Photonuclear Data Index

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Miscellaneous Publication 277

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NATIONAL BUREAU OF STANDARDS • A. V. Astin, *Director*

Photonuclear Data Index

Prepared by
Photonuclear Data Group

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Photonuclear Data Group

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Foreword

A project on photonuclear data is being conducted in the Radiation Physics Division of the NBS Institute for Basic Standards with the support of the NBS Office of Standard Reference Data. The objective of this project is the creation and maintenance of a current Photonuclear Data File which will be used as source material for a series of miscellaneous reports covering various aspects of the field.

The present publication is the first report of the series. It is essentially an index of the data in the File as of January 1, 1965. It is expected that it will be possible to make revisions and additions to the index rather rapidly so that it can be kept both complete and up to date. It is anticipated that many of the future publications of the project will contain critically evaluated data and will be included in the National Standard Reference Data Series.

The NBS Office of Standard Reference Data was established to carry out the Bureau's assigned responsibility to administer the National Standard Reference Data System (NSRDS). This System is a government-wide effort to give the American technical community optimum access to the quantitative data of physical science, critically evaluated and compiled for convenience. The NSRDS was established by the President's Office of Science and Technology, acting upon the recommendation of the Federal Council for Science and Technology. Its general objective is to coordinate and integrate existing data evaluation and compilation activities into a systematic, comprehensive program, supplementing and expanding technical coverage when necessary, establishing and maintaining standards for the output of the participating groups, and providing mechanisms for the dissemination of the output as required.

A. V. Astin, Director.

Contents

PHOTONUCLEAR DATA INDEX

Photonuclear Data Project*

Radiation Physics Division
National Bureau of Standards, Washington, D. C.

ABSTRACT

An index to experimental data on photonuclear reactions is presented. Organized by element and isotope, each entry in the index supplies quantitative information for a specific reaction on the ranges of excitation energy, source energy, detected particle energy, and emission angles for reaction produced covered in each reference. Information is also given on the type of measurement and detector used.

INTRODUCTION

The function of this data index is to furnish a means of readily locating experimental data in the field of photonuclear reactions. This index differs from a bibliography in that it supplies quantitative information about the content of a paper. Each entry in the index corresponds to the measurement of a specific photonuclear reaction for a specific nuclide or group of nuclides. An attempt is made to give as complete a description of each measurement as is possible in a single line. The type of measurement is indicated as well as the range of excitation energies covered, the type of detector used and its energy response, and the type of angular distribution data obtained. The object has been to give a description of each measurement that is complete enough to permit an individual looking for specific types of data in the field to locate the pertinent references without having to go through a large number of irrelevant papers as might be the case if only the title of the paper or the reaction studied were listed for each entry.

For the purposes of this index the general criterion as to what constitutes a measurement of photonuclear data is that the measurement must give information on the electromagnetic matrix element between the ground state and excited states of some nucleus. The most common type of reactions are: (γ,γ), (γ,n), (γ,p), (p,γ_o), and (e,e'). Two reactions which fit the matrix element criterion, but which were not included in the compilation because of their rather special nature are heavy particle coulomb excitation and the thermal neutron capture reaction: (n,γ_o). The energy region of interest is from 0 to about 150 MeV. Most of the experiments are concerned with the excitation energy range 8 to 30 MeV, the region of the giant dipole resonance.

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* Participants in the photonuclear data project: N. V. Baggett, T. M. Collins, E. G. Fuller, J. C. Holland, J. H. Hubbell, and J. S. O'Connell.

REF.	ELEM. SYM.	A	Z
R.R. Harvey, J.T. Caldwell, R.L. Bramblett, S.C. Fultz Phys. Rev. 136, B126-31 (1964)	Bi	209	83

METHOD	REF. NO.
Positron annihilation; ion chamber	64 Ha 2 NVB

REACTION	RESULT	EXCITATION ENERGY	SOURCE		DETECTOR		ANGLE
			TYPE	RANGE	TYPE	RANGE	
G,N	ABX	6-27	D	6-26	BF3-I		4PI
G,2N	ABX	12-27	D	12-26	BF3-I		4PI

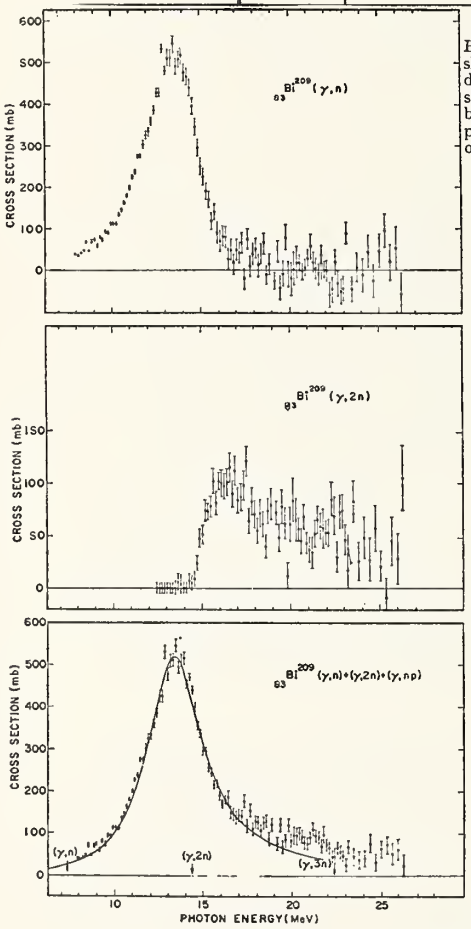

FIG. 4. Top figure shows data points for $\sigma[(\gamma,n)+(\gamma,np)]$ for Bi^{209}, obtained from single-neutron counting data. Center figure shows data for $\sigma(\gamma,2n)$ obtained from double-neutron counting data. Data points for the compound nucleus formation cross section of Bi^{209}, i.e., $\sigma[(\gamma,n)+(\gamma,np)]+\sigma(\gamma,2n)$ are shown in the bottom figure. Solid curve is a plot of a Lorentz line having the parameters given in Table II. The data are uncertain below 8 MeV owing to low beam intensities encountered.

TABLE II. Lorentz line parameters and σ_{-2} values for Pb isotopes and Bi.

Isotope	Peak σ_0 (mb)	Width Γ (MeV)	E_0 (MeV)	σ_{-2} (mb/MeV)	$0.00225A^{5/3}$ (mb/MeV)
Pb^{206}	525	3.75	13.7	15.6±1.6	16.2
Pb^{207}	485	3.87	13.6	14.5±1.5	16.3
Pb^{208}	495	3.78	13.6	14.1±1.4	16.4
Bi^{209}	520	3.83	13.5	16.6±1.7	16.6

TABLE I. Integrated cross sections in MeV-b, up to 28 MeV, for Pb isotopes and Bi.

Isotope	$\int_0^{28}\sigma(\gamma,n)dE$	$\int_0^{28}\sigma(\gamma,2n)dE$	$\int_0^{28}\sigma dE$	$\int_0^{28}\sigma dE+W$	$0.06NZ/A$
Pb^{206}	2.22	0.56	2.78±0.28	3.07±0.36	2.96
Pb^{207}	2.05	0.60	2.65±0.27	2.95±0.30	2.97
Pb^{208}	1.96	0.95	2.91±0.29	3.21±0.32	2.98
Bi^{209}	2.17	0.76	2.93±0.29	3.25±0.33	3.00

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Fig. 1. Example of Photonuclear Data Sheet. See text for definitions of symbols used.

THE PHOTONUCLEAR DATA FILE

The source of the data used to compile this index is the Photonuclear Data File. This file consists of data sheets containing abstracts of the significant data from each reference. The data are presented in a form such that an experienced worker in the field of photonuclear reactions can judge the quality of the data contained in each reference. Each sheet gives information about the type of reaction studied and the method of measurement. In addition, the significant figures and tables in the original paper are given, often on a reduced scale. Each data sheet covers either one element or one isotope of an element so that a given reference normally results in several data sheets. Fig. 1 is an example of one of these data sheets.

In addition, a master "reprint" file of each paper abstracted is maintained. Various index files permit the location of a given paper in the compilation by means of any of the authors of the paper or by the institutions at which the work was carried out.

SCOPE OF THE DATA INDEX

This version of the index covers experimental photonuclear physics articles published in the period from 1955 through 1964. For the period 1955 through 1959 papers were located by using the bibliographies of Toms[1] and the International Atomic Energy Agency Bibliographical Series No. 10, (Photonuclear Reactions)[2] and Atomic Energy Review[3]. For the period 1960 through 1964, six journals (Physical Review, Physical Review Letters, Nuclear Physics, Physics Letters, Journal of Experimental and Theoretical Physics (JETP), and Il Nuovo Cimento) were searched - issue by issue - and Nuclear Science Abstracts was used to find papers in other journals. The above-mentioned bibliographies were also used to cross check this period.

Only articles published in journals were abstracted. In a few cases, conference reports were used if the article was fairly complete and it was likely that this was the final report of the experiment.

DESCRIPTION OF THE INDEX

The data index of each element begins with the isotopic abundances for that element and a list of particle thresholds for each isotope. The abundances were taken from a compilation by Gladys Fuller[4]. This reference should be consulted for remarks concerning the accuracy of these values and possible variations with the source of the sample. The reaction thresholds were taken from a list of Q-values computed by J. H. E. Mattauch, W. Thiele, and A. H. Wapstra[5]. The values given in reference 5 have been arbitrarily rounded off to the nearest 0.1 MeV except for those cases where the uncertainties quoted are of the order of 1 MeV. In these cases, thresholds are given to the nearest MeV.

In the index itself the data content of an experimental pape is listed under eight categories:

I. Reference number

II. Nucleus excited

III. Reaction

IV. Type of information

V. Excitation energy range

VI. Source type and energy range

VII. Detector type, energy and angular range

VIII. Remarks

For each element or isotope if known, entries are grouped by the reactions studied. The entries under a given nucleus and reaction are ordered chronologically.

I. Reference number (REF)

The reference number is used to cite the full bibliographical reference which is given in the bibliography following the data index. This number is made up of the year and the first two letters of the first author's name, plus an additional serial number. For example, a paper published in 1963 by Galileo would have a reference number 63 Gal.

II. Nucleus excited (NUCLIDE)

The atomic number (Z), chemical symbol, and mass number (A) of the excited nucleus (not necessarily the target nucleus) is given. The mass number is listed only if the isotopic assignment is unambiguous.

III. Reaction

The following table defines the symbols used under IN, OUT:

$	polarization of the incident or outgoing particle or polarization or alignment of the target
A	alpha particle
D	deuteron
E	electron

E/	inelastically scattered electron
E+	positron
F	fission
G	photon
G/	inelastically scattered photon
He3	He^3
MU-T	total photon absorption
N	neutron
P	proton
T	triton
XN	all neutrons
XP	all protons

When two reaction products are listed under OUT they were detected in coincidence, e.g., the notation E, E/P means the inelastically scattered electron and proton were detected in coincidence in a reaction of the type: $A + e \rightarrow (A - 1) + e + p$, while E, P means that only the proton was detected.

IV. Type of information (RES)

The following catalog of abbreviations applies to the type of result obtained in an experiment:

ABI	absolute integrated cross-section data $\int \sigma dE_\gamma$
ABX	absolute cross-section data
ABY	absolute yield data
FMF	form factor
LFT	excitated state lifetime
NOX	no cross-section data
RLI	relative integrated cross-section data

RLX relative cross-section data

RLY relative yield data

SPC particle energy spectrum

V. Excitation energy range (EXCIT)

The excitation energy range of the nucleus involved in the gamma-ray transition is given in MeV. For reactions initiated by gamma rays the excitation energy is taken as the gamma-ray energy; for reactions initiated by particles the binding energy and kinematic corrections are made. The abbreviation THR stands for threshold.

VI. Source type and energy range (SOURCE)

The source of incident particles is characterized by the letter C or D indicating that the source was continuous or discrete in energy. The source energy is indicated under MIN-MAX. The usual source of photons is bremsstrahlung which would be marked C. The range of end point energies is given.

VII. Detector type, energy, and angular range (DETECTOR)

The following abbreviations apply under detector TYPE:

ACT measurement of radioactivity of the target

BBL bubble chamber

BF3 BF_3 neutron counter with moderator, e.g., Halpern detector, long counter

CCH cloud chamber

EMU emulsions (photographic plates)

IØN ionization chamber

MAG magnetic spectrometer

MGC magnetic Compton spectrometer

MGP magnetic pair spectrometer

MØD moderated neutron detector <u>not</u> employing a BF_3 counter, e.g., rhodium foil, Szilard-Chalmers reaction, He^3, Li^6 reactions

NAI — NaI (Tℓ) spectrometer

SCD — semiconductor (solid state) detector

SCI — scintillator detector other than NaI; e.g., CsI, KI, organic (liquid or solid), stilbene, He

SPK — spark chamber

TEL — counter telescope

THR — threshold detector, e.g., $Si^{29}(n,p)\ Al^{29}$

TØF — time-of-flight detector

The symbols D or I under TYPE means that the reaction product was detected differentially or integrally in energy. For example, a scintillator (SCI) is usually used differentially (D) while a BF_3 detector used with a neutron moderator (BF3) integrates over neutron energy. The range of detected particle angular distribution is shown under ANG with the following designations:

0-180 — one number in this column means the measurements were made at this angle only (angle in degrees)

4 PI — a 4π geometry was used or a method like radioactivity or a total absorption measurement

DST — an angular distribution was measured

VIII. Remarks

This additional information was selected in a fairly unsystematic way and limited by the available space. It should therefore not be regarded as exhaustive or consistent. An asterisk indicates that a completed data sheet was not in the file as of the time the bibliographic card was prepared. In this case the information given in the index was obtained from the abstract of the article referenced.

Some of the abbreviations used in this column are:

BREAKS — levels located by "breaks" in the yield curve

CF — compared with

COINC — coincidence

DT BAL — detail balance

G-WIDTH Γ_γ, gamma-ray transition width

J-PI spin and parity assignments of levels are made

POL polarization

Q-SQUARE momentum transfer squared (q^2)

REL relative

SEP ISOTPS separated isotope used

REFERENCES

1. M. E. Toms, "Bibliography of Photo- and Electronuclear Disintegrations", Bibliography No. 22, U.S. Naval Research Laboratory, Washington, D. C.

2. Bibliographical Series No. 10, "Photonuclear Reactions", International Atomic Energy Agency, Vienna.

3. B. I. Goryachev, Atomic Energy Review 2, 71-148 (1964).

4. Gladys Fuller, 1959 Nuclear Data Tables (NUCLEAR DATA PROJECT)-National Academy of Sciences, National Research Council, Washington, D. C.

5. J. H. E. Mattauch, W. Thiele, and A. H. Wapstra, Nuclear Physics 67, 32 (1965).

HYDROGEN Z=1

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
1	99.99	*	*	*	*	*	*	*	*
2	1.5(-2)	2.2	2.2	*	*	*	*	*	*
3	*	6.3	8.5	*	*	*	8.5	8.5	*

REF	NUCLIDE Z A		REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	DETECTOR MIN-MAX	ANG	REMARKS
58MO2	1H 1		G,MU-T	ABX		C 94	SCI-D		4PI	*
60WY1	1H 1		G,MU-T	ABX		C 90	NAI-D	13-80		
58OX1	1H 1		G,G	ABX		C 87	TEL-D		DST	
58AL1	1H 1		G,G	ABX					124	*
55OX1	1H 1		G,G	ABX		30-95			DST	*
60GO1	1H 1		G,G	ABX		C 75	TEL-D	40-70	DST	
61BA3	1H 1		G,G	ABX		C247			DST	*
63ST1	1H 1		G,G	ABX		C900	TEL-D		90	
59FR1	1H 2		E,E/	SPC	0-95	D175	MAG-D		DST	Q = 206 MEV/C
61KE3	1H 2		E,E/	RLX	0 20	D204-500	MAG-D		145	
62BA1	1H 2		E,E/	ABX	0 10	D 42	MAG-D		180	GAS TARGET
62PE1	1H 2		E,E/	ABX	0 20	D 42	MAG-D		180	SOLID TARGET
63BA1	1H 2		E,E/	SPC	0 14	D 42	MAG-D		180	
57BA1	1H 2		G,N	RLY	THR 265	C -265		20-	DST	*
58BA1	1H 2		G,N	ABX	THR 255	C170,255	THR-I	21	DST	
60GE3	1H 2		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61JO1	1H 2	$	G,N	NOX	0 1	D 3	BF3-I		DST	NEUTRONS POLARIZED
61TA1	1H 2		G,N	RLX		C 22	THR-I	6-	DST	
63BE7	1H 2	$	G,N	NOX	12 30	C 30	SCI-D	12-	DST	NEUTRONS POLARIZED
63BO4	1H 2	$	G,N	SPC	3 9	C 3-9	SCI-D		DST	NEUTRONS POLARIZED
63FR1	1H 2	$	G,N	NOX	11 23	C 24	CCH-D		148	NEUTRONS POLARIZED
55OD1	1H 2		G,NP			C	SCI-D		DST	*
56OD1	1H 2		G,NP	RLX	THR 340	C340			DST	*
55AL1	1H 2		G,P	ABX	20 65	C 20-65	EMU-I		DST	
56DI1	1H 2		G,P	ABX	THR 293	C136-293	TEL-D		DST	*
56KE1	1H 2		G,P	ABX	75 450	C150-450	TEL-D		DST	
56WH1	1H 2		G,P	ABX	60 250	C 60-250	EMU-D		DST	
57AL1	1H 2		G,P	ABX	THR 148	C 54-148	TEL-D		DST	*
58TA2	1H 2		G,P	ABX	THR 200	C200			DST	*
58WH1	1H 2		G,P	ABX	9 23	C 9-23	NAI-I		DST	
60FE2	1H 2	$	G,P	ABX	150 300	C150-300	EMU-D		44	PROTONS POLARIZED
60GA1	1H 2		G,P	ABX	50 90	C 94	TEL-D		DST	
61MY1	1H 2		G,P	ABX	350 900	C500-900	TEL-D		DST	
63LO1	1H 2	$	G,P	NOX	2 294	C294	SPK-D		58	
64LI1	1H 2	$	G,P	RLX	80-140	C400-500	MAG-D		90	PHOTONS POLARIZED
64BO2	1H 3		G,N	ABX	7 9	D 7-9	BF3-I		4PI	
64IM1	1H 4		N,G	ABY		D 0-1	ACT-I		4PI	NO H4 FOUND

HELIUM Z=2

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
3	1.4(-4)	7.7	5.5	*	*	*	*	7.7	7.7
4	99.99	20.6	19.8	19.8	20.6	*	*	*	*

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58BA3	2HE		G,NP		THR 280	C280			DST	*
56RE1	2HE		G,P				CCH-D		DST	*
60RE2	2HE		G,XP				CCH-D	100-		*
63GO2	2HE3		G,P	ABX	5 90	C170	CCH-D		4PI	ALSO G,N
63WA1	2HE3		G,P	ABX	6,7	D 6,7	ION-D		4PI	
64BE5	2HE3		G,2P	ABX	8-22	C 8-22	SCI-D		90	FORM FACTOR
63BE1	2HE3		G,PD	ABX	8 20	C 22	SCI-D	4-	90	
63FI2	2HE3		G,PD	ABX	13 27	C 31	SCI-D		90	
64BE2	2HE3		G,PD	ABX	THR 30	C 34	SCD-D	3-10	90	SPECTRUM
64BE5	2HE3		G,PD	ABX	8-22	C 8-22	SCI-D		90	FORM FACTOR
64GO1	2HE3		G,PD	ABX	THR-120	C175	CCH-D		DST	
63GR1	2HE3		P,G	ABX	5 6	C 0-1	NAI-D		DST	S AND P WAVE PARTS
61BU2	2HE4		E,E/	ABX	0 325	D400,500	MAG-D		DST	
58GO1	2HE4		G,N	ABX	20 160	C170	CCH-D		DST	
58LI1	2HE4		G,N	ABI	40 60	C 70	EMU-I		DST	DETECTED HE3
57GO1	2HE4		G,NP	ABI	20 160	C170	CCH-D		4PI	
58GO2	2HE4		G,NP	ABX	25 170	C170	CCH-D		4PI	
57GO1	2HE4		G,P	ABX	20 160	C170	CCH-D		DST	
60MI1	2HE4		G,P	ABX	23 32	D 32	EMU-D		90	
62MA1	2HE4		G,P	NOX	23 32	C 70	EMU-D		DST	
55PE2	2HE4		P,G	ABX	20 36	D 0-6	NAI-D		DST	
62GA1	2HE4		P,G	ABX	24 27	D 6-10	NAI-D		DST	
62GE1	2HE4		P,G	ABX	23 28	D 4-11	NAI-D		DST	
63BU2	2HE5		D,G	RLY	17 18	D 0-1	NAI-D			

LITHIUM Z=3

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
6	7.42	5.7	4.7	15.8	15.8	1.5	*	3.7	28.7
7	92.58	7.3	10.0	2.5	28.3	2.5	12.9	12.0	29.1

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58AL1	3LI		G,G	ABX	2				124	*
64GO3	3LI		E,E/	ABX	4	D 40-70	MAG-D		180	FMF
60KU2	3LI		G,N	ABX	THR 90	C 90	TEL-D	10-	DST	
55BA5	3LI		G,XN	ABX	THR-250	C250		30-	DST	*
55HE1	3LI		G,XN	RLX	13 32	C 13-32	BF3-I		4PI	ENRICHED LI7
58RY1	3LI		G,XN	ABX	5 24	C 5-24	BF3-I		4PI	
60FA1	3LI		G,XN	ABX	11 56	C 11-57	BF3-I		4PI	
63CO3	3LI		G,XN	ABX	8 75	C 8-100	BF3-I		4PI	
64AL1	3LI		G,XN	ABX	THR 19	C -19	BF3-I		4PI	
55OD1	3LI		G,NP		THR-252	C140-252	SCI-D		DST	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56OD1	3LI		G,NP	RLX	THR-340	C340			DST	*
58BA3	3LI		G,NP		THR 280	C280			DST	*
56KL1	3LI		G,P	SPC	THR 80	C 30-80	EMU-D		DST	* MULTIPOLARITY
60KO5	3LI		G,P	SPC						*
63KI1	3LI		G,P	ABX	150 335	C335	TEL-D	143-183	DST	
63KU2	3LI		G,P	ABX	10 30	C 30			DST	G-WIDTH
58WH2	3LI		G,XP	ABX	40 100	C 45-110	TEL-D	30-80	DST	
61MA2	3LI		G,XP	NOX	10 21	C 21	SCI-D	1-10	DST	
62BE1	3LI		G,D	RLY	THR 260	C160-260	MAG-D	4-10	DST	YLD REL TO PROTONS
55MI1	3LI		G,T	RLY	THR-21	CTHR-21	EMU-I			*
61SH6	3LI		G,T		THR 10	C 10	EMU-D		DST	* J-PI
63KU2	3LI		G,T	ABX	12 27	C 30			DST	G-WIDTH
64IM1	3LI4		P,G	ABY		D 0-3	NAI-D		90	NO LI4 FOUND
64ER2	3LI6		G,MU-T	ABX	5 40	5-40				
59CO4	3LI6		G,G	LFT	4	C 6	NAI-D			
62BO6	3LI6		G,G	LFT	4	C 4	NAI-D		110	J-PI
62SE1	3LI6		G,G	NOX	4	C 17	NAI-D		90	
63SK1	3LI6		G,G	LFT	4	C 4	NAI-D			
60BA4	3LI6		E,E/	ABI	4	D 40	MAG-D	32-40	DST	
63BA1	3LI6		E,E/	ABI	3 16	D 42	MAG-D		180	4 LEVELS
63BE2	3LI6		E,E/	FMF	2 8	D101	MAG-D		DST	5 LEVELS
63BE8	3LI6		E,E/	FMF	0 7	D100-180	MAG-D		DST	J-PI, B(E2)
63BI1	3LI6		E,E/	ABX	5 40	D101	MAG-D		60	
56ED2	3LI6		G,N	ABX	6	D 6	MOD-I		4PI	
60PR1	3LI6		G,N	RLI	5 17	C 17	SCI-I		90	COINC WITH PROTONS
64GR2	3LI6		G,N	ABX	5 9	D 5-9	BF3-I		4PI	
59RO1	3LI6		G,XN	ABX	5 20	C 4-20	BF3-I		4PI	
63CO1	3LI6		G,XN	ABX	5 50	C 5-50	BF3-I		4PI	
64BA2	3LI6		G,XN	ABX	5-60	C 5-60	BF3-I		4PI	
60PR1	3LI6		G,NP	RLI	7 17	C 17	SCI-I		90	
60BA3	3LI6		G,P	ABY	30 80	C 35-87	TEL-D	16-35	DST	
60KO3	3LI6		G,P	SPC	5 23	C 28	EMU-D	1-18	60	SEPARATED ISOTOPES
60PR1	3LI6		G,P	SPC	5 17	C 17	SCI-D	5-9	90	RLI, COINC WITH N
62VO1	3LI6		G,P	ABY	11 90	C 30-90	TEL-D	7-15	90	
64SH2	3LI6		G,P	ABX	8-10	C 10	EMU-D	1-3	DST	
60CH1	3LI6		G,XP	RLY	20 90	C 90	TEL-I	15-30	DST	
62CH2	3LI6		G,XP	RLY	20 90	C 30-90	TEL-D	15-30	DST	REL TO DEUTERONS
59DA1	3LI6		G,D	ABX	2,3	D 2,3	ION-D		4PI	WIDTH
62VO1	3LI6		G,D	ABY	8 90	C 30-90	TEL-D	7-15	90	
64KO4	3LI6		G,D	RLY	THR 35	C 35	EMU-D	1-5	DST	REL TO T
60CH1	3LI6		G,XD	RLY	17 90	C 90	TEL-D	15-30	DST	REL TO PROTONS,SPC
62CH2	3LI6		G,XD	RLY	16 90	C 30-90	TEL-D	15-30	DST	REL TO PROTONS
62VO1	3LI6		G,T	ABY	23 90	C 30-90	TEL-D	7-15	90	
64KO4	3LI6		G,T	SPC	THR 35	C 35	EMU-D	2-8	DST	YLD REL TO D
60CH1	3LI6		G,XT	RLY	31 90	C 90	TEL-I	17-30	DST	REL TO PROTONS
64NE1	3LI6		G,H4	ABY	24-250	C250	ACT-I		4PI	NO H4 FOUND
58BE3	3LI7		G,G	LFT	1	C 1			120	* WIDTH
59SW1	3LI7		G,G	LFT	1	D 1	NAI-D			
60BO3	3LI7		G,G	LFT	0	C 2	NAI-D			
62MO1	3LI7		G,G	LFT	0	C 0	NAI-D			
63MO1	3LI7		G,G	LFT	0	D 0	NAI-D			
64BO1	3LI7		G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
63BA1	3LI7		E,E/	ABI	7 14	D 42	MAG-D	24-42	180	
63BE3	3LI7		E,E/	FMF	4 8	D100-180	MAG-D		DST	
63BE8	3LI7		E,E/	FMF	0 7	D100-180	MAG-D		DST	J-PI, B(E2)
64BI4	3LI7		E,E/	ABX	1 6	D150	MAG-D		DST	
64GR2	3LI7		G,N	ABX	THR 11	DTHR-11	BF3-I		4PI	WIDTH
59RO1	3LI7		G,XN	ABX	8 20	C 4-20	BF3-D		4PI	
60ST1	3LI7		G,NP	RLY	142 320	C320	TEL-D	130	76	REL TO H2 CROS SEC

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62GR2	3LI7		G,P	ABY	10 30	C 10-30	ACT-I		4PI	
62LI1	3LI7	$	G,P	NOX	165-	C355	TEL-D	155	DST	PLR P BY C SCT
62SH1	3LI7		G,P	ABX	12 16	C 12-16	EMU-D	2-5	DST	G-WDTH
62VO1	3LI7		G,P	ABY	17 90	C 25-90	TEL-D	7-15	DST	
63KU1	3LI7		G,P	ABY	3 10	D 20-30	TEL-D	4-12	DST	
63NE1	3LI7		G,2P	ABY	THR 320	C320	ACT-I		4PI	
64SH1	3LI7		G,2P	ABX	THR-210	C210	ACT-I		90	H5 LIMIT
60CH1	3LI7		G,XP	ABX	25 90	C 90	TEL-I	15-30	DST	
62CH2	3LI7		G,XP	RLY	25 90	C 25-90	TEL-D		DST	REL TO DEUTERONS
62VO1	3LI7		G,D	ABY	17 90	C 25-90	TEL-D	7-15	DST	
60CH1	3LI7		G,XD	RLX	25 90	C 90	TEL-D	15-31	DST	REL TO PROTONS,SPC
62CH2	3LI7		G,XD	RLY	25 90	C 25-90	TEL-D		DST	REL TO PROTONS
60MI2	3LI7		G,T	ABX	6 15	C 11-20	EMU-D		DST	J-PI
62VO1	3LI7		G,T	ABY	14 90	C 25-90	TEL-D	7-15	DST	
63KU1	3LI7		G,T	ABY	14 25	C 30	TEL-D	7-13	DST	
60CH1	3LI7		G,XT	RLX	19 90	C 90	TEL-D	17-30	DST	REL TO PROTONS,SPC
64NE1	3LI7		G,H4	ABY	23-250	C250	ACT-I		4PI	NO H4 FOUND

BERYLLIUM Z=4

A	ABUND.	SEPARATION ENERGIES (MEV) G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
9	100.00	1.7	16.9	17.7	21.2	2.5	20.6	18.9	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59GE1	4BE8		P,G	ABX	21 25	D 4-8	NAI-D		90	
60MA2	4BE8		P,G	RLY	17 18	D 0-1	NAI-D		DST	
61ME1	4BE8		P,G	NOX	18	D 0	NAI-D		DST	
62CA3	4BE8		P,G	RLX	18 20	D 0-2	NAI-D		DST	
63MI1	4BE8		P,G	RLX	19 26	D 2-9	NAI-D		DST	
63PE1	4BE8		P,G	RLX	18 27	D 1-11	NAI-D		DST	
63RE1	4BE8		P,G	ABX	19 26	D 4-8	NAI-D		DST	
63RI1	4BE8		P,G	LFT	18	D 0-3	NAI-D		90	
64SC2	4BE8		P,G	RLX	17 19	D 0-2	NAI-D		DST	J-PI
64TA1	4BE8		P,G	ABX	21 25	D 4-9	NAI-D		90	
62MI4	4BE9		G,MU-T	ABX	15 27	C 31	MGC-D	15-32		
64TE1	4BE9		G,MU-T	ABX	20 21	D 20-21	NAI-D		96	
60BA4	4BE9		E,E/	ABI	2	D 42	MAG-D	36-42	160	
62ED1	4BE9		E,E/	SPC	0 20	D 42	TEL-D	22-42	180	G-WDTH, ABX
63NG1	4BE9		E,E/	LFT	1 6	D 60-250	MAG-D		DST	
63NG2	4BE9		E,E/	FMF	4 47	D100-180	MAG-D		135	
55JO1	4BE9		G,N	RLY	12 65	C 65	SCI-D	10-	DST	
56ED1	4BE9		G,N	ABX	2 8	D 2-8	MOD-I		4PI	
56FA1	4BE9		G,N	NOX	THR 18	C 18	SCI-I		DST	
58AS1	4BE9		G,N	NOX	2 17	C 17	SCI-I		DST	
58BA2	4BE9		G,N	ABX	2 16	C 2-16	BF3-I		4PI	COMPARED WITH E,N
59GI1	4BE9		G,N	ABX	1	D 1,1	BF3-I		4PI	
59TH1	4BE9		G,N	ABX	6 18	C 6-18	BF3-I		4PI	
60KU2	4BE9		G,N	RLY	12 90	C 90	TEL-I	10-	DST	
61JA1	4BE9		G,N	ABX	THR 5	CTHR-5	BF3-I		4PI	
62BO4	4BE9	$	G,N	NOX	3	D 3	BF3-I		DST	NEUTRONS POLARIZED
62BO7	4BE9		G,N	NOX	5 9	D 5-9	SCI-I		DST	
62CU1	4BE9		G,N	ABX	4 32	C 32	EMU-D		DST	
62JO2	4BE9		G,N	ABX	1 1	D 1-1	MOD-I		4PI	
63BO4	4BE9	$	G,N	ABX	3 9	D 5-9	SCI-D		DST	NEUTRONS POLARIZED
64CO1	4BE9	$	G,N	NOX	3	D 3			DST	NEUTRONS POLARIZED

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS	Be B
58BA2	4BE9		E,N	ABX	2 16	C 2-16	BF3-I	4PI	COMPARED WITH G,N	
59BA3	4BE9		E,N	ABI		-17			*	
57LO1	4BE9		G,2N	ABY	20 30	C 20-30	ACT-I	4PI		
64AR2	4BE9		G,2N	RLY	21 57	C 44,57	ACT-I	4PI	REL TO C12(G,N)	
55BA5	4BE9		G,XN	ABX	THR-250	C250	30-	DST	*	
55DI1	4BE9		G,XN	NOX	2 70	C 70	SCI-I	DST		
59KU1	4BE9		G,XN	NOX	12 88	C 88	TEL-I 10-	DST		
60BE1	4BE9		G,XN	ABX	2 17	C 5-17	TOF-D	DST		
60ST1	4BE9		G,NP	RLX	149 320	C320	TEL-D130	76	REL TO H2 CROS SEC	
56CO1	4BE9		G,P	ABY	19 24	C 24	EMU-D 2-7			
56KL1	4BE9		G,P	SPC	7 80	C 30-80	EMU-D	DST	* MULTIPOLARITY	
56ST1	4BE9		G,P	SPC	17 25	C 25	EMU-D		* YIELD	
57CH1	4BE9		G,P	SPC	17 80	C 60-80	EMU-D	DST	*	
58CH1	4BE9		G,P	SPC	THR 44	C 44	EMU-D 4-	DST	6 ENERGY GROUPS	
62CL1	4BE9		G,P	ABX	16 54	C 16-54	ACT-I	4PI		
62CU1	4BE9		G,P	ABX	16 28	C 32	EMU-D	DST		
62LI1	4BE9	$	G,P	NOX	190	C355	TEL-D175	DST	PROTONS POLARIZED	
62VO2	4BE9		G,P	ABX	40 90	C 40-90	TEL-I 15-			
63KI1	4BE9		G,P	NOX	THR 335	C335	TEL-D154-174	DST		
55TA1	4BE9		G,XP	ABX	67-280	C280	TEL-D 50-75	175	*	
58WH2	4BE9		G,XP	ABX	40 100	C 45-110	TEL-D 30-60	90		
59CH1	4BE9		G,XP	SPC	17 90	C 90			* YLD REL TO G,D	
60CH1	4BE9		G,XP	RLY	30 90	C 90	TEL-I 15-30	DST	REL TO DEUTERONS	
62CH2	4BE9		G,XP	ABX	40 90	C 40-90	MAG-D 15-30	DST		
62BA1	4BE9		G,D	ABY	40 60	C 45-62	ACT-I	4PI		
59CH1	4BE9		G,XD	SPC	17 90	C 90			* YLD REL TO G,P	
60CH1	4BE9		G,XD	RLY	19 90	C 90	TEL-I 15-30	DST	REL TO PROTONS	
62CH2	4BE9		G,XD	ABX	40 90	C 40-90	MAG-D 15-30	DST		
60CH1	4BE9		G,XT	RLY	32 90	C 90	TEL-I 15-30		REL TO DEUTERONS	
64BE1	4BE9		G,A	SPC	THR 34	C 34	SCD-D 3-	DST	J-PI	
64BE1	4BE9		G,2A	SPC	THR 34	C 18-34	SCD-D 3-	90	J-PI	

BORON Z=5

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
10	19.61	8.4	6.6	18.7	17.8	4.5	27.0	8.3	23.5
11	80.39	11.5	11.2	11.2	27.2	8.7	19.9	18.1	30.9

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
59CO5	5B		G,G	ABI	5,7	C 5,7	NAI-D 2-6	130	
60RE1	5B		G,G	ABX	7	D 7	NAI-D	90	
62SE1	5B		G,G	RLY	0 13	C 13	NAI-D	90	
64BO1	5B		G,G	LFT	1 3	C 1-3	NAI-D	100	ABI
63CO3	5B		G,XN	ABX	THR 80	CTHR-80	BF3-I	4PI	
60CH1	5B		G,XP	RLY	THR 90	C 90	TEL-I 16-30	90	REL TO DEUTERONS
63KI1	5B		G,XP	ABX	THR 355	C335	TEL-D140-192	DST	
62DO1	5B		E,P	RLY	30	D 30	MAG-D 3-15		
60CH1	5B		G,XD	RLY	THR 90	C 90	TEL-I 16-30	90	REL TO PROTONS
60CH1	5B		G,XT	RLY	THR 90	C 90	TEL-I 16-30	90	REL TO DEUTERONS

B C	REF	NUCLIDE Z	A		REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
	62ED1	5B	10		E,E/	ABX	0 20	D 42	MAG-D	25-42	180	
	64GR2	5B	10		G,N	ABX	9 11	D 9-11	BF3-I		4PI	WIDTH
	62VO2	5B	10		G,P	ABX	23 90	C 90	SCI-D	15-	90	
	62CH2	5B	10		G,XP	ABX	23 90	C 30-90	TEL-D	16-30	90	
	62VO2	5B	10		G,D	ABX	25 90	C 90	SCI-D	15-	90	
	62CH2	5B	10		G,XD	ABX	22 90	C 30-90	TEL-D	16-30	90	
	62EL1	5B	10		P,G	NOX	7 8	D 1	NAI-D			J-PI
	63FU3	5B	10		P,G	ABX	7 9	D 1-2	NAI-D		DST	G-WDTH, J-PI, T
	60BO3	5B	11		G,G	LFT	2	C 1-2	NAI-D		110	
	58ME1	5B	11		G,G	LFT	2	D 2	NAI-D			
	58RA1	5B	11		G,G	LFT	4	D 4	NAI-D		DST	
	62BO6	5B	11		G,G	LFT	2	C 1-2	NAI-D		110	J-PI
	63VA1	5B	11		G,G	NOX	0 3	C 3	NAI-D			
	62ED1	5B	11		E,E/	ABX	0 20	D 42	MAG-D	25-42	180	
	62LI1	5B	11	$	G,P	NOX	THR 355	C355	TEL-D		DST	POLARIZED PROTONS
	62VO1	5B	11		G,P	RLY	THR 40	C 40	TEL-D	8-19	90	
	58TA1	5B	11		G,2P	ABX	THR 320	C100-320	BF3-I		4PI	DELAYED NEUTRONS
	63NE2	5B	11		G,3P	ABY	THR 320	C320	ACT-I		4PI	
	62CH2	5B	11		G,XP	RLY	19 40	C 40	TEL-D	8-19	90	REL TO PROTONS
	62VO1	5B	11		G,D	RLY	THR 40	C 40	TEL-D	8-19	90	
	62CH2	5B	11		G,XD	RLY	24 40	C 40	TEL-D	8-19	90	REL TO PROTONS
	62VO1	5B	11		G,T	RLY	THR 40	C 40	TEL-D	8-19	90	
	63SU2	5B	11		D,G	ABX	16 20	D 1-4	NAI-D		DST	

CARBON Z=6

A	ABUND.(1)	G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
12	98.89	18.7	16.0	27.4	26.3	7.4	31.8	27.4	27.2
13	1.11	4.9	17.5	23.9	24.4	10.7	23.7	20.9	31.6

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A		REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58MO2	6C			G,MU-T	ABX	THR 94	C 94	SCI-D		4PI	*
58WO1	6C			G,MU-T	ABX	20 21	D 20-21	NAI-D	20-21		
58ZI1	6C			G,MU-T	ABX	19 26	C 19-30	MGP-D			
59BU1	6C			G,MU-T	ABX	22 24	C 22-24	MGP-D	22-24		
59KO1	6C			G,MU-T	ABX	15 30	C 31	NAI-D			
59PE2	6C			G,MU-T	RLX	THR 31	C 31	ACT-I			
60CA1	6C			G,MU-T	ABX	20 21	D 20-21	NAI-D			
60TA2	6C			G,MU-T	ABX	11 32	C 11-32	MAG-D			
60WY1	6C			G,MU-T	ABX	13 83	C 35-90	NAI-D	13-83		
60ZI1	6C			G,MU-T	ABX	10 30	C 32	MGP-D	10-30		
63BU1	6C			G,MU-T	ABX	13 27	C 13-27	MGP-D			
63BU3	6C			G,MU-T	ABX	13 27	C220	MGP-D		4PI	
57HA1	6C			G,G	ABX	0 19	C 19	NAI-D			
58AL1	6C			G,G	ABX	2				124	*
58RA1	6C			G,G	LFT	4	D 4	NAI-D		DST	
59PA3	6C			G,G	ABX	17	D 17				* J-PI, WIDTH
59PE5	6C			G,G	ABX	19-61	C 19-61			135	*
60BU3	6C			G,G	ABX	15	C 15			DST	* WIDTH
60JA1	6C		$	G,G	NOX	0 25	C 25	NAI-D		DST	J-PI, MULTIPOLARIT

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS	C
61DE4	6C		G,G	ABX	19 36	C 32	NAI-D		140		
61WI1	6C		G,G		50-130	50-130	TEL-D		DST	*	
62SE1	6C		G,G	SPC	0 19	C 19	NAI-D	2-19	90		
63SC3	6C		G,G	ABX	15	D 15,18	NAI-D		DST	G-WDTH	
59PE5	6C		G,G/	ABX	19-61	C 19-61			135	*	
56FR1	6C		E,E/	ABX	0-35	D187	MAG-D		DST	J-PI	
59BA1	6C		E,E/	ABI	0 30	D 43	MAG-D	10-43	160		
60BA4	6C		E,E/	SPC	0 30	D 42	MAG-D	12-42	DST	ABI, MULTIPOLARITY	
61BO4	6C		E,E/	SPC	0 164	D194	MAG-D		135		
61DU1	6C		E,E/	ABX	13-18	D 46-154	MAG-D		135		
62ED1	6C		E,E/	ABI	15	D 42	MAG-D		180	G WIDTH,J-PI	
63BO3	6C		E,E/	ABX	4 25	D200	MAG-D	20-190	135		
63GO4	6C		E,E/	ABX	0 30	D 42	MAG-D	12-42	180		
63LE1	6C		E,E/	FMF	0 35	D 55	MAG-D	20-55	180	Q-RANGE 0-1	
64CR1	6C		E,E/	ABX	4 10	D250	MAG-D		DST	WIDTHS	
64GO2	6C		E,E/	ABX	10-32	D 40-70	MAG-D		DST	FMF	
64GO3	6C		E,E/	ABX	15	D 40-70	MAG-D		180	FMF	
64AM1	6C		E,E/P	RLX	THR 150	D550	MAG-D		51		
56TZ2	6C		G,N	ABX	22-24	C 22-24				* NEUTRON WIDTH	
58BA5	6C		G,N	RLX	19-21	19-21				* BREAKS	
60EM2	6C		G,N	SPC	20 30	C 30	EMU-D	1-10	DST		
62FU5	6C		G,N	ABX	21 31	C 31	SCI-D		90		
62MI2	6C		G,N	ABX	18 26	D 18-26	BF3-I		4PI		
55BA5	6C		G,XN	ABX	THR-250	C250		30-	DST	*	
55DI1	6C		G,XN	NOX	THR 70	C 70	SCI-I		DST		
56FA1	6C		G,XN	NOX	THR 23	C 23	SCI-I		DST		
57BA1	6C		G,XN	RLY	THR 265	C -265			DST	*	
58BA1	6C		G,XN	ABY	THR 255	C170,255	THR-I	21-	DST		
59KU1	6C		G,XN	ABY	THR 88	C 88	TEL-D	15-40	DST		
61PR1	6C		G,XN	RLY	30 85	C 30-85	THR-I	11-	4PI		
62MI2	6C		G,XN	ABX	18 26	D 18-26	BF3-I		4PI		
63CO3	6C		G,XN	ABX	THR 80	CTHR-80	BF3-I		4PI		
63FU1	6C		G,XN	ABX	20 29	C 31	SCI-D	2-11	90	SPECTRUM	
58WH2	6C		G,NP	ABX	THR 110	C 40-110	TEL-D	37-65	DST	COINC WITH BF3	
60ST1	6C		G,NP	RLX	157 320	C320	TEL-D	130	76	REL TO H2 CROS SEC	
64TA3	6C		G,NP	SPC	THR-100	C170	CCH-D		4PI		
55JO1	6C		G,P	RLY	THR 65	C 65	SCI-D	14-	DST		
55ST2	6C		G,P	SPC	THR-23	C 23	EMU-D			*	
56KL1	6C		G,P	SPC	THR 80	C 30-80	EMU-D		DST	* MULTIPOLARITY	
56MA1	6C		G,P	ABX	18	D 18	EMU-D	0-3	4PI		
56ST1	6C		G,P	SPC	THR 25	C 25	EMU-D			* YIELD	
57CH1	6C		G,P	SPC	THR 80	C 60-80	EMU-D		DST	*	
57LI1	6C		G,P	SPC	THR-35	C 35	EMU-D		DST	*	
59BA2	6C		G,P	SPC	34 89	C 82,89	SCI-D	18-52	90		
64SH4	6C		G,P	ABX	20 23	D 20-23	SCI-D		4PI	WIDTHS	
64TA3	6C		G,P	SPC	THR-100	C170	CCH-D		4PI		
55TA1	6C		G,XP	ABX	-280	C280	TEL-D	50-75	175	*	
56CO1	6C		G,XP	ABY	THR 24	C 24	EMU-D		90		
57MI2	6C		G,XP	SPC	THR-31	C 31			DST	*	
58BA4	6C		G,XP	RLX	THR 40	C -40	MAG-D		DST	* SPECTRUM	
58CH1	6C		G,XP	SPC	THR 44	C 30,44	EMU-D	5-26	DST		
59BA2	6C		G,XP	SPC	THR 89	C 82,89	TEL-D	18-52	90		
59CH1	6C		G,XP	SPC	THR 80	C 80				* YLD REL TO G,D	
59PE4	6C		G,XP	ABX	22 62	C 22-90	SCI-D		DST		
60BA1	6C		G,XP	ABY	THR 90	C 30,90	TEL-D	19-39	58		
60CH1	6C		G,XP	RLY	THR 90	C 90	TEL-I	16-30	DST	REL TO DEUTERONS	
61CE1	6C		G,XP	ABX	THR 342	D245-342	TEL-D	100-220	60		
61VA1	6C		G,XP	NOX	20 40	C 24,40	MAG-D		DST		
62CH2	6C		G,XP	RLY	THR 90	C 90	TEL-D	15-30	DST	REL TO DEUTERONS	
62HE1	6C		G,XP	SPC	19 27	C 31	SCD-D	3-9			
62LI1	6C	$	G,XP	RLY	THR 335	C335	TEL-D	135-200	DST	PROTONS POLARIZED	

C REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62PA1	6C		G,XP	ABY	THR 150	C150	SCI-D	33-98	60	
63FI4	6C		G,XP	SPC	19 30	C 31	SCI-D	3-14	90	SPECTRUM
63KI1	6C		G,XP	ABY	THR 335	C335	TEL-D	156-192	DST	
63MU1	6C		G,XP	ABY	THR 24	C 24	SCD-D	2-7	120	
63WA2	6C		G,XP	RLY	THR 65	C 65	SCI-D	6-21	DST	
61VA1	6C		E,P	NOX	20 40	C 24,40	MAG-D		DST	
62DO1	6C		E,XP	SPC	25 30	D 25-30	MAG-D	2-13	DST	
58MA1	6C		G,PT	ABX	THR 250	C150,250	EMU-D		DST	* SPC
56LI1	6C		G,PA	ABX	30 50	C 25-70	EMU-I			
58MA1	6C		G,PA	ABX	THR 250	C150,250	EMU-D		DST	* SPC
62MO2	6C		G,PA	ABI	25 120	C120	EMU-D		4PI	
60CH1	6C		G,XD	RLX	THR 90	C 90	TEL-I	16-30	DST	REL TO PROTONS
59CH1	6C		G,XD	SPC	THR 80	C 80				* YLD REL TO G,P
62CH2	6C		G,XD	RLY	THR 90	C 90	TEL-D	15-30	DST	REL TO PROTONS
55HA1	6C		G,3A	RLY	9 33	C 27,33	EMU-D		DST	
58MA1	6C		G,3A	ABX	THR 250	C150,250	EMU-D		DST	* SPC
60GA2	6C		G,3A	ABX	15,18	D 15,18	EMU-I			
61SE3	6C		G,3A	RLY	18	D 18	EMU-D		4PI	
63SH2	6C		G,3A	NOX	8 70	C 70	EMU-D		4PI	Q-VALUE DISTRIB
61JA2	6C	11	P,G	NOX	10	D 0-2	NAI-D	0-10	90	J-PI, G-WIDTH
62OP2	6C	11	P,G	ABX	11 14	D 2-5	NAI-D		0	
56TZ1	6C	12	G,MU-T	ABX	23	23				*
64GU1	6C	12	E,E/	FMF	15	D	NAI-D		DST	Q=0.2-0.5, WIDTH
55BA1	6C	12	G,N	ABX	18 36	C 18-260	ACT-I		4PI	ABY 18-250
55SP2	6C	12	G,N	RLX	THR	CTHR				* THRESHOLD
57CA2	6C	12	G,N	ABX	20 31	C 20-31	ACT-I		4PI	
58BA2	6C	12	G,N	RLY	24 145	D 24-145	ACT-I		4PI	COMPARED WITH E,N
59CO1	6C	12	G,N	ABX	20 21	D 20-21	ACT-I		4PI	
59SA1	6C	12	G,N	RLX	19-31	C 31	ACT-I		4PI	* BREAKS
60GE2	6C	12	G,N	RLY	19 20	C 19,20	ACT-I		4PI	THRESHOLD
60GE3	6C	12	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61RO2	6C	12	G,N	ABX	19 23	C 19-23	ACT-I		4PI	
62BO3	6C	12	G,N	ABX	18 90	C 18-90	ACT-I		4PI	
62DE1	6C	12	G,N	ABX	20 21	D 20-21	ACT-I		4PI	
58BA2	6C	12	E,N	RLY	24 145	D 24-145	ACT-I		4PI	COMPARED WITH G,N
59OC1	6C	12	G,2N	RLI	THR-100	CTHR-100	ACT-I		4PI	REL TO G,N
57CO1	6C	12	G,XN	ABX	19 41	C 19-40	BF3-I		4PI	
58BA2	6C	12	E,N	RLY	24 145	D 24-145	ACT-I		4PI	COMPARED WITH G,XN
61TH1	6C	12	G,P	ABI	18 23	C 18-23	ACT-I		4PI	18 BREAKS
58TA1	6C	12	G,3P	ABX	100 320	C100-320	ACT-I		4PI	LI-9 N BY BF3
55CA2	6C	12	G,3A	ABX	12-18	D 12-18	EMU-D			*
55CO1	6C	12	G,3A	ABX	7 70	C 70	EMU-D			*
55GL1	6C	12	G,3A	SPC	18	D 18	EMU-D			*
55GO1	6C	12	G,3A			C	EMU-D		DST	* ANG. CORRELATION
57MU1	6C	12	G,3A		15,18	D 15,18	EMU-D		DST	* ANG. CORRELATION
64GR1	6C	12	G,3A	ABY	7 24	C 17-24	EMU-I		4PI	
64TO1	6C	12	G,3A	ABX	9 22	C 22	EMU-D		DST	SPECTRUM
59GE1	6C	12	P,G	ABX	19 23	C 4-8	NAI-D	19-23	90	
59GO1	6C	12	P,G	RLX	19 26	D 3-11	NAI-D	19-26	DST	
61GO2	6C	12	P,G	ABX	19 27	D 3-11	NAI-D		DST	G,P ABI BY DT BAL
61SE2	6C	12	P,G	RLY	16	D 0	NAI-I		90	G-WDTH, MULTIPOLAR
63BE5	6C	12	P,G	RLY	21 28	D 6-13	NAI-I		90	
63RE1	6C	12	P,G	ABX	30 39	D 15-25	NAI-D		90	ABI BY DETAIL BAL
64AL2	6C	12	P,G	ABX	19 29	D 4-14	NAI-D		DST	
64AL3	6C	12	P,G	NOX	20 30	D 4-14	NAI-D		DST	
64BL1	6C	12	HE3,G	ABX	28	D 2-5	NAI-D		90	

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60ED1	6C	13	G,N	ABX	6 7	D 6-7	BF3-I		4PI	
64GR2	6C	13	G,N	ABX	6 11	D 6-11	BF3-I		4PI	
57CO1	6C	13	G,XN	ABX	6 41	C 6-40	BF3-I		4PI	
61SA2	6C	13	G,XN	SPC	7 14	C 14	TOF-D	2-9	79	
57CO1	6C	13	G,P	ABX	17 45	C 17-40	ACT-I		4PI	
64KO2	6C	13	G,P	SPC	20-32	C 32	SCI-D	3-13	90	SEPARATED ISOTOPES
64DE2	6C	13	G,XP	ABX	18-50	C 18-50	ACT-I		4PI	

NITROGEN Z=7

A	ABUND.(1)	SEPARATION ENERGIES (MEV) G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
14	99.63	10.5	7.6	22.7	20.7	11.6	30.6	12.5	25.1
15	0.37	10.8	10.2	14.8	28.3	11.0	21.4	18.4	31.0

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64BO1	7N		G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
60MU1	7N		G,N	RLY	THR 20	C 15-20	ACT-I		4PI	BREAKS
60BA7	7N		G,XN	RLX	THR 200	C200	CCH-D		DST	
63FU2	7N		G,XN	SPC	10 30	C 31	SCI-D	3-20	90	
60BA7	7N		G,NP	RLI	THR 200	C200	CCH-D		DST	
60KO1	7N		G,NP	SPC	THR 90	C 90	CCH-D	0-18	DST	PROTON SPECTRUM
56JO1	7N		G,P	SPC		C	EMU-D		DST	*
57LI1	7N		G,P	SPC	THR-70	C 30,70	EMU-D			*
58GR1	7N		G,P	ABY	8	D 8	ION-D		DST	* G-WIDTH
60BA7	7N		G,P	RLX	THR 200	C200	CCH-D		DST	
60KO1	7N		G,P	ABI	THR 90	C 90	CCH-D	0-40	DST	
60WA1	7N		G,P	SPC	8 16	C 12,16	EMU-D	1-8	DST	
60RE2	7N		G,XP				CCH-D100-			*
63FI4	7N		G,XP	SPC	0 31	C 31	SCI-D	2-20	90	
64KO1	7N		G,XP	SPC	THR-31	C 15-31	SCI-D	2-22	90	ABX
58MA1	7N		G,PA	ABX	THR 250	C150,250	EMU-D		DST	* SPC
62MO2	7N		G,PA	ABI	18 120	C120	EMU-D		4PI	
64TO2	7N		G,A	ABX	THR 22	C 22	EMU-D		DST	
60HE2	7N	13	P,G	ABX	2 3	D 0-1	NAI-D			
62PA2	7N	13	P,G	ABX	8 11	D 6-9	NAI-D		90	
62WA1	7N	13	P,G	ABX	15 20	D 14-20	NAI-D		90	
63FI1	7N	13	P,G	ABX	11 41	D 10-49	NAI-D		90	
63YO2	7N	13	P,G	ABX	2 4	D 1-2	NAI-D		DST	
60CA1	7N	14	G,MU-T	ABX	7 21	D 20-21	NAI-D			
62GO1	7N	14	G,MU-T	ABI	0 170	C170	CCH-D			
61SW1	7N	14	G,G	LFT	2	D 2	NAI-D		DST	
62ED1	7N	14	E,E/	ABX	0 10	D 42	TEL-D		180	
63BA1	7N	14	E,E/	ABX	0 18	D 42	MAG-D	25-42	180	G-WDTH
64BI1	7N	14	E,E/	ABX	0 8	D120,180	MAG-D		DST	FORM FACTORS
55CH1	7N	14	G,N	ABX	10-16	C 10-16	ACT-I		4PI	* ALSO USED BF3
59MU1	7N	14	G,N	RLY	11 17	C 11-17	ACT-I		4PI	
60FA1	7N	14	G,N	ABX	11 61	C 13-61	BF3-I		4PI	
60GE1	7N	14	G,N	RLX	10 12	C 10-12	ACT-I		4PI	
60GE2	7N	14	G,N	RLY	10 11	C 10-11	ACT-I		4PI	E-THRESHOLD
60KI2	7N	14	G,N	ABX	10 25	C 10-25	ACT-I		4PI	
60SA2	7N	14	G,N	RLY	10 13	C 10-13	ACT-I		4PI	
62GO1	7N	14	G,N	ABI	11 170	C170	CCH-D		4PI	

NO REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62KO2	7N	14	G,N	ABX	11 90	C 90	CCH-D		DST	
59OC1	7N	14	G,2N	RLI	THR-100	CTHR-100	ACT-I		4PI	REL TO G,N
56WR1	7N	14	G,NP	ABX	12 23	C 19-23	CCH-D		4PI	
62GO1	7N	14	G,NP	ABI	12 170	C170	CCH-D		4PI	
62KO2	7N	14	G,NP	ABX	16 90	C 90	CCH-D		DST	
55CO1	7N	14	G,NP3A		THR 70	C 70	EMU-D			*
62KO2	7N	14	G,NP3A	RLY	20 90	C 90	CCH-D		4PI	
62GO1	7N	14	G,NA	ABI	20 170	C170	CCH-D		4PI	
56WR1	7N	14	G,P	ABX	7 23	C 19-23	CCH-D		4PI	
58CO2	7N	14	G,P	NOX	7 30	C 18-30	EMU-D	2-15	90	
62GO1	7N	14	G,P	ABI	7 170	C170	CCH-D		4PI	
56LI1	7N	14	G,PA	ABX	25 50	C 25-70	EMU-I			
56WR1	7N	14	G,PA	ABX	17 23	C 19-23	CCH-D		4PI	
55CO1	7N	14	G,D3A		THR 70	C 70	EMU-D			*
56WR1	7N	14	G,A	ABX	12 23	C 19-23	CCH-D		4PI	
62GO1	7N	14	G,A	ABI	12 170	C170	CCH-D		4PI	
55CO1	7N	14	G,2A	ABX	THR 70	C 70	EMU-D			*
56WR1	7N	14	G,2A	ABX	16 23	C 19-23	CCH-D		4PI	
60HE2	7N	14	P,G	ABX	8	D 0-1	NAI-D		DST	G-WDTH
60RO1	7N	14	P,G	NOX	9	D 2	NAI-D		DST	J-PI
60RO2	7N	14	P,G	ABY	10	D 2-3	NAI-D		DST	J-PI
61HE1	7N	14	P,G	ABX	8	D 0-1	NAI-D		0	
61SE1	7N	14	P,G	RLY	6,9	D 2	MGP-D		DST	J-PI
63PR1	7N	14	P,G	NOX	9	D 2	NAI-D		DST	G-WDTH, AMPL RATIO
58RH1	7N	15	G,P	ABX	11 25	C 19,25	EMU-D	1-8	DST	
64KO3	7N	15	G,P	SPC	12 31	C 19-31	SCI-D		90	ABX
63FI3	7N	15	G,XP	SPC	13 31	C 25,31	SCI-D	3-13	90	ABI, SEP ISOTOPES

OXYGEN Z=8

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
16	99.76	15.7	12.1	25.0	22.8	7.2	28.9	23.0	22.3
17	3.7(-2)	4.1	13.8	18.6	18.8	6.4	19.8	16.3	25.3
18	.20	8.0	15.9	15.8	25.6	6.2	12.2	21.9	29.0

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59PE2	80		G,MU-T	ABX	THR 30	C 31	ACT-I			
60WY1	80		G,MU-T	ABX	18 35	C 90	NAI-D	10-40		
64TE1	80		G,MU-T	ABX	20 22	D 20-22	NAI-D		96	WATER TARGET
59PE5	80		G,G	ABX	19-61	C 19-61			135	*
60RE1	80		G,G	ABX	7	D 7	NAI-D	7	DST	
59PE5	80		G,G/	ABX	19-61	C 19-61			135	*
60IS1	80		E,E/	RLX	20 30	D 60-150	MAG-D		DST	
61IS1	80		E,E/	FMF		D				* GIANT RES REGION
63BI2	80		E,E/	FMF	11 14	D	MAG-D			
64BI2	80		E,E/	ABX	0 150	D 90-215	MAG-D		DST	SUM RULES
64GO2	80		E,E/	ABX	17-32	D 40-70	MAG-D		180	FMF
59MI2	80		G,N	NOX	THR 30	C 30	EMU-D	2-13	90	
60KU2	80		G,N	RLY	THR 90	C 90	TEL-I	10-	DST	
61BR1	80		G,N	ABI	0 34	C 34	ACT-I		4PI	
62BI4	80		G,N	ABI	60 150	C 60-150	ACT-I		4PI	MULTIPOLARITY
62FU5	80		G,N	ABX	21 31	C 31	SCI-D	2-13	90	
64BR1	80		G,N	ABX	15-30	D 15-30	BF3-I		4PI	

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64TA4	80		G,N	SPC	16 26	D 34	TOF-D		90	
57BA3	80		G,XN		THR	CTHR				*
63CO3	80		G,XN	ABX	16 75	C 16-100	BF3-I		4PI	
63FU1	80		G,XN	SPC	THR 31	C 31	SCI-D	2-13	90	
64FI1	80		G,XN	SPC	THR 32	C 25-32	TOF-D		70	
64YE1	80		G,XN	SPC	THR 35	C 34	TOF-D		90	BRANCHING RATIOS
62BI4	80		E,N	ABY	60 150	C 60-150	ACT-I		4PI	MULTIPOLARITY
55OD1	80		G,NP		THR-252	C140-252	SCI-D		DST	*
56OD1	80		G,NP	RLX	THR-340	C200-340			DST	*
56JO1	80		G,P	SPC		C	EMU-D		DST	*
56ST1	80		G,P	SPC		C 25	EMU-D		DST	* YIELD
57JO1	80		G,P	ABX	12 26	C 20-26	EMU-D	1-13	DST	
57MI3	80		G,P	RLY	THR-30	C 30	EMU-D		DST	*
61FI1	80		G,P	ABI	THR 35	C 35	SCI-D	2-6	90	
61SH3	80	$	G,P	SPC	THR 21	C 21	EMU-D	0-10	DST	POLARIZED PHOTONS
57BR1	80		G,XP	SPC	10 19	C 28	EMU-D	10-		
57MI1	80		G,XP	NOX	THR 30	C 30	EMU-D	4-8	DST	
61HE2	80		G,XP	SPC	0 35	C 35	SCI-D	6-22	90	
63FI4	80		G,XP	SPC	14 30	C 31	SCI-D	2-15	90	
58MA1	80		G,PA	ABX	THR 250	C150,250	EMU-D		DST	* SPC
62MO2	80		G,PA	ABI	23 120	C120	EMU-D		4PI	
62BI4	80		G,T	ABY	60 150	C 60-150	ACT-I		4PI	MULTIPOLARITY
57JO1	80		G,A	SPC	7 19	C 19-	EMU-D	2-11	DST	
64TO2	80		G,A	ABX	THR 22	C 22	EMU-D		DST	
58MA1	80		G,4A	ABX	THR 250	C150,250	EMU-D		DST	* SPC
64TO2	80		G,4A	ABX	THR 22	C 22	EMU-D		DST	
59CO2	80	15	P,G	ABX	19 25	D 14-20	NAI-D	19-25	90	
61CO1	80	15	P,G	ABX	19 25	D 14-20	NAI-D	19-25	90	
63BA2	80	15	P,G	NOX	8	D 1	NAI-D		DST	
63HE1	80	15	P,G	LFT	8	D 0-1	NAI-D			
58SI3	80	16	G,MU-T	RLX	16 25	C 15-25	ACT-I			
60CA1	80	16	G,MU-T	ABX	20 21	D 20-21	NAI-D			
60ZI1	80	16	G,MU-T	ABX	12 26	C 30	MGP-D	12-26		
62BU1	80	16	G,MU-T	ABX	19 27	C250	MGP-D	19-30		
63BU1	80	16	G,MU-T	ABX	12 26	C250	MGP-D	12-26		
57SW1	80	16	G,G	LFT	7,7	D 7,7	NAI-D			
62SE1	80	16	G,G	NOX	7	C 16	NAI-D		90	
62BI2	80	16	E,E/	FMF	19	D140-215	MAG-D		DST	J-PI, MULTIPOLE
62BI3	80	16	E,E/	FMF	44,49	D150	MAG-D			
62ED1	80	16	E,E/	NOX	0 16	D 41	MAG-D		180	
63BA1	80	16	E,E/	ABX	19	D 41	MAG-D	20-42	180	
63IS1	80	16	E,E/	NOX	22 26	C100-215	MAG-D			
64BI3	80	16	E,E/	ABX	6 14	D100-218	MAG-D		DST	FORM FACTORS
55CA1	80	16	G,N	ABX	17	D 0	ACT-I		4PI	
55PE1	80	16	G,N	ABI	15 23	C 16-23	ACT-I		4PI	
57CA2	80	16	G,N	ABX	16 31	C 15-30	ACT-I		4PI	
57ER1	80	16	G,N	ABX	16 32	C 16-32	ACT-I		4PI	
57SP2	80	16	G,N	RLX	16 25	C 14-25	ACT-I		4PI	
57SV1	80	16	G,N	ABX	20 25	C 16-30	NAI-D		120	G,G/N
58BE1	80	16	G,N	RLY	15 17	C 15-17	ACT-I		4PI	THRESHOLD, BREAK
59KI1	80	16	G,N	ABI	15 18	C 15-19	ACT-I		4PI	BRKS
59MI3	80	16	G,N	NOX	16 31	C 31	EMU-D	4-14	DST	
59PE3	80	16	G,N	NOX	16 17	C 16-18	ACT-I		4PI	BRKS
59SA2	80	16	G,N	RLY			ACT-I		4PI	* BREAKS
60GE1	80	16	G,N	ABX	15 17	C 15-17	ACT-I		4PI	
60GE2	80	16	G,N	NOX	15 17	C 15-17	ACT-I		4PI	
60SA1	80	16	G,N	NOX	15 16	C 15-16	ACT-I		4PI	BRKS
61KE1	80	16	G,N	ABX	17 18	D 17-18	ACT-I		4PI	
61RO2	80	16	G,N	ABY	16 22	C 22	ACT-I		4PI	

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62BO2	80	16	G,N	ABX	15,30	C 15-30	BF3-I		4PI	
62BR1	80	16	G,N	ABI	THR 32	C 32	ACT-I		4PI	
62DE1	80	16	G,N	ABX	20	D 20	ACT-I		4PI	
62FI1	80	16	G,N	RLX	18 29	C 31	TOF-D	3-13	90	
62GO1	80	16	G,N	ABI	THR 170	C170	CCH-D			
62GO2	80	16	G,N	ABX	12 75	C170	CCH-D		DST	
63AN1	80	16	G,N	ABX	15 60	C 15-60	ACT-I		4PI	
63CA1	80	16	G,N	ABX	16 30	D 16-30	BF3-I		4PI	
63GE2	80	16	G,N	ABX	15 23	C 15-23	ACT-I		4PI	
64DE3	80	16	G,N	ABX	17 18	D 17-18	ACT-I		4PI	
59OC1	80	16	G,2N	RLI	THR-100	CTHR-100	ACT-I		4PI	REL TO G,N
62BR1	80	16	G,2N	ABI	THR 32	C 32	ACT-I		4PI	
62MI2	80	16	G,XN	ABX	15 25	D 15-25	BF3-I		4PI	
63AU1	80	16	G,XN	SPC	20 56	C 46,56	TOF-D	4-25	90	
60ST1	80	16	G,NP	RLY	153 320	C320	TEL-D	130	76	REL TO H2 CROS SEC
62GO1	80	16	G,NP	ABI	THR 170	C170	CCH-D			
62KO1	80	16	G,ND	RLY	THR 90	C 90	CCH-I			
55SC2	80	16	G,NA	ABX	26-32	C 32	ACT-I		4PI	*
62GO1	80	16	G,NA	ABI	THR 170	C170	CCH-D			
55SP1	80	16	G,P	ABX	14 18	C 19	EMU-D	1-6	DST	
55ST1	80	16	G,P	ABX	14 25	C 25	EMU-D	1-12		
56CO1	80	16	G,P	ABX	18 25	C 25	EMU-D	6-12		
56LI2	80	16	G,P	SPC	17 70	C 30-70	EMU-D	5-17	DST	
57SV1	80	16	G,P	ABX	20 25	C 16-30	NAI-D		120	G,G/P
58MI1	80	16	G,P	ABX	15 30	C 15-30	EMU-D	2-16		
59BR2	80	16	G,P	NOX	23 30	C 32	EMU-D	10-18	DST	
62GO1	80	16	G,P	ABI	THR 170	C170	CCH-D			
62GO2	80	16	G,P	ABX	12 75	C170	CCH-D		DST	
63SC1	80	16	G,P	NOX	THR 31	C 31	SCD-D	5-18		
62DO1	80	16	E,P	ABX	16 27	D 30	MAG-D	4-13		
62KO1	80	16	G,PD	RLY	THR 90	C 90	CCH-I			
55SC2	80	16	G,TA	ABX	25-32	C 32	ACT-I		4PI	*
62GO1	80	16	G,A	ABI	THR 170	C170	CCH-D			
64GR1	80	16	G,A	ABY	7 14	C 17,24	EMU-D		4PI	SPC
64GR1	80	16	G,4A	ABY	14 24	C 24	EMU-I		4PI	
55CO1	80	16	G,4A	ABX	THR 70	C 70	EMU-D			*
55HA1	80	16	G,4A	NOX	20 32	C 27,33	EMU-D	1-10		
56DA1	80	16	G,4A	ABI	22 25	C 70	EMU-D			
59CO2	80	16	P,G	ABX	21 26	D 14-19	NAI-D		90	
59TA1	80	16	P,G	ABX	16 20	D 4-9	NAI-D	16-20	90	
60HE1	80	16	P,G	ABX	12	D 0-1	NAI-D			
61CO1	80	16	P,G	ABX	21 26	D 10-15	NAI-D	21-26	90	
63GO5	80	16	P,G	RLY	13 17	D 1-6	NAI-D			
64TA2	80	16	P,G	ABX	16 26	D 4-14	NAI-D		DST	
63SU2	80	16	D,G	ABX	21 25	D 1-11	NAI-D		DST	
64LA2	80	16	A,G	ABX	10 13	D 3-8	NAI-D		DST	J-PI, WIDTHS
64MI1	80	16	A,G	RLX	13	D 7-8	NAI-D		DST	J-PI, WIDTHS
61LA1	80	18	E,E/	FMF	2 6	D150	MAG-D	140-150	DST	
64MU1	80	18	G,N	SPC	10-20	C 20	EMU-D	1-10	DST	J-PI, 2189 TRACKS
63FU2	80	18	G,XN	SPC	11 31	C 31	SCI-D	3-20	90	
55RE1	80	18	G,P	ABI	THR 400	C 50-400	ACT-I		4PI	
64KO2	80	18	G,P	SPC	18-32	C 32	SCI-D	3-13	90	SEPARATED ISOTOPES

FLUORINE Z=9

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
19	100.00	10.4	8.0	11.7	22.1	4.0	19.6	6.1	23.9

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
63SE1	9F	17	P,G	RLY	4	D 3	NAI-D		DST	J-PI, WIDTH
64TE1	9F	19	G,MU-T	ABX	20 21	D 20-21	NAI-D		96	
60BO3	9F	19	G,G	LFT	1	C 0-2	NAI-D		100	J-PI
60RE1	9F	19	G,G	ABX	7	D 7	NAI-D		90	
62BO6	9F	19	G,G	LFT	0 4	C 0-4	NAI-D		DST	
64BO1	9F	19	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
63BA1	9F	19	E,E/	SPC	0 16	D 42	MAG-D		180	
58BE1	9F	19	G,N	NOX	10 11	C 10-11	ACT-I		4PI	THRESHOLD
60GE2	9F	19	G,N	NOX	10 11	C 10-11	ACT-I		4PI	THRESHOLD
60KI4	9F	19	G,N	ABX	10 23	C 10-23	ACT-I		4PI	
60SA2	9F	19	G,N	RLY	10 12	C 10-12	ACT-I		4PI	
60WA2	9F	19	G,N	ABX	10 240	C120-240	ACT-I		4PI	
62DE1	9F	19	G,N	ABX	20 21	D 20-21	ACT-I		4PI	
59OC1	9F	19	G,2N	RLI	THR-100	CTHR-100	ACT-I		4PI	REL TO G,N
60FO2	9F	19	G,P	RLX	10 18	C 16,19	EMU-D		DST	
62BR3	9F	19	G,P	SPC	18	D 18	EMU-D	2-10	DST	
63MU1	9F	19	G,P	SPC	11 24	C 24	SCD-D	3-11	120	
62DO1	9F	19	E,P	SPC	10 19	D 18-30	MAG-D	2-10	DST	
55RE1	9F	19	G,2P	ABI	THR 400	C 80-400	ACT-I		4PI	
55LA1	9F	19	G,XP	SPC	8-17	10-17			DST	* ABI

NEON Z=10

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
20	90.92	16.9	12.8	23.9	21.2	4.7	28.5	23.3	20.8
21	0.26	6.8	13.0	21.6	19.9	7.3	23.6	19.6	23.6
22	8.82	10.4	15.3	21.5	26.3	9.7	17.1	23.4	26.4

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62DO1	10NE		G,MU-T	ABI	THR 170	C170	CCH-D		4PI	
62GO1	10NE		G,MU-T	ABI	0 170	C170	CCH-D			
62DO1	10NE		G,N	ABI	THR 170	C170	CCH-D		4PI	INCLUDES G,2N
62GO1	10NE		G,N	ABI	THR 170	C170	CCH-I			INCLUDES G,2N
57KO1	10NE		G,NP	ABY	THR 80	C 80	CCH-D		4PI	
62DO1	10NE		G,NP	ABI	THR 170	C170	CCH-D		4PI	
62GO1	10NE		G,NP	ABI	THR 170	C170	CCH-I			
62GO4	10NE		G,NP	ABX		C	CCH-I		DST	*
62DO1	10NE		G,NA	ABI	THR 170	C170	CCH-D		4PI	
62GO1	10NE		G,NA	ABI	THR 170	C170	CCH-I			
56AT1	10NE		G,P		THR 23	C 23	CCH-D			*
57KO1	10NE		G,P	ABY	THR 80	C 80	CCH-D	1-15	DST	ABI
62DO1	10NE		G,P	ABI	THR 170	C170	CCH-D		4PI	INCLUDES G,D
62GO1	10NE		G,P	ABI	THR 170	C170	CCH-I			INCLUDES G,D
62GO4	10NE		G,P	ABX		C	CCH-I		DST	*
57KO1	10NE		G,2P	ABY	THR 80	C 80	CCH-D		4PI	
60RE2	10NE		G,XP				CCH-D100-			*
62SU1	10NE		G,XP	SPC	16 23	C 23	EMU-D	2-13	90	

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
63FI4	10NE	G,XP	SPC	15 29	C 31	SCI-D	2-15	90	
56AT1	10NE	G,PA	THR	23	C 23	CCH-D		*	
57KO1	10NE	G,PA	ABY THR	80	C 80	CCH-D		4PI	
62GO4	10NE	G,PA	ABX		C	CCH-I		DST	*
56AT1	10NE	G,A	THR	23	C 23	CCH-D		*	
62GO1	10NE	G,A	ABI THR	170	C170	CCH-I			
56AT1	10NE	G,2A	THR	23	C 23	CCH-D		*	
57KO1	10NE	G,2A	ABY THR	80	C 80	CCH-D		4PI	
57KO1	10NE	G,5A	ABY THR	80	C 80	CCH-D		4PI	
55RE1	10NE	G,N17	ABI THR	400	C 90-400	ACT-I		4PI	
63BA1	10NE20	E,E/	SPC	0 16	D 42	MAG-D		180	J-PI, WIDTHS, ABX
59HA1	10NE20	G,N	ABX	15,18	D 15,18	ION-D		4PI	
59HA1	10NE20	G,P	ABX	15,18	D 15,18	ION-D		4PI	
62DO1	10NE20	E,P	SPC	3 11	D 18-30	MAG-D	3-14	DST	ABI
59HA1	10NE20	G,PA	ABX	15,18	D 15,18	ION-D		4PI	
59HA1	10NE20	G,A	ABX	15,18	D 15,18	ION-D		4PI	
59HA1	10NE20	G,2A	ABX	15,18	D 15,18	ION-D		4PI	
60BR1	10NE20	P,G	RLY	17 23	D 4-11	NAI-D			
64AL3	10NE20	P,G	NOX	17 22	D 4-9	NAI-D		DST	
64TA1	10NE20	P,G	ABX	17 24	D 4-11	NAI-D		90	
60KO2	10NE22	G,NP	SPC THR	90	C 90	CCH-D	2-20	DST	SEPARATED ISOTOPES
60KO2	10NE22	G,P	SPC THR	90	C 90	CCH-D	2-24	DST	SEPARATED ISOTOPES
59HA1	10NE22	G,A	ABX	15,18	D 15,18	ION-D		4PI	

SODIUM Z=11

A	ABUND.	SEPARATION ENERGIES (MEV) G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
23	100.00	12.4	8.8	17.4	24.4	10.5	23.5	19.2	24.1

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61BE2	11NA21	P,G	SPC	4	D 1	NAI-D		DST	
60KR1	11NA22	P,G	SPC	7 9	D 0-2	NAI-D			
56FU1	11NA23	G,G	ABX	4 40	C 4-40	NAI-D		120	ERRATUM PR 106,933
59RA1	11NA23	G,G	LFT	1	D 1	NAI-D		DST	
60MO1	11NA23	G,G	NOX	9	D 9	NAI-D		DST	WIDTH
62BO6	11NA23	G,G	LFT	0 4	C 0-4	NAI-D		110	
62MO1	11NA23	G,G	LFT	1	C 1	NAI-D		130	
64ME1	11NA23	G,G	LFT	4	D 4	NAI-D		DST	J-PI, WIDTH
64SW1	11NA23	G,G	NOX	7	D 7,7	NAI-D		DST	J-PI, WIDTH
63BA1	11NA23	E,E/	SPC	0 20	D 42	MAG-D		180	ABX
58CH2	11NA23	G,N	RLY THR		CTHR	BF3-I		4PI	THRESHOLD
59OC1	11NA23	G,2N	RLI THR-100		CTHR-100	ACT-I		4PI	REL TO G,N
63CO3	11NA23	G,XN	ABX	13 80	C 13-80	BF3-I		4PI	
63SA1	11NA23	G,XN	ABX	12 24	C 12-24	BF3-I		4PI	
60WA2	11NA23	G,2N2P	ABX THR	240	C120-240	ACT-I		4PI	
58KE1	11NA23	G,P	SPC	18	D 18	NAI-D	3-8	4PI	ABX
58OP1	11NA23	G,P	SPC	18	D 18	NAI-D	3-8	4PI	ABX
62OD1	11NA23	G,P	SPC	11 18	C 18	EMU-D	2-10	DST	ABY
55RE1	11NA23	G,N17	ABI THR	400	C 90-400	ACT-I		4PI	
62BR2	11NA23	P,G	NOX	9 10	D 0-1	NAI-D		DST	J-PI

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
24	78.70	16.5	11.7	26.7	23.1	9.3	29.9	24.1	20.5
25	10.13	7.3	12.1	23.0	20.1	9.9	23.9	19.1	22.6
26	11.17	11.1	14.1	21.6	26.0	10.6	18.4	23.2	24.8

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE	MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56FU1	12MG		G,G	ABX	4 40	C	4-40	NAI-D		120	ERRATUM PR 106,993
58BU1	12MG		G,G		1	D	1			4PI	* WIDTH
59LA1	12MG		G,G			C	13				*
59VA1	12MG		G,G		1,4						*
60BU3	12MG		G,G	ABX	11	C	11			DST	* WIDTH MULTIPOL.
61SU1	12MG		G,G	RLY	7 14	C	7-14	NAI-D		120	
62SE1	12MG		G,G	NOX	0 16	C	16	NAI-D		90	
63SU1	12MG		G,G	ABX	4 14	C	4-14	NAI-D		120	
64GO3	12MG		E,E/	ABX	11	D	40-70	MAG-D		180	FMF
55YE1	12MG		G,N	ABX	11-17		11-17				*
58SP2	12MG		G,N	ABX	8 17	C	8-17	BF3-I		4PI	
56YE1	12MG		G,XN	ABY	7 23	C	7-23	BF3-I		4PI	
63CO3	12MG		G,XN	ABX	10 80	C	10-80	BF3-I		4PI	
62SH11	12MG		G,P	ABX	15 24	C	THR-24	SCI-D	1-	DST	
64FO1	12MG		G,P	SPC	THR 40	C	20-40	EMU-D	1-18	DST	RLX
64IS1	12MG		G,XP	ABX	THR-32	C	15-32	SCI-D	0-3		
55RE1	12MG		G,N17	ABI	THR 400	C	80-400	ACT-I		4PI	
60BU2	12MG	24	G,G	ABX	11	C	11			DST	* WIDTH, MULTIPOL
60ME1	12MG	24	G,G	NOX	1	D	1	NAI-D		DST	J-PI, WIDTH
60TO1	12MG	24	G,G	NOX	9 11	C	13	NAI-D		118	THRESHOLD
62BO6	12MG	24	G,G	LFT	0 4	C	0-4	NAI-D		DST	
64BO1	12MG	24	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI
63BA1	12MG	24	E,E/	SPC	0 16	D	42	MAG-D		180	J-PI, WIDTHS
60KI1	12MG	24	G,N	ABX	16 25	C	16-25	ACT-I		4PI	
55NA1	12MG	24	G,XN	ABX	16 24	C	9-24	BF3-I		4PI	
63YA1	12MG	24	G,P	SPC	15 22	C	22	EMU-D	2-10	DST	RLY
60WA2	12MG	24	G,2N3P	ABX	THR 240	C	240	ACT-I		4PI	
63SH3	12MG	24	G,C12*	RLY	THR 70	C	70	EMU-D		4PI	15 6-ALPHA EVENTS
61GO1	12MG	24	P,G	RLY	15 23	D	3-11	NAI-D		90	
62GL1	12MG	24	P,G	NOX	12	D	0-1	NAI-D		55	
62PR1	12MG	24	P,G	NOX	12 13	D	0-1	NAI-D		55	WIDTHS
63GO3	12MG	24	P,G	RLY	15 23	D	4-12	NAI-D		90	
60ME1	12MG	25	G,G	NOX	2	D	2	NAI-D		DST	J-PI, WIDTH
61RA1	12MG	25	G,G	LFT	2	D	2	NAI-D		DST	J-PI
62BO6	12MG	25	G,G	LFT	0 4	C	0-4	NAI-D		DST	
64BO1	12MG	25	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI
55NA1	12MG	25	G,XN	ABX	7 24	C	9-24	BF3-I		4PI	
61RA1	12MG	26	G,G	LFT	2	D	2	NAI-D		DST	
64BO1	12MG	26	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI

ALUMINUM Z=13

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
27	100.00	13.1	8.3	18.2	23.7	10.1	24.4	19.4	22.4

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
63GA1	13AL25		P,G	LFT	1	D 1	SCI-D			
63MC2	13AL25		P,G	NOX	2	D 1	NAI-D		DST	J-PI, E2/M1 RATIO
62NE2	13AL26		P,G	NOX	7 8	D 1-2	NAI-D		0	
63GA1	13AL26		P,G	LFT	1	D 1	SCD-D			
63HO1	13AL26		P,G	NOX	0 2	D -I	NAI-D		DST	J-PI, ISOSPIN
58ZI1	13AL27		G,MU-T	ABX	17 25	C 17-30	MGP-D			
59DU1	13AL27		G,MU-T	ABX	13 30	C 29,30	MGC-D			
59KO1	13AL27		G,MU-T	ABX	13 30	C 30	NAI-D			
59MI1	13AL27		G,MU-T	ABX	13 30	C 30	MGC-D			
60CA1	13AL27		G,MU-T	ABX	13 21	D 20-21	NAI-D			
60TA2	13AL27		G,MU-T	ABX	7 28	C 28	MAG-D			
60WY1	13AL27		G,MU-T	ABX	13 55	C 35-90	NAI-D			
60ZI1	13AL27		G,MU-T	ABX	13 30	C 10-30	MGP-D			
64TE1	13AL27		G,MU-T	ABX	20 21	D 20-21	NAI-D		96	
56FU1	13AL27		G,G	ABX	4 40	C 4-40	NAI-D		120	ERRATUM PR106,993
58AL1	13AL27		G,G	ABX	2				124	*
60ME1	13AL27		G,G	NOX	1,2	D 1,2	NAI-D		DST	
60RE1	13AL27		G,G	ABX	7	D 7	NAI-D		90	
60VA1	13AL27		G,G	LFT	1	C 3				*
61DE4	13AL27		G,G	ABX	14 32	C 32	NAI-D		DST	
61TO1	13AL27		G,G	ABX	3 15	C 4-15	NAI-D		120	
62BO6	13AL27		G,G	LFT	3	C 0-4	NAI-D		DST	
63VA3	13AL27		G,G	NOX	2	C 3	NAI-D		DST	WIDTH
63VA4	13AL27		G,G	NOX	2,3	C 4	NAI-D		120	WIDTH
64BO1	13AL27		G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
63BA1	13AL27		E,E/	SPC	0 18	D 42	MAG-D	24-42	180	ABX
63GO4	13AL27		E,E/	ABX		D 41	MAG-D		180	
64AM1	13AL27		E,E/P	RLX	THR 150	D550	MAG-D		51	
55JO1	13AL27		G,N	RLY	15 65	C 65	SCI-D	2-	DST	
55JO1	13AL27		G,N	RLY	23-65	C 65	SCI-D	10-	DST	
57FE1	13AL27		G,N	RLY	22 31	C 31	THR-I	5-	DST	
58AS1	13AL27		G,N	NOX	13 17	C 17	SCI-I		DST	
58BA5	13AL27		G,N	RLX	12-14	12-14				* BREAKS, THRESH.
58CH2	13AL27		G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
58FE1	13AL27		G,N	ABX	13 30	C 13-30	ACT-I		4PI	
59KU1	13AL27		G,N	NOX	23 88	C 88	SCI-I	10-	DST	QUASI-DEUTERON
60CH2	13AL27		G,N	ABX	13 21	D 12-21	BF3-I		4PI	
60GE3	13AL27		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
60KU2	13AL27		G,N	RLY	23 90	C 90	TEL-I	10-	DST	
61BA1	13AL27		G,N	ABX	13 19	C 12-19	BF3-I		4PI	
61PR1	13AL27		G,N	RLX	13 85	C 25-85	THR-D	11-		
62BO2	13AL27		G,N	ABX	13 30	C 14-30	BF3-I		4PI	
62MU1	13AL27		G,N	ABX	13 24	C 13-24	BF3-I		4PI	
63MI4	13AL27		G,N	SPC	15 30	C 24,30	EMU-D	2-15	90	
55BA5	13AL27		G,XN	ABX	THR-250	C250		30-	DST	*
55DI1	13AL27		G,XN	NOX	13 70	C 70	SCI-I		DST	
56HE1	13AL27		G,XN	RLY	13-31	C 31				* REL TO TRITONS
56WA1	13AL27		G,XN	RLY	13-31	C 31	ACT-I		4PI	* REL TO TRITONS
58FE1	13AL27		G,XN	ABX	13 30	C 13-30	THR-I	5-		FAST NEUTRONS
59CO3	13AL27		G,XN	SPC	15 30	C 24,30	EMU-D	2-15	90	
63CO3	13AL27		G,XN	ABX	12 80	C 80	BF3-I		4PI	
60ST1	13AL27		G,NP	RLX	149 320	C320	TEL-D	130	76	REL TO H2 CROS SEC

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60GO2	13	AL27	G,N2P	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,PD, G,HE3
60WA2	13	AL27	G,4N4P	ABX	THR 240	C120-240	ACT-I		4PI	
55DA1	13	AL27	G,P	SPC	THR-70	C 70	EMU-D	-16		*
55JO1	13	AL27	G,P	RLY	THR 65	C 65	SCI-D	14-	DST	
57RO1	13	AL27	G,P	RLX	15,18	D 15,18				* REL TO CU63(G,N)
59BA2	13	AL27	G,P	SPC	25 52	C 18-52	TEL-D	15-70	90	
60CH2	13	AL27	G,P	ABX	12 21	C 12-21	ION-I		4PI	
61MA1	13	AL27	G,P	RLY	11 35	C 35	MGP-D	3-14	DST	
62BR3	13	AL27	G,P	SPC	18	D 18	EMU-D	2-10	DST	
62SE2	13	AL27	G,P	ABX	15,18	D 15,18	SCI-D			
62SH8	13	AL27	G,P	SPC	10 24	C 24	EMU-D	2-14	DST	
62SH11	13	AL27	G,P	ABX	10 24	C 24	SCI-I	2-	DST	
63OD1	13	AL27	G,P	ABY	10 22	C 22	EMU-D	2-	DST	
62DO1	13	AL27	E,P	SPC	17 29	D 18-30	MAG-D	3-15	DST	VIRTUAL PHOTONS
58AU1	13	AL27	G,2P	ABX	20 63	C 20-63	ACT-I		4PI	
55TA1	13	AL27	G,XP	ABX	58-280	C280	TEL-D	50-75	175	*
56DA2	13	AL27	G,XP	SPC	11 70	C 70	EMU-D	2-14	DST	ABY
57BA2	13	AL27	G,XP	SPC	8 85	C 85	TEL-D			* FAST PROTONS
57MI2	13	AL27	G,XP	SPC	8-31	C 31			DST	*
58BA4	13	AL27	G,XP	RLX	8 40	C -40	MAG-D		DST	* SPECTRUM
58BA6	13	AL27	G,XP	SPC	23 85	C 85		15-65		* QUASI-DEUTERON
60CH1	13	AL27	G,XP	RLX	24 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
61MA2	13	AL27	G,XP	NOX	8 21	C 21	SCI-D	1-10	DST	
62CH2	13	AL27	G,XP	RLY	23 35	C 35	MAG-D	15-30	DST	REL TO DEUTERONS
63MI5	13	AL27	G,XP	ABY	12 22	C 22	SCI-D	4-	DST	
60GO2	13	AL27	G,PD	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,N2P, G,HE3
61MA1	13	AL27	G,D	RLY	20 35	C 35	MGP-D	3-10	DST	
60CH1	13	AL27	G,XD	RLX	32 90	C 90	TEL-I	15-30	90	REL TO PROTONS
62CH2	13	AL27	G,XD	RLY	32 35	C 35	MAG-D	15-30	DST	REL TO PROTONS
56HE1	13	AL27	G,T	RLY	18-31	C 31				* REL TO NEUTRONS
56WA1	13	AL27	G,T	RLY	18-31	C 31	ACT-I		4PI	* REL TO NEUTRONS
60GO2	13	AL27	G,HE3	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,N2P, G,PD
57BO1	13	AL27	G,A	ABX	10-31	C 31	EMU-D		DST	* SPC
58TO2	13	AL27	G,A	ABY	10 22	C 22	EMU-I		4PI	
61MA1	13	AL27	G,A	RLY	19 35	C 35	MGP-D	9-14	DST	
62BE3	13	AL27	G,A	SPC	16 30	C 30	SCD-D	6-12	DST	ASYMMETRY SPECTRUM
55RE1	13	AL27	G,N17	ABI	THR 400	C 80-400	ACT-I		4PI	
61NO1	13	AL27	P,G	NOX	9	D 1				J-PI, WIDTH
62LA1	13	AL27	P,G	NOX	11	D 3	NAI-D		DST	J-PI
62OP1	13	AL27	P,G	NOX	9	D 0-1	NAI-D		DST	J-PI
63VA5	13	AL27	P,G	RLY	9 10	D 1-2	NAI-D		DST	SEPARATED ISOTOPES
64VA1	13	AL27	P,G	NOX	10 11	D 2-3	NAI-D		DST	J-PI
64VA2	13	AL27	P,G	NOX	10	D 2	NAI-D			J-PI
63CV1	13	AL28	N,G	ABX	12 22	D 14	TEL-D		4PI	

Si

SILICON Z=14

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
28	92.21	17.2	11.6	27.5	23.2	10.0	30.5	24.7	19.9
29	4.70	8.5	12.3	24.6	20.6	11.1	25.7	20.1	21.9
30	3.09	10.6	13.5	22.2	24.8	10.7	19.1	23.0	24.0

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	NUCLIDE A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	DETECTOR MIN-MAX	ANG	REMARKS
59DU1	14SI		G,MU-T	ABX	15 25	C 29,30	MGC-D			
60RE1	14SI		G,G	ABX	7	D 7	NAI-D		90	
61SU1	14SI		G,G	RLY	11	C 6-13	NAI-D		120	
61TO1	14SI		G,G	ABX	4 14	C 5-14	NAI-D		120	
62SE1	14SI		G,G	NOX	11	C 16	NAI-D		90	
64GO3	14SI		E,E/	ABX	12	D 40-70	MAG-D		180	FMF
63BO1	14SI		G,N	ABX	15 25	C 10-30	BF3-I		4PI	
63SA1	14SI		G,N	ABX	10 24	C 10-24	BF3-I		4PI	
63CO3	14SI		G,XN	ABX	13 80	C 13-80	BF3-I		4PI	
58EM1	14SI		G,P	NOX	THR 30	C 30	EMU-D		DST	
62SH11	14SI		G,P	ABX	THR 24	CTHR-24	SCI-I	2-	DST	
64MA1	14SI		G,P	ABX	17-22	D 17-22	SCD-D		4PI	BRANCHING RATIOS
64UL1	14SI		G,P	SPC	14-20	C 17-20	SCD-D	1-9	4PI	SCD TARGET
60CH1	14SI		G,XP	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
61SH4	14SI		G,XP	SPC	THR 24	C 24	EMU-D	2-13	DST	ABSOLUTE YIELD
61SH5	14SI		G,XP	SPC	14 24	C 24	EMU-D	2-12		
64LO2	14SI		G,XP	SPC	THR-21	C 21	SCI-D	2-10	4PI	SCD TARGET
64UL2	14SI		G,XP	SPC	THR 30	C 15-30	SCD-D	2-18	4PI	
60CH1	14SI		G,XD	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO PROTONS
60CH1	14SI		G,XT	RLY	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
64MA1	14SI		G,A	ABX	17-22	D 17-22	SCD-D		4PI	BRANCHING RATIOS
64UL1	14SI		G,A	SPC	14-20	C 17-20	SCD-D		4PI	SCD TARGET
60TO1	14SI	28	G,G	RLY	THR 13	C 13	NAI-D			THRESHOLD
62BO6	14SI	28	G,G	LFT	2	C 0-4	NAI-D		110	J-PI, WIDTH
64BO1	14SI	28	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
60BA4	14SI	28	E,E/	SPC	0 30	D 43	MAG-D	13-43	160	ABI
62ED1	14SI	28	E,E/	ABI	0 12	D 42	TEL-D		180	G-WDTH
61BE1	14SI	28	G,N	RLY	THR	CTHR	ACT-I		4PI	THRESHOLD
63CA1	14SI	28	G,N	ABX	17 30	D 15-30	BF3-I		4PI	
60WA2	14SI	28	G,4N5P	ABX	THR 240	C240	ACT-I		4PI	
61SH1	14SI	28	G,P	SPC	14 24	C 24	EMU-D	2-12		
62BI1	14SI	28	G,P	SPC	18	D 18	SCD-D	4-9	DST	
62BI1	14SI	28	G,A	SPC	18	D 18	SCD-D	4-9	DST	
60KI3	14SI	28	P,G	RLX	19 26	D 8-15	NAI-D		90	
61GO1	14SI	28	P,G	RLY	15 22	D 3-11	NAI-D		DST	
61KI1	14SI	28	P,G	ABX	7 15	D 7-15	NAI-D		90	
63AN2	14SI	28	P,G	NOX	13	D 1-3	NAI-D		90	
63SI1	14SI	28	P,G	NOX	12	D 1	NAI-D		DST	J-PI
64AL3	14SI	28	P,G	ABX	15 24	D 4-13	NAI-D		DST	
64RA1	14SI	28	P,G	RLX	16-18	D 5-7	NAI-D		90	FLUCTUATIONS
62SM1	14SI	28	A,G	ABY	11 13	D 1-3	NAI-D	8-13	DST	J-PI, SEP ISOTOPES
64WE1	14SI	28	A,G	NOX	12-14	D 3-5	NAI-D		DST	WIDTHS
62BO6	14SI	29	G,G	LFT	1,2	C 0-4	NAI-D		DST	J-PI, WIDTHS
61BE1	14SI	29	G,N	RLY	THR	CTHR	ACT-I		4PI	THRESHOLD
61BE1	14SI	30	G,N	RLY	THR	CTHR	ACT-I		4PI	THRESHOLD

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
31	100.00	12.3	7.3	17.9	22.5	9.7	23.6	17.9	20.8

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE	MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60NE1	15P	29	P,G	NOX	4 5	D	1-3	NAI-D		DST	J-PI, WIDTH
61VA3	15P	29	P,G	NOX	3 5	D	0-2	NAI-D		DST	J-PI, WIDTHS
61VA2	15P	30	P,G	NOX	7	D	1	NAI-D		DST	J-PI
62AN2	15P	30	P,G	NOX	7 8	D	1-2	NAI-D		90	J-PI
63VA2	15P	30	P,G	NOX	7	D	1 2	NAI-D			J-PI
64EJ1	15P	30	P,G	NOX	7	D	1	NAI-D		DST	J-PI, WIDTHS
59DU1	15P	31	G,MU-T	ABX	10 30	C	29,30	MGC-D			
61BO3	15P	31	G,MU-T		10-20		10-20	THR-I		4PI	*
60BO3	15P	31	G,G	LFT	1	C	0-2	NAI-D		100	J-PI
62BO6	15P	31	G,G	LFT	1	C	0-4	NAI-D		110	J-PI, WIDTH
64BO1	15P	31	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI
63BA1	15P	31	E,E/	SPC	0 15	D	42	MAG-D	27-42	180	ABX
63LO2	15P	31	E,E/	FMF	1 6	D	130,180	MAG-D		DST	
55BA2	15P	31	G,N	RLY	12 13	C	12-13	ACT-I		4PI	THRESHOLD
56SC1	15P	31	G,N	RLY	12-22	C	22	ACT-I		4PI	*
58CH2	15P	31	G,N	RLY	THR	C	THR	BF3-I		4PI	THRESHOLD
60GE3	15P	31	G,N	NOX	THR	C	THR	ACT-I		4PI	THRESHOLD
61SA1	15P	31	G,N	RLY	12 14	C	12-14	ACT-I		4PI	THRESHOLD
62EM1	15P	31	G,N	SPC	10 30	C	30	EMU-D	2-13	DST	
62MU2	15P	31	G,N	ABX	12 24	C	24	BF3-I		4PI	
63BO1	15P	31	G,N	ABX	13 28	C	10-30	BF3-I		4PI	
57BA3	15P	31	G,XN		THR	C	THR				*
63CO3	15P	31	G,XN	ABX	13 80	C	80	BF3-I		4PI	
63MC3	15P	31	G,XN	ABX	12 24	C	12-24	ACT-I		4PI	
59OC1	15P	31	G,N2P	RLI	THR-100	C	THR-100	ACT-I		4PI	REL TO G,N
60WA2	15P	31	G,6N6P	ABX	THR 240	C	240	ACT-I		4PI	
62SH12	15P	31	G,P	SPC	10 19	C	19	EMU-D	2-12	4PI	
59OC1	15P	31	G,2P	RLI	THR-100	C	THR-100	ACT-I		4PI	REL TO G,N
61SH4	15P	31	G,XP	SPC	9 24	C	24	EMU-D	2-14	DST	ABSOLUTE YIELD
64IS1	15P	31	G,XP	ABX	THR-32	C	15-32	SCI-D	0-3		
60GO2	15P	31	G,NA24	ABX	30 260	C	30-260	ACT-I		4PI	INCLUDES G,HE4N2P
62TU1	15P	31	P,G	NOX	8 9	D	1-2	EMU-D		DST	J-PI
64TU1	15P	31	$P,G	NOX	10	D	3	EMU-D		90	J-PI, POL OF G

S

SULPHUR Z=16

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
32	95.0	15.1	9.0	24.0	19.1	6.9	28.1	21.2	16.1
33	0.76	8.6	9.6	21.3	17.1	7.1	23.7	17.5	18.2
34	4.22	11.4	10.9	20.4	21.9	7.9	20.1	21.0	20.3
36	1.4(-2)	9.9	*	19.3	*	8.9	16.9	21.2	*

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59DU1	16S		G,MU-T	ABX	11 30	C 29,30	MGC-D			
59KO1	16S		G,MU-T	ABX	12 30	C 31	NAI-D			
56FU1	16S		G,G	ABX	4 40	C 4-40	NAI-D		120	
60RE1	16S		G,G	ABX	7	D 7	NAI-D		90	
61TO1	16S		G,G	ABX	4 13	C 5-13	NAI-D		120	
64BO1	16S		G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
63BO1	16S		G,N	ABX	12 28	C 10-30	BF3-I		4PI	
63CO3	16S		G,XN	ABX	14 80	C 0-80	BF3-I		4PI	
63MU2	16S		G,XN	ABX	15 22	C 15-22	SCI-D	3-9	90	SPECTRUM
64FI1	16S		G,XN	SPC	THR 25	C 23,25	TOF-D		70	
55RI1	16S		G,NP	RLY	THR-65	C 65	CCH-I			* REL TO DEUTERONS
55RI1	16S		G,ND	RLY	THR-65	C 65	CCH-I			* REL TO PROTONS
61FO1	16S		G,P	SPC	10 30	C 30	EMU-D	2-17	DST	
62SH11	16S		G,P	ABX	9 24	C 9-24	SCI-I		DST	
60CH1	16S		G,XP	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
61MA2	16S		G,XP	NOX	9 21	C 21	SCI-D	1-10	DST	
63SH4	16S		G,XP	SPC	11 24	C 24	EMU-D	2-15		
64IS1	16S		G,XP	ABX	THR-32	C 15-32	SCI-D	0-3		
60CH1	16S		G,XD	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO PROTONS
60CH1	16S		G,XT	RLY	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
62BO6	16S	32	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI
61BI1	16S	32	E,E/	FMF	0-4	D150	MAG-D		135	MULTIPOLARITY
63BA1	16S	32	E,E/	SPC	0 22	D 42	MAG-D	17-42	180	G-WIDTH
64LO1	16S	32	E,E/	FMF	0 9	D120-180	MAG-D		DST	J-PI
59FA1	16S	32	G,N	ABX	20 30	C 30	THR-I	5-		
59FA1	16S	32	G,N	ABX	16 30	C 30	ACT-I		4PI	
60FE1	16S	32	G,N	ABX	15 30	C 31	ACT-I		4PI	
62KU1	16S	32	G,N	ABX	15 25	C 12-27	ACT-I		4PI	
62MU2	16S	32	G,N	ABX	15 22	C 12-24	BF3-I		4PI	
60FE1	16S	32	G,XN	ABX	12 31	C 31	MOD-I		4PI	
60FE1	16S	32	G,XN	ABX	20 31	C 31	THR-I	5-		
62BO3	16S	32	G,XN	ABX	16 90	C 30-90	BF3-I		4PI	
55DE1	16S	32	G,NP	ABX	18 22	C 18-22	ACT-I		4PI	
58GO3	16S	32	G,NP	RLY	21 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
59FA1	16S	32	G,NP	ABX	21 30	C 30	ACT-I		4PI	
60FE1	16S	32	G,NP	ABX	21 31	C 31	ACT-I		4PI	
62BO3	16S	32	G,NP	ABX	20 90	C 30-90	ACT-I		4PI	
60WA2	16S	32	G,6N7P	ABX	THR 240	C240	ACT-I		4PI	
55VI1	16S	32	G,D	ABX	19-22	C 17-22	ACT-I		4PI	INCLUDES G,NP
58GO3	16S	32	G,D	RLY	19 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
62BE4	16S	32	P,G	ABY	9 10	D 0-1	NAI-D		DST	J-PI
62NE1	16S	32	P,G	RLY	9 10	D 0-1	NAI-I		90	J-PI
63CH1	16S	32	P,G	SPC	9 10	D 0-1	NAI-D		DST	J-PI
63KI2	16S	32	P,G	ABX	17 22	D 8-14	NAI-I		DST	
63SP1	16S	32	P,G	NOX	9 10	D 0-1	NAI-D		DST	J-PI, G-WDTH
64SM1	16S	32	P,G	ABY	9 10	D 0-1	NAI-D		DST	J-PI, WIDTHS
64SM1	16S	32	A,G	ABY	9 10	D 2-3	NAI-D		DST	J-PI, WIDTHS
62BO6	16S	34	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI

CHLORINE Z=17

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
35	75.53	12.6	6.4	18.0	19.6	7.0	24.1	17.8	17.3
37	24.47	10.3	8.4	16.8	21.9	7.9	18.9	18.3	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57BA3	17CL	G,XN		THR	CTHR				*
55ER1	17CL	G,A	ABX	THR-32	C 32	EMU-I			* AGCL EMULSION
62BO6	17CL35	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI
55BA3	17CL35	G,N	RLY	12 22	C 22	ACT-I		4PI	THRESHOLD
55BO2	17CL35	G,N	ABX	13-21	C 13-21	ACT-I		4PI	
55DE1	17CL35	G,N	ABX	13 21	C 13-21	ACT-I		4PI	THRESHOLD
56SC1	17CL35	G,N	RLY	12-22	C 22	ACT-I		4PI	*
59FE1	17CL35	G,N	ABX	12 31	C 31	ACT-I		4PI	
59FE1	17CL35	G,N	ABX	16 31	C 31	THR-I	4-	4PI	
61SA1	17CL35	G,N	RLY	12 14	C 12-14	ACT-I		4PI	THRESHOLD
62KU1	17CL35	G,N	ABX	12 25	C 27	ACT-I		4PI	
59SE1	17CL36	N,G	SPC	9	C 0	NAI-D		90	G-WIDTH
62BO6	17CL37	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI
60GE3	17CL37	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

ARGON Z=18

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
36	0.34	15.3	8.5	24.2	18.6	6.6	28.3	21.2	14.9
38	6.3(-2)	11.8	10.2	20.7	20.8	7.2	20.6	20.6	18.6
40	99.6	9.9	12.5	18.2	23.0	6.8	16.4	20.6	22.8

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57KO2	18AR	G,P		THR-90	C 90	EMU-D		DST	* 302 TRACKS
59EM2	18AR	G,P	SPC	10 30	C 23-30	EMU-D	2-14	90	
61FI1	18AR	G,P	RLY	0 35	C 35	SCI-D		90	
55SP3	18AR	G,XP	SPC	THR-23	C 23				* ABS YIELD
59EM2	18AR	G,A	ABX	6 12	C 23-30	EMU-D		90	
61KO1	18AR	G,A	SPC	10 17	C 70	ION-D	3-12	90	
64ER1	18AR36	P,G	RLY	8 10	D 2-3	NAI-D		DST	J-PI, WIDTHS
64ER1	18AR36	A,G	RLY	8 10	D 2-3	NAI-D		DST	J-PI, WIDTHS
64ER1	18AR38	A,G	RLY	9 10	D 2-3	NAI-D		DST	J-PI, WIDTHS
64PH1	18AR38	A,G	RLY	99 11	D 3-4	NAI-D		DST	J-PI, WIDTHS

Ar K	REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
	63BA1	18	AR40	E,E/	SPC	0 24	D 42	MAG-D	18-42	180	
	59PE1	18	AR40	G,N	ABX	10 23	C 14-44	ACT-I		4PI	SYNTHESIS
	60FA1	18	AR40	G,N	ABX	13 49	C 10-50	BF3-I		4PI	
	59PE1	18	AR40	G,2N	ABX	17 23	C 14-44	ACT-I		4PI	SYNTHESIS
	59BR1	18	AR40	G,NP	ABI	21 34	C 34	ACT-I		4PI	
	59PE1	18	AR40	G,NP	ABX	19 40	C 14-44	ACT-I		4PI	SYNTHESIS
	60DO1	18	AR40	G,NP	ABI	21 33	C 30,34	ACT-I		4PI	
	56KO1	18	AR40	G,P	NOX	12 90	C 90	CCH-I	2-10	DST	
	58GU1	18	AR40	G,P	SPC	13 15	C 15	CCH-D	0-2	DST	
	59BR1	18	AR40	G,P	ABI	12 34	C 34	ACT-I		4PI	
	59PE1	18	AR40	G,P	ABX	13 33	C 14-44	ACT-I		4PI	SYNTHESIS
	60DO1	18	AR40	G,P	ABI	12 33	C 30,34	ACT-I		4PI	
	62DO1	18	AR40	E,P	SPC	13 30	D 30	MAG-D	3-16	76	SEPARATED ISOTOPE
	58IA1	18	AR40	G,XP	ABI	12 70	C 70	CCH-D	0-14	DST	

POTASSIUM Z=19

A	ABUND.	SEPARATION ENERGIES (MEV) G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
39	93.10	13.1	6.4	18.5	19.2	7.2	25.1	18.2	16.6
40	1.2(-2)	7.8	7.6	17.5	16.7	6.4	20.9	14.2	18.3
41	6.88	10.1	7.8	15.8	20.7	6.2	17.9	17.7	20.3

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61TO1	19K		G,G	ABX	6 12	C 6-12	NAI-D		120	
59EM1	19K		G,XN	SPC	7 31	C 31	EMU-D	2-14	DST	
63CO3	19K		G,XN	ABX	12 80	C 0-80	BF3-I		4PI	
62BO6	19K	39	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI
63BA1	19K	39	E,E/	SPC	0 16	D 42	MAG-D	26-42	180	
55BO2	19K	39	G,N	ABX	13-21	C 13-21	ACT-I		4PI	
55DE1	19K	39	G,N	ABX	13 21	C 13-21	ACT-I		4PI	THRESHOLD
60GE3	19K	39	G,N	NOX	THR	CTHR	ACT-I		4PI	THRESHOLD
62GO3	19K	39	G,N	ABX	14 24	C 14-24	ACT-I		4PI	
60HO1	19K	39	G,NP	ABY	20 25	C 20-25	ACT-I		4PI	REACTION UNCERTAIN
55SC2	19K	39	G,NA	ABX	14-32	C 32	ACT-I		4PI	*
57ER1	19K	39	G,NA	ABI	13 32	C 32	ACT-I		4PI	
58KE1	19K	39	G,P	ABX	18	D 18	SCI-D	2-12	4PI	
58OP2	19K	39	G,P	ABX	18	D 18	SCI-D	3-12	4PI	
62SH9	19K	39	G,P	SPC	6 24	C 24	EMU-D	1-15	4PI	
60HO1	19K	39	G,D	ABY	20 25	C 20-25	ACT-I		4PI	REACTION UNCERTAIN
63KO2	19K	41	P,G	RLY	9	D 0-1	NAI-D		DST	SEPARATED ISOTOPES

CALCIUM Z=20

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
40	96.97	15.7	8.3	25.0	18.8	7.0	29.3	21.5	14.7
42	0.64	11.5	10.3	19.7	20.2	6.2	19.8	20.4	18.1
43	0.15	7.9	10.7	19.8	18.3	7.6	19.4	18.2	19.9
44	2.06	11.1	12.2	20.9	23.3	8.8	19.1	21.8	21.6
46	3.3(-3)	10.4	13.8	21.5	*	11.1	17.8	23.2	*
48	0.19	9.9	15.3	22.5	*	*	17.2	24.	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59DU1	20CA		G,MU-T	ABX	11 30	C 29,30	MGC-D			
56FU1	20CA		G,G	ABX	4 40	C 4-40	NAI-D		120	
61DE4	20CA		G,G	ABX	15 32	C 32	NAI-D		DST	
61TO1	20CA		G,G	ABX	6 12	C 6-12	NAI-D		120	
60KU2	20CA		G,N	RLY	15 90	C 90	TEL-I	10-	DST	
59AG1	20CA		G,XN	SPC	THR-30	C 30				* SURFACE EFFECTS
59EM1	20CA		G,XN	SPC	7 31	C 31	EMU-D	2-14		
63CO3	20CA		G,XN	ABX	15 80	C 0-80	BF3-I		4PI	
64FI1	20CA		G,XN	SPC	THR 32	C 25,32	TOF-D		70	
57SC1	20CA		G,3N3P	ABX	THR-70	C 70				*
59KO2	20CA		G,P	SPC	THR-85	C 85	EMU-D			* 7000 TRACKS
64IS2	20CA		G,P	ABX	14-32	C 14-32	EMU-D	1-13	DST	SPC
64RA2	20CA		G,P	ABX	14 27	C 30	SCI-I	5-	DST	INCLUDES G,NP
63MI5	20CA		G,XP	ABY	6 22	C 22	SCI-I	4-	DST	
64HA1	20CA		P,G	ABX	14 23	D 6-15	SCI-D		90	DETAILED BALANCE
64SI1	20CA		P,G	NOX	9 10	D 1-2	NAI-D		DST	J-PI
61EC1	20CA	40	G,G	NOX	10	D 10	NAI-D		DST	J-PI, G-WIDTH
62BO6	20CA	40	G,G	LFT	0 4	C 0-4	NAI-D		110	J-PI
61PE1	20CA	40	E,E/	ABX	11 26	D120-180	MAG-D		DST	
62ED1	20CA	40	E,E/	NOX	0-	D 42	TEL-D		160	NO EXCITATION OBS
63BA1	20CA	40	E,E/	SPC	0 23	D 42	MAG-D	18-42	180	J-PI
63BL1	20CA	40	E,E/	FMF	0 11	D120-220	MAG-D	169-179	100	
64HO1	20CA	40	E,E/	ABX	10-17	D 80-200	MAG-D		DST	
62MI2	20CA	40	G,N	ABX	15 23	D 15-25	BF3-I		4PI	
63MI2	20CA	40	G,N	ABX	15 26	C 15-30	BF3-I		4PI	
60FE1	20CA	40	G,XN	ABX	12 31	C 31	ACT-I		4PI	
60FE1	20CA	40	G,XN	ABX	18 31	C 31	THR-I	5-		
60LI2	20CA	40	G,XN	ABI	THR 34	C 34	NAI-I			
64BA1	20CA	40	G,XN	ABX	15 30	C 15-30	ACT-I		4PI	
58HO1	20CA	40	G,NP	ABX	26 32	C 26-32	ACT-I		4PI	THRESHOLD
60FE1	20CA	40	G,NP	ABX	21 31	C 31	ACT-I		4PI	
62DR1	20CA	40	G,P	SPC	8 22	C 22	EMU-D	1-13	DST	
62JO1	20CA	40	G,P	SPC	8 21	C 20,21	EMU-D	2-12	DST	
62SH12	20CA	40	G,P	SPC	10 21	C 21	EMU-D	2-13		
62CH2	20CA	40	G,XP	RLY	8 35	C 35	MAG-D		DST	REL TO DEUTERONS
62CH2	20CA	40	G,XD	RLY	19 35	C 35	MAG-D		DST	REL TO PROTONS
61PO1	20CA	40	P,G	RLY	9 10	D 1-2	NAI-D			
62RA1	20CA	40	P,G	SPC	9 10	D 1-2	NAI-D		DST	J-PI, G-WIDTH
64TA1	20CA	40	P,G	ABX		D 9-14	NAI-D		100	
63SI2	20CA	42	P,G	RLY	11 12	D 1-2	NAI-D			SEPARATED ISOTOPES
58BR1	20CA	44	G,P	ABI	12 31	C 31	ACT-I		4PI	

Sc
Ti

SCANDIUM Z=21

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
45	100.00	11.3	6.9	17.5	21.0	7.9	21.0	18.1	19.1

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
61BU1	21SC41	P,G	ABI	1 3	D 0-2	ACT-I 0-4	4PI	

TITANIUM Z=22

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
46	7.93	13.1	10.4	22.9	20.7	8.0	22.6	21.7	17.2
47	7.28	8.9	10.5	22.0	18.4	9.0	22.1	19.3	18.7
48	73.94	11.6	11.4	22.4	22.6	9.4	20.5	22.1	19.9
49	5.51	8.1	11.3	21.8	20.4	10.1	19.8	19.6	20.8
50	5.34	10.9	12.2	22.0	24.0	10.7	19.1	22.3	21.8

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
63MI5	22TI	G,XP	ABY	8 22	C 22	SCI-I 4-	DST	
64SC1	22TI	G,A	SPC	THR 33	C 33	SCD-D 4-13	90	ABS YIELD
63KA1	22TI46	G,G	ABX	1	D 1	NAI-D	108	
58SI4	22TI46	G,N	RLX	13-22	CTHR-22	ACT-I	4PI	
62SH5	22TI46	G,N	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI46	G,NP	ABX	22 31	C 14-31	ACT-I	4PI	
64BO1	22TI47	G,G	LFT	1 3	C 1-3	NAI-D	100	ABI
62SH5	22TI47	G,P	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI47	G,2P	ABX	14 31	C 14-31	ACT-I	4PI	
63AK1	22TI48	G,G	LFT	2	D 2	NAI-D	150	
64BO1	22TI48	G,G	LFT	1 3	C 1-3	NAI-D	100	ABI
60ST1	22TI48	G,NP	RLX	152 320	C320	TEL-D130	76	REL TO H2 CROS SEC
62SH5	22TI48	G,NP	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI48	G,P	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI49	G,NP	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI49	G,P	ABX	14 31	C 14-31	ACT-I	4PI	
62SH5	22TI50	G,NP	ABX	14 31	C 14-31	ACT-I	4PI	
58SI4	22TI50	G,P	RLX	12-22	CTHR-22	ACT-I	4PI	
62SH5	22TI50	G,P	ABX	14 31	C 14-31	ACT-I	4PI	

VANADIUM Z=23

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
50	0.24	9.3	7.9	19.2	19.8	9.9	20.9	16.1	19.3
51	99.76	11.0	8.1	18.7	22.6	10.3	20.4	19.0	20.2

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
60RE1	23V	G,G	ABX	7	D 7	NAI-D	90	
56HE2	23V	G,N	RLY	THR-31	C 31			* REL TO ALPHAS
61BA2	23V	G,XN	ABY	THR 22	C 22	THR-I 5-	DST	
58HA1	23V	G,P	SPC	THR-30	C 30	EMU-D	DST	*
63MI5	23V	G,XP	ABY	5 22	C 22	SCI-I 4-	DST	
56HE2	23V	G,A	RLY	THR-31	C 31			* REL TO NEUTRONS
58TO2	23V	G,A	ABY	8 22	C 22	EMU-I	DST	
63KR1	23V	G,A	RLY	8 30	C 21,30	SCD-I	90	
62KE1	23V 51	E,E/	SPC	0 17	D183-600	TEL-D	DST	SOURCE 183,300,600
58CH2	23V 51	G,N	RLY	THR	CTHR	BF3-I	4PI	THRESHOLD
60GE3	23V 51	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD
62FU1	23V 51	G,N	ABX	11 28	D 8-28	BF3-I	4PI	QUADRUPOLE MOMENT
62FU1	23V 51	G,2N	ABX	20 28	D 8-28	BF3-I	4PI	QUADRUPOLE MOMENT
58KA1	23V 51	G,XN	ABX	12 22	C 12-22	BF3-I	4PI	
62FU1	23V 51	G,NP	ABX	20 28	D 8-28	BF3-I	4PI	QUADRUPOLE MOMENT
57ER1	23V 51	G,A	ABI	8 32	C 32	ACT-I	4PI	
59DY1	23V 51	G,A	ABX	14 25	C 25	ACT-I	4PI	
61CA2	23V 51	G,A	ABX	THR 32	CTHR-32	ACT-I	4PI	
62KR1	23V 51	G,A	ABI	10 30	C 21,30	SCD-D	90	

CHROMIUM Z=24

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
50	4.31	12.9	9.6	23.2	20.3	8.6	23.3	21.2	16.3
52	83.76	12.0	10.5	22.4	21.8	9.4	21.3	21.6	18.6
53	9.55	7.9	11.1	21.0	18.8	9.1	20.0	18.5	20.1
54	2.38	9.7	12.	19.7	22.1	7.9	17.6	20.9	22.

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
60RE1	24CR	G,G	ABX	7	D 7	NAI-D	90	
57FE2	24CR	G,N	ABY	15 30	C 14-30	THR-I 5-14	90	
58CO1	24CR	G,N	SPC	6 30	C 20,30	EMU-D 2-14	90	THRESHOLD
61BA2	24CR	G,XN	ABY	THR 22	C 22	THR-I 5-	DST	
64CO2	24CR	G,XN	ABY	THR-80	C 80	BF3-I	4PI	
62DE1	24CR50	G,N	ABX	20	D 20	ACT-I	4PI	
64BO1	24CR52	G,G	LFT	1 3	C 1-3	NAI-D	100	ABI
64BE3	24CR52	E,E/	FMF	0 9	D150,180	MAG-D	DST	J-PI
60GE3	24CR52	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD
64BO1	24CR53	G,G	LFT	1 3	C 1-3	NAI-D	100	ABI
60GE3	24CR53	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD

MANGANESE Z=25

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
55	100.00	10.2	8.1	17.2	21.2	7.9	19.2	17.8	20.

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56FU1	25MN55	G,G	ABX	4 40	C 4-40	NAI-D		120	
60RE1	25MN55	G,G	ABX	7	D 7	NAI-D		90	
64BO1	25MN55	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
58CH2	25MN55	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
59PA2	25MN55	G,N	ABX	10 24	C 10-24	BF3-I		4PI	
60GE3	25MN55	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61TA1	25MN55	G,N	NOX	16 22	C 22	THR-I	6-	90	
57HI1	25MN55	E,3N	ABX	30 60	D 64,82	ACT-I		4PI	
58KA1	25MN55	G,XN	ABX	11 22	C 11-22	BF3-I		4PI	
60FL1	25MN55	G,XN	ABX	11 27	C 12-30	BF3-I		4PI	QUADRUPOLE MOMENT
61BA2	25MN55	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
64CO2	25MN55	G,XN	ABY	THR-80	C 80	BF3-I		4PI	
61CA1	25MN56	D,G	ABX	16 18	D 3-5	ACT-I		4PI	

IRON Z=26

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
54	5.82	13.6	8.9	22.9	19.7	8.4	24.1	20.9	15.4
56	91.66	11.2	10.2	20.9	20.3	7.6	20.5	20.4	18.3
57	2.19	7.6	10.6	19.6	18.2	7.3	18.8	17.9	19.6
58	0.33	10.0	12.0	19.4	22.0	7.6	17.7	20.6	21.4

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59KO1	26FE	G,MU-T	ABX	10 27	C 31	NAI-D			
60RE1	26FE	G,G	ABX	7	D 7	NAI-D		DST	
63SU1	26FE	G,G	ABX	4 14	C 4-14	NAI-D		120	
64BO1	26FE	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
57HE1	26FE	G,2N	RLY	THR-70	C 70				* REL TO G,NP
55BA5	26FE	G,XN	ABX	THR-250	C250		30-	DST	*
55DI1	26FE	G,XN	NOX	THR 70	C 70	SCI-I		DST	
56HA1	26FE	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
61BA2	26FE	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
64CO2	26FE	G,XN	ABY	THR-80	C 80	BF3-I		4PI	
57HE1	26FE	G,NP	RLY	THR-70	C 70				* REL TO G,2N
63MI5	26FE	G,XP	ABY	8 22	C 22	SCI-I	4-	DST	
58TO2	26FE	G,A	ABY	7 22	C 22	EMU-I		DST	
63KR1	26FE	G,A	RLY	7 30	C 21,30	SCD-I		90	
55DE1	26FE53	G,N	ABX	11 24	C 11-24	ACT-I		4PI	
55DE1	26FE54	G,N	ABX	11 24	C 11-24	ACT-I		4PI	
57CA2	26FE54	G,N	ABX	12 30	C 13-30	ACT-I		4PI	
62DE1	26FE54	G,N	ABX	20	D 20	ACT-I		4PI	
58GO3	26FE54	G,NP	RLY	19 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
58GO3	26FE54	G,D	RLY	19 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61KE2	26FE56	G,G	NOX	1	D 1	NAI-D			G-WDTH
58TO1	26FE56	G,N	RLY	12 22	C 22	BF3-I		4PI	THRESHOLD
60GE3	26FE56	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58TO1	26FE57	G,N	RLY	12 22	C 22	BF3-I		4PI	THRESHOLD
60GE3	26FE57	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

Fe
Co

COBALT Z=27

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
59	100.00	10.5	7.4	16.6	20.3	7.0	19.0	17.4	19.3

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	27CO59	G,G	ABX	7	D 7	NAI-D		90	
64BO1	27CO59	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
61CR1	27CO59	E,E	NOX	0 4	D183	MAG-I		DST	G-WDTH, MULTIPOLES
58CH2	27CO59	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	27CO59	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62CA1	27CO59	G,N	NOX	11 30	C 30	ACT-I		4PI	ISOMER RATIO
62FU1	27CO59	G,N	ABX	11 28	C 9-28	BF3-I		4PI	
62FU1	27CO59	G,2N	ABX	19 28	C 9-28	BF3-I		4PI	
56HA1	27CO59	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
56HE1	27CO59	G,XN	RLY	10-31	C 31				* REL TO TRITONS
58KA1	27CO59	G,XN	ABX	10 22	C 10-22	BF3-I		4PI	
56WA1	27CO59	G,XN	RLY	10-31	C 31	ACT-I		4PI	* REL TO TRITONS
60FL1	27CO59	G,XN	ABX	11 24	C 12-30	BF3-I		4PI	QUADRUPOLE MOMENT
61BA2	27CO59	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
61EM1	27CO59	G,XN	SPC	13 30	C 30	EMU-D	2-12	90	
64BA2	27CO59	G,XN	ABX	10-30	C 10-30	BF3-I		4PI	
64CO2	27CO59	G,XN	ABY	THR-80	C 80	BF3-I		4PI	
62FU1	27CO59	G,NP	ABX	18 28	C 9-28	BF3-I		4PI	
56WO1	27CO59	G,N2P	ABY	THR-309	C309	ACT-I		4PI	*
60GO2	27CO59	G,N2P	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,PD, G,HE3
56WO1	27CO59	G,5NP	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,5N2P	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,6NP	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,6N2P	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,7N3P	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,8N4P	ABY	THR-309	C309	ACT-I		4PI	*
56WO1	27CO59	G,9N5P	ABY	THR-309	C309	ACT-I		4PI	*
56FO1	27CO59	G,P	RLY	7 30	C 30	EMU-D		90	YLD REL TO G,D
61FO1	27CO59	G,P	SPC	7 30	C 30	EMU-D	2-17	DST	
60CH1	27CO59	G,XP	RLX	22 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
63MI5	27CO59	G,XP	ABY	7 22	C 22	SCI-I	4-	DST	
60GO2	27CO59	G,PD	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,N2P, G,HE3
56FO1	27CO59	G,D	RLY	15 30	C 30	EMU-D		90	YLD REL TO G,P
61FO1	27CO59	G,D	RLY	15 30	C 30	EMU-D		DST	NO DEUTERONS FOUND
60CH1	27CO59	G,XD	RLX	30 90	C 90	TEL-I	15-30	90	REL TO PROTONS
56HE1	27CO59	G,T	RLY	16-31	C 31				* REL TO NEUTRONS
56WA1	27CO59	G,T	RLY	16-31	C 31	ACT-I		4PI	* REL TO NEUTRONS
60CH1	27CO59	G,XT	RLY	32 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
60GO2	27CO59	G,HE3	ABX	30 260	C 30-260	ACT-I		4PI	ALSO G,N2P, G,PD
58TO2	27CO59	G,A	ABY	7 22	C 22	EMU-I		DST	
61FO1	27CO59	G,A	SPC	9 30	C 30	EMU-D		DST	

NICKEL Z=28

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
58	67.88	12.2	8.2	21.1	17.7	6.4	22.5	19.6	14.2
60	26.23	11.4	9.5	20.1	19.2	6.3	20.4	20.0	16.9
61	1.19	7.8	9.9	19.3	17.0	6.5	19.2	17.4	18.1
62	3.66	10.6	11.1	19.5	21.0	7.0	18.4	20.5	19.8
64	1.08	9.7	12.5	19.1	22.9	8.0	16.5	21.0	*

REF	NUCLIDE Z	NUCLIDE A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	DETECTOR MIN-MAX	ANG	REMARKS
61MI1	28NI		G,MU-T	ABX	6 22	D 6-22	NAI-D			
56FU1	28NI		G,G	ABX	4 40	C 4-40	NAI-D		120	
60KA1	28NI		G,G	LFT	1	D 1				* ABX
60RE1	28NI		G,G	ABX	7	D 7	NAI-D		90	
61TO1	28NI		G,G	ABX	4 14	C 4-14	NAI-D		120	
62BE2	28NI		G,G	ABX	5 9	D 5-9	NAI-D		135	
64AR1	28NI		G,G	ABX	8	D 8	NAI-D		DST	J, WIDTH
64GI1	28NI		G,G	NOX	8	D 8	NAI-D		135	WIDTH
56HA1	28NI		G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
61BA2	28NI		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
64CO2	28NI		G,XN	ABY	THR-80	C 80	BF3-I		4PI	
55DL1	28NI		G,P	SPC	18	D 18	EMU-D			
55JO1	28NI		G,P	RLY	THR 65	C 65	SCI-D	14-	DST	
56LE1	28NI		G,P	ABX	8 28	C 21-28	EMU-I		DST	
57RO1	28NI		G,P	RLX	15,18	D 15,18				* REL TO CU63(G,N)
57SP1	28NI		G,P	SPC	9 18	C 18	EMU-D	1-9	DST	
62SE2	28NI		G,P	ABX	15,18	D 15,18	SCI-I		0	
57BA2	28NI		G,XP	SPC		C 85	TEL-D	20-65		*
58BA6	28NI		G,XP			C 85		15-65		* QUASI-DEUTERON
60CH1	28NI		G,XP	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
61MA2	28NI		G,XP	NOX	8 21	C 18,21	SCI-D	1-10	DST	
63MI5	28NI		G,XP	ABY	8 22	C 22	SCI-I	4-	DST	
63YA2	28NI		G,D	RLY	15 26	C 26	EMU-D	3-9	90	REL TO PROTONS
60CH1	28NI		G,XD	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO PROTONS
60CH1	28NI		G,XT	RLY	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
57BO1	28NI		G,A	ABX	THR-31	C 31	EMU-D		DST	* SPC
58TO2	28NI		G,A	ABY	6 22	C 22	EMU-I		DST	
63KR1	28NI		G,A	SPC	6 30	C 21,30	SCD-D	1-13	90	RELATIVE YIELDS
64SC1	28NI		G,A	SPC	THR 33	C 33	SCD-D	4-13	90	ABS YIELD
64BO1	28NI	58	G,G	LFT	1 3	C 1-3	NAI-D		100	ABI
61CR1	28NI	58	E,E/	NOX	0 8	D183	MAG-D		DST	G-WDTH, MULTIPOLES
59CA4	28NI	58	G,N	ABX	12 32	C 12-32	ACT-I		4PI	
59RO2	28NI	58	G,N	ABX	12 24	C 24	ACT-I		4PI	
59CA4	28NI	58	G,NP	ABX	12 32	C 12-32	ACT-I		4PI	
59CA4	28NI	58	G,P	ABX	12 32	C 12-32	ACT-I		4PI	
56ME2	28NI	60	G,G	LFT	1	D 1	NAI-D		DST	J-PI
61CR1	28NI	60	E,E/	NOX	0 5	D183	MAG-D		DST	G-WDTH, MULTIPOLES
59CA4	28NI	62	G,P	ABX	12 32	C 12-32	ACT-I		4PI	

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
63	69.09	10.8	6.1	16.1	18.9	5.8	19.7	16.8	17.2
65	30.91	9.9	7.4	15.5	20.7	6.8	17.8	17.1	19.9

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX		DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58MO2	29CU		G,MU-T	ABX	THR 94	C 94		SCI-D		4PI	*
58ZI1	29CU		G,MU-T	ABX	15 21	C 15-30		MGP-D			
55BU1	29CU		G,G	ABX	0-3						*
56FU1	29CU		G,G	ABX	4 40	C 4-40		NAI-D		120	
57BE1	29CU		G,G	ABX	18-22	C 18-22					*
59PE5	29CU		G,G	ABX	19-61	C 19-61				135	*
60RE1	29CU		G,G	ABX	6 7	D 6-7		NAI-D		DST	G-WDTH
61TO1	29CU		G,G	ABX	3 16	C 3-16		NAI-D		120	
62BE2	29CU		G,G	ABX	5 9	D 5-9		NAI-D		135	
63KA3	29CU		G,G	ABX	1,1	D 1,1		NAI-D		120	
59PE5	29CU		G,G/	ABX	19-61	C 19-61				135	*
57FE1	29CU		G,N	RLY	17 31	C 15-31		THR-I	5-	DST	
58AS1	29CU		G,N	NOX	8 17	C 17		SCI-I		DST	
60CH2	29CU		G,N	RLX	8 21	C 8-21		BF3-I		4PI	REL TO PROTONS
60KU2	29CU		G,N	RLY	18 90	C 90		TEL-I	10-	DST	
61TA1	29CU		G,N	NOX	12 22	C 22		THR-I	6-	DST	
62MI3	29CU		G,N	ABX	10 20	D 10-20		BF3-I		4PI	
64FU1	29CU		G,2N	ABX	18-28	D 9-28		BF3-I		4PI	
55BA5	29CU		G,XN	ABX	THR-250	C250			30-	DST	*
55DI1	29CU		G,XN	SPC	THR 70	C 70		EMU-D	0-14	DST	USED SCI FOR DST
55LI1	29CU		G,XN	SPC	8 70	C 70		EMU-D	1-12		
55MC1	29CU		G,XN	RLY	THR 22	C 22		NAI-I			* DETECT BY I128
56GA1	29CU		G,XN	ABX	11 27	C 18-27		BF3-I		4PI	
56HA1	29CU		G,XN	ABX	15,18	D 15,18		BF3-I		4PI	
56HE1	29CU		G,XN	RLY	THR-31	C 31					* REL TO TRITONS
61BA2	29CU		G,XN	ABY	THR 22	C 22		THR-I	3-	DST	
61BA2	29CU		G,XN	ABY	THR 22	C 22		THR-I	5-	DST	
61MI1	29CU		G,XN	ABX	6 22	D 6-22		BF3-I		4PI	
64CO2	29CU		G,XN	ABY	THR-80	C 80		BF3-I		4PI	
64FU1	29CU		G,XN	ABX	9-28	D 9-28		BF3-I		4PI	
59BA3	29CU		E,NP	ABI							*
55DA1	29CU		G,P	SPC	THR-70	C 70		EMU-D	-16		*
55DL1	29CU		G,P	SPC	18	D 18		EMU-D			
56CH1	29CU		G,P	SPC	15,18	D 15,18		EMU-D	3-12		
56FO1	29CU		G,P	RLY	THR 30	C 30		EMU-D		90	YLD REL TO G,D
56LE1	29CU		G,P	RLX	3 31	C 19-31		EMU-I		DST	
57RO1	29CU		G,P	RLX	15,18	D 15,18					* REL TO CU63(G,N)
60CH2	29CU		G,P	ABX	9 21	C 8-21		ION-I		4PI	
61FO1	29CU		G,P	SPC	5 30	C 30		EMU-D	2-16	DST	YIELD REL TO ALPHA
61HO1	29CU		G,P	RLY	3 45	C 45		EMU-I		DST	REL TO DEUTERONS
62SE2	29CU		G,P	ABX	15,18	D 15,18		SCI-I			
62VO1	29CU		G,P	RLY	6 90	C 34,90		TEL-D	4-19	90	
63OD1	29CU		G,P	ABY	5 22	C 22		EMU-I	2-	DST	
64RA3	29CU		G,P	ABX	THR-27	C 30		SCI-I	5-	DST	
55TA1	29CU		G,XP	ABX		C280		TEL-D	50-75	175	*
56DA2	29CU		G,XP	SPC	6 70	C 70		EMU-D	3-15	DST	
60CH1	29CU		G,XP	RLX	THR 90	C 90		TEL-I	15-30	90	REL TO DEUTERONS
61MA2	29CU		G,XP	NOX	6 21	C 21		SCI-D	1-10	DST	
63MI5	29CU		G,XP	ABY	7 22	C 22		SCI-I	4-	DST	
56FO1	29CU		G,D	RLY	THR 30	C 30		EMU-D		90	YLD REL TO G,P
60KO4	29CU		G,D	RLY	15 35	C 70		EMU-D		DST	
61HO1	29CU		G,D	RLY	11 45	C 45		EMU-I		DST	REL TO PROTONS
62VO1	29CU		G,D	RLY	11 90	C 34,90		TEL-D	4-19	90	

REF	NUCLIDE Z	NUCLIDE A	REACTION IN,OUT	RES	EXCIT	SOURCE	SOURCE MIN-MAX	DETECTOR TYPE	DETECTOR MIN-MAX	ANG	REMARKS
63YA2	29CU		G,D	RLY	14 26	C	26	EMU-D	3-9	DST	YIELD REL TO PROTN
64SH3	29CU		G,D	RLY	15-40	C	24-40	-I		4PI	MASS SPECTROMETER
60CH1	29CU		G,XD	RLX	THR 90	C	90	TEL-I	15-30	90	REL TO PROTONS
56HE1	29CU		G,T	RLY	THR-31	C	31				* REL TO NEUTRONS
62VO1	29CU		G,T	RLY	15 90	C	34,90	TEL-D	4-19	90	
60CH1	29CU		G,XT	RLY	THR 90	C	90	TEL-I	15-30	90	REL TO DEUTERONS
57BO1	29CU		G,A	ABX	THR-31	C	31	EMU-D		DST	* SPC
58TO2	29CU		G,A	SPC	7 22	C	22	EMU-D	2-14	DST	
61FO1	29CU		G,A	RLY	7 22	C	30	EMU-I		DST	REL TO PROTONS
63KR1	29CU		G,A	SPC	9 30	C	21,30	SCD-D	2-8	90	RELATIVE YIELD
64SC1	29CU		G,A	SPC	THR 33	C	33	SCD-D	6-14	90	ABS YIELD
61CA1	29CU	60	D,G	ABX	14 16	D	3-5	ACT-I		4PI	
60BO3	29CU	63	G,G	LFT	0 2	C	0-2	NAI-D		100	J
61RO1	29CU	63	G,G	ABX	0 1	D	0-1	NAI-D		DST	LIFETIMES
62BO6	29CU	63	G,G	LFT	0 4	C	0-4	NAI-D		110	J-PI
63MC1	29CU	63	G,G	LFT	1	D	1	NAI-D		90	
64BO1	29CU	63	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI
55CA1	29CU	63	G,N	RLY	18	D	18	ACT-I		4PI	
55SC1	29CU	63	G,N	ABX	10 20	C	12-20	ACT-I		4PI	
58BE1	29CU	63	G,N	RLY	10 11	C	10-11	ACT-I		4PI	THRESHOLD
59NA1	29CU	63	G,N	ABX	18	D	18	BF3-I		4PI	
59PE3	29CU	63	G,N	RLY	10 11	C	10-11	ACT-I		4PI	THRESHOLD
60GE3	29CU	63	G,N	NOX	THR	C	THR	BF3-I		4PI	THRESHOLD
61CO2	29CU	63	G,N	ABX	12 18	D	12-18	ACT-I		4PI	
62DE1	29CU	63	G,N	ABX	21	D	21	ACT-I		4PI	
64FU1	29CU	63	G,2N	ABX	19-28	D	10-28	BF3-I		4PI	
56WA1	29CU	63	G,XN	RLY	11-31	C	31	ACT-I		4PI	* REL TO TRITONS
64FU1	29CU	63	G,XN	ABX	10-28	D	10-28	BF3-I		4PI	
57HI1	29CU	63	E,N	ABX	10 82	D	30-82	ACT-I		4PI	MULTIPOLARITIES
60YA1	29CU	63	G,P	ABX	15,18	D	15,18	ACT-I		4PI	
62CH2	29CU	63	G,XP	RLY	6 90	C	34-90	TEL-D		DST	REL TO DEUTERONS
63GO8	29CU	63	G,D	RLY	14 22	C	22	EMU-I		DST	REL TO PROTONS
62CH2	29CU	63	G,XD	RLY	11 90	C	34-90	TEL-D		DST	REL TO PROTONS
56WA1	29CU	63	G,T	RLY	16-31	C	31	ACT-I		4PI	* REL TO NEUTRONS
58TO2	29CU	63	G,A	ABY	6 22	C	22	EMU-I		DST	SEPARATED ISOTOPE
63GO8	29CU	63	G,A	RLY	THR 22	C	22	EMU-I		DST	REL TO PROTONS
60ST1	29CU	64	G,NP	RLX	144 320	C	320	TEL-D	130	76	REL TO H2 CROS SEC
60BO3	29CU	65	G,G	LFT	0 2	C	0-2	NAI-D		100	
63KA1	29CU	65	G,G	LFT	1	D	1	NAI-D		108	MEAN ABS CROSS SEC
64BE6	29CU	65	G,G	LFT	1	D	1	NAI-D		DST	MIXING RATIO
64BO1	29CU	65	G,G	LFT	1 3	C	1-3	NAI-D		100	ABI
58BE1	29CU	65	G,N	RLY	9 11	C	9-11	ACT-I		4PI	THRESHOLD
60GE3	29CU	65	G,N	NOX	THR	C	THR	BF3-I		4PI	THRESHOLD
61CO2	29CU	65	G,N	RLX	15,18	D	15,18	ACT-I		4PI	REL TO CU63
64FU1	29CU	65	G,2N	ABX	16-28	D	10-28	BF3-I		4PI	
60AI1	29CU	65	G,3N	ABI	29 110	C	29-110	ACT-I		4PI	
56WA1	29CU	65	G,XN	RLY	10-31	C	31	ACT-I		4PI	* REL TO TRITONS
64FU1	29CU	65	G,XN	ABX	10-28	D	10-28	BF3-I		4PI	
56OS1	29CU	65	G,P	SPC		C		EMU-D		DST	*
60LI1	29CU	65	G,P	ABX	12 28	C	12-28	EMU-D	3-20	DST	SPECTRUM
62CH2	29CU	65	G,XP	RLY	7 90	C	34-90	TEL-D		DST	REL TO DEUTERONS
62CH2	29CU	65	G,XD	RLY	15 90	C	34-90	TEL-D		DST	REL TO PROTONS
56WA1	29CU	65	G,T	RLY	15-31	C	31	ACT-I		4PI	* REL TO NEUTRONS
57ER1	29CU	65	G,A	ABI	4 32	C	32	ACT-I		4PI	

ZINC Z=30

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
64	48.89	11.9	7.7	19.0	16.7	4.0	21.0	18.6	13.8
66	27.81	11.0	8.9	18.2	18.3	4.6	19.0	18.8	16.4
67	4.11	7.1	8.9	17.4	15.7	4.8	18.1	16.0	17.3
68	18.57	10.2	10.0	17.7	19.8	5.3	17.3	19.1	18.5
70	0.62	9.2	*	17.2	*	5.9	15.7	19.5	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	30ZN	G,G	ABX	7	D 7	NAI-D		90	
63SU1	30ZN	G,G	ABX	4 14	C 4-14	NAI-D		120	
61TA1	30ZN	G,N	NOX	12 22	C 22	THR-I	6-	DST	
56GA1	30ZN	G,XN	ABX	7 27	C 9-27	BF3-I		4PI	
56HA1	30ZN	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
64CO2	30ZN	G,XN	ABY	THR-80	C 80	BF3-I		4PI	
57EL1	30ZN	G,NP	RLX	THR-32	C 32				* REL TO CU
55DL1	30ZN	G,P	ABX	18	D 18	EMU-D			
56OS1	30ZN	G,P	SPC	THR 31	C 20-31	EMU-D		DST	*
63MI5	30ZN	G,XP	ABY	10 22	C 22	SCI-I	4-	DST	
58TO2	30ZN	G,A	ABY	2 22	C 22	EMU-I		DST	
55DE1	30ZN64	G,N	ABX	12 23	C 12-23	ACT-I		4PI	
55VI1	30ZN64	G,N	ABX	12-22	C 12-22	ACT-I		4PI	
59NA1	30ZN64	G,N	ABX	18	D 18	BF3-I		4PI	
60RO4	30ZN64	G,N	ABX	12 23	C 12-23	ACT-I		4PI	
61CO2	30ZN64	G,N	RLX	15,18	D 15,18	ACT-I		4PI	REL TO CU63(G,N)
62DE1	30ZN64	G,N	ABX	21	D 21	ACT-I		4PI	
55DE1	30ZN64	G,2N	ABY	20 23	C 20-23	ACT-I		4PI	THRESHOLD
55VI1	30ZN64	G,2N	ABY	15-22	C 12-22	ACT-I		4PI	
58HO1	30ZN64	G,2N	ABI	20 28	C 28	ACT-I		4PI	THRESHOLD
58GO3	30ZN64	G,NP	ABX	16 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
58HO1	30ZN64	G,NP	ABI	18 28	C 28	ACT-I		4PI	THRESHOLD
58GO3	30ZN64	G,D	ABX	16 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
55DE1	30ZN66	G,NP	ABX	19 23	C 19-23	ACT-I		4PI	
58GO3	30ZN66	G,NP	ABX	16 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
58HO1	30ZN66	G,NP	ABX	21 32	C 15-32	ACT-I		4PI	THRESHOLD
55VI1	30ZN66	G,D	ABX	20-22	C 20-22	ACT-I		4PI	INCLUDES G,NP
58GO3	30ZN66	G,D	ABX	16 22	C 16-22	ACT-I		4PI	REACTION UNCERTAIN
58HO1	30ZN68	G,P	RLY	10 32	C 15-32	ACT-I		4PI	THRESHOLD

GALLIUM Z=31

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
69	60.4	10.3	6.6	15.4	18.0	4.5	16.6	16.9	16.6
71	39.6	9.3	7.9	15.1	19.7	5.3	17.0	17.1	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64CO2	31GA		G,XN	ABY	THR-80	C 80	BF3-I		4PI	
59CA1	31GA	66	D,G	ABX	14 16	D 3-5	ACT-I		4PI	NOT GRND STAT TRAN
60GE3	31GA	71	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

GERMANIUM Z=32

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
70	20.52	11.5	8.5	18.6	17.6	4.1	20.	18.9	15.1
72	27.43	10.7	9.7	18.2	19.1	5.0	18.2	19.1	17.6
73	7.76	6.8	10.0	17.3	16.7	5.3	17.5	16.5	18.4
74	36.54	10.1	11.0	18.2	20.8	6.3	17.0	20.2	19.9
76	7.76	9.4	*	18.4	*	7.5	16.9	20.8	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56HE2	32GE		G,N	RLY	THR-31	C 31				* REL TO ALPHAS
64CO2	32GE		G,XN	ABY	THR-80	C 80	BF3-I		4PI	
56HE2	32GE		G,A	RLY	THR-31	C 31				* REL TO NEUTRONS
55BO1	32GE	70	G,N	ABX	12-21	C 12-21	ACT-I		4PI	
55DE1	32GE	70	G,N	ABX	9 21	C 9-21	ACT-I		4PI	THRESHOLD
60FE1	32GE	70	G,N	ABX	11 31	C 31	ACT-I		4PI	
60FE1	32GE	70	G,NP	ABX	18 31	C 31	ACT-I		4PI	
56ME1	32GE	72	G,G	LFT	1	D 1	NAI-D		DST	J
58TO1	32GE	73	G,N	RLY	7 22	C 22	BF3-I		4PI	THRESHOLD
56ME1	32GE	74	G,G	LFT	1	D 1	NAI-D		DST	J
55BO1	32GE	76	G,N	ABX	9-21	C 9-21	ACT-I		4PI	
55DE1	32GE	76	G,N	ABX	9 21	C 9-21	ACT-I		4PI	
62CA1	32GE	76	G,N	NOX	10 30	C 30	ACT-I		4PI	ISOMERIC RATIO

ARSENIC Z=33

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
75	100.00	10.2	6.9	15.4	19.4	5.3	18.3	17.1	17.9

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62ME2	33AS75		G,G	LFT	1	D 1	NAI-D		0	
63SU1	33AS75		G,G	ABX	4 14	C 4-14	NAI-D		120	
56SU1	33AS75		G,N	RLY	THR-320	C140,320	ACT-I		4PI	*
57FE2	33AS75		G,N	ABY	14 30	C 14-30	THR-I	5-	4PI	
58CH2	33AS75		G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	33AS75		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61TA1	33AS75		G,N	NOX	7 22	C 22	THR-I	6-	DST	
56SU1	33AS75		G,3N	RLY	THR-320	C140,320	ACT-I		4PI	*
58KA1	33AS75		G,XN	ABX	10 22	C 10-22	BF3-I		4PI	
61BA2	33AS75		G,XN	ABY	THR 22	C 22	THR-I	3-	DST	
61BA2	33AS75		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
64CO2	33AS75		G,XN	ABY	THR-80	C 80	BF3-I		4PI	
56SU1	33AS75		G,N2P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,3N2P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,4N4P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,4N5P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,5N2P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,5N5P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,7N2P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,7N4P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,8N6P	RLY	THR-320	C140,320	ACT-I		4PI	*
56SU1	33AS75		G,13N4	RLY	THR-320	C140,320	ACT-I		4PI	* G,13N4P
56SU1	33AS75		G,14N6	RLY	THR-320	C140,320	ACT-I		4PI	* G,14N6P
56SU1	33AS75		G,2P	RLY	THR-320	C140,320	ACT-I		4PI	*

SELENIUM Z=34

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
74	0.87	12.1	8.6	19.3	17.2	4.1	20.7	19.4	14.2
76	9.02	11.2	9.5	19.3	18.9	5.1	19.2	19.8	16.4
77	7.58	7.4	9.6	18.7	16.1	5.7	18.6	17.0	17.3
78	23.52	10.5	10.4	18.9	20.1	6.0	17.9	20.1	18.4
80	49.82	9.9	11.4	18.7	21.5	7.0	16.9	20.4	*
82	9.19	9.3	*	18.8	*	*	16.0	21.2	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60DE2	34SE		G,G	LFT	1	D 1				*
63KA2	34SE		G,G/	RLY	1	C 5	ACT-I		4PI	
63VE2	34SE		G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
63PR2	34SE	76	G,G	LFT	1	D 1	NAI-D			
58HO1	34SE	80	G,NP	RLY	20 32	C 32	ACT-I		4PI	THRESHOLD
56SI2	34SE	82	G,N	ABX	9-22	C 9-22	ACT-I		4PI	

BROMINE Z=35

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
79	50.54	10.7	6.3	15.8	18.7	5.5	19.0	16.9	16.7
81	49.46	10.2	7.5	15.9	20.2	6.5	18.0	17.4	18.9

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
63KA2	35BR	G,G/	RLY	1	C 4	ACT-I		4PI	
57KI1	35BR81	G,N	RLY	10 70	C 15-70	BF3-I		4PI	
60GE3	35BR81	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62CA1	35BR81	G,N	NOX	10 30	C 30	ACT-I		4PI	ISOMERIC RATIO
55SC2	35BR81	G,A	ABX	6-32	C 32	ACT-I		4PI	*
57ER1	35BR81	G,A	ABI	6 32	C 32	ACT-I		4PI	

RUBIDIUM Z=37

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
85	72.15	10.5	7.0	16.5	19.6	6.6	19.	17.6	17.7
87	27.85	9.9	8.6	17.1	21.8	8.0	18.6	18.5	20.5

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61BA2	37RB	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
58TO1	37RB85	G,N	RLY	10 11	C 22	ACT-I		4PI	THRESHOLD
60GE3	37RB85	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58TO1	37RB87	G,N	RLY	9 11	C 22	BF3-I		4PI	THRESHOLD
60GE3	37RB87	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
57ER1	37RB87	G,NA	ABI	17 32	C 32	ACT-I		4PI	
57ER1	37RB87	G,A	ABI	8 32	C 32	ACT-I		4PI	

STRONTIUM Z=38

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
84	0.56	12.	8.	20.2	17.9	5.2	21.	19.6	14.6
86	9.86	11.5	9.6	20.	19.4	6.3	20.0	20.1	16.6
87	7.02	8.4	9.4	20.1	17.4	7.3	20.0	18.1	18.0
88	82.56	11.1	10.6	20.7	21.3	7.9	19.5	20.6	19.2

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
63KA2	38SR	G,G/	RLY	1	C 6	ACT-I		4PI	
63VE2	38SR	G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
61BA2	38SR	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
62CA1	38SR86	G,N	NOX	12 30	C 30	ACT-I		4PI	ISOMER RATIO
56YE2	38SR86	G,XN	ABX	11 23	C 24	BF3-I		4PI	
56YE2	38SR87	G,XN	ABX	9 23	C 24	BF3-I		4PI	
56YE2	38SR88	G,XN	ABX	11 23	C 24	BF3-I		4PI	

YTTRIUM Z=39

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
89	100.00	11.5	7.1	18.1	19.9	7.9	20.7	18.2	17.7

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58SI1	39Y 89	G,G/	ABY	2 21	C 22	ACT-I		4PI	
63KA2	39Y 89	G,G/	RLY	1	C 5	ACT-I		4PI	
63VE2	39Y 89	G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
58CH2	39Y 89	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	39Y 89	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62RE1	39Y 89	G,N	NOX	6 55	C 55	THR-I		DST	
63GE1	39Y 89	G,N	RLY	11 12	C 11-12	BF3-I		4PI	THRESHOLD
56YE2	39Y 89	G,XN	ABX	12 23	C 24	BF3-I		4PI	
58KA1	39Y 89	G,XN	ABX	12 22	C 12-22	BF3-I		4PI	
61BA2	39Y 89	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	

ZIRCONIUM Z=40

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
90	51.46	12.0	8.4	20.6	18.8	6.7	21.	19.9	15.5
91	11.23	7.2	8.7	18.6	14.9	5.4	19.2	15.6	16.2
92	17.11	8.6	9.4	15.7	17.2	3.0	15.8	17.4	17.1
94	17.40	8.2	10.3	15.9	18.5	3.8	14.9	17.8	18.9
96	2.80	7.8	11.	16.1	20.9	4.9	14.3	18.5	21.2

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	40ZR	G,G	ABX	7	D 7	NAI-D		90	
64DU1	40ZR	G,P	SPC	THR-34	C 22-34	MAG-D	2-16	DST	ABX
63MI5	40ZR	G,XP	ABY	8 22	C 22	SCI-I	4-	DST	
63AX1	40ZR90	G,G	ABX	8 13	D 8-13	NAI-D		135	
56AX1	40ZR90	G,N	RLX	12 23	C 12-23	ACT-I		4PI	THRESHOLD
59MU2	40ZR90	G,N	RLX	12 24	C 12-25	ACT-I		4PI	
62CA1	40ZR90	G,N	NOX	12 30	C 30	ACT-I		4PI	ISOMERIC RATIO
56YE2	40ZR90	G,XN	ABX	12 23	C 24	BF3-I		4PI	
59NA1	40ZR90	G,XN	ABX	12 24	C 5-24	BF3-I		4PI	THRESHOLD
64BL2	40ZR90	P,G	RLX	13-17	D 5-9	NAI-D		DST	ANALOGUE T = 6
55NA1	40ZR91	G,XN	ABX	7 24	C 5-24	BF3-I		4PI	THRESHOLD
56YE2	40ZR91	G,XN	ABX	7 23	C 24	BF3-I		4PI	
56YE2	40ZR92	G,XN	ABX	9 23	C 24	BF3-I		4PI	

Nb
Mo

NIOBIUM Z=41

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
93	100.00	8.8	6.0	13.4	15.7	2.0	16.6	14.7	15.4

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58CH2	41	NB93	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
58SI2	41	NB93	G,N	ABX	8 22	C 8-22	ACT-I		4PI	
60GE3	41	NB93	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61WE1	41	NB93	G,N	ABX	9 10	D 9-11	ACT-I		4PI	
58KA1	41	NB93	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
60BA5	41	NB93	G,P	ABX	14 40	C 40	MAG-D		DST	SPECTRUM
60BA6	41	NB93	G,P	SPC	17 40	C 10-40	MAG-D	5-18	DST	
63OS1	41	NB93	G,P	RLY	10 28	C 19-28	EMU-D	3-21	DST	SPECTRUM
63MI5	41	NB93	G,XP	ABY	10 22	C 22	SCI-I	4-	DST	
64SC3	41	NB93	G,XP	SPC	THR 32	C 32	SCI-D	2-15	90	ABY
58TO2	41	NB93	G,A	ABY	2 22	C 22	EMU-I		DST	
64SC1	41	NB93	G,A	SPC	THR 33	C 33	SCD-D	6-14	90	ABS YIELD

MOLYBDENUM Z=42

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
92	15.84	12.6	7.3	20.8	16.9	5.	22.8	19.5	12.6
94	9.04	9.7	8.5	16.6	15.4	2.1	17.7	17.4	14.5
95	15.72	7.4	8.7	16.2	14.2	2.2	17.1	15.9	15.1
96	16.53	9.2	9.3	16.5	16.6	2.8	16.5	17.8	16.1
97	9.46	6.8	9.2	16.1	15.2	2.8	16.0	16.1	16.5
98	23.78	8.6	9.8	16.3	17.4	3.3	15.5	17.9	17.3
100	9.63	8.3	11.	15.5	18.2	3.2	14.2	18.	19.

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	42	MO	G,G	ABX	7	D 7	NAI-D		90	
57EL1	42	MO	G,NP	RLX	THR-32	C 32				* REL TO CU
55JO1	42	MO	G,P	RLY	THR 65	C 65	SCI-D	14-	DST	
63MI5	42	MO	G,XP	ABY	10 22	C 22	SCI-I	4-	DST	
59MU2	42	MO92	G,N	ABX	13 24	C 0-25	ACT-I		4PI	
62CA1	42	MO92	G,N	NOX	7 30	C 30	ACT-I		4PI	ISOMERIC RATIO
62DE1	42	MO92	G,N	ABX	21	D 21	ACT-I		4PI	
64GE1	42	MO92	G,N	ABX	THR 22	CTHR-33	ACT-I		4PI	
64GE1	42	MO92	G,2N	ABX	THR 34	CTHR-33	ACT-I		4PI	MIXED WITH G,NP
58HO1	42	MO92	G,NP	RLY	19 32	C 32	ACT-I		4PI	THRESHOLD
64GE1	42	MO92	G,NP	ABX	THR 34	CTHR-33	ACT-I		4PI	MIXED WITH G,2N
62JA1	42	MO96	N,G	SPC	9	D 0-1	NAI-D	4-10	90	
64GE1	42	MO97	G,P	ABX	THR 26	CTHR-33	ACT-I		4PI	
64GE1	42	MO98	G,NP	ABX	THR 32	CTHR-33	ACT-I		4PI	
64GE1	42	MO98	G,P	ABX	THR 26	CTHR-33	ACT-I		4PI	
64GE1	42	MO100	G,N	ABX	THR 20	CTHR-33	ACT-I		4PI	MIXED WITH G,P
57FE3	42	MO100	G,P	ABX	14 31	C 14-31	ACT-I		4PI	
64GE1	42	MO100	G,P	ABX	THR 20	CTHR-33	ACT-I		4PI	MIXED WITH G,N

RHODIUM Z=45

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
103	100.00	9.3	6.2	13.9	15.6	3.1	16.8	15.4	16.3

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59IK1	45	RH103	G,G/	ABX	1-2	D 1-2	ACT-I		4PI	*
60BO2	45	RH103	G,G/	ABX	6 26	C 6-26	ACT-I		4PI	
63VE2	45	RH103	G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
58CH2	45	RH103	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
59PA2	45	RH103	G,N	ABX	9 24	C 9-24	BF3-I		4PI	QUADRUPOLE MOMENT
60GE3	45	RH103	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62BO1	45	RH103	G,N	ABX	10 23	C 10-23	BF3-I		4PI	
58KA1	45	RH103	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
59AG1	45	RH103	G,XN	SPC	9-30	C 30				* SURFACE EFFECTS
55DA1	45	RH103	G,P	SPC	THR-70	C 70	EMU-D	-16		*
62SH2	45	RH103	G,P	ABY	9 34	C 23,34	EMU-D	3-24	DST	SPECTRUM
62SH4	45	RH103	G,P	ABY	9 34	C 23,34	EMU-D	3-24	DST	SPECTRUM
56DA2	45	RH103	G,XP	ABY	10 70	C 70	EMU-D	4-16	DST	SPECTRUM
63IS2	45	RH103	G,XP	ABX	13 32	C 14-32	SCI-D	3-	DST	
58TO2	45	RH103	G,A	ABY	THR 22	C 22	EMU-I		DST	

PALLADIUM Z=46

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
102	0.96	10.4	7.8	17.4	15.2	2.1	19.	17.7	13.3
104	10.97	10.0	8.7	17.0	16.4	2.6	17.6	18.0	14.9
105	22.23	7.1	8.8	16.6	14.2	2.9	17.1	15.8	15.7
106	27.33	9.5	9.3	16.8	17.6	3.2	16.6	18.4	16.4
108	26.71	9.2	10.0	16.6	18.5	3.9	15.8	18.5	17.8
110	11.81	8.8	11.	16.4	19.6	4.4	15.0	18.7	19.2

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62ME1	46	PD105	G,G	NOX	1	D 1	NAI-D		DST	J-PI,TRANS PROBABL

SILVER Z=47

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
107	51.35	9.5	5.8	13.9	16.4	2.8	17.	15.4	15.1
109	48.65	9.2	6.5	13.8	17.3	3.3	16.5	15.8	16.4

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58MO2	47AG		G,MU-T	ABX	THR 94	C 94	SCI-D		4PI	*
60RE1	47AG		G,G	ABX	7	D 7	NAI-D		DST	G-WDTH
58BO1	47AG		G,G/	ABX	12-28	C 12-28				*
63KA2	47AG		G,G/	RLY	1	C 5	ACT-I		4PI	
63VE2	47AG		G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
57FE1	47AG		G,N	RLY	17 31	C 15-31	THR-I	5-	DST	
61TA1	47AG		G,N	NOX	7 22	C 22	THR-I	6-	DST	
56HA1	47AG		G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
61BA2	47AG		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
57RO1	47AG		G,P	RLX	15,18	D 15,18				* REL TO CU63(G,N)
59LO1	47AG		G,P	ABX	17 31	C 16-32	SCI-D	4-25	DST	SPECTRUM
62SE2	47AG		G,P	ABX	15,18	D 15,18	SCI-I		0	
63MI5	47AG		G,XP	ABY	4 22	C 22	SCI-I	4-	DST	
58TO2	47AG		G,A	ABY	2 22	C 22	EMU-I		DST	
63BI3	47AG	107	G,G	ABX	1	D 1	ACT-I		4PI	MOSSBAUER
63BO5	47AG	107	G,G/	ABX	6 26	C 6-26	ACT-I		4PI	SEPARATED ISOTOPES
58BE1	47AG	107	G,N	RLY	9 10	C 9-10	ACT-I		4PI	THRESHOLD
59MU2	47AG	107	G,N	ABX	9 21	C 9-25	ACT-I		4PI	
60GE3	47AG	107	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61WE1	47AG	107	G,N	ABX	9 11	D 9-11	ACT-I		4PI	THRESHOLD
62BO1	47AG	107	G,N	ABX	10 22	C 10-22	BF3-I		4PI	
62CA1	47AG	107	G,N	NOX	9 30	C 30	ACT-I		4PI	ISOMERIC RATIO
62FU6	47AG	107	G,N	RLY	9 34	C 34	ACT-I		4PI	YLD REL TO CU62
56WA1	47AG	107	G,XN	RLY	9-31	C 31	ACT-I		4PI	* REL TO TRITONS
56WA1	47AG	107	G,T	RLY	13-31	C 31	ACT-I		4PI	* REL TO NEUTRONS
58BE1	47AG	109	G,N	RLY	9 10	C 9-10	ACT-I		4PI	THRESHOLD
59NA1	47AG	109	G,N	ABX	18	D 18	BF3-I		4PI	
60GE3	47AG	109	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
56WA1	47AG	109	G,XN	RLY	9-31	C 31	ACT-I		4PI	* REL TO TRITONS
56WA1	47AG	109	G,T	RLY	13-31	C 31	ACT-I		4PI	* REL TO NEUTRONS
55ER1	47AG	109	G,A	ABX	3-32	C 32	ACT-I		4PI	* AGCL EMULSION
55SC2	47AG	109	G,A	ABX	3-32	C 32	ACT-I		4PI	*
57ER1	47AG	109	G,A	ABI	THR 32	C 32	ACT-I		4PI	
59RO3	47AG	109	G,A	ABX			ACT-I		4PI	*

CADMIUM Z=48

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
106	1.22	11.	7.	17.2	14.6	1.6	19.	17.4	12.3
108	0.88	10.3	8.1	17.	15.7	2.3	18.3	17.7	13.9
110	12.39	9.9	8.9	16.9	16.9	2.9	17.2	18.1	15.4
111	12.75	7.0	9.1	16.6	14.6	3.3	16.8	15.9	16.2
112	24.07	9.4	9.7	16.8	17.9	3.5	16.4	18.5	16.8
113	12.26	6.5	9.7	16.5	15.6	3.9	15.9	16.2	17.6
114	28.86	9.0	10.3	16.8	18.9	4.1	15.6	18.8	18.3
116	7.58	8.7	11.2	*	16.6	4.9	14.7	18.7	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56GA1	48CD		G,MU-T	ABX	6 27	C 6-27	BF3-I			
55BU1	48CD		G,G	ABX	0-3					*
60RE1	48CD		G,G	ABX	7	D 7	NAI-D		90	
61TO1	48CD		G,G	ABX	4 14	C 4-14	NAI-D		120	
63SU1	48CD		G,G	ABX	4 14	C 4-14	NAI-D		120	
64GI1	48CD		G,G	NOX	8	D 8	NAI-D		135	WIDTH
63KA2	48CD		G,G/	RLY	1	C 6	ACT-I		4PI	
60KU2	48CD		G,N	RLY	16 90	C 90	TEL-I	10-	DST	
55MC1	48CD		G,XN	RLY	THR 22	C 22	NAI-I			* DETECT BY I128
56GA1	48CD		G,XN	ABX	6 27	C 6-27	BF3-I		4PI	
61BA2	48CD		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
60RO3	48CD		G,P	SPC	18	D 18	EMU-D	2-9	DST	
55TA1	48CD		G,XP	ABX		C280	TEL-D	50-75	175	*
63MI5	48CD		G,XP	ABY	11 22	C 22	SCI-I	4-	DST	
63KR1	48CD		G,A	SPC	3 21	C 21	SCD-D	2-13	90	RELATIVE YIELD
62HU2	48CD	111	G,G/	ABX	7	D 7	ACT-I		4PI	ISOMERIC RATIO
63VE1	48CD	111	G,G/	NOX	1 2	D 1-2	NAI-D		90	
59KU2	48CD	112	G,P	ABY		C				*
60KU1	48CD	112	G,P	ABX	10 30	C 10-30	ACT-I		4PI	
59KU2	48CD	113	G,P	ABY		C				*
60KU1	48CD	113	G,P	ABX	10 30	C 10-30	ACT-I		4PI	
59KU2	48CD	114	G,P	ABY		C				*
60KU1	48CD	114	G,P	ABX	10 30	C 10-30	ACT-I		4PI	
62CA1	48CD	116	G,N	NOX	9 30	C 30	ACT-I		4PI	ISOMERIC RATIO
59KU2	48CD	116	G,P	ABY		C				*
60KU1	48CD	116	G,P	ABX	11 30	C 11-30	ACT-I		4PI	

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INDIUM Z=49

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
113	4.28	9.4	6.1	13.9	16.8	3.0	17.3	15.5	15.7
115	95.72	9.0	6.8	13.9	17.9	3.8	16.3	15.9	17.1

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
55BU1	49IN		G,G	ABX	0-3					*
55BU2	49IN		G,G/	ABX	0 14	C 1-14	ACT-I		4PI	
63KA2	49IN		G,G/	RLY	1	C 6	ACT-I		4PI	
56HE2	49IN		G,N	RLY	THR-31	C 31				* REL TO ALPHAS
57RO2	49IN		G,P	SPC		D			DST	*
60BA5	49IN		G,P	ABX	16 40	C 16-40	MAG-D		DST	
58BA4	49IN		G,XP	RLX	THR 40	C -40	MAG-D		DST	* SPECTRUM
60CH1	49IN		G,XP	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
63MI5	49IN		G,XP	ABY	8 22	C 22	SCI-I	4-	DST	
60CH1	49IN		G,XD	RLX	THR 90	C 90	TEL-I	15-30	90	REL TO PROTONS
60CH1	49IN		G,XT	RLY	THR 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
56HE2	49IN		G,A	RLY	THR-31	C 31				* REL TO NEUTRONS
58TO2	49IN		G,A	ABY	1 22	C 22	EMU-I		DST	
62CA1	49IN	113	G,N	NOX	6 30	C 30	ACT-I		4PI	ISOMERIC RATIO
56BO1	49IN	115	G,G/	ABX	5 27	C 5-27	ACT-I		4PI	
62HU2	49IN	115	G,G/	NOX	7	D 7	ACT-I		4PI	ISOMERIC RATIO
63VE1	49IN	115	G,G/	NOX	1 2	D 1-2	NAI-D		90	
56BO1	49IN	115	G,N	ABX	9 27	C 9-27	BF3-I		4PI	
58BE1	49IN	115	G,N	RLY	9 10	C 9-10	ACT-I		4PI	THRESHOLD
60GE3	49IN	115	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62AN1	49IN	115	G,N	SPC	9 28	C 28	EMU-D	1-11	DST	
62BO1	49IN	115	G,N	ABX	10 23	C 10-23	BF3-I		4PI	

TIN Z=50

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
112	0.96	11.1	7.8	17.1	15.0	1.8	*	17.6	12.9
114	0.66	10.3	8.5	14.3	15.3	2.6	18.1	18.0	14.6
115	0.35	7.5	8.7	17.0	14.4	3.2	17.9	16.1	15.6
116	14.30	9.6	9.3	17.1	17.4	3.4	17.1	18.3	16.1
117	7.61	6.9	9.5	16.8	15.3	3.8	16.5	16.2	16.9
118	24.03	9.3	10.0	17.1	18.5	4.1	16.3	18.8	17.5
119	8.58	6.5	9.9	16.8	16.3	4.4	15.8	16.5	18.2
120	32.85	9.1	10.8	17.1	19.6	4.8	15.6	19.0	19.0
122	4.72	8.8	11.6	17.3	20.8	5.7	15.0	20.	*
124	5.94	8.5	12.	18.	*	*	14.4	20.4	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56FU1	50SN		G,G	ABX	4 40	C 4-40	NAI-D		120	
60RE1	50SN		G,G	ABX	7	D 7	NAI-D		DST	G-WDTH
61TO1	50SN		G,G	ABX	3 15	C 3-15	NAI-D		120	
62BE2	50SN		G,G	ABX	5 9	D 5-9	NAI-D		135	
63AX1	50SN		G,G	ABX	6 10	D 6-10	NAI-D		135	
63KA3	50SN		G,G	ABX	1,1	D 1,1	NAI-D		120	
64AR1	50SN		G,G	ABX	6,7	D 6,7	NAI-D		135	
63KA2	50SN		G,G/	RLY	1	C 6	ACT-I		4PI	

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
55DI1	50SN	G,XN	NOX	THR 70	C 70	SCI-I		DST	
56HA1	50SN	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
58FU1	50SN	G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
60RO3	50SN	G,P	SPC	18	D 18	EMU-D		DST	
63MI5	50SN	G,XP	ABY	10 22	C 22	SCI-I	4-	DST	
63YA2	50SN	G,D	RLY	12 24	C 24	EMU-D	3-11	DST	SPC, YLD REL TO P
61KU1	50SN112	G,N	ABX	10 21	C 10-21	ACT-I		4PI	
62KA1	50SN116	G,G	LFT	1	D 1	NAI-D			
62LI2	50SN116	G,G	LFT	1	D 1	NAI-D		132	
63BE6	50SN116	G,G	LFT	1	D 1	NAI-D		100	
60ME2	50SN117	G,G	LFT	1	D 1	NAI-D		125	
61HU1	50SN118	G,P	RLY	6 24	C 24	ACT-I		4PI	THRESHOLD
60ST1	50SN119	G,NP	RLX	146 320	C320	TEL-D130		76	REL TO H2 CROS SEC
60KU1	50SN120	G,NP	ABX	23 27	C 23-27	ACT-I		4PI	
60KU1	50SN120	G,P	ABX	16 27	C 16-27	ACT-I		4PI	
61KU1	50SN124	G,N	ABX	8 20	C 8-20	ACT-I		4PI	

ANTIMONY Z=51

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
121	57.25	9.3	5.8	12.9	17.1	3.1	16.3	14.9	16.6
123	42.75	9.0	6.6	13.1	18.	4.1	15.8	15.4	18.

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	51SB	G,G	ABX	7	D 7	NAI-D		90	
63SU1	51SB	G,G	ABX	4 14	C 4-14	NAI-D		120	
56HE2	51SB	G,N	RLY	THR-31	C 31				* REL TO ALPHAS
63YA2	51SB	G,D	RLY	10 24	C 24	EMU-D	3-11	126	SPC,YLD REL TO P
56HE2	51SB	G,A	RLY	THR-31	C 31				* REL TO NEUTRONS
63ME1	51SB121	G,G	LFT	1	D 1	NAI-D		DST	J-PI
60GE3	51SB121	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61CO2	51SB121	G,N	RLX	15,18	D 15,18	ACT-I		4PI	REL TO CU63 SIGMA
62DE1	51SB121	G,N	ABX	20	D 20	ACT-I		4PI	
57ER1	51SB121	G,D	ABX	18 32	C 18-32	ACT-I		4PI	
55ER1	51SB121	G,A	ABX	3-32	C 32	ACT-I		4PI	*
61WO1	51SB121	G,A	ABX	15 24	C 15-24	ACT-I		4PI	
60GE3	51SB123	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58HO1	51SB123	G,NP	RLY	18 32	C 32	ACT-I		4PI	THRESHOLD

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TELLURIUM Z=52

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
120	8.9(-2)	10.3	7.2	15.8	13.9	0.3	18.	16.8	12.3
122	2.46	10.1	8.0	15.8	15.2	1.1	17.0	17.3	13.8
123	0.87	6.9	8.1	15.7	13.0	1.5	17.0	15.0	14.5
124	4.61	9.4	8.6	15.9	16.2	1.8	16.4	17.6	15.1
125	6.99	6.6	8.7	15.7	14.0	2.2	16.0	15.2	15.8
126	18.71	9.1	9.1	15.8	17.2	2.5	15.7	17.9	16.4
128	31.79	8.8	9.6	15.7	18.0	3.2	15.1	18.0	17.5
130	34.48	8.4	10.1	15.6	18.7	3.7	14.5	18.0	18.5

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	52TE	G,G	ABX	7	D 7	NAI-D		DST	
64PA1	52TE	G,G	LFT	1	D 1	NAI-D		90	
60HA1	52TE	G,A	SPC	8 33	C 33	EMU-D	8-14	DST	
63SH5	52TE122	G,G	LFT	1	D 1	NAI-D		105	
61AK1	52TE124	G,G	LFT	1	D 1				
60GE3	52TE125	G,N	NOX THR		CTHR	BF3-I		4PI	THRESHOLD
60GE3	52TE126	G,N	NOX THR		CTHR	BF3-I		4PI	THRESHOLD
60GE3	52TE128	G,N	NOX THR		CTHR	BF3-I		4PI	THRESHOLD,ALSO 130
60GE3	52TE130	G,N	NOX THR		CTHR	BF3-I		4PI	THRESHOLD,ALSO 128

IODINE Z=53

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
127	100.00	9.1	6.2	13.4	16.3	2.2	16.2	15.4	15.3

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56GA1	53I 127	G,MU-T	ABX	9 27	C 9-27	BF3-I			
56FU1	53I 127	G,G	ABX	4 40	C 4-40	NAI-D		120	
60RE1	53I 127	G,G	ABX	7	D 7	NAI-D		90	
56ER1	53I 127	G,N	ABX	15,18	D 15,18	ACT-I		4PI	
57FE2	53I 127	G,N	RLY	14 30	C 14-30	THR-I	5-14	90	
58CH2	53I 127	G,N	RLY THR		CTHR	BF3-I		4PI	THRESHOLD
60GE3	53I 127	G,N	NOX THR		CTHR	BF3-I		4PI	THRESHOLD
60KU2	53I 127	G,N	RLY	16 90	C 90	TEL-I	10-	DST	
60RE1	53I 127	G,N	ABX	7	D 7	NAI-I		90	
61NA1	53I 127	G,N	ABX	8 22	C 10-20	ACT-I		4PI	
61TA1	53I 127	G,N	NOX	12 22	C 22	THR-I	6-	DST	
56ER1	53I 127	G,2N	ABX	15,18	D 15,18	ACT-I		4PI	
61NA1	53I 127	G,2N	ABX	16 22	C 10-20	BF3-I		4PI	ALSO ACTIVATION
58FU1	53I 127	G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
56GA1	53I 127	G,XN	ABX	9 27	C 9-27	BF3-I		4PI	
58KA1	53I 127	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
61BA2	53I 127	G,XN	ABY THR	22	C 22	THR-I	5-	DST	
58KE1	53I 127	G,P	ABX	18	D 18	SCI-D	6-11	0	SPECTRUM
59BO1	53I 127	G,P	ABX	15,18	D 15,18	SCI-D			* SPC, CSI TARGET
60TA1	53I 127	G,P	ABX	14 32	C 14-32	SCI-D	3-24	4PI	SPC, CSI TARGET
61SE4	53I 127	G,P	ABX	15,18	D 15,18	SCI-D		4PI	CSI TARGET, SPC

CESIUM Z=55

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
133	100.00	9.0	6.1	13.2	16.2	2.1	16.2	15.1	15.3

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58CH2	55CS133	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	55CS133	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58KA1	55CS133	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
58KE1	55CS133	G,P	ABX	18	D 18	SCI-D		0	SPECTRUM
59BO1	55CS133	G,P	ABX	15,18	D 15,18	SCI-D			* SPC, CSI TARGET
60TA1	55CS133	G,P	ABX	14 32	C 14-32	SCI-D		4PI	SPC, CSI TARGET
61SE4	55CS133	G,P	ABX	15,18	D 15,18	SCI-D		4PI	CSI TARGET, SPC

BARIUM Z=56

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
130	0.10	10.	7.	16.1	14.0	0.6	18.	16.8	12.0
132	9.7(-2)	9.6	7.6	15.7	14.6	0.9	17.2	16.9	13.1
134	2.42	9.2	8.0	15.7	15.4	1.4	16.6	17.1	14.2
135	6.59	7.2	8.5	15.7	13.6	2.0	16.4	15.2	14.8
136	7.81	9.2	8.7	15.9	16.3	2.3	16.4	17.7	15.6
137	11.32	6.9	9.0	16.2	14.8	2.7	16.2	15.6	16.0
138	71.66	8.5	8.9	15.7	16.8	2.8	15.5	17.6	16.6

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	56BA	G,G	ABX	7	D 7	NAI-D		90	
63KA2	56BA	G,G/	RLY	1	C 5	ACT-I		4PI	
57FE1	56BA	G,N	RLY	17 31	C 15-31	THR-I	5-	DST	SPECTRUM
61BA2	56BA	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
59HA2	56BA	G,A				EMU			*
60GE3	56BA137	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

LANTHANUM Z=57

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
138	8.9(-2)	7.	6.0	13.7	13.9	2.3	16.6	13.0	15.0
139	99.91	8.8	6.2	13.2	16.0	2.1	16.	14.8	15.1

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58SP1	57LA	G,N	RLX	8 18	C 8-18	BF3-I		4PI	
61TA1	57LA	G,N	NOX	11 22	C 22	THR-I	6-	DST	
62MI3	57LA	G,N	ABX	10 21	D 10-21	BF3-I		4PI	
62RE1	57LA	G,N	NOX	11 55	C 55	THR-I	6-	DST	
58FU1	57LA	G,XN	ABY	7-40	C 7-40	BF3-I		4PI	
61BA2	57LA	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
61MI1	57LA	G,XN	ABX	6 22	D 6-22	BF3-I		4PI	
64RI1	57LA	G,XN	ABX	8-30	C 8-30	BF3-I		4PI	
58CH2	57LA139	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	57LA139	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58KA1	57LA139	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	

CERIUM Z=58

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
136	0.19	10.	7.	16.0	13.8	.6	17.7	16.9	12.3
138	0.25	9.	7.	16.	14.7	1.2	17.3	16.8	13.1
140	88.48	9.0	8.0	16.	15.0	1.4	16.6	16.8	14.2
142	11.07	7.2	8.9	12.1	14.4	-1.4	12.6	15.7	15.9

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64BE4	58CE	G,G	LFT	2	D 2	NAI-D		120	
62MI3	58CE	G,N	ABX	10 21	D 10-21	BF3-I		4PI	
58FU1	58CE	G,XN	ABY	7-40	C 7-40	BF3-I		4PI	
61BA2	58CE	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
61MI1	58CE	G,XN	ABX	6 22	D 6-22	BF3-I		4PI	
59HA2	58CE	G,A				EMU			*
62CA1	58CE140	G,N	NOX	5 30	C 30	ACT-I		4PI	ISOMERIC RATIO
62FU6	58CE140	G,N	RLY	5 31	C 31	ACT-I		4PI	
60GE3	58CE142	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

PRASEODYMIUM Z=59

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
141	100.00	9.4	5.2	13.3	14.3	1.	17.1	14.3	13.2

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61BO3	59PR141	G,MU-T		10-20	10-20	THR-I		4PI	*
62BE2	59PR141	G,G	ABX	5 9	D 5-9	NAI-D		135	
64AR1	59PR141	G,G	ABX	6-9	D 6-9	NAI-D		135	
58CH2	59PR141	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
59CA2	59PR141	G,N	ABX	10 32	C 33	ACT-I		4PI	
59CA3	59PR141	G,N	ABX	10 32	C 10-32	ACT-I		4PI	
59FE2	59PR141	G,N	ABX	9 30	C 30	ACT-I		4PI	THRESHOLD
60GE3	59PR141	G,N	NOX	THR	CTHR	ACT-I		4PI	THRESHOLD
61BO1	59PR141	G,N	ABX	9 29	C 10-29	ACT-I		4PI	
61CO2	59PR141	G,N	ABX	15,18	D 15,18	ACT-I		4PI	
61TA1	59PR141	G,N	NOX	12 22	C 22	THR-I	6-	DST	
62DE1	59PR141	G,N	ABX	20	D 21	ACT-I		4PI	
62RE1	59PR141	G,N	NOX	6 55	C 55	THR-I		DST	
59CA2	59PR141	G,2N	ABX	18 32	C 33	ACT-I		4PI	THRESHOLD
59FE2	59PR141	G,2N	ABX	16 30	C 30	ACT-I		4PI	THRESHOLD
61BO1	59PR141	G,2N	ABX	16 29	C 10-29	ACT-I		4PI	
61MO1	59PR141	G,3N	ABI	27 33	C 27-33	ACT-I		4PI	THRESHOLD
58KA1	59PR141	G,XN	ABX	10 22	C 10-22	BF3-I		4PI	
60TH1	59PR141	G,XN	ABX	9 18	C 7-18	BF3-I		4PI	
64RI1	59PR141	G,XN	ABX	9-30	C 9-30	BF3-I		4PI	
61SH2	59PR141	G,P	ABY	5 34	C 23,34	EMU-D	4-18	DST	
62SH4	59PR141	G,P	SPC	5 34	C 23,34	EMU-D	4-22	DST	

NEODYMIUM Z=60

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
142	27.11	9.8	7.2	15.8	13.8	0.7	17.7	16.6	12.5
143	12.17	6.1	7.5	14.2	10.8	0.7	15.9	13.4	13.1
144	23.85	7.8	8.0	12.7	13.2	-1.9	13.9	15.3	13.7
145	8.30	5.7	7.9	12.6	11.8	-1.6	13.6	13.8	14.4
146	17.22	7.6	8.6	12.8	14.2	-1.2	13.3	15.5	15.0
148	5.73	7.3	9.	12.7	15.	-0.6	12.	16.1	*
150	5.62	7.3	*	13.	*	0.3	12.3	16.	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64AR1	60ND	G,G	ABX	7	D 7	NAI-D		135	
59HA2	60ND	G,A				EMU			*
59CA3	60ND142	G,N	ABX	10 32	C 10-32	ACT-I		4PI	
63BL2	60ND144	G,G	ABX	2	D 2				
63RI2	60ND144	G,G	LFT	2	D 2	NAI-D		90	G-WDTH, SEP ISOTPS
60GE3	60ND145	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
59CA3	60ND150	G,N	RLX	8 32	C 8-32	ACT-I		4PI	

Sm
Eu

SAMARIUM Z=62

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
144	3.09	10.5	6.4	16.3	12.6	0.	*	16.2	10.5
147	14.97	6.3	7.1	12.	10.4	-2.3	14.8	13.4	12.4
148	11.24	8.1	7.6	13.0	12.8	-2.0	14.5	15.3	13.0
149	13.83	5.8	7.5	12.6	11.1	-1.9	14.0	13.5	13.5
150	7.44	8.0	8.3	12.9	13.8	-1.5	13.8	15.5	14.2
152	26.72	8.2	8.6	13.6	15.3	-0.3	13.8	16.5	15.6
154	22.71	7.9	8.9	13.9	16.3	1.1	13.8	16.	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	62SM	G,G	ABX	7	D 7	NAI-D		90	
62BE2	62SM	G,G	ABX	5 9	D 5-9	NAI-D		135	
64AR1	62SM	G,G	ABX	9	D 9	NAI-D		135	
59DI1	62SM	G,N	ABX			ACT-I		4PI	*
58FU1	62SM	G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
59HA2	62SM	G,A				EMU			*
55DE1	62SM144	G,N	ABX	9 23	C 9-23	ACT-I		4PI	
56SI1	62SM144	G,N	ABX	9 22	C 22	ACT-I		4PI	THRESHOLD
59CA3	62SM144	G,N	ABX	10 32	C 10-32	ACT-I		4PI	
60GE3	62SM149	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
59CA3	62SM154	G,N	ABX	8 32	C 8-32	ACT-I		4PI	
62KO3	62SM154	G,P	RLX	THR 20	C 20	ACT-I		4PI	REL TO NEUTRONS

EUROPIUM Z=63

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
151	47.82	7.9	4.9	10.2	12.7	-2.0	14.4	12.9	13.1
153	52.18	8.5	5.9	11.2	14.7	-0.3	14.8	14.2	14.5

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60GE3	63EU151	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	63EU153	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

GADOLINIUM Z=64

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
152	0.20	8.	7.3	13.3	12.5	-2.2	15.0	15.3	12.2
154	2.15	8.6	7.6	13.9	14.0	-1.0	15.1	16.2	13.5
155	14.73	6.4	7.6	14.1	12.2	-0.1	15.1	14.1	14.0
156	20.47	8.5	8.0	14.1	14.8	0.2	15.0	16.2	14.7
157	15.68	6.4	8.0	14.0	13.3	0.6	14.9	14.4	15.2
158	24.87	7.9	8.4	13.8	15.4	0.7	14.3	16.0	15.9
160	21.90	6.1	*	13.3	*	0.9	13.3	16.1	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60DE1	64GD155	G,G	LFT	1	D 1	NAI-D		125	SEPARATED ISOTOPES
60GE3	64GD157	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
59CA3	64GD160	G,N	ABX	8 32	C 8-32	ACT-I		4PI	

TERBIUM Z=65

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
156	5.2(-2)	10.	7.	14.	12.7	-1.4	16.5	16.	11.8
159	99.95	8.2	6.2	12.0	14.4	0.2	14.9	14.2	14.6

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
59ME1	65TB	G,G	LFT	1	D 1	NAI-D		DST	MULTIPOLARITY
64LA1	65TB	G,G	ABX	10 25	C	NAI-D		DST	
64BR1	65TB	G,N	ABX	8-28	D 8-28	BF3-I		4PI	
64BR1	65TB	G,2N	ABX	14-28	D 8-28	BF3-I		4PI	
58FU1	65TB	G,XN	ABY	7-40	C 7-40	BF3-I		4PI	
58FU2	65TB	G,XN	ABX	8-23	CTHR-25	BF3-I		4PI	
58CH2	65TB159	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	65TB159	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62BO1	65TB159	G,N	ABX	8 21	CTHR-21	BF3-I		4PI	
58KA1	65TB159	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
60TH1	65TB159	G,XN	ABX	8 18	C 7-18	BF3-I		4PI	

Dy
Ho

DYSPROSIUM Z=66

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
156	5.2(-2)	7.1	*	12.9	*	0.6	12.8	15.8	*
158	9.0(-2)	9.	6.9	14.	13.3	-0.8	15.7	16.	12.5
160	2.29	8.6	7.4	13.9	13.8	-0.4	15.4	15.6	13.6
161	18.88	6.4	7.5	13.6	12.3	-0.3	15.0	13.9	14.0
162	25.53	8.2	8.0	13.6	14.5	0.0	14.6	15.7	14.9
163	24.97	6.2	8.3	13.4	13.4	0.2	14.5	14.3	15.5
164	28.18	7.7	8.5	13.4	15.4	0.5	13.9	16.0	16.

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61BA2	66DY		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
60GE3	66DY	163	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

HOLMIUM Z=67

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
165	100.00	8.0	6.1	11.6	14.	-0.2	14.6	13.8	14.7

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62FU3	67HO	165	G,G	ABX	8 28	C 8-28	NAI-D		90	TENSOR POLARIZABIL
63LA1	67HO	165	G,G	ABX	9 26	C 9-27	NAI-D		DST	
64LA1	67HO	165	G,G	ABX	10 25	C 27	NAI-D		DST	
63TI1	67HO	165	G,G/	ABX	10 19	D 10-19	NAI-D		135	
58CH2	67HO	165	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	67HO	165	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
61WE1	67HO	165	G,N	ABX	8 11	D 8-11	ACT-I		4PI	
62RE1	67HO	165	G,N	NOX	11 55	C 55	THR-I	5-	DST	
63BR1	67HO	165	G,N	ABX	8 28	C 8-28	BF3-I		4PI	QUADRUPOLE MOMENT
63BR1	67HO	165	G,2N	ABX	14 28	C 14-28	BF3-I		4PI	QUADRUPOLE MOMENT
58FU1	67HO	165	G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
58KA1	67HO	165	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
60TH1	67HO	165	G,XN	ABX	8 18	C 7-18	ACT-I		4PI	
62FU3	67HO	165	G,XN	ABX	8 24	C 8-24	BF3-I		4PI	QUADRUPOLE MOMENT
63BR1	67HO	165	G,NP	ABX	13 28	C 13-28	BF3-I		4PI	QUADRUPOLE MOMENT

ERBIUM Z=68

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
162	0.14	9.	6.	14.	12.2	-1.5	*	15.4	11.3
164	1.56	8.8	6.8	14.	12.8	-1.3	15.6	15.2	12.3
166	33.41	8.5	7.4	13.5	13.5	-0.8	15.2	15.5	13.5
167	22.94	6.4	7.5	13.4	12.3	-0.6	15.0	13.9	14.3
168	27.07	7.8	8.0	13.1	14.4	-0.5	14.2	15.3	15.0
170	14.88	7.2	8.5	12.7	*	-0.1	13.2	15.7	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62FU3	68ER		G,G	ABX	8 28	C 8-28	NAI-D		90	TENSOR POLARIZABIL
63LA1	68ER		G,G	ABX	9 26	C 9-27	NAI-D		DST	
64LA1	68ER		G,G	ABX	10 25	C	NAI-D		DST	
63KA2	68ER		G,G/	RLY	1	C 4	ACT-I		4PI	
58FU1	68ER		G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
62FU3	68ER		G,XN	ABX	8 24	C 8-24	BF3-I		4PI	QUADRUPOLE MOMENT
60GE3	68ER	167	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
63MI3	68ER	170	G,P	NOX	THR 21	C 21	ACT-I		4PI	

THULIUM Z=69

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
169	100.00	8.0	5.6	12.8	13.2	-1.1	15.	13.4	13.5

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58CH2	69TM	169	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	69TM	169	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58KA1	69TM	169	G,XN	ABX	8 22	C 8-22	BF3-I		4PI	

YTTERBIUM Z=70

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
168	0.14	9.	6.	13.	11.8	-2.1	15.9	14.8	11.0
170	3.03	8.	6.6	13.	12.2	-2.0	15.3	14.7	12.1
171	14.31	6.8	6.9	12.9	11.2	-1.6	15.	13.4	12.9
172	21.82	8.1	7.4	13.0	13.3	-1.3	14.9	15.1	13.8
173	16.13	6.5	7.6	11.4	12.4	-0.8	14.6	14.0	14.6
174	31.84	7.4	8.0	12.9	14.4	-0.5	13.9	15.1	15.1
176	12.73	6.6	8.	12.0	*	-0.7	12.5	12.7	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58FU1	70YB		G,XN	ABY	7-40	C 7-40	BF3-I		4PI	
60GE3	70YB	173	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

Lu
Hf

LUTETIUM Z=71

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
175	97.41	7.8	5.5	11.0	12.8	-1.4	14.4	13.0	13.5
176	2.59	6.1	5.9	10.7	12.0	-1.6	14.0	11.7	13.9

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
62DE2	71LU175	G,G	LFT	1	D 1	NAI-D		DST	J-PI, MULTIPOLARIT
58KI1	71LU175	G,N	ABX	8 23	C 8-23	BF3-I		4PI	THRESHOLD
58KA1	71LU175	G,XN	ABX	8 22	C 8-22	BF3-I		4PI	
60GE3	71LU175	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

HAFNIUM Z=72

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
174	0.18	*	5.8	13.	11.3	-2.6	*	14.4	10.9
176	5.20	8.	6.4	12.4	11.7	-2.4	15.0	14.3	11.9
177	18.50	6.4	6.6	12.1	10.6	-2.5	14.	12.8	12.5
178	27.14	7.6	7.3	11.9	12.4	-2.4	14.0	14.2	13.5
179	13.75	6.1	7.5	11.8	11.8	-2.1	13.7	13.4	14.0
180	35.24	7.3	7.9	12.2	13.6	-1.4	13.4	14.9	15.1

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61HA1	72HF	G,G	LFT	1	D 1				* 2 LEVELS
63KA2	72HF	G,G/	RLY	1	C 5	ACT-I		4PI	
63VE2	72HF	G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
58TO1	72HF177	G,N	RLY	6 7	C 6-7	BF3-I		4PI	THRESHOLD
60GE3	72HF177	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
58TO1	72HF179	G,N	RLY	6 7	C 6-7	BF3-I		4PI	THRESHOLD
60GE3	72HF179	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	72HF180	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
180	1.2(-2)	6.8	5.9	11.1	11.6	-2.1	14.6	12.0	13.4
181	99.99	7.6	6.2	11.1	13.3	-1.4	14.4	13.5	14.1

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58FU3	73TA	G,G	ABX	5-27	C 5-27	NAI-D		120	
64LA1	73TA	G,G	ABX	10 25	C 32	NAI-D		DST	
55JO1	73TA	G,N	RLY	THR 65	C 65	SCI-D	5-	DST	
55JO1	73TA	G,N	RLY	THR 65	C 65	SCI-D	10-	DST	
64GR2	73TA	G,N	ABX	THR 11	DTHR-11	BF3-I		4PI	
58FU1	73TA	G,XN	ABY	7-40	C 7-40	BF3-I		4PI	
58FU2	73TA	G,XN	ABX	8-23	CTHR-25	BF3-I		4PI	
58BA4	73TA	G,XP	RLX	THR 40	C -40	MAG-D		DST	* SPECTRUM
56GA1	73TA181	G,MU-T	ABI	8 27	C 8-27	BF3-I			
63LA1	73TA181	G,G	NOX	11 22	C 27	NAI-D		DST	
63YO1	73TA181	G,G	ABX	6 8	D 6-8	NAI-D		120	
57CA1	73TA181	G,N	RLX	8 31	C 8-31	ACT-I		4PI	
57FE2	73TA181	G,N	RLY	14 30	C 14-30	THR-I		90	
58BE2	73TA181	G,N	SPC	8 16	C 14,16	TOF-D	1-7	120	
58CA1	73TA181	G,N	ABX	7 32	C 7-32	ACT-I		4PI	THRESHOLD
58CH2	73TA181	G,N	RLY	THR	CTHR	BF3-I		4PI	THRESHOLD
58CO1	73TA181	G,N	SPC	9 30	C 20,30	EMU-D	2-18	90	THRESHOLD
58SP1	73TA181	G,N	ABX	8 18	C 8-18	BF3-I		4PI	
59AU1	73TA181	G,N	ABX	18 65	C 18-65	THR-I	5-	4PI	
59CA3	73TA181	G,N	ABX	8 33	C 8-33	ACT-I		DST	
59PA1	73TA181	G,N	ABX	8 22	C 8-22	BF3-I		4PI	THRESHOLD
60BA2	73TA181	G,N	RLX	8 32	C 8-32	ACT-I		4PI	
60GE3	73TA181	G,N	NOX	THR	CTHR	ACT-I		4PI	THRESHOLD
61WE1	73TA181	G,N	ABX	7 11	D 7-11	ACT-I		4PI	THRESHOLD
62BO1	73TA181	G,N	ABX	9 23	C 9-23	BF3-I		4PI	
62MI3	73TA181	G,N	ABX	7 22	D 7-22	BF3-I		4PI	
63BR1	73TA181	G,N	ABX	8 28	D 8-28	BF3-I		4PI	QUADRUPOLE MOMENT
63ZA1	73TA181	G,N	SPC	9 19	C 14,19	EMU-D	2-12	DST	
60BA2	73TA181	E,N	RLY	8 42	D 8-42	ACT-I		4PI	REL TO G,N
57CA1	73TA181	G,2N	RLX	14 31	C 8-31	MOD-I		4PI	MIXED WITH G,3N
58CA1	73TA181	G,2N	ABX	14 32	C 7-32	ACT-I		4PI	THRESHOLD
63BR1	73TA181	G,2N	ABX	13 28	D 8-28	BF3-I		4PI	QUDRPL MOM, THRESH
57CA1	73TA181	G,3N	RLX	14 31	C 8-31	MOD-I		4PI	MIXED WITH G,2N
58CA1	73TA181	G,3N	ABX	22 32	C 7-32	ACT-I		4PI	THRESHOLD
60BA2	73TA181	G,3N	RLX	22 32	C 22-32	ACT-I		4PI	
60BA2	73TA181	E,3N	RLY	22 42	D 22-42	ACT-I		4PI	REL TO G,3N
56GA1	73TA181	G,XN	ABX	8 27	C 8-27	BF3-I		4PI	
56HA1	73TA181	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
57CA1	73TA181	G,XN	RLX	8 31	C 8-31	MOD-I		4PI	
58KA1	73TA181	G,XN	ABX	9 22	C 9-22	BF3-I		4PI	
61BA2	73TA181	G,XN	ABY	THR 22	C 22	THR-I	3-	DST	
61BA2	73TA181	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
61MI1	73TA181	G,XN	ABX	6 22	D 6-22	BF3-I		4PI	
63BR1	73TA181	G,NP	ABX	14 28	D 8-28	BF3-I		4PI	
59SE2	73TA181	G,P	ABX	15,18	D 15,18	EMU-D			*
60BA5	73TA181	G,P	ABX	17 39	C 17-39	MAG-D	6-22	DST	SPECTRUM
60CA2	73TA181	G,P	ABX	15 32	C 15-32	ACT-I		4PI	THRESHOLD
55TO1	73TA181	G,XP	SPC	11 23	C 23	EMU-D	5-18	DST	ABSOLUTE YIELD
60CH1	73TA181	G,XP	RLX	22 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
60CH1	73TA181	G,XD	RLX	27 90	C 90	TEL-I	15-30	90	REL TO PROTONS
60CH1	73TA181	G,XT	RLY	27 90	C 90	TEL-I	15-30	90	REL TO DEUTERONS
57ER1	73TA181	G,A	ABI	1 32	C 32	ACT-I		4PI	

TUNGSTEN (WOLFRAM) Z=74

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
180	0.14	*	6.5	12.8	11.6	-2.6	*	14.4	11.7
182	26.41	8.0	7.0	13.0	12.8	-1.7	14.9	14.7	13.2
183	14.40	6.2	7.1	12.4	11.7	-1.6	14.2	13.2	13.4
184	30.64	7.4	7.7	12.1	13.1	-1.5	13.6	14.6	14.3
186	28.41	7.2	8.3	12.2	14.4	-1.1	13.0	15.0	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	74W		G,G	ABX	7	D 7	NAI-D		90	
63KA2	74W		G,G/	RLY	1	C 5	ACT-I		4PI	
56HA1	74W		G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
61BA2	74W		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
62SH3	74W		G,P	SPC	THR-34	C 23,34			DST	* ABY, MULTIPOL
62SH4	74W		G,P	SPC	7 34	C 23,34	EMU-D	5-24	DST	ABSOLUTE YIELD
62SH6	74W		G,P	SPC	7 34	C 23,34	EMU-D	5-24	DST	
63SH1	74W		G,P	ABX	15 34	C 15-34	SCI-I		DST	MULTIPOLARITIES
60GE3	74W	183	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62CA2	74W	184	G,P	ABX	15 32	C 32	ACT-I		4PI	
62CA2	74W	186	G,N	ABX	9 32	C 32	ACT-I		4PI	
60GE3	74W	186	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62CA2	74W	186	G,P	ABX	15 32	C 32	ACT-I		4PI	

RHENIUM Z=75

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
185	37.07	8.	5.4	10.5	12.2	-2.3	14.	12.9	13.1
187	62.93	7.3	6.0	10.5	13.2	-1.6	13.5	13.2	14.3

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
64LA3	75RE187		G,G	LFT	0 1	D 0-1	NAI-D		DST	MIXING AMPLITUDES
60GE3	75RE187		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

IRIDIUM Z=77

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
191	37.3	8.2	5.4	10.7	12.8	-2.0	14.5	13.2	13.4
193	62.7	7.8	5.8	10.9	14.0	-1.0	13.9	13.5	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
63KA2	77IR	G,G/	RLY	1	C 5	ACT-I	4PI	
63VE2	77IR	G,G/	ABX	0 1	D 0-1	NAI-D		ISOMERS
64LA4	77IR191	G,G	LFT	0 1	D 0-1	NAI-D	125	
60GE3	77IR193	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD

PLATINUM Z=78

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
190	1.3(-2)	9.	6.	13.	11.1	-3.2	15.9	14.6	11.0
192	0.78	8.	6.8	13.	12.3	-2.3	15.0	15.1	12.2
194	32.9	8.4	7.6	13.0	13.3	-1.4	14.7	15.4	13.4
195	33.8	6.1	7.6	12.9	11.8	-1.2	14.5	13.7	14.0
196	25.3	7.9	8.1	13.1	14.2	-0.8	14.0	15.5	14.8
198	7.21	7.6	8.8	13.1	15.1	0.0	13.4	15.7	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE MIN-MAX	ANG	REMARKS
63KA2	78PT	G,G/	RLY	1	C 5	ACT-I	4PI	
63VE2	78PT	G,G/	ABX	0 1	D 0-1	NAI-D		ISOMERS
64GL1	78PT	G,N	SPC	16	D 16	TOF-D 0-5	90	
62SH2	78PT	G,P	SPC	7 34	C 23,34	EMU-D 4-25	DST	ABSOLUTE YIELD
62SH3	78PT	G,P	SPC	THR 23	C 23		DST	* ABY, MULTIPOL
62SH4	78PT	G,P	SPC	7 34	C 23,34	EMU-D 4-26	DST	ABSOLUTE YIELD
60GE3	78PT195	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD
60GE3	78PT196	G,N	NOX	THR	CTHR	BF3-I	4PI	THRESHOLD
62CH1	78PT196	N,G	NOX	8	D 0-1	NAI-D	90	REL TRANS PROBABIL

GOLD Z=79

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
197	100.00	8.1	5.8	11.4	13.6	-0.9	14.8	13.8	14.0

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE	MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56GA1	79AU197		G,MU-T	ABI	7 27	C	7-27	BF3-I			
58ZI1	79AU197		G,MU-T	ABX	9 20	C	9-30	MGP-D			
56FU1	79AU197		G,G	ABX	4 40	C	4-40	NAI-D		120	
60RE1	79AU197		G,G	ABX	7	D	7	NAI-D		90	
62OC1	79AU197		G,G	ABX	11 18	D	11-18	NAI-D		135	
63LA1	79AU197		G,G	ABX	9 26	C	9-32	NAI-D		DST	
64LA1	79AU197		G,G	ABX	10 25	C		NAI-D		DST	
56ME3	79AU197		G,G/	ABX	4-24	C	4-24	ACT-I		4PI	*
63KA2	79AU197		G,G/	RLY	1	C	4	ACT-I		4PI	
63VE2	79AU197		G,G/	ABX	0 1	D	0-1	NAI-D			ISOMERS
57FE1	79AU197		G,N	RLY	15 31	C	15-31	THR-I	5-	DST	
58BE2	79AU197		G,N	SPC	7 16	C	14,16	TOF-D	1-7	120	
58CA2	79AU197		G,N	SPC	10 19	C	30	EMU-D	2-19	90	THRESHOLD
58CH2	79AU197		G,N	RLY	THR	C	THR	BF3-I		4PI	THRESHOLD
59AU1	79AU197		G,N	ABX	18 65	C	18-65	THR-I	5-	4PI	YLD REL TO CU63
60AS1	79AU197		G,N	SPC	6 55	C	55	EMU-D	1-10	90	
60BA2	79AU197		G,N	RLX	10 20	C	10-38	ACT-I		4PI	
60BA8	79AU197		G,N	ABX	8-18	C	18	ACT-I		4PI	*
60GE3	79AU197		G,N	NOX	THR	C	THR	BF3-I		4PI	THRESHOLD
61NA1	79AU197		G,N	ABX	10 22	C	10-22	ACT-I		4PI	
61TA1	79AU197		G,N	NOX	12 22	C	22	THR-I	6-	DST	
61WE1	79AU197		G,N	ABX	8 10	D	8-10	ACT-I		4PI	
62FU2	79AU197		G,N	ABX	8 25	D	7-25	BF3-I		4PI	MIXED WITH G,NP
62MI3	79AU197		G,N	ABX	6 22	D	6-22	BF3-I		4PI	
62RE1	79AU197		G,N	NOX	11 55	C	55	THR-I	5-	DST	
63ZA1	79AU197		G,N	SPC	7 19	C	14,19	EMU-D	1-6	DST	
60BA2	79AU197		E,N	RLY	14 38	D	14-38	ACT-I		4PI	REL TO G,N
60BA2	79AU197		G,2N	RLX	15 26	C	15-38	ACT-I		4PI	
61NA1	79AU197		G,2N	ABX	15 22	C	10-22	ACT-I		4PI	
62FU2	79AU197		G,2N	ABX	14 25	D	7-25	BF3-I		4PI	
60BA2	79AU197		E,2N	RLY	17 38	D	17-38	ACT-I		4PI	REL TO G,2N
56GA1	79AU197		G,XN	ABX	7 27	C	7-27	BF3-I		4PI	
56HA1	79AU197		G,XN	ABX	15,18	D	15,18	BF3-I		4PI	
58FU1	79AU197		G,XN	ABY	7-40	C	7-40	BF3-I		4PI	
58FU2	79AU197		G,XN	ABX	8-23	C	THR-25	BF3-I		4PI	
58KA1	79AU197		G,XN	ABX	8 22	C	8-22	BF3-I		4PI	
61MI1	79AU197		G,XN	ABX	6 22	D	6-22	BF3-I		4PI	
62FU2	79AU197		G,NP	ABX	14 25	D	7-25	BF3-I		4PI	MIXED WITH G,N
55DA1	79AU197		G,P	SPC	THR-70	C	70	EMU-D	-16		*
59MA1	79AU197		G,P	RLY	6-70	C	70	EMU-I			* REL TO DEUTERONS
60BA5	79AU197		G,P	SPC	9 40	C	40	MAG-D	3-28	DST	ABS INTEG CROS SEC
60MA1	79AU197		G,P	SPC	13 23	C	23	EMU-D	7-17	DST	ABSOLUTE YIELD
56DA2	79AU197		G,XP	SPC	11 70	C	70	EMU-D	5-17	DST	ABSOLUTE YIELD
60CH1	79AU197		G,XP	RLX	21 90	C	90	TEL-I	15-30	90	REL TO DEUTERONS
59MA1	79AU197		G,D	RLY	12-70	C	70	EMU-I			* REL TO PROTONS
60CH1	79AU197		G,XD	RLY	27 90	C	90	TEL-I	15-30	90	REL TO PROTONS
60CH1	79AU197		G,XT	RLY	26 90	C	90	TEL-I	15-30	90	REL TO DEUTERONS

MERCURY Z=80

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
196	0.15	9.	6.6	13.	12.4	-1.9	16.	15.0	11.7
198	10.02	8.6	7.1	13.4	13.1	-1.3	15.3	15.2	12.9
199	16.84	6.6	7.2	13.3	11.8	-0.8	15.3	13.8	13.7
200	23.13	8.0	7.7	13.3	14.0	-0.7	14.7	15.3	14.2
201	13.22	6.2	7.6	13.0	12.7	-0.3	14.2	14.0	14.8
202	29.80	7.8	8.5	13.2	14.9	-0.1	14.0	15.4	15.
204	6.85	7.5	9.	13.5	16.1	1.	13.5	16.	*

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57KN1	80HG	G,G	LFT	1	1				*
60RE1	80HG	G,G	ABX	7	D 7	NAI-D		DST	G-WDTH
62BE2	80HG	G,G	ABX	5 9	D 5-9	NAI-D		135	
63FL1	80HG	G,G	LFT	2 6	D 2-6	NAI-D			G-WDTH
63YO1	80HG	G,G	ABX	6 8	D 6-8	NAI-D		DST	
64AR1	80HG	G,G	ABX	5	D 5	NAI-D		135	
63KA2	80HG	G,G/	RLY	1	C 6	ACT-I		4PI	
63VE2	80HG	G,G/	ABX	0 1	D 0-1	NAI-D			ISOMERS
55MC1	80HG	G,XN	RLY	THR 25	C 22	NAI-I			* DETECT BY I128
56HA1	80HG	G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
61BA2	82PB	G,XN	ABY	THR 22	C 22	THR-I	3-	DST	
61BA2	80HG	G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
63FR2	80HG198	G,G	ABX	1	D 1	NAI-D	1	DST	LIFETIME, J-PI
62CA1	80HG198	G,N	NOX	THR 30	C 30	ACT-I		4PI	ISOMERIC RATIO
60GE3	80HG199	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
60GE3	80HG201	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
62EU1	80HG201	G,N	ABI	9 23	C 9-23	ACT-I		4PI	RELATIVE YIELD
62CA2	80HG201	G,P	ABX	16 32	C 16-32	ACT-I		4PI	
55ME1	80HG202	G,G	LFT	1	D 1			DST	
60GE3	80HG202	G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD

THALLIUM Z=81

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
203	29.5	7.7	5.7	11.2	13.4	-0.9	14.6	13.5	14.2
205	70.5	7.5	6.4	11.4	15.	0.0	14.2	14.0	15.

REF	NUCLIDE Z A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
56GA1	81TL	G,MU-T	ABX	7 27	C 7-27	BF3-I			
60RE1	81TL	G,G	ABX	7	D 7	NAI-D		90	
56HE2	81TL	G,N	RLY	THR-31	C 31				* REL TO ALPHAS
56GA1	81TL	G,XN	ABX	7 27	C 7-27	BF3-I		4PI	
57EL2	81TL	G,NA	RLX	THR-32	C 32				*
56HE2	81TL	G,A	RLY	THR-31	C 31				* REL TO NEUTRONS
57EL2	81TL	G,A	RLX	THR-32	C 32				*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61DE3	81TL203		G,G	LFT	1	D 1	NAI-D		DST	REL CROSS SECTION
57ER1	81TL203		G,NA	ABI	11 32	C 32	ACT-I		4PI	MIXED WITH G,A
57ER1	81TL203		G,A	ABI	0 32	C 32	ACT-I		4PI	MIXED WITH G,NA
60GE3	81TL205		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
57ER1	81TL205		G,NA	ABX	29 32	C 18-32	ACT-I		4PI	
57ER1	81TL205		G,A	ABX	18 32	C 18-32	ACT-I		4PI	

LEAD Z=82

A	ABUND.(1)	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
204	1.48	8.2	6.6	12.8	12.4	-2.0	15.2	14.4	12.3
206	23.6	8.1	7.3	13.0	13.4	-1.1	14.8	14.8	13.7
207	22.6	6.7	7.5	13.0	12.7	-0.4	14.8	14.0	14.9
208	52.3	7.4	8.0	12.9	14.5	-0.5	14.1	14.9	15.4

(1) ABUNDANCE DEPENDS ON SOURCE

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58MO2	82PB		G,MU-T	ABX	THR 94	C 94	SCI-D		4PI	*
61MI1	82PB		G,MU-T	ABX	6 22	D 6-22	NAI-D			
55BU1	82PB		G,G	ABX	0-3					*
56FU1	82PB		G,G	ABX	4 40	C 4-40	NAI-D		120	
59CO6	82PB		G,G	ABX	6,7	D 6,7	NAI-D		80	*
60AL1	82PB		G,G	SPC	1	D 1			DST	*
60RE1	82PB		G,G	ABX	7	D 7	NAI-D		DST	G-WDTH
61MI1	82PB		G,G	ABX	9 22	D 9-22	NAI-D		DST	
61TO1	82PB		G,G	ABX	3 16	C 3-16	NAI-D		120	
62BE2	82PB		G,G	ABX	5 9	D 5-9	NAI-D		135	
62FU4	82PB		G,G	ABX	4 9	C 4-9	NAI-D		120	
63BO2	82PB		G,G	ABX	9	D 9	NAI-D		DST	
63FL1	82PB		G,G	LFT	2 6	D 2-6	NAI-D			G-WDTH
63YO1	82PB		G,G	ABX	5 8	D 5-8	NAI-D		DST	
64AR1	82PB		G,G	ABX	7,7	D 7,7	NAI-D		135	
64GI1	82PB		G,G	NOX	7,8	D 7,8	NAI-D		135	WIDTH
55JO1	82PB		G,N	RLY	THR 65	C 65	SCI-D	5-	DST	
55JO1	82PB		G,N	RLY	THR 65	C 65	SCI-D	10-	DST	
58AS1	82PB		G,N	NOX	THR 17	C 17	SCI-I		DST	
60GR1	82PB		G,N	ABI	10 21	C 10-21	BF3-I		4PI	
61TA1	82PB		G,N	NOX	10 22	C 22	THR-I	6-	DST	
62BR4	82PB		G,N	SPC	8 33	C 33	SCI-D	0-11	90	
62MI3	82PB		G,N	ABX	6 22	D 6-22	BF3-I		4PI	
64AL4	82PB		G,N	NOX	THR 18	C 18	SCI-I	4-	DST	
64DO1	82PB		G,N	ABX	8-20	C 8-20	BF3-I		4PI	
64GL1	82PB		G,N	SPC	16	D 16	TOF-D	0-5	90	
55BA5	82PB		G,XN	ABX	THR-250	C250		30-	DST	*
55DI1	82PB		G,XN	SPC	THR 70	C 70	EMU-D	1-8	DST	
55MC1	82PB		G,XN	RLY	THR 22	C 22	NAI-I			* DETECT BY I128
56HA1	82PB		G,XN	ABX	15,18	D 15,18	BF3-I		4PI	
57TO1	82PB		G,XN	ABX	8 22	C 8-22	BF3-I	1-9	4PI	SPECTRUM WITH EMUL
58FU1	82PB		G,XN	RLX	7-40	C 7-40	BF3-I		4PI	
61BA2	82PB		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
61MI1	82PB		G,XN	ABX	6 22	D 6-22	BF3-I		4PI	
62SH2	82PB		G,P	SPC	10 34	C 23,34	EMU-D	6-16	DST	
62SH3	82PB		G,P	SPC	THR 34	C 34			DST	* ABY, MULTIPOL
62SH4	82PB		G,P	SPC	9 34	C 23,34	EMU-D	5-25	DST	
55TA1	82PB		G,XP	ABX	-280	C280	TEL-D	50-75	175	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	82PB206		G,G	ABX	7	D 7	NAI-D		DST	G-WDTH, RADIOLEAD
62FU4	82PB206		G,G	ABX	4 9	C 4-9	NAI-D		120	RADIOLEAD
63AX1	82PB206		G,G	ABX	6 8	D 6-8	NAI-D		135	
60GE3	82PB206		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
64HA2	82PB206		G,N	ABX	6 27	D 6-26	BF3-I		4PI	
64HA2	82PB206		G,2N	ABX	12 27	D 12-26	BF3-I		4PI	
62FU4	82PB206		G,XN	ABX	8 19	C 8-19	BF3-I		4PI	
60GE3	82PB207		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
63BE4	82PB207		G,N	SPC	7 9	C 9	TOF-D	0-2		
64HA2	82PB207		G,N	ABX	6 27	D 6-26	BF3-I		4PI	
64HA2	82PB207		G,2N	ABX	12 27	D 12-26	BF3-I		4PI	
62FU4	82PB207		G,XN	ABX	6 19	C 6-19	BF3-I		4PI	
60ST1	82PB207		G,NP	RLX	144 320	C320	TEL-D	130	76	REL TO H2 CROS SEC
55DE1	82PB207		G,P	ABX	11 21	C 11-21	ACT-I		4PI	MIXED WITH PB208
62SO1	82PB207		G,P	ABX	15 33	C 15-33	ACT-I		4PI	MIXED WITH PB208
63AX1	82PB208		G,G	ABX	6 8	D 6-8	NAI-D		135	
63FL2	82PB208		G,G	LFT	3 8	D 7	SCI-D		4PI	G-WDTH
64AR1	82PB208		G,G	ABX	7-8	D 7-8	NAI-D		135	WIDTH
60BA4	82PB208		E,E/	SPC	0 23	D 43	MAG-D	20-43	160	ABS INTEGR CROSSEC
61CR1	82PB208		E,E/	NOX	0 8	D183	MAG-D		DST	J-PI, TRANS RATE
56PR1	82PB208		G,N	RLY	7 22	C 22	NAI-I		90	SEPARATED ISOTOPES
58FA1	82PB208		G,N	ABX	11 18	C 10-20	ACT-I		4PI	ISOMERIC PRODUCT
60GE3	82PB208		G,N	NOX	THR	CTHR	BF3-I		4PI	THRESHOLD
63BE4	82PB208		G,N	SPC	7 10	C 9,10	TOF-D	0-3		
64HA2	82PB208		G,N	ABX	6 27	D 6-26	BF3-I		4PI	
64HA2	82PB208		G,2N	ABX	12 27	D 12-26	BF3-I		4PI	
62FU4	82PB208		G,XN	ABX	7 19	C 7-19	BF3-I		4PI	
62SO1	82PB208		G,NP	ABX	15 33	C 15-33	ACT-I		4PI	ALSO(G,D),PB207G,P
55DE1	82PB208		G,P	ABX	11 21	C 11-21	ACT-I		4PI	MIXED WITH PB207
62SO1	82PB208		G,P	ABX	15 33	C 15-33	ACT-I		4PI	MIXED WITH PB207
55TO1	82PB208		G,XP	SPC	13 23	C 23	EMU-D	5-17	DST	SEPARATED ISOTOPES
62SO1	82PB208		G,D	ABX	15 33	C 15-33	ACT-I		4PI	ALSO G,NP,PB207G,P

BISMUTH Z=83

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
209	100.00	7.4	3.8	9.4	10.9	-3.1	14.3	11.2	11.8

REF	NUCLIDE Z	NUCLIDE A	REACTION IN,OUT		RES	EXCIT		SOURCE	MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
61MI1	83	BI209	G,MU-T		ABX	6	22	D	6-22	NAI-D			
56FU1	83	BI209	G,G		ABX	4	40	C	4-40	NAI-D		120	
60RE1	83	BI209	G,G		ABX	7		D	7	NAI-D		DST	G-WDTH
61MI1	83	BI209	G,G		ABX	9	22	D	9-22	NAI-D		DST	
61TO1	83	BI209	G,G		ABX	3	16	C	3-16	NAI-D		120	
62FU4	83	BI209	G,G		ABX	4	9	C	4-9	NAI-D		120	
63AX1	83	BI209	G,G		ABX	5	8	D	5-8	NAI-D		135	
63SU1	83	BI209	G,G		ABX	4	14	C	4-14	NAI-D		120	
63YO1	83	BI209	G,G		ABX	6	8	D	6-8	NAI-D		DST	
64AR1	83	BI209	G,G		ABX	7		D	7	NAI-D		135	
61CR1	83	BI209	E,E/		NOX	0	5	C	183	TEL-I		DST	J-PI, G-WDTH
63BA1	83	BI209	E,E/		SPC	0	23	D	42	MAG-D	19-42	180	J-PI
56FE1	83	BI209	G,N		RLX	7	20	C	7-30	THR-D	1-8	DST	
57DE1	83	BI209	G,N		RLY	10	30	C	10-30	ACT-I		4PI	ISOMER
57FE1	83	BI209	G,N		RLY	10	30	C	20,30	THR-I	5-	DST	
57ZA1	83	BI209	G,N		SPC	8	19	C	19	EMU-D	1-12	DST	REL YIELD
58BE2	83	BI209	G,N		SPC	8	16	C	14,16	TOF-D	1-7	120	
60EM1	83	BI209	G,N		SPC	8	30	C	30	EMU-D	1-13	DST	
60GE3	83	BI209	G,N		NOX	THR		C	THR	BF3-I		4PI	THRESHOLD
60KU2	83	BI209	G,N		RLY	17	90	C	90	TEL-I	10-	DST	
61TA1	83	BI209	G,N		NOX	13	22	C	22	THR-I	6-	DST	
62BO5	83	BI209	G,N		ABX	8	22	D	8-22	NAI-I			
62MI3	83	BI209	G,N		ABX	8	22	D	8-22	BF3-I		4PI	
62RE1	83	BI209	G,N		NOX	11	55	C	55	THR-I	4-	DST	
63ZA1	83	BI209	G,N		SPC	8	19	C	14,19	EMU-D	1-12	DST	
64AL4	83	BI209	G,N		NOX	THR	18	C	18	SCI-I	4-	DST	
64DE1	83	BI209	$ G,N		NOX	THR	-80	C	80	CCH-D	0-16	135	NEUTRONS POLARIZED
64GL1	83	BI209	G,N		SPC	16		D	16	TOF-D	0-5	90	
64HA2	83	BI209	G,N		ABX	6	27	D	6-26	BF3-I		4PI	
64HA2	83	BI209	G,2N		ABX	12	27	D	12-26	BF3-I		4PI	
56GA1	83	BI209	G,XN		ABX	7	27	C	7-27	BF3-I		4PI	
56HA1	83	BI209	G,XN		ABX	15,18		D	15,18	BF3-I		4PI	
58KA1	83	BI209	G,XN		ABX	8	22	C	8-22	BF3-I		4PI	
61BA2	83	BI209	G,XN		ABY	10	22	C	22	THR-I	3-	DST	
61BA2	83	BI209	G,XN		ABY	12	22	C	22	THR-I	5-	DST	
61MI1	83	BI209	G,XN		ABX	6	22	D	6-22	BF3-I		4PI	
61WA1	83	BI209	G,XN		SPC	10	22	C	22	EMU-D	3-9	DST	
62FU4	83	BI209	G,XN		ABX	7	10	C	7-10	BF3-I		4PI	
63AN3	83	BI209	G,XN		ABY	9	85	C	85	EMU-D	1-12	DST	
61DE2	83	BI209	G,F		ABX	300	999	C	300-999	EMU-I		4PI	

RADIUM Z = 88

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58DU1	88RA		G,F							* YIELD-MASS DIST.

THORIUM Z=90

A	ABUND.	SEPARATION ENERGIES (MEV) G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
232	100.00	6.4	7.7	10.	*	-4.1	11.4	14.	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
60RE1	90TH232		G,G	ABX	7	D 7	NAI-D		DST	
64LA1	90TH232		G,G	ABX	10 25	C	NAI-D		DST	
56GI1	90TH232		G,N	ABX	8 16	C 8-20	ACT-I		4PI	
57AV1	90TH232		G,N	RLI	7-13	C 7-13				* REL TO G,F
55BA4	90TH232		G,XN	ABY	12	C 19	BF3-I		4PI	
56GA1	90TH232		G,XN	ABX	5 27	C 5-27	BF3-I		4PI	
57KA1	90TH232		G,XN	ABX	THR-23	C -23				*
61BA2	90TH232		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
55BA4	90TH232		G,F	ABY	12	C 19	ION-I		4PI	
55LA2	90TH232		G,F	ABY						* DELAYED NEUTRONS
55VA1	90TH232		G,F	ABY	THR-19	C 19	ION-I			* AV. NO. NEUTRONS
56DU1	90TH232		G,F	RLY		C 6-				* SYMMETRIC FISS.
56GI1	90TH232		G,F	ABX	8 20	C 8-20	ACT-I		4PI	
56KO2	90TH232		G,F	ABX	THR-24	C 8-24				*
56KO3	90TH232		G,F	SPC	THR-18	C 18	ION-D			*
57AV1	90TH232		G,F	RLI	7-13	C 7-13	ACT-I		4PI	* REL TO G,N
57BA4	90TH232		G,F		THR-20	C 6-20			DST	*
57SC2	90TH232		G,F		THR-10	C 4-10				* SYMM. VS ASYMM.
58FA2	90TH232		G,F		THR-16	C 16	EMU-D		DST	* MULTIPOLARITY
60KO6	90TH232		G,F	SPC	THR-70	C 70				* MASS DISTRIB.
60PR2	90TH232		G,F		6 7	D 6-7				* PROMPT N YIELD
61BO2	90TH232		G,F	SPC			EMU-D			*
61DE2	90TH232		G,F	ABX	300 999	C300-999	EMU-I		4PI	
62DE3	90TH232		G,F	ABX	7	D 7	EMU-I		DST	
62HU1	90TH232		G,F	ABX	6,7	D 6,7	ION-I		0	
62MO3	90TH232		G,F	ABY	THR 20	C 12,20	BF3-I		4PI	DELAYED N YIELDS
63BA3	90TH232		G,F	RLY	0 12	C 12	EMU-I		DST	
63DE1	90TH232		G,F	ABX	6	D 6	EMU-I		DST	
63KO1	90TH232		G,F	SPC	THR 90	C 90	ION-D		DST	
62MI1	90TH232		N,G	ABX		D 0-4	ACT-I		4PI	

A	ABUND.	SEPARATION ENERGIES (MEV)							
		G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
234	5.6(-3)	6.8	6.6	10.3	10.6	-4.8	12.7	13.3	12.0
235	0.72	5.3	6.7	10.0	9.5	-4.7	12.0	11.9	12.3
238	99.27	6.1	7.6	10.0	*	-4.3	11.4	14.0	*

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
58MO2	92U		G,MU-T	ABX	THR 94	C 94	SCI-D		4PI	*
56FU1	92U		G,G	ABX	4 40	C 4-40	NAI-D		120	
58MO1	92U		G,G	ABX	90	90			DST	* SMALL ANGLES
63BO2	92U		G,G	ABX	9	D 9	NAI-D		DST	
61TA1	92U		G,N	NOX	THR 22	C 22	THR-I	6-	DST	
61BA2	92U		G,XN	ABY	THR 22	C 22	THR-I	5-	DST	
64GL1	92U		G,N	SPC	16	D 16	TOF-D	0-5	90	
55BA4	92U		G,XN	ABY	12	C 19	BF3-I		4PI	
56GA1	92U		G,XN	ABX	5 27	C 5-27	BF3-I		4PI	
55BA4	92U		G,F	ABY	12	C 19	ION-I		4PI	
55KA1	92U		G,F	ABX		C				* SYMM. VS ASYMM.
55LA2	92U		G,F	ABY						* DELAYED NEUTRONS
55VA1	92U		G,F	ABY	THR-19	C 19	ION-I			* AV. NO. NEUTRONS
56BA1	92U		G,F		THR-27	C 9-27	FMU-I		DST	*
56DU1	92U		G,F	RLY		C 5-				* SYMMETRIC FISS.
56KO2	92U		G,F	ABX	THR-24	C 8-24				*
56KO3	92U		G,F	SPC	THR-18	C 18	ION-D			*
57BA4	92U		G,F		THR-27	C 9-27			DST	*
57SC2	92U		G,F		THR-10	C 4-10				* SYMM. VS ASYMM.
58BA7	92U		G,F		THR-27	C 6-27			DST	*
60FO1	92U		G,F	NOX	6 20	C 6-20	EMU-I		DST	
60KO6	92U		G,F	SPC	THR-70	C 70				* MASS DISTRIB.
60PR2	92U		G,F		6 7	D 6-7				* PROMPT N YIELD
60TA3	92U		G,F	SPC	6	D 6	EMU-D		DST	
61DE1	92U		G,F	NOX	6 20	C 6-20	EMU-I		DST	
61DE2	92U		G,F	ABX	300 999	C300-999	EMU-I		4PI	
62BO8	92U		G,F	SPC	THR 50	C 17-50	ION-D		90	
62KO4	92U		G,F	NOX	THR 35	C 35	ION-D		DST	MASS DISTRIBUTION
62MO3	92U		G,F	ABY	THR 20	C 12,20	BF3-I		4PI	DELAYED N YIELDS
63BO6	92U		G,F	NOX	THR 35	C 35	ION-D		DST	
63PE2	92U		G,F	RLY	THR 14	C 14	ACT-I		4PI	
57KA1	92U	233	G,XN	ABX	THR-23	C -23				*
57BA4	92U	233	G,F		THR-20	C 6-20			DST	*
62HU1	92U	233	G,F	ABX	6,7	D 6,7	ION-I		0	
57BA4	92U	234	G,F		THR-20	C 6-20			DST	*
62HU1	92U	234	G,F	ABX	6,7	D 6,7	ION-I		0	
64BO3	92U	235	G,N	ABX	8-21	D 8-21	BF3-I		4PI	
64BO3	92U	235	G,2N	ABX	8-21	D 8-21	BF3-I		4PI	
57BA4	92U	235	G,F		THR-20	C 6-20			DST	*
62HU1	92U	235	G,F	ABX	6,7	D 6,7	ION-I		0	
64BO3	92U	235	G,F	ABX	6-19	D 6-19	ION-I		4PI	
57BA4	92U	236	G,F		THR-20	C 6-20			DST	*
62HU1	92U	236	G,F	ABX	6,7	D 6,7	ION-I		0	
56GI1	92U	238	G,N	ABX	8 16	C 8-20	ACT-I		4PI	
57KA1	92U	238	G,XN	ABX	THR-23	C -23				*
56GI1	92U	238	G,F	ABX	8 20	C 8-20	ACT-I		4PI	

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57BA4	92U	238	G,F		THR-20	C 6-20			DST	*
60BO1	92U	238	G,F	SPC	THR 70	C 70	ION-D			
62DE3	92U	238	G,F	ABX	7	D 7	EMU-I		DST	
62HU1	92U	238	G,F	ABX	6,7	D 6,7	ION-I		0	
63DE1	92U	238	G,F	ABX	7	D 7	EMU-I		DST	

U
Np
Pu
Am

NEPTUNIUM Z = 93

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57BA4	93NP	237	G,F		THR-20	C 6-20			DST	*
62HU1	93NP	237	G,F	ABX	6,7	D 6,7	ION-I		0	

PLUTONIUM Z = 94

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57KA1	94PU	239	G,XN	ABX	THR-23	C -23				*
57BA4	94PU	239	G,F		THR-20	C 6-20			DST	*
57BA4	94PU	240	G,F		THR-20	C 6-20			DST	*

AMERICIUM Z = 95

REF	NUCLIDE Z	A	REACTION IN,OUT	RES	EXCIT	SOURCE MIN-MAX	DETECTOR TYPE	MIN-MAX	ANG	REMARKS
57BA4	95AM	241	G,F		THR-20	C 6-20			DST	*

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