2 25.9 ± 0.2			0.21 0.42 1.15 1.30 1.45 1.25 1.25	Scint count 279- and 192-keV γ with NaI.	61AN

Reaction	Target spin	E	σ_m	$\sigma_g^\dagger$	σ_m/σ_g	Comments	Reference
Hg ¹⁹⁶ (d,p)	0+	11			0.15 ± 0.03	σ_m scint count 133-keV γ ; σ_g scint count 77-keV γ with NaI.	60VH
		11			0.16 ± 0.03		
Pt(He ⁴ , xn)		18.4			0.35 ± 0.04	σ_m scint count 133-keV γ ; σ_g scint count 77-keV γ with NaI.	60VH
		20.6			0.67 ± 0.07		
		22.7			1.00 ± 0.10		
		24.7			1.47 ± 0.16		
		25.4			1.59 ± 0.25		
Hg ¹⁹⁸ (He ⁴ , α n)	0+	41			0.9 ± 0.1	σ_m scint count 133-keV γ ; σ_g scint count 77-keV γ with NaI.	60VH
		41			1.0 ± 0.1		

[†] σ_g includes σ_m (3/2-) and σ_m (5/2-).

Isomer	Half-life	Spin, parity	Level	Decay scheme		Reference
Po ^{211m}	25.5s	($\frac{25}{2}^+$)	1.46	IT α γ	($\sim 0.2\%$) 7.27(91%) to 1.63 level; 7.99(1.7%) to 0.89 level; 8.30(0.25%) to 0.57 level; 8.87(7.0%) to 0 level 1.63--0.57--0; 0.89--0.	62PA
Po ²¹¹	0.52s	(9/2+)		α γ	6.57(0.53%) to 0.89 level; 6.90(0.50%) to 0.57 level; 7.44(99%) to 0 level. 0.89--0; 0.57--0.	62PA

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Po ²¹⁰ (n, γ)	0+	Thermal	~ 0.5	~ 30	~ 0.017	Scint count α with solid-state detector.	61HO
Pb ²⁰⁸ (He ⁴ ,n)	0+	18 20 21.5 23 24.5 26 27 39	0.01 0.17 2.3 4.6 5.5 4.7 2.7 2.3	2.6 15 90 46 30 25 11.5 4.1	0.004 0.011 0.026 0.10 0.18 0.19 0.24 0.56	Ionization chamber count α .	54S

Isomer	Half-life	Spin, parity	Level	Decay scheme
Pa ^{234m}	1.18m			IT (0.63%). β^- 0.58(1%); 1.50(9%); 2.31(90%). γ energies 0.043; 0.230; 0.255; 0.770; 0.803; 0.807; 1.01; 1.24; 1.44; 1.69; 1.83.
Pa ²³⁴	6.66h			β^- 0.16(28%); 0.32(32%); 0.53(27%); 1.13(13%). γ 0.803--0; 0.803--0.0435--0; 0.143--0.0435.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Pa ²³³ (n, γ)	(3/2-)	Thermal	43,000	25,000	1.7 $\pm$ 0.3	σ_m prop count β .	55SP
		Pile	75,000	32,300	2.3 $\pm$ 0.4	σ_g scint count and 4 π β count.	
		Resonance integral in- cluding 1/ ν	400,000	270,000	1.5		
Pa ²³³ (n, γ)	(3/2-)	Thermal	20,000	19,000	1.05 $\pm$ 0.25	σ_m scint count β with anthracene;	60EW
		Resonance integral in- cluding 1/ ν , 0.5 ev to ∞	470,000	460,000	1.02 $\pm$ 0.30	σ_g scint count 0.80--1.03 Mev γ with NaI.	

Isomer	Half-life	Spin, parity	Level	Decay scheme
Np ²³⁶	>5000y	(6-)		β^-
Np ²³⁶	22h	1-		β^- (~12%) to 0.045 level; (~45%) to 0 level. γ 0.045--0. KC (~34%) to 0 level; (~9%) to 0.045 level. $L/K \leq 0.3$. γ 0.045--0.

Reaction	Target spin	E	$\sigma(5000y)/\sigma(22h)$	Comments	Reference
U ²³⁵ (d,n)	<u>7/2-</u>	18	0.17	$\sigma(22h)$ α count Np ²³⁵ and mass spectrometric analysis. $\sigma(5000y)$ α count Pu ²³⁶ , assuming 15% L-capture.	58GH

Isomer	Half-life	Spin, parity	Level	Decay scheme			
Np ^{240m}	7.3m			β^-	0.76(6%); 1.26(11%); 1.59(31%) to 0.600 level; 2.16(52%).		
				γ	0.600--0(13%); 0.600--0.043(22%)--0. other energies: ~0.85(6%); ~1.5(3.5%).		
Np ²⁴⁰	63m			β^-	0.89.		
				γ	energies 0.085; 0.160; 0.245; 0.44; 0.57; 0.60; 0.92; 1.00; 1.16.		

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Np ²³⁹ (n, γ)	<u>5/2+</u>	Pile	23,000	17,000	1.3 ^{+1.4} _{-0.8}	σ_m scint count 1.5-Mev γ (2.8%). σ_g scint count 0.97-Mev γ (38%).	56LK

Isomer	Half-life	Spin, parity	Level	Decay scheme	Reference
$\text{Am}^{242\text{m}}$	152y	5-	0.0486	IT.	60AP
Am^{242}	16h	1-		β^- (~50%) to 0.0422 level; (~50%) to 0 level. γ 0.0422--0.	

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
$\text{Am}^{241}(\text{n}, \gamma)$	<u>5/2-</u>	Pile	50,000	750,000	(0.067 $\pm$ 0.055)		58HS

Isomer	Half-life	Spin, parity	Level	Decay scheme	
Es ^{254m}	37h	2		β^-	1.04(99+%).
				EC	(~0.1%).
				γ	energy 0.66(40%).
Es ²⁵⁴	480d	7		α	6.42.
				γ	energy 0.062.

Reaction	Target spin	E	σ_m	σ_g	σ_m/σ_g	Comments	Reference
Cf ²⁵² (He ⁴ ,pn)	0+	40.0	6	≤ 0.2	≥ 34	σ_m count α of Fm ²⁵⁴ . σ_g α count.	61CS

CHAPTER IV. SUMMARY AND DISCUSSION OF SOME COLLECTED DATA

In this chapter, some of the collected experimental data involving the same types of reactions are summarized. Data which are characterized by "?" (unreliable and uncertain) in the preceding tables are not considered. Since most of the available data on isomeric yields from spallation reactions at high energies and fission do not truly represent independent yields, these reactions are not included here. Photon-induced reactions are also omitted in this chapter. The isomeric-yield ratios (in this chapter only) are expressed as the ratios of the cross sections for the formation of the high-spin states to that of the low-spin states, $\sigma(H)/\sigma(L)$. Data involving isomers whose spin values are unknown are excluded from this chapter.

Table 1 is a summary of data for reactions induced by thermal and 14-Mev neutrons. Figures 2 to 11 show the variations of $\sigma(H)/\sigma(L)$ as a function of bombarding energy (in Mev) in the laboratory system, for the $(n, 2n)$, (p, n) , $(d, 2n)$, $(d, 4n)$, (He^4, n) , $(\text{He}^4, 2n)$, $(\text{He}^4, 3n)$, (p, pn) , $(\text{He}^4, \alpha n)$, and (d, p) reactions, respectively.

In reactions which proceed through the compound-nucleus-formation mechanism, the projectile gives all of its angular momenta to the compound nucleus. The average angular momentum brought in by the projectile increases with the kinetic energy of the projectile. Particle evaporations and gamma cascades do not remove much angular momenta from the compound nucleus and the residual nucleus (the nucleus after particle evaporations and before gamma de-excitation). Therefore, one expects an increase of the ratio $\sigma(H)/\sigma(L)$ with increasing projectile energy in this class of reactions. Such effects are observed in many of the reactions shown in Figs. 2 to 8. Exceptions are the $\text{Sc}^{45}(n, 2n) \text{Sc}^{44}$, $\text{Cr}^{52}(d, 2n) \text{Mn}^{52}$, $\text{V}^{50}(\text{He}^4, 2n) \text{Mn}^{52}$, and $\text{V}^{51}(\text{He}^4, 3n) \text{Mn}^{52}$ reactions.

In some isomers, the metastable states lie very high above the ground states. At bombarding energies slightly above the reaction thresholds for the formation of the ground states, the yields of the metastable states will be small compared with those of the ground states. If the metastable states have lower spin values than the ground states, then one does not expect the ratio $\sigma(H)/\sigma(L)$ to increase rapidly with projectile energy near the reaction thresholds. Evidence for this argument is found in the decrease of the ratio $\sigma(H)/\sigma(L)$ with projectile energy near the thresholds in the (p, n) , $(d, 2n)$, $(\text{He}^4, 2n)$, and $(\text{He}^4, 3n)$ reactions forming the Mn^{52} isomeric pair.

It may be interesting to note that both the $\text{Cr}^{52}(d, 2n)$ and $\text{V}^{50}(\text{He}^4, 2n)$ reactions form the same compound nucleus, Mn^{54} . According to the compound-nucleus-formation model, the excited Mn^{54} nuclei produced in these two reactions should de-excite in a way characteristic of only the excitation energy

and angular momenta, and not the different modes of formation. The values of $\sigma(H)/\sigma(L)$ for the formation of Mn^{52} isomers in the $(He^4, 2n)$ reaction are higher than those in the $(d, 2n)$ reaction at the same excitation energies of Mn^{54} . This is indicative of the relatively larger amounts of angular momenta brought in by the He^4 ions compared with those supplied by the deuterons.

The relatively rapid increase of $\sigma(H)/\sigma(L)$ in the $Cd^{116}(n, 2n)$ reaction with bombarding energy, compared with the other $(n, 2n)$ reactions (Fig. 2), may be explained in terms of the spin values of the target nuclei, of neutron, and of the ground and metastable states of the product nuclei. The spin of Cd^{116} is small (0) and close to the ground state spin of Cd^{115} ($1/2$); whereas the metastable state spin is high ($11/2$). At low neutron bombarding energy, the lower spin state is comparatively favored. As the bombarding energy is increased, the neutron brings in higher average angular momenta and the higher spin state is then increasingly favored. In the case of the $Sc^{45}(n, 2n)$ reaction, the target spin value ($7/2$) lies between the spin values of both the isomeric states (6,7 competing with 0,1,2, and 3). Since the intrinsic spin of neutron is only $1/2$, the residual nucleus just before the final gamma de-excitation will have an average spin value not too far from those (say 2,3 and 6,7) of the isomeric states. Thus, slight change of $\sigma(H)/\sigma(L)$ with bombarding energy at high neutron energies is obtained. In the $Au^{197}(n, 2n)$ reaction, the target spin ($3/2$) is small compared with the spins of both the isomeric states (11 competing with 2,4,6, and 7), and the increase of $\sigma(H)/\sigma(L)$ with neutron bombarding energy is relatively slow. Similar phenomena are observed in some other reactions presented in Figs. 3, 4, and 6.

At bombarding energies above 50 Mev, many reactions are thought to proceed predominantly by direct interactions in which only part of the target nucleus is involved. The amount of angular momentum transfer between the projectile and the target nucleus will be small, and relatively little change in the isomeric-yield ratio with bombarding energy is expected. Constant ratios of isomeric yields at projectile energies above 50 Mev are observed in some (p, pn) reactions, as shown in Fig. 9.

Table 1
REACTIONS INDUCED BY THERMAL AND 14 MEV NEUTRONS

Reaction	E	Target	Isot Spin	Product	Compound Spin	σ_{th} σ_{tot}	
n, γ	Thermal	Ce74	0	Ce75	7/2 n, γ 12	0.22 - 0.02	
		Ge76	0	Ge77	7/2 n, γ 12	0.9 - 0.2	
		Se80	0	Se81	7/2 n, γ 1/2	0.13 - 0.01	
		Sn112	0	Sn113	7/2 n, γ 12	0.4 - 0.06	
		Dy164	0	Dy165	7/2 n, γ 12	0.50 - 0.01	
		Sr84	0	Sr85	9/2 7/2 n, γ 12	0.6 - 0.40	
		Zn68	0	Zn69	9/2 n, γ 1/2	0.074 $\pm$ 0.015	
		Zn70	0	Zn71	9/2 n, γ 12	0.081 - 0.017	
		Sr82	0	Sr83	9/2 n, γ 12	~0.09	
		Br84	0	Br85	9/2 n, γ 12	0.67	
		Cd114	0	Cd115	11/2 n, γ 12	0.1	
		Sn122	0	Sn123	11/2 n, γ 2	0.0053 - 0.0131	
		Sr124	0	Sr125	11/2 n, γ 2	0.25 - 0.017	
		Te124	0	Te125	11/2 n, γ 2 1/2	0.16 - 0.04	
		Te126	0	Te127	11/2 n, γ 3/2	0.15 - 0.02	
		Te128	0	Te129	11/2 n, γ 3/2	0.079 - 0.016	
		Ir130	0	Ir131	11/2 n, γ 3/2	0.15 - 0.03	
		Ce136	0	Ce137	11/2 n, γ 3/2	0.0 - 0.05	
		Ce138	0	Ce139	11/2 n, γ 3/2	0.028 - 0.012	
		Pr140	0	Pr141	13/2 n, γ 1 2 5/2	0.044 - 0.005	
		Pt190	0	Pt191	13/2 n, γ 5/2	0.071 $\pm$ 0.013	
		Pd108	0	Pd109	11/2 n, γ 5/2	0.02 - 0.004	
		Pd110	0	Pd111	11/2 n, γ 5/2	<0.06	
		Pd112	0	Pd113	25/2 n, γ 3/2	~0.017	
		Eu103	1/2	Eu104	5 n, γ 2 1	0.05 - 0.01	
		Au199	1/2	Au200	6 n, γ 2 1	0.28 - 0.005	
		Br76	3/2	Br77	5 n, γ 1	0.04 - 0.01	
		Ir171	3/2	Ir172	6 n, γ 1	0.77 - 0.02	
		Sr121	5/2	Sr122	7 n, γ 4 2	0.0 - 0.0	
		Eu151	5/2	Eu152	5 n, γ 0	2.0 - 0.2	
		Am241	5/2	Am242	5 n, γ 1	0.007 - 0.005	
		Pb85	5/2	Pb86	6 n, γ 2	7.7 - 0.8	
		Cu69	0	Cu70	5 n, γ 1	1.4 - 0.0	
		La133	7/2	La134	6 n, γ 5/4	0.0 - 0.02	
		Ta181	7/2	Ta182	6 n, γ 1 5	0.0042 - 0.011	
		Ir113	3/2	Ir114	5 n, γ 1	2.5 - 0.0	
		In115	9/2	In116	5 n, γ 1	0.3 - 0.4	
$n, 2\gamma$		146	Sr86	0	Sr87	7/2 2 $n, 2\gamma$ 1 1	0.82 - 0.14
		141	Zr9	0	Zr10	2 $n, 2\gamma$ 1	0.4 - 0.4
		144	Sr74	0	Sr75	2 $n, 2\gamma$ 1 1	0.27
		141	Ce136	0	Ce137	11/2 2 $n, 2\gamma$ 1 1	0.92 - 0.1
		146	Pr140	0	Pr141	2 $n, 2\gamma$ 1 2	0.8 - 0.1
		147	Pr142	0	Pr143	11/2 2 $n, 2\gamma$ 3 2	0.745
		147	Sn144	0	Sn145	11/2 2 $n, 2\gamma$ 3 2	0.355
		147	Sn144	0	Sn145	11/2 2 $n, 2\gamma$ 3 2	0.72
		148	Au107	1/2	Au108	6 $n, 2\gamma$ 1	0.81 - 0.19
		148	Pr136	3/2	Pr137	5 $n, 2\gamma$ 0	2.0 - 0.5
		141	Br81	3/2	Br82	5 $n, 2\gamma$ 1 2	1.1 - 0.2
		148	Br81	3/2	Br82	5 $n, 2\gamma$ 2	1.4 - 0.2
		145	Au117	3/2	Au118	1 $n, 2\gamma$ 1 6 7	0.0008 - 0.0045
		145	Ce150	7/2	Ce151	5 $n, 2\gamma$ 2	2.3 $\pm$ 0.3
		144	Sr85	7/2	Sr86	6 $n, 2\gamma$ 0 1 2 3	0.75 - 0.04
n, p		148	N56	0	C5	5 n, p 2	0.17 - 0.06
		141	As75	2	As76	2 n, p 1 2	0.00 - 0.11
		146	Br81	3/2	Sr1	7/2 n, p 1 2	1.25 - 0.15
		141	Ce69	3/2	Zn69	9/2 n, p 1 2	1.4
		14	Gd71	3/2	Zr71	9/2 n, p 1 2	2.3
		141	Zr91	5/2	Y91	9/2 n, p 1/2	1.23 - 0.14
		141	Hg165	7/2	D165	7/2 n, p 1 2	>40
		15	Ir115	9/2	Cd115	11/2 n, p 1 2	0.9 - 0.3
n, α		148	Ir168	0	D168	7/2 n, α 1 2	0.5 - 0.2
		14	Ge72	0	Zr69	9/2 n, α 1 2	1.1
		14	Ce74	0	Zn71	9/2 n, α 1 2	2.3
		15	Sn118	0	Cd115	11/2 n, α 1/2	1.24 - 0.17
		141	Ba138	0	X135	11/2 n, α 3/2	1.0 - 0.2
		148	Ni142	0	Cu139	11/2 n, α 3/2	5 - 3
		145	Ni92	1/2	Y	11/2 n, α 3/2	0.5 - 0.20

Fig. 2. Isomeric-yield Ratios of (n,2n) Reactions.

Fig. 3. Isomeric-yield Ratios of (p,n) Reactions.

Fig. 4. Isomeric-yield Ratios of (d,2n) Reactions.

Fig. 5. Isomeric-yield Ratios of (d,4n) Reaction.

Fig. 6. Isomeric-yield Ratios of (He^4, n) Reactions. Fig. 7. Isomeric-yield Ratios of $(\text{He}^4, 2n)$ Reactions. Fig. 8. Isomeric-yield Ratios of $(\text{He}^4, 3n)$ Reactions.

Fig. 9
Isomeric-yield Ratios of
(p,pn) Reactions.

Fig. 10
Isomeric-yield Ratios
of (He⁴, an) Reactions.

Fig. 11
Isomeric-yield Ratios of
(d,p) Reactions.

APPENDIX. REFERENCES.

Each reference is designated by two numbers and one or more letters. The arrangement of references follows the numerical order first, and then the alphabetical order. Each reference contains the authors' names, the abbreviated name of the journal or report, the volume number underlined, the page number, and the year of publication in parentheses, in that order.

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