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EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

**TABLES OF CROSS-SECTIONS
OF NUCLEAR REACTIONS WITH NEUTRONS
IN THE 14-15 MeV ENERGY RANGE**

by

H. NEUERT and H. POLLEHN

1963



Report established by
the University of Hamburg, Germany
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SUMMARY

During the last few years many measurements of nuclear reactions with neutrons $(n, 2n)$, (n, p) , (n, np) , (n, d) , (n, He^3) , (n, t) , (n, α) and $(n, n\alpha)$ in the energy range $E_n = 14-15$ MeV have been carried out, so that a compilation of the cross-sections of these reactions seemed to be of general value. Thus, these tables of cross-sections will give a general picture of the measured values available, provide a basis for special theoretical considerations, and in some cases point up the urgency of making further investigations on more precise measurements in this field.

The tables are arranged as follows :

- I. Column I will mark each single measurement : the first number gives the atomic number and the second the mass of the target nucleus. The second number is left out if only the cross-section of the natural element has been measured. The small letter marks the type of reaction :

- a — $(n, 2n)$ reaction
- b — (n, p) reaction
- c — $(n, np + n, pn + n, d)$ reaction
- d — $(n, p + n, pn)$ reaction
- e — (n, np) or (n, nd) reaction
- f — (n, d) or (n, He^3) reaction
- g — $(n, p + n, pn + n, np + nd)$ reaction
- h — (n, t) or $(n, 2p)$ or (n, tn) reaction
- i — (n, α) reaction
- k — $(n, n\alpha)$ reaction

The following number indicates the measurements of the different authors in order of succession.

II. References.

III. Half-life used for the measurement. If the half-life has especially been remeasured, an index mark is given.

IV. Neutron energy in MeV.

V. Cross-section in mb and error.

VI. Specification of the absolute measurement of neutron flux. In the case of relative measurements, the cross-section used for comparison is given.

VII. Description of method.

VIII. Sources of uncertainties which according to the author have been used for calculation of error given in column V.

IX. Target used for experiments.

In many cases not all the details could be specified in the columns because the publications do not contain though all the information necessary for columns III through IX.

It is obvious that two methods were mainly used for the determination of cross-sections :

- 1) Registration of the particles emitted in the reaction (nuclear plates, telescope);
- 2) Measurement of β - and γ -ray activities of the targets after irradiation by the neutrons.

For comparison of the results of different authors the following items must be observed :

- a) Method 1) does not permit of any discrimination between $(n, p\gamma)$ - and (n, pn) or between $(n, \alpha\gamma)$ - and $(n, \alpha n)$ -reactions.
- b) By method 2) the reactions (n, np) , (n, pn) and (n, d) cannot be separated.
- c) For a determination of cross-sections by method 2) it is necessary to know the intensities and the energies of all the β - and γ -rays emitted from the residual nuclei. For many nuclei the decay scheme is not known precisely. As a result of this, some errors may appear in the calculation of the cross-section from the radioactivities measured. But even by using equal decay schemes considerable differences in the results may still arise according to the method applied (measurement of total β -ray-activity, measurement of definite γ -energies in photopeaks, measurement of the total γ -activity, counting of positron annihilation radiation by coincidences).
- d) As in many publications not all the sources of uncertainties were thoroughly examined for a calculation of the errors, a comparison of the errors quoted by different authors can be made with some reserve only (see VIII). If quoted in the publications column V indicates whether the error given is the mean (mostly) or the probable error.
- e) Though a large number of results was compiled, it will still be difficult to make more precise statements on the quality of the single measurements. If there are several results available for one reaction at equal neutron energies it can be concluded from the tables which value could be used as an average. In the following we have considered some important reactions frequently used for comparison or relative measurements.

CROSS-SECTIONS OF SOME REACTIONS FREQUENTLY USED FOR COMPARISONS AND RELATIVE MEASUREMENTS

Some reactions frequently used as a basis for relative measurements of cross-sections are given below. The individual results cannot be used without detailed examination to find out the most probable values of the cross-sections. In some cases however values can be found which may within certain limits represent a usable mean cross-section. It will in general and with all respect to the older experiments be reasonable to give more consideration to the newer results because the methods have been improved considerably; the results from nuclear plate and telescope measurements in particular may mostly include higher errors, because of the lower statistics, for instance. It will be easier to carry out the measurements of the induced radioactivity with improving accuracy. Furthermore, the energy dependence

of the cross-sections has to be considered if the measurements extend to a larger range of energy (between 12 and 20 MeV, for instance).

1) $\text{Li}^6(n, \alpha) \text{H}^3$

Though careful measurements were carried out early on by Kern (K58 I) we should like to give priority to the values of Ribe (R52), Frye (F54) and Pollehn (P61 II) which concur fairly closely

$$\sigma = 26 \text{ mb at } 14.1 \text{ MeV};$$

2) $\text{O}^{16}(n, p) \text{N}^{16}$

As the scattering of the values given for $E_n = 14.5$ MeV is relatively low, a mean value of $\sigma = 40$ mb is proposed;

3) $\text{Al}^{27}(n, p) \text{Mg}^{27}$

At the energy $E_n = 14.1$ MeV nearly all values join to give

$$\sigma = 81 \text{ mg.}$$

The values for $E_n = 14.8$ MeV are more scattered, but they all come from relative measurements;

4) $\text{Al}^{27}(n, \alpha) \text{Na}^{24}$

It is important to remember that the cross-sections of this reaction slowly decrease from 14 to 15 MeV. For $E_n = 14.1$ MeV the values accumulate to

$$\sigma = 121 \text{ mb},$$

though recent results by Prestwood (P61 I; P61 IV) gave a value which is 6 mb higher. At 14.8 MeV the results of different authors meet at 114 mb;

5) $\text{Fe}^{56}(n, p) \text{Mn}^{56}$

In this case the results at 14 to 15 MeV are widely scattered, so that it will be necessary to consider further measurements. Averaging several results yields a value of

$$\sigma = 114 \text{ mb at } 14.3 \text{ MeV};$$

6) $\text{Cu}^{63}(n, 2n) \text{Cu}^{62}$.

Although this reaction is frequently used for comparison, the different results are astonishingly far from uniform. A mean value is about

$$\sigma \approx 500 \text{ mb at } E_n = 14.1 \text{ MeV};$$

7) $\text{Cu}^{65}(n, 2n) \text{Cu}^{14}$

Only a scarce number of absolute measurements is available. A mean value of about $\sigma \approx 930$ mb is not yet sufficiently reliable.

On the basis of the more recent experiments by Prestwood (P61 I; P61 IV) on $\text{Al}^{27}(n, \alpha)$, this value should be lower about 20 mb.

From all reactions considered here the values of $\text{Al}^{27}(n, \alpha)$ appear most accurate (about $\pm 3\%$); for the other reactions deviations of 5 to 8% from the values suggested here should be allowed.

D E U T E R I U M

$$D^2(n, 2n) H^1$$

1-2a1	A58 II	—	13.1	200 ± 20	abs. : x-from $T(d,n)$ $^{11}Be^4$	Pulsed neutron source of 2.5 μ sec duration. Detec- tion of double pulses in a cadmium loaded liquid scintillator of 40'' length and 40'' ϕ . The targets were in a hole of the scin- tillator	Standard deviation contains : stat. ($\sim 8\%$), calibr. (3.4%), neu- tron flux (4%)	Several thin discs CD_2
1-2a2	H60	—	—	190 ± 19	—	—	—	—

I	II	III	IV	V	VI	VII	VIII	IX
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L I T H I U M

$\text{Li}^6(n, p)$

3-6b1	B53 I		14.1	6.7 ± 0.8	abs. : α -from $T(d, n) \text{He}^4$	β -activity, 2π geometry prop. - counter. Calibration by the Cu^{62} activity from $\text{Cu}^{60}(n, 2n) \text{Cu}^{62}$ with $\sigma_{\text{Cu}^{60}(n, 2n)} = 350$ mb at 14.1 MeV (cf. 29-63a). Decrease of the activity was recorded with a time-analyser	Standard deviation contains : statistics, calibration, $\sigma_{\text{Cu}^{62}}(n, 2n)$, neutron flux	Isotopically enriched Li-foils: $\text{Li}^6(90.9\%)$ 420 mg/cm ² : Li^7 (99.9%) 510 mg/cm ²
3-6b2 diff.	F54	—	14	6 ± 2 $d\Omega = 4\pi$	abs. : α -from $T(d, n) \text{He}^4$	Nuclear plate	Deviation contains : statistics neutron flux (4%) geometry (1.55%) separation of particle groups (<7%)	Isotop. enriched Li foils Li^6 (90.9%) Li^7 (99.9%) thickness <10 mg/cm ²

$\text{Li}^6(n, d) \text{ He}^5$

3-6e1 diff.	F54			89 ± 10 $d\Omega = 0^\circ\text{--}169^\circ$		cf. 3-6b2		
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$\text{Li}^6(n, d) \text{ He}^{5m}$

3-6e1m	F54			77 ± 9 $d\Omega = 0^\circ\text{--}169^\circ$		cf. 3-6b2		
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$\text{Li}^6(n, t) \text{ He}^4$

3-6h1	R52			26 ± 3.6		—	Li^6 in prop. - counter. Energy spectrum was recorded with a multi-channel analyser	—	With Li^6 enriched Li-foil
3-6h2 diff.	F54	—	14	26 ± 4 $d\Omega = 4\pi$			cf. 3-6b2		

I	II	III	IV	V	VI	VII	VIII	IX
3-6h3	R56 I	—	14.1 ± 0.08	26 ± 4	abs. : α -from $T(d, n) He^4$	cf. 3-6h1	Mean total error	cf. 3-6b2
3-6h4	K58 I	—	14.0^{+1}_{-1} $\pm 0.2-0.3$	28.5 ± 1.6	abs. : α -from $D(d, n) He^4$	Direct counting of the H^3 and He^4 in a $Li^3I(Eu)$ - crystal of $1.5''$ diameter and $0.5''$ height	Mean total error	Li^3I -crystal 96.1% Li^3I
			$14.2 \pm 0.2-0.3$	28.1 ± 1.6				
			$14.5 \pm 0.2-0.3$	27 ± 1.5				
			$15 \pm 0.2-0.3$	26.5 ± 1.5				
3-6h5	P61 II	—	$14.1 \pm 0.15^{+2}_{-2}$	25.8 ± 1.5	abs. : α -from $T(d, n) He^4$	$\alpha + H^3$ from $Li^3(n, t) He^4$ were measured in coinci- dence with α from $T(d, n)$ He^4 ; α from $D(d, n) He^4$ with a prop. counter and $\alpha + H^3$ from $Li^3(n, t) He^4$ with a $Li^3I(Eu)$ crystal. The Li^3I -crystal served as target and counter	Mean total error	Li^3I -crystal 96% Li^3I $1''$ α $1''$ hight

$$\text{Li}^6(n, dn) \text{He}^4$$

3-6*h*1 diff. R56 III — 14^{±3} 300 ± 50 cf. 3-7*h*2

$$\text{Li}^7(n, d) \text{He}^6$$

3-7el B53 I $0.83 \pm 0.03^{*1}$ 14.1 9.8 ± 0.98 cf. 3-6bl
 sec.

*1 Also measured for $12.5 \text{ MeV} \leq E_\eta \leq 18.3 \text{ MeV}$

^{**} Also measured for $E_\mu = 2,6$ MeV

*³ Also measured for $4.4 \text{ MeV} \leq E_n \leq 14 \text{ MeV}$

^{**} Measured by the authors.

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Li}^7(n, t) \text{ He}^5$								
3-7h1 diff.	F54	—	14	55 ± 8 $d\Omega \leq 0^\circ - 169^\circ$		cf. 3-6b2		
$\text{Li}^7(n, tn) \text{ He}^4$								
3-7h2 diff.	R56 III	—	14 ^{*1}	300 ± 40	abs. : proton recoils in normal emulsions	Nuclear plates with Li- loaded emulsions	—	Element

^{*1} Also measured for $4.4 \text{ MeV} \leq E_n \leq 14 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
B E R Y L L I U M								
$\text{Be}^9(n, 2n) \text{ Be}^8$								
4-9a1	A58 II	—	14.1	540 ± 40		cf. 1-2a1		
4-9a2 diff.	R57	—	14.1	420 ± 70 En > 0.5 MeV $d\Omega = 4\pi$	abs. α -from $T(d, n) \text{ He}^4$	Nuclear plate; plates ar- ranged cyl. around a cyl. target. Only the recoil protons were recorded	Estimated total error	Element, cylinder
4-9a3	H60	—	—	520 ± 40	—	—	—	—
4-9a4 diff.	M61 III	—	14.1	a) 540 ± 70	—	a) Be-powder mixed with the emulsion of a nuclear plate	—	Powder 20 mg/cm ³
				b) $4\pi \left[\frac{d\sigma}{d\Omega} \right] = 480 \pm 9$ means for $0 = 0^\circ$, 20° , 45° , 65° , 90° , 105° , 120°		b) Metallic Be cyl. sur- rounded by several plates		Metallic Be
$\text{Be}^9(n, z) \text{ He}^6$								
4-9i1	B53I	$0.83 \pm 0.03^*$	14.1	10 ± 1		cf. 3-6b1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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B O R O N

$B^{10}(n, dn') 2He^4$

5-10e1 diff.	F-56	—	14.1^{*1}	128 ± 19	—	Nuclear plate with B^{10} loaded emulsion	—	—
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$B^{10}(n, t) 2He^4$

5-10h1	F-56	—	14.1^{*1}	102 ± 17	—	cf. 5-10e1	—	—
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$B^{11}(n, p) Be^{11}$

5-11b1	K-611	—	14.5 ± 0.8	3.2 ± 0.4	rel. : cf. 29-63a _a $Cu^{63}(n, 2n) = 556 mb$	cf. 13-27b4	Powder thin target
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5-11b2	K-62	13.6 sec	14.8 ± 0.4	3.3 ± 0.6	rel. : cf. 29-33a $Cu^{63}(n, 2n) = 507 mb$	a) β -activity 2π -geometry (corrections cf. 13-27i _b) b) γ -activity, measuring of the area under the photo-peak with a $3'' \times 3''$ NaI crystal	Probable total error	Powder thin target
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$B^{11}(n, z) Li^8$

5-11i1 diff.	A56	—	$14.7 \pm 0.68^{*2}$	30.9 ± 6.3	abs. : z -from $T(d, n) He^4$	Nuclear plate with B^{11} Total error loaded emulsion	B^{11} -powder
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5-11i2	H54	0.88 sec	14	~ 30	—	BF_3 -counter. Measuring of the z from Be^8 after the β -decay of Li^8	—
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*1 Also measured for $6 \text{ MeV} \leq E_n \leq 20 \text{ MeV}$

*2 Also measured for $12.6 \text{ MeV} \leq E_n \leq 20 \text{ MeV}$

C A R B O N

$C^{12}(n, 2n) C^{11}$

6-12a1	B61 II				Only rel. measurement of the excitation function* ¹ cf. 29-63a1 * ⁴			
6-12a2	B52							
6- a2	A58 II	—	14.1	6 ± 6	$C^{nat}(n, 2n)$			
					cf. 1-2a1			
6-12b1	K59 I	$18.87 \pm 0.50^{*2}$ msec	$14.92 \pm 0.48^{*3}$	1.93 ± 0.25	rel. : cf. 3-6b4 $Li^6(n, t) = 26.5mb$ for $E_n = 15$ MeV	Pulsed neutron source, Total error 7 pulses/sec ; 1 msec duration. Counting between pulses. The pulse height distribution was recorded with a 100 channel and the total counts with a 9 channel time analyser		Plastic - scintillator served as a carbon containing target and permitted counting the β as a 4π counter

*¹ Measured from threshold to 37 MeV

*² Measured by the authors

*³ Also measured for 14.92 MeV $\leq E_n \leq 17.5$ MeV

*⁴ Measured from threshold to 27 MeV

I	II	III	IV	V	VI	VII	VIII	IX
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N I T R O G E N

$N^{14}(n, 2n) N^{13}$

7-14a1	P53	9.9 min	14.5 ± 0.35	5.67 ± 0.85	abs. : α -from $T(d, n)$ He ⁴	β^+ -activity, prop. counter. Calibration with standard sources	Standard deviation, no systematic errors	Sugar, cylinder 3 cm σ max. height 1.27 cm, but always more than half max. range of the β
7-14a2	R58 II	12.3 min	14	~ 8.5	ref. : cf. 29-63a $Cu^{63}(n, 2n) = 500$ mb	β^+ activity 0.511 MeV annihilation radiation measured in coincidence with 2 scintillation counters (NaI crystals)	—	—
7-14a3	F-60*	—	13.77 ± 0.20	5.18 ± 0.6	rel. : cf. 3-6h4 Li ⁶ (n, t) He ⁴ = 28.1 mb Leaky-integrator used	β^+ activity. 0.511 MeV annihilation radiation measured in coincidence with 2NaI crystals. Calibration with Na ²²	Error contains : $\sigma Li^6(n, t) - 5\%$, $d\Omega / d\Omega H^3(d, n) - 4\%$, leaky integr. - 2 %, cal. - 5 %, stat. 1-15 % target position 2 %	$N_6 C_6 H_6$, cylinder 7/16" o. 1" height
7-14a4	B61 I	—	14.1	4 ± 1.2	—	β activity and γ activity	Estimated total error	NH_4NO_3
7-14a5	A58 II	—	14.1	19 ± 10	—	cf. 1-2a1	—	Melamine cf. 1-2a1
7-14a6	D54	10 min	14	3.4 ± 1	abs. : α -from $T(d, n)$ He ⁴	β^+ activity 0.511 MeV annihilation radiation measured in coincidence, counting-system calibrated with Na ²²	—	Liquid nitrogen
7-14a7	R61 II	12.3 ± 0.65 min	14.4 ± 0.3	7.41 ± 0.58	rel. : cf. 29-63a $Cu^{63}(n, 2n) = 503$ mb	β^+ activity 0.511 MeV annihilation radiation measured in coincidence with 2NaI crystals. Calibration with Cu ⁶³	Mean total error	NaN_3 , variable thickness, 1 cm o

* Also measured for 12.4 MeV $\leq E_n \leq 18$ MeV

I	II	III	IV	V	VI	VII	VIII	IX
7-14a8	B61 II			cf 6-12a1*				
7-14i1	L52	—	14.1	~100	rel. : cf. A50 $\sigma n \cdot p$ scattering = 675 mb	In a cloud-chamber N^{14} and H^1 in a known ratio	—	Gas

* Also measured from threshold to 37 MeV

I	II	III	IV	V	VI	VII	VIII	IX
O X Y G E N								
$O^{16}(n, 2n) O^{15}$								
8-16a1	B61 II			cf. 6-12a1*1				
					$O^{16}(n, p) N^{16}$			
8-16b1	P53	7.3 sec	14.5 ± 0.35	49 ± 25		cf. 7-14a1		
8-16b2	L52	—	14.1	35		cf. 7-14i1	for $N^{14} \rightarrow O^{16}$	
8-16b3	M54	$7.38 \pm 0.05^{*2}$	14^{*3}	89 ± 27	rel. : cf. 29-63a2 $Cu^{62}(n, 2n) = 510$ mb	Stilben; 4 cm o $\frac{1}{2}$ mm height. The counting efficiency for the β of Cu^{62} was supposed to be the same as for the β of N^{16}	Estimated total error 5 gr. H_2O	
8-16b4	K61 I	7 sec	14.5 ± 0.8	39 ± 3.9		cf. 5-11b1		Powder
8-16b5	D60 I	7.352 ± 0.009 sec cf. E59I	14.7 ± 0.1	39.2 ± 1.6	abs. proton recoil telescope	β -activity, 4π counter. Liquid-scintillator served as target and counter. Counting efficiency proved with Tl^{204} (99.5 %). Activity measured with 2 multipliers switched in coincidence; γ -spectrum recorded with a calibrated NaI-crystal	Total error	Liquid-scintillator : Dioxane (383 gr.) Naphthalene (37.5 gr.), PPO (37.5 gr.), POPOP (0.010 gr.)
8-16b6	S61 I	7.35 sec.	14.4	34 ± 6	abs. : proton recoil telescope	β -activity, liquid-scintillator served as target and counter	—	Liquid-scintillator
8-16b7	K62	7.4 sec	14.8 ± 0.4	38.2 ± 5	rel. : cf. 29-63a $Cu^{62}(n, 2n) = 507$ mb	cf. 5-11b2		

*1 Measured from threshold to 37 MeV

*2 Measured by the authors

*3 Measured also for 12 MeV $\leq E_n \leq 18$ MeV

I	II	III	IV	V	VI	VII	VIII	IX
8-16 <i>f</i> 1	L52	—	14.1	~15	$O^{16}(n, d) N^{15}$			
8-16 <i>i</i> 1	L52	—	14.1	~310	$O^{16}(n, z) C^{13}$	cf. 7-14 <i>i</i> 1		

I	II	III	IV	V	VI	VII	VIII	IX
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FLUORINE

$F^{19}(n, 2n) F^{18}$

9-19a1	P53	1.8h	14.5 ± 0.35	60.6 ± 8		cf. 7-14a1	CaF ₂ , NaF cf. 7-14a1
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9-19a2	R58 I	1.85h	14	51.3		cf. 7-14a2
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9-19a3	B61 I	—	14.1	50 ± 15		cf. 7-14a4	CF ₂
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9-19a4	A58 II	—	14.1	62 ± 8.7		cf. 1-2a1	CF ₂
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9-19a5	R61 II	$1.85 \pm 0.04^{*1}$	14.4 ± 0.3	51.9 ± 3.8		cf. 7-14a7	CF ₂
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9-19a6	B61 II		cf. 6-12a1 ^{*2}				
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$F^{19}(n, p) O^{19}$

9-19b1	P53	30 sec	14.5 ± 0.35	135 ± 47		cf. 7-14a1	CaF ₂ , NaF cf. 7-14a1
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9-19b2	K61 I	—	14.5 ± 0.8	16.5 ± 2	rel.: cf. 13-27b5 $\Delta F(n, p) = 87 \pm 8$ mb	cf. 5-11b1	AlF ₃ , CF ₂
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9-19b3	K62	29 sec	14.8 ± 0.4	14.3 ± 3.5		cf. 5-11b2	
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$F^{19}(n, z) N^{16}$

9-19i1	K61 I	—	14.5 ± 0.8	57 ± 7		cf. 5-11b2	AlF ₃ -powder CF ₂ , thin target
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^{*1} Measured by the authors

^{*2} Also measured from threshold to 37 MeV

I

II

III

IV

V

VI

VII

VIII

IX

S O D I U M

Na²³(n, 2n) Na²²

11-23a1	P55	2.6y	14.1 ± 0.2	13.8 ± 2.2	rel. : Al ²⁷ (n, z) = ? Sandwich-method	β -activity ; 4π prop. counter calibrated with Na ²² . Chemical separation	2x mean deviation from 6 measurements	NaF; after chem. separation NaCl (30-80 mg)
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Na²³(n, p) Ne²³

11-23b1	P53	40 sec	14.5 ± 0.35	33.9 ± 15		cf. 7-14a1		NaCl
11-23b2	B60	40 sec	14.1 ± 0.1	9 ± 4	rel. : cf. 53-127a I ¹³⁷ (n, 2n) = 1200 mb	β -activity, NaI crystal served as target and counter	Stat. error	NaI crystal
11-23b3	M61 II	—	14.8	29 ± 2.9		cf. 11-23i2		
11-23b4	W61 II	37.6 sec	No measurements for* 14 MeV $\leq E_n \leq$ 15 MeV		abs. : proton-recoil-spectrometer. Leaky integrator	β -activity, $1\frac{1}{2}'' \times 1\frac{1}{2}''$ NaI crystal served as target and counter	—	NaI crystal

Na²³(n, p) Ne²³ + Na²³(n, pn) Ne²²

11-23d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 57 ± 20 b) 50 ± 20	rel. : cf. 26-54d3 Fe ⁵⁴ (n, p) = 395 mb	Shielded nuclear plate surrounded by several targets arranged in a circle of 8 cm \varnothing . Only protons with 0~120° counted. Separation of n,p- and n,np-processes by stat. theory with level densities : a) $p \sim \exp(-e/T)$ b) $p \sim \exp(2(aU))^{1/2}$ Probably the cross-sections contain n,d-processes	Deviation contains : 6 targets of 2 \times 1 cm ² stat. error ; separation and 6-40 mg/cm ² of n,p- and n,np-thickness processes
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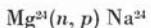
* Measured for 4 MeV $\leq E_n \leq$ 19 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Na}^{23}(n, \gamma) \text{ F}^{20}$								
11-2341	B60	12 sec.	14.1 ± 0.1	29 ± 10	rel. : cf. 53-127a $\text{F}^{20}(n, 2n) \approx 1200mb$	β -activity NaI-crystal served as target and 4 π counter	Stat. error	NaI-crystal
11-2342	M61 II	—	14.8	222 ± 22	rel. : cf. 29-63a3 $\text{Cu}^{63}(n, 2n) \approx 550mb$ Sandwich-method	β -activity 2 π geometry, prop. counter, Calibration with standard sources	Mean deviation of the single experimental points	Powder or foils
11-2343	W61 II	10.7 sec.	No measurements for* $14 \text{ MeV} \leq E_\mu \leq 15 \text{ MeV}$		cf. 11-234			

* Measured for $4 \text{ MeV} \leq E_\mu \leq 19 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
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M A G N E S I U M



12-24b1	P53	15 <i>h</i>	14.5 \pm 0.35	191 \pm 35		cf. 7-14 <i>a</i> 1	Element	
12-24b2	D60 II	—	15 \pm 0.4	203 \pm 11		cf. 26-56 <i>b</i> 1		
12-24b3	B61 V	—	14	190 \pm 10	rel. : cf. 16-32 <i>b</i> 2 $S^2(n, p) = 254mb$	Activation method	—	—
12-24b4	K59 III	—	13.03 \pm 0.2	219 \pm 26	—	cf. 14-28 <i>b</i> 2		
12-24b5	C56	12 <i>h</i>			β -activity measured with 3 uncalibrated geiger-counters. The excitation curves were fitted at 14.5 MeV with the cross-section for the same reaction found by P53* ¹			
12-24b6	I61	—	14.00* ² 14.10 14.50 14.90	198 \pm 30 200 \pm 30 180 \pm 27 173 \pm 24	—	γ -activity measured with a 4" diameter by 4" long NaI crystal	Uncertainties primarily involve : neutron flux calibration of the NaI crystal	—
12-24b7	G61 IV	—	14.00* ³ 14.50 14.90 15.00	185 \pm 15 174 \pm 14 170 \pm 12 170 \pm 12	—	—	—	—



12-24d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 118 \pm 16 b) 110 \pm 16		cf. 11-23 <i>d</i> 1		
12-24d2 diff.	C60 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 285 \pm 20$ means for $\theta = 62^\circ, 75^\circ, 95^\circ, 138^\circ, 162^\circ$ and $d\theta = 10^\circ$		cf. 16-32 <i>d</i> 2		

*¹ Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

*² Also measured for 12.00 MeV $\leq E_n \leq$ 19.50 MeV

*³ Also measured for 12.6 MeV $\leq E_n \leq$ 17.1 MeV

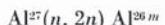
I	II	III	IV	V	VI	VII	VIII	IX
$Mg^{21}(n, p) Na^{21m}$								
12-24b1m	G59 1	20 msec*	14.5	$80 \pm \sim 36 - 40$	rel. : cf. 29-63a $Cu^{63}(n, 2n) = 500mb$	Pulsed neutron source, 1 pulse/sec, 1.3 msec duration; γ -activity measured between pulses with an experimentally calibrated NaI crystal. <i>a)</i> Total spectrum was recorded with a multi-channel pulse height analyser <i>b)</i> Decrease of the photo-peak was measured with a time-analysyer (Channel width $0.1\text{-}4.10^{-2}$ sec)	Estimated total error	Thick target; 4.5 or 10 cm \varnothing
$Mg^{25}(n, p) Na^{25}$								
12-25b1	P53	60 sec	14.5 ± 0.35	44.9 ± 18		cf. 7-14a1		Element
12-25b2	N58	60 sec	14.8 ± 0.8	60 ± 10	rel. : cf. 8-16b3 $O^{16}(n, p) = 89mb$	cf. 12-26b1		
$Mg^{25}(n, p) Na^{25} + Mg^{25}(n, p) Na^{21}$								
12-25d1 diff.	A61	--	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ <i>a)</i> 67 ± 10 <i>b)</i> 63 ± 10		cf. 11-23d1		
$Mg^{26}(n, p) Na^{26}$								
12-26b1	N58	1.04 ± 0.03 sec*	14.8 ± 0.8	50 ± 5	rel. : cf. 8-16b3 $O^{16}(n, p) = 89mb$	β -activity counted with a plastic-scintillator	--	MgO, natural and enriched $Mg^{26}O \neq 99\%$ cylinder 1-6 cm \varnothing , 2-3 cm height

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
12-26d1	A61	—	14.1	$Mg^{26}(n, p) Na^{26} + Mg^{26}(n, pn) Na^{25}$ $4\pi \left[\frac{d\sigma}{d\Omega} \right]_{12^{\circ}} =$ a) 27 ± 7 b) 27 ± 7		ef. 11-23d1		
12-26i1	N58	38.0 ± 0.3 sec*	14.8 ± 0.8	89 ± 5		ef. 12-26b1		
12-g1 diff.	V57	—	14	$Mg^{nat}(n, p + n, pn + n, np + n, d) Na$ $4\pi \left[\frac{d\sigma}{d\Omega} \right] = 32 \pm 3.8$ abs. : means for $0 = 30^{\circ}$, $45^{\circ}, 60^{\circ}, 90^{\circ}, 120^{\circ},$ $135^{\circ}, 150^{\circ}$ and $E_p <$ 6 MeV	α -from $T(d, n) He^4$ —	Shielded CsI crystal in coincidence with α from $T(d, n) \alpha$. σ probably con- tains (n, α) processes	—	Height : 2.5 MeV energy loss for 6 MeV protons ; calibration with a polyethylene foil
12-d1 diff.	H62 III	—	14.4 ± 0.2	88 ± 9 means for $0 = 0^{\circ} \rightarrow 150^{\circ}$ in 30° intervals and $E_p > 3$ MeV	abs. : neutron flux moni- tored by a BF_3 counter calibrated with a Ra-Be source and the n, p -scat- tering	Telescope with 3 prop. counters and a CsI-crys- tal. Separation of n, p - and n, np -processes by stat. theory	—	—

* Measured by the authors

A L U M I N U M



13-27a1m	M60			cf. 13-27b6* ¹				
13-27b1	P53	10 min	14.5 ± 0.35	52.4 ± 14		cf. 7-14a1		
13-27b2	F52	9.6 min	14.1	79 ± 5.5	abs. : \propto from $T(d, n)$ He ⁴	β -activity, 2 prop. counters 4 different geometries (4.5° : 13° : 23° : 45°): counters and geometries calibrated with standard sources. Scattering and absorption in the targets determined by measurements with targets of different thickness; extrapolation to thickness 0	Total error without uncertainties in the decay-scheme	Element, $1.2'' \varnothing$. Purity > 99 %
13-27b3	Y57	9.8 min	14.1 ± 0.15	82.2 ± 6.6	abs. : z-from $T(d,n)$ He ⁴ with ZnS counter	β -activity, 2π and 4π geometry. Corrections for absolute β counting were determinated a) by measurements in 2π and 4π geometry b) by measurements with targets of different thickness; extrapolation to thickness 0	Total error without systematic deviations	—
13-27b4	P59 I	9.46 ± 0.02 min* ²	14.8 ± 0.8	53 ± 5	rel. : cf. 29-63a3 $\text{Cu}^{60}(n, 2n) = 556$ mb Sandwich method	β -activity, 2π geometry prop. counter. Corrections for absolute β -counting computed (cf. N52: B53 III; G51: B49; Z50: J50; W53: C57 I)	Maximal deviations of the single experimental points from the means	Element: discs 1.7-2.1 cm \varnothing thickness 3 mg/cm ²

^{*1} Measured from threshold to 21 MeV^{*2} Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
13-27b5	K61 I	—	14.5 \pm 0.8	87 \pm 8	rel. : cf. 29-63a3 Cu ⁶³ (n, 2n) = 556 mb Sandwich method	cf. 27-59b1		Element and Al ₂ O ₃ : thin target
13-27b6	M60	—	Rel. measurement. Excitation curve fitted at 14.1 MeV * ¹			γ -activity: NaI crystal of 2.54 cm height and 3.81 cm \varnothing . γ -spectrum was recorded with a multi- channel-analysyer	Rel. error: no sys- tematic deviations	Element: cylinder 2.5 cm height 5.08 cm \varnothing
13-27b7	K59 II	9.5 min	14.3 \pm 0.5	115.5 \pm 10	rel. : cf. 26-56b Fe ⁵⁶ (n, p) = 110 mb Sandwich method	β -activity, prop. counter with a window of 4.5 mg/cm ²	Stat. error, Other de- viations \sim 10 %	Powder 20 mg/cm ² in tape of 9 mg/cm ² . Purity \sim 99.9 %
13-27b8	P61 III	9.6 \pm 0.3 min* ²	14.1 \pm 0.1	80.8 \pm 4.5	rel. : cf. 3-6h5 Li ⁶ (n, t) = 25.8 mb	γ -activity — NaI- well- crystal of 3" \varnothing and 2" height, and a hole of 1" \varnothing and 1" depth. Decrease of the total spectrum and of single γ -lines recorded. Corrections for abs. γ - counting anal. computed (cf. P61 VII). Decay- scheme : cf. S58	Standard total error	Element, powder in a plexiglas-cell of 1" \varnothing and 1" height
13-27b9	M61 II	—	14.6	77 \pm 7.7	rel. : cf. 29-63a3 Cu ⁶³ (n, 2n) = 556 mb or cf. 13-27b8 Al ²⁷ (n, z) = 117 mb Sandwich method	β -activity, 2 π geometry prop.-counter. Corrections for abs. β -counting com- puted and experim. deter- minated by standard sour- ces	Mean deviation of the experim. points	Powder or foils
13-27b10	D60 II	—	15 \pm 0.4	59 \pm 6		cf. 26-56b7		
13-27b11	H59	—	14.8	80.8 \pm 10	—	γ -activity, NaI crystal	—	—

*¹ Also measured for 12 MeV \leq E_n \leq 21 MeV

*² Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
13-27b12	S61 II	10.00 ± 0.03 min ^{*1}	14.1 ± 0.2	85 ± 2.8	abs. : α -from $T(d, n) \text{He}^4$	β -activity, block of sandwiched targets: plastic- and target- foils served as counter and target. Calibration by standard sources	Stat. deviation	Foils
13-27b13	K62	9.5 min	14.8 ± 0.4	82 ± 10		cf. 5-11b2		
13-27b14	G61 IV	—	14.35 ± 0.1 ^{*2} 14.4 14.9 ± 0.2	52 ± 3 57 ± 4 56.5 ± 3	—	—	—	—
$\text{Al}^{27}(n, p) \text{Mg}^{27} + \text{Al}^{27}(n, pn) \text{Mg}^{26}$								
13-27d1	A57 II	—	14.1	70 ± 14	abs. : α -from $T(d, n) \text{He}^4$	Nuclear plate, separation of n, p - and n,np -processes by stat. theory. σ probably contains n,d -processes	Estimated total error	Isotopically enriched targets; thickness 5-12 mg/cm ²
13-27d2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 87 ± 11 b) 76 ± 10		cf. 11-23d1		
13-27d3 diff.	S60	—	14.1	$2 \frac{d\sigma}{d\Omega} = 90 \pm 18$ for $d\Omega = 0^\circ - 180^\circ$	abs. : proton recoil spectrometer	Direct measurement of the protons by a shielded CsI crystal. Approximately 2π geometry. Distance from target to crystal = 2 mm. Separation of n,p - and n,np -processes by stat. theory. Probably σ contains n, d -processes	Estimated total error	Isotopically enriched targets; thickness ~ 15 mg/cm ²

^{*1} Measured by the authors

^{*2} Also measured for $13.2 \text{ MeV} \leq E_n \leq 17.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27d4 diff.	G61 III	—	14.8 ± 0.8	$4\pi \left[\frac{d\sigma}{d\theta} \right] =$ a) 89 ± 8 for the isotr. part b) 116 ± 10 for the total part, means for 10 angles between 0° and 150°		cf. 28-58d4		Foils, thickness 7.1 mg/cm ²
13-27d5 diff.	H62 III	—	14.4 ± 0.2	93 ± 10 for $E_p > 2.8$ MeV $\text{Al}^{27}(n, np) \text{Mg}^{26}$		cf. 12-g1		
13-27e1	A57 III	—	14.1	70 ± 14		cf. 13-27d1		
13-27e2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} = 53 \pm 11$		cf. 11-23b4		
13-27e3 diff.	H62 III	—	14.4 ± 0.2	17 ± 6 for $E_p > 2.8$ MeV		cf. 12-g1		
13-27e4 diff.	G61 III	—	14.8 ± 0.8	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 157 \pm 15$ means for 10 angles between 0° and 150°		cf. 28-58d4		
$\text{Al}^{27}(n, p) \text{Mg}^{27} + \text{Al}^{27}(n, pn + n, np + n, d) \text{Mg}^{26}$								
13-27g1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 34 \pm 6$ means for $0 = 30^\circ,$ $45^\circ, 60^\circ, 90^\circ, 120^\circ,$ $135^\circ, 150^\circ$ and $E_p > 6$ MeV		cf. 12-g1		
13-27g2 diff.	H57	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 79 \pm 16$ abs. : recoil-protons in a nuclear plate	Nuclear plates cyl. arran- ged around the target	Estimated total error	Al-foils; thickness 7.1 mg/cm ²	

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Al}^{27}(n, t) \text{Na}^{23}$								
13-27 <i>i</i> 1	P62	—	14.7	< 0.02	—	—	—	—
$\text{Al}^{27}(n, z) \text{Na}^{24}$								
13-27 <i>i</i> 1	P53	15 <i>h</i>	14.5 ± 0.35	78.9 ± 16	cf. 7-1- <i>ta</i> 1	—	—	—
13-27 <i>i</i> 2	F52	15 <i>h</i>	14.1	135 ± 9.5	cf. 13-27 <i>b</i> 2	—	—	—
13-27 <i>i</i> 3	Y57	15.1 <i>h</i>	14.1 ± 0.15	120 ± 14	cf. 13-27 <i>b</i> 3	—	—	—
13-27 <i>i</i> 4	P59 I	$15.00 \pm 0.06 h^{*1}$	14.8 ± 0.8	114 ± 7	cf. 13-27 <i>b</i> 4	—	—	—
13-27 <i>i</i> 5	M60	—	—	cf. 13-27 <i>b</i> 6*2	—	—	—	—
13-27 <i>i</i> 6	K59 II	15.0 <i>h</i>	14.3 ± 0.5	111 ± 9	cf. 13-27 <i>b</i> 7	—	—	—
13-27 <i>i</i> 7	K59 III	—	$14.2 \pm 0.4^{*3}$	113 ± 16	rel. : cf. 3- <i>hh</i> 4	γ -activity, $3'' \times 3''$ NaI	Deviation contains :	Powder, $3/4'' Z$, $1/2''$
			14.7 ± 0.4	120 ± 16	$\text{Li}^6(n, t) \text{He}^4 = 28.1 \text{ mb}$	well-crystal with a hole of	neutron-flux : $\sim 7 \text{ } \mu\text{A}$	height
			14.7 ± 0.4	113 ± 15	for $E_n = 14.2 \text{ MeV}$	$3/4'' \otimes$ and $2''$ depth.		
					Leaky-integrator	Calibration (total counts)	target position $\sim 3 \text{ } \mu\text{m}$	
						with standard sources	stat. error $\sim 3.5 \text{ } \mu\text{m}$	
							calibration $\sim 6.9 \text{ } \mu\text{m}$	
13-27 <i>i</i> 8	S59 II	—	14.8*4	117 ± 8	rel. : U^{238} fiss. = ?	γ -activity, NaI crystal exp. calibrated	—	—
13-27 <i>i</i> 9	P61 IV	—	$13.88 \pm 0.10^{*5}$	128 ± 6.4	abs. : z-from	β -activity, 2π geometry	—	—
			14.09 ± 0.10	127 ± 6.4	$T(d, n) \text{He}^4$	Corrections for absolute		
			14.31 ± 0.13	124 ± 6.2		β -counting exp. determined		
			14.50 ± 0.20	120 ± 6.5		(cf. B59 I). Chemical		
			14.68 ± 0.26	118 ± 5.8		separation		
			14.81 ± 0.31	115 ± 5.8				
			14.93 ± 0.36	113 ± 5.7				

*1 Measured by the authors

*2 Also measured for $12 \text{ MeV} \leq E_n \leq 21 \text{ MeV}$

*3 Also measured for $13.0 \text{ MeV} \leq E_n \leq 15.7 \text{ MeV}$

*4 Also measured for $6.2 \text{ MeV} \leq E_n \leq 8.3 \text{ MeV}$

*5 Also measured for 7 MeV and $12.1 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27i10	G58	—	14.1 ± 0.04	116 ± 5.3	abs. : α from $T(dn) \text{He}^4$	β -activity, 2π and 4π geo-metry : corrections for abs. β -counting exp. de- terminated (cf. B59 I)	Estimated total error	Element
13-27i11	K57	—	14.8	82 ± 16	abs. : α from $T(d, n) \text{He}^4$	Nuclear plate. Al- foils between the plates. Sep-a- ration of ρ and α by the « temperature method » (cf. D51). Separation of n, α -; $n, n\alpha$ -and n, xn -processes	Estimated total error	Al foils of 1.8 mg/cm^2 thickness
13-27i12	D60 II	—	14.5 ± 0.4	116 ± 9	rel. : cf. 29-63a3 $\text{Cu}^{63}(n, 2n) = 556 \text{ mb}$ Sandwich-method	β -activity, prop. counter	—	Thickness : 27 mg/ cm^2
13-27i13	I61	—	No measurement for* ¹ $14 \text{ MeV} \leq E_n \leq 15 \text{ MeV}$			cf. 12-24b6		
13-27i14	S62	—	14.6 ± 0.2 — 0.3	115 ± 2		cf. 37-87a1		
13-27i15	T60	—	13.9* ² 14.0 14.1 14.6 15.1	95 89 87 107 93	—	—	—	—
13-27i16	G61 IV	—	14 14.4 14.5 14.7 14.8	124 ± 6 116 ± 3 118 ± 5 115 ± 6 109 ± 3	—	—	—	—
$\text{Al}^{27}(n, \alpha) \text{Na}^{24m}$								
13-27ilm	G59 I	20 msec	14.5	40 ± 20		cf. 12-24b1m		

*¹ Measured for $12.6 \text{ MeV} \leq E_n \leq 18 \text{ MeV}$

*² Also measured for $8.2 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
S I L I C O N								
$\text{Si}^{28}(n, p) \text{ Al}^{28}$								
14-28b1	P53	2.4 min	14.5 \pm 0.35	220 \pm 50			cf. 7-14a1	
14-28b2	K59 III	—	14.0 \pm 0.4* ¹ 14.2 \pm 0.4 14.7 \pm 0.4 15.0 \pm 0.4	440 \pm 57 365 \pm 29 340 \pm 37 303 \pm 30			cf. 13-27i7	
14-28b3	C56	—		cf. 12-24b8* ²				
14-28b4	F58 II	—	14	\sim 380	—	—	—	—
$\text{Si}^{28}(n, p) \text{ Al}^{28} + \text{Si}^{28}(n, pn) \text{ Al}^{27}$								
14-28d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 243 \pm 22 b) 246 \pm 22			cf. 11-23d1	
$\text{Si}^{28}(n, np) \text{ Al}^{27}$								
14-28e1	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 27 \pm 20			cf. 11-23d1	
$\text{Si}^{29}(n, p) \text{ Al}^{29}$								
14-29b1	P53	6.7 min	14.5 \pm 0.35	101 \pm 30			cf. 7-14a1	
$\text{Si}^{29}(n, 2p) \text{ Mg}^{28}$								
14-29h1	B62 II	21.3 h	14.7	≤ 0.50	—	—	—	—

*¹ Also measured for 12.33 MeV $\leq E_n \leq$ 18.24 MeV

*² Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Si}^{30}(n, \alpha) \text{Mg}^{27}$								
14-30i1	P53	10 min		14.5 \pm 0.35	45.9 \pm 25		cf. 7-14a1	
$\text{Si}^{nat}(n, p + n, pn) \text{Al}$								
14-d1 diff.	II62 III	—		14.4 \pm 0.2	160 \pm 16 for $E_p \sim 2.9 \text{ MeV}$		cf. 12-d1	

I	II	III	IV	V	VI	VII	VIII	IX
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P H O S P H O R U S

$P^{31}(n, 2n) P^{30}$

15-31a1	R58 II	2.4 min	14	11.9		cf. 7-14a2
15-31a2	F60	—	$14.74 \pm 0.27^{*1}$	8.7 ± 2.7		cf. 7-14a3
15-31a3	R61 II	2.53 ± 0.12 min ^{*2}	14.4 ± 0.3	10.9 ± 8.5		cf. 7-14a7
15-31a4	K62	2.55 min	14.8 ± 0.4	8.9 ± 1.2	rel. : cf. 29-63a $Cu^{63}(n, 2n) = 507$ mb Sandwich-method	γ -activity, measuring of Probable total error Powder the area under the photo- peak with a $3 \times 3''$ NaI crystal. Calibration with standard sources

$P^{31}(n, p) Si^{31}$

15-31b1	P53	2.7h	14.5 ± 0.35	64.2 ± 8.4	cf. 7-14a1
15-31b2	F52	170 min	14.1	91 ± 9	cf. 13-27b2
15-31b3	G58	2.65h	14.1 ± 0.04	85.5 ± 7	cf. 13-27i10
15-31b4	K62	2.65h	14.8 ± 0.4	82 ± 10	cf. 5-11b2

$P^{31}(n, p) Si^{31} + P^{31}(n, pn) Si^{30}$

15-31d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 184 ± 14 b) 114 ± 14	cf. 11-23d1
15-31d2 diff.	H62 III	—	14.4 ± 0.2	155 ± 16 for $E_p > 2.9$ MeV	cf. 12-d1

*1 Also measured for $12.5 \text{ MeV} \leq E_n \leq 18 \text{ MeV}$

*2 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$P^{31}(n, np) Si^{30}$								
15-31e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 163 ± 14		cf. 11-23d1		
15-31e2 diff.	H62 III	—	14.4 ± 0.2	70 ± 14 for $E_p > 2.9$ MeV		cf. 12-d1		
$P^{31}(n, d) Si^{30}$								
15-31f1 diff.	C60 II	—	14.5	14.5 ± 2.8	abs. : proton-recoil-telescope	Telescope ; 2 prop.-counters in coincidence with a CsI crystal and 1 prop. counter before the target in anticoine. to the other counters	—	—
$P^{31}(n, z) Al^{28}$								
15-31i1	P53	2.4 min	14.5 ± 0.35	146 ± 30		cf. 7-14a1		
15-31i2	K62	2.3 min	14.8 ± 0.4	153 ± 20		cf. 15-31a4		
15-31i3	G61 IV	—	$13.9 \pm 0.15^*$ 14.4 ± 0.12 14.9 ± 0.1	119 ± 5 117 ± 5 116 ± 5		cf. 12-24b10		

* Also measured for 13 MeV $\leq E_n \leq 16.6$ MeV

I

II

III

IV

V

VI

VII

VIII

IX

S U L P H U R

$$S^{32}(n, p) P^{32}$$

16-32b1	P53	<i>14d</i>	14.5 ± 0.35	369 ± 44		cf. 7-14 <i>a1</i>	Element
16-32b2	A57 I	<i>14.3d</i>	$13.89 \pm 0.025^*$	257 ± 13	rel. : $S^{32}(n, p) =$	β -activity, 4π geometry,	Probable error
			14.1 ± 0.04	248 ± 13	254 ± 10 mb for	prop. counter. Chemical	
			14.32 ± 0.16	231 ± 12	$E_n = 14.10 \pm 0.04$ MeV	separation	
			14.53 ± 0.26	225 ± 12	abs. : for $E_n = 14.10$ MeV		
			14.70 ± 0.29	220 ± 11	\propto from $T(d, n)$ He ⁴		
			14.83 ± 0.40	213 ± 11			
			14.93 ± 0.45	213 ± 11			
			14.95 ± 0.47	214 ± 11			

$$S^{32}(n, p) P^{32} + S^{32}(n, pn) P^{31}$$

16-32d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 365 ± 25 b) 289 ± 25		cf. 13-23 <i>d1</i>	
16-32d2 diff.	C60 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 109 \pm 10,$ means for $0 = 62^\circ,$ $75^\circ, 95^\circ, 138^\circ, 162^\circ$ and $d\theta = 10^\circ$		cf. 15-31 <i>f1</i>	
16-32d3 diff.	E59 III	—	14.1	185 ± 30 lower limit for $\sigma, E_p > 5$ MeV	abs. : proton recoil telescope	Telescope ; 2 prop. counters in coincidence with a CsI	Element 31 mg/cm ²

$$S^{32}(n, np) P^{31}$$

16-32e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ 105 ± 25		cf. 11-23 <i>d1</i>
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* Also measured for 1.59 MeV $\leq E_n \leq 14.95$ MeV

I	II	III	IV	V	VI	VII	VIII	IX
$S^{32}(n, d) P^{31}$								
16-32f1 diff.	C60 II	—	14.5	14 \pm 4.2		cf. 15-31f1		
$S^{32}(n, t) P^{30}$								
16-32h1	W62	—	14.7 \pm 0.3	0.020 \pm 0.005		cf. 29-63a11		
16-32h2	P62	—	14.7	< 0.02	—	Counting of the tritium in a low-background prop. counter	—	—
$S^{31}(n, p) P^{31}$								
16-34b1	P53	12.4 sec	14.5 \pm 0.35	85.2 \pm 38		cf. 7-14a1		
$S^{31}(n, z) Si^{31}$								
16-34i1	P53	2.7h	14.5 \pm 0.35	138 \pm 35		cf. 7-14a1		Element
16-34i2	A57 I	2.5 \pm 0.2 h	14.10 \pm 0.04	126 \pm 7	rel. : cf. 16-32b2 $S^a(n, p) = 254$ mb		cf. 16-32b2	
$S^{nat}(n, p + n, pn) P$								
16-d1 diff.	H62 III	—	14.4 \pm 0.2	206 \pm 21 for $E_p > 2.8$ MeV		cf. 12-d1		
$S^{nat}(n, np) P$								
16-e1 diff.	H62 III	—	14.4 \pm 0.2	73 \pm 15 for $E_p > 2.8$ MeV		cf. 12-d1		
$S^{nat}(n, z) Si$								
16-i1 diff.	K58 III	—	14.8	38.2 \pm 7.6	abs. : z from $T(d, n) He^4$	Nuclear plate : Separation of n, z : n, nz^- ; and $n, z n^-$ processes	Estimated total error	$S^{nat}, 2.54$ mg/cm ²

C H L O R I N E

$\text{Cl}^{35}(n, 2n) \text{ Cl}^{34m}$

17-35a1m	P53	33 min	14.5 ± 0.35	3.47 ± 1.56		cf. 7-14a1		
17-35a2m	S59 I	32.4 min	14.8 ± 0.8	5.6 ± 2		cf. 17-24b2		
17-35a3m	R59 I	37.7 min	14	5.3 ± 0.4	rel. : cf. 29-63a $\text{Cu}^{63}(n, 2n) = 500 \text{ mb}$	β^+ -activity; 0.511 MeV annihilation radiation measured in coincidence with 2 NaI scint. counters	No systematic errors	—
17-35a4m	R61 II	$31.2 \pm 0.6 \text{ min}^*$	14.4 ± 0.3	5.42 ± 0.41		cf. 7-14a7		
17-35a5m	K61 II	33 min	14.8 ± 0.5	12 ± 1.8	rel. : cf. 26-56b $\text{Fe}^{56}(n, p) = 126 \text{ mb}$ Sandwich method	β -activity, prop. counter. Corrections for abs. β -counting computed	Error contains : neutron flux 2-5 %, statistics 2-8 %, decay const. 1 %, γ -pulses 3 %	Powder 20 mg/ cm^2m , in tape of 9 mg/ cm^2m , Purity 99.9 %

$\text{Cl}^{35}(n, p) \text{ S}^{35} + \text{Cl}^{35}(n, pn) \text{ S}^{34}$

17-35d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 125 ± 38 b) 107 ± 38		cf. 11-23d1		
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$\text{Cl}^{35}(n, \alpha) \text{ P}^{32}$

17-35i1	P53	14d	14.5 ± 0.35	191 ± 30		cf. 7-14a1		
17-35i2	S59 I	14.5d	14.8 ± 0.8	199 ± 32		cf. 17-37b2		

$\text{Cl}^{37}(n, p) \text{ S}^{37}$

17-37b1	P53	5 min	14.5 ± 0.35	33.4 ± 7		cf. 7-14a1		NH ₄ Cl; NaCl; LiCl
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
17-37b2	S59 I	5 min	14.8 ± 0.8	25.4 ± 2.1	rel. : cf. 29-63a3 $\text{Cu}^{63}(n, 2n) = 556 \text{ mb}$	β -activity, plastic-scintilator or prop. counter. Scattering and absorption of the β in the target is supposed to be the same as in the Cu-monitor	—	C_6Cl_6 ; 9.5-12.7 cm o. thickness : $\sim 85 \text{ mg/cm}^2$
17-37b3	C56			cf. 12-24b8*				
					$\text{Cl}^{37}(n, \alpha) \text{ P}^{34}$			
17-37i1	P53	12.4 sec	14.5 ± 0.35	52.4 ± 25		cf. 7-14a1		
17-37i2	S59I	12.5 sec	14.8 ± 0.8	43.8 ± 7		cf. 17-37b2		

* Measured for $12.5 \text{ MeV} \leq E_n \leq 17.5 \text{ MeV}$

I

II

III

IV

V

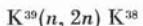
VI

VII

VIII

IX

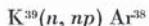
P O T A S S I U M



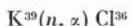
19-39a1	P53	7.7 min	14.5 ± 0.35	10 ± 5.5		cf. 7-14a1	KNO ₃
19-39a2	R58 II	7.7 min	14	3.8		cf. 7-14a2	
19-39a3	R61 II	7.7 \pm 0.5 min	14.4 ± 0.3	3.37 ± 0.27		cf. 7-14a7	
19-39a4	K61 II	7.7 min	14.8 ± 0.5	6 ± 0.9		cf. 17-35a5m	



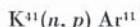
19-39d1	B60	—	14.1 ± 0.1	354 ± 53	rel.: KI(n, p) + KI(n, np) + KI(n, α) = 650 mb and KI(n, p) neglected (cf. 53- 127b1)	Total σ measured for all charged particles produced in the KI crystal. KI in coincidence with α from T(d, n) He ⁴ . Separation of α -, p -, and γ -pulses by pulse-shape-discrimination. Separation of n, p - and n, np - reactions by stat. theory	Stat. error	KI-crystal
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19-39e1	B60	—	14.1 ± 0.1	186 ± 27		cf. 19-39d1	
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19-39i1	B60	—	14.1 ± 0.1	84 ± 13	cf. 19-39d1	Instead of n, p ; n, np say n, α ; $n, n\alpha$
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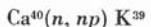
19-41b1	P53	110 min	14.5 ± 0.35	81.2 ± 32.5		cf. 7-14a1	KNO ₃
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I	II	III	IV	V	VI	VII	VIII	IX
$K^{41}(n, He^3) Cl^{39}$								
19-41 <i>f</i> 1	B62 II	55.5 min	14.7	< 2.5	—	—	—	—
$K^{41}(n, 2p) Cl^{40}$								
19-41 <i>h</i> 1	B62 II	1.4 min	14.7	< 0.090	—	—	—	—
$K^{41}(n, \alpha) Cl^{38}$								
19-41 <i>i</i> 1	P53	38 min	14.5 ± 0.35	31.4 ± 11		ef. 7-14 <i>a</i> 1		KNO ³
19-41 <i>i</i> 2	B60	38 min	14.1 ± 0.1	12 ± 13	rel. : cf. 53-127 <i>a</i> $1^{227}(n, 2n) = 1200$ mb	β -activity, KI-crystal served as target and 4 <i>π</i> counter	Stat. error	KI crystal

C A L C I U M



20-40d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 451 ± 38 b) 298 ± 38	cf. 11-23d1
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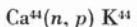
20-40e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ 205 ± 37	cf. 11-23d1
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20-40h1	W62	—	14.7 ± 0.3	< 0.1	cf. 29-63a11
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20-42b1	H62 I	$12.37 \pm 0.09 h^*$	14.9	140 ± 45	rel. : cf. 13-27i10 $\text{Al}^{27}(n, \alpha) = 116 \text{ mb}$	γ -activity, measuring of the area under the photo-peak with a $1 \times 1\frac{1}{2}''$ NaI crystal	Mean total error	CaCO_3
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20-44b2	H62 I	$22 \pm 0.3 \text{ min}^*$	14.9	25 ± 12	.	cf. 20-42b1
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
Ca ⁴⁴ (n, z) Ar ⁴¹								
20-44 <i>a</i> 1	H62 I	1.85 <i>h</i>	14.9	35 ± 10		ef. 20-42 <i>b</i> 1		
Ca ⁴⁸ (n, 2n) Ca ⁴⁷								
20-48 <i>a</i> 1	H62 I	—	14.9	1070 ± 360		ef. 20-42 <i>b</i> 1		

S C A N D I U M

$\text{Sc}^{45}(n, 2n) \text{ Sc}^{44g}$

21-45a1g	P61 I	3.92h	14.01 \pm 0.10 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26	138.5 \pm 5.2* ¹ 150.0 \pm 5.7 169.0 \pm 6.4 181.4 \pm 6.9 204.3 \pm 77	cf. 22-46a2
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21-45a2g	M61 II	—	14.8	179 \pm 27	cf. 11-23i2
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21-45a3g	R61 II	4.04 \pm 0.08* ²	14.4 \pm 0.3	198 \pm 15	cf. 7-14a7
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21-45a4g	K59 II	4.01h	14.3 \pm 0.5	129 \pm 9	cf. 13-27b7
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21-45a5g	K61 II	4.01h	14.8 \pm 0.5	148 \pm 22	cf. 17-35a5m
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$\text{Sc}^{45}(n, 2n) \text{ Sc}^{44m}$

21-45a1m	P61 I	2.44h	14.01 \pm 0.10 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26	107.4 \pm 3.5* ¹ 116.2 \pm 3.7 127.3 \pm 4.1 134.3 \pm 4.3 144.7 \pm 4.6	cf. 22-46a2
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21-45a2m	M61 II	—	14.8	149 \pm 22	cf. 11-23i2
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21-45a3m	R61 II	59.1 \pm 1.2h* ²	14.4 \pm 0.3	149 \pm 11	cf. 7-14a7
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Sc_2O_3

$\text{Sc}^{45}(n, 2n) \text{ Sc}^{44tot}$

21-45a1t	P61 I	—	14.01 \pm 0.10 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26	249.5 \pm 6.2* ¹ 266.2 \pm 6.7 296.3 \pm 7.7 315.7 \pm 8.2 349.0 \pm 9.1	cf. 22-46a2
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*¹ Also measured for 11.6 MeV $\leq E_n \leq$ 19.6 MeV

*² Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Sc}^{45}(n, p) \text{ Ca}^{45}$								
21-45 <i>b1</i>	P61 I	—	14.09 \pm 0.10 14.31 \pm 0.13 14.54 \pm 0.20 14.81 \pm 0.31	54 \pm 4 ^{*1} 55.5 \pm 4 57 \pm 4 49.5 \pm 4	—	cf. 22-46 <i>a2</i>	—	—
21-45 <i>f1</i>	B62 II	22 <i>h</i>	14.7	< 0.30	—	—	—	—
$\text{Sc}^{45}(n, \text{He}^3) \text{ K}^{43}$								
21-45 <i>h1</i>	B62 II	22 min	14.7	< 0.21	—	—	—	—
$\text{Sc}^{45}(n, 2p) \text{ K}^{44}$								
21-45 <i>i1</i>	K59 II	12.4 <i>h</i>	14.3 \pm 0.5	132 \pm 8	—	cf. 13-27 <i>b7</i>	—	—
21-45 <i>i2</i>	M61 II	—	14.8	63 \pm 9.5	—	cf. 11-23 <i>i2</i>	—	—
21-45 <i>i3</i>	P61 I	—	14.09 \pm 0.10 ^{*2} 14.31 \pm 0.13 14.50 \pm 0.20 14.81 \pm 0.31	55 \pm 2.7 55 \pm 2.7 56.3 \pm 2.8 53.5 \pm 2.7	—	cf. 22-46 <i>a2</i>	—	—

^{*1} Also measured for 13.4 MeV $\leq E_n \leq$ 14.8 MeV

^{*2} Also measured for 8 MeV $\leq E_n \leq$ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
TITANIUM								
$Ti^{46}(n, 2n) Ti^{45}$								
22-46a1	R58 II	2.9h	14	27.9		cf. 7-14a2	—	—
22-46a2	P61 I	3.09	$13.88 \pm 0.10^{*2}$	7.0 ± 1	rel. : cf. 13-27i9	β -activity, 2π geometry. Corrections for absolute β -counting exp. determined (cf. B59 I). Measuring of the activity after chem. separation	—	—
			14.09 ± 0.10	13 ± 3				
			14.50 ± 0.20	28.0 ± 3				
			14.93 ± 0.36	44.5 ± 3				
22-46a3	P59 I	$3.06 \pm 0.08h^{*2}$	14.8 ± 0.8	50.4 ± 8.1		cf. 13-27b4		Element, discs, 2.1 cm \otimes thickness 3 mg/cm ²
22-46a4	R61 II	$2.91 \pm 0.06h^{*2}$	14.4 ± 0.3	31.8 ± 2.4		cf. 7-14a7		
$Ti^{46}(n, p) Sc^{46}$								
22-46b1	P59 I	$85 \pm 2d^{*2}$	14.8 ± 0.8	~ 520		cf. 13-27b4		Element, nat., discs 1.7-2.1 cm \otimes 8 mg/ μ cm ² thickness. TiO_2 powder enriched : $Ti^{46}(86.6 \text{ \%})$, Ti^{49} (81.1 %), $Ti^{50}(84.69 \text{ \%})$
22-46b2	R62	—	—	~ 240	—	—	—	—
$Ti^{46}(n, p) Sc^{46} + Ti^{46}(n, pn) Sc^{45}$								
22-46d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$		cf. 11-23d1		
				a) 203 ± 20				
				b) 196 ± 20				

*1 Also measured for $13.4 \text{ MeV} \leq E_\eta \leq 19.5 \text{ MeV}$

^{**} Measured by the authors.

I	II	III	IV	V	VI	VII	VIII	IX
Ti ⁴⁷ (n, p) Sc ⁴⁷								
22-47b1	P59 I	3.45 ± 0.06d*1	14.8 ± 0.8	230 ± 39		cf. 13-27b4		cf. 22-46b1
22-47b2	R62	—	—	170	—	—	—	—
Ti ⁴⁷ (n, p) Sc ⁴⁷ + Ti ⁴⁷ (n, pn) Sc ⁴⁶								
22-47d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 112 ± 16 b) 111 ± 16		cf. 11-23d1		
Ti ⁴⁸ (n, p) Sc ⁴⁸								
22-48b1	P53	1.8d	14.5 ± 0.35	92.7 ± 32.4		cf. 7-14a1	TiHx	
22-48b2	P59 I	14.0 ± 0.9h*1	14.8 ± 0.8	58 ± 6.7		cf. 13-27b4		cf. 22-46b1
22-48b3	G61IV	—	13.9** ² 14.4 ± 0.15 15	66 ± 2 66 ± 3 65 ± 3		cf. 12-24b10		
Ti ⁴⁸ (n, p) Sc ⁴⁸ + Ti ⁴⁸ (n, pn) Sc ⁴⁷								
22-48d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 29 ± 8 b) 29 ± 8		cf. 11-23d1		
Ti ⁴⁹ (n, p) Sc ⁴⁹								
22-49b1	P59 I	58 ± 2 min*1	14.8 ± 0.8	29 ± 5		cf. 13-27b4		cf. 22-46b1
22-49b2	K59 II	56.3 min	14.3 ± 0.5	97 ± 17		cf. 13-27b7		

*¹ Measured by the authors

*² Also measured for $12.7 \leq E_n \leq 17$ MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\mathrm{Ti}^{50}(n, p) \mathrm{Sc}^{50}$ I								
22-50b1 I	P59 I	1.80 ± 0.20 min*	14.8 ± 0.8	27 ± 6		cf. 13-27b4		cf. 22-46b1
22-50b2 I	K59 II	1.55 min	14.3 ± 0.5	147 ± 13		cf. 13-27b7		
$\mathrm{Ti}^{50}(n, p) \mathrm{Sc}^{50}$ II								
22-50b1 II	P59 I	22 ± 0.3 min*	14.8 ± 0.8	48 ± 15		cf. 13-27b4		cf. 22-46b1
$\mathrm{Ti}^{50}(n, 2p) \mathrm{Ca}^{49}$								
22-50h1	B62 II	8.8 min	14.7	< 0.10	—	—	—	—
$\mathrm{Ti}^{nat}(n, p + n, pn) \mathrm{Sc}$								
22-d1 diff.	H62 III	—	14.4 ± 0.2	35 ± 4 for $E_p > 3.7$ MeV		cf. 12-d1		

* Measured by the authors

I

II

III

IV

V

VI

VII

VIII

IX

V A N A D I U M

$$V^{51}(n, 2n) V^{50}$$

23-51a1	A58 I	—	14.1	660 ± 50	cf. 1-2a1	Element
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$$V^{51}(n, p) Ti^{51}$$

23-51b1	P53	6 min	14.5 ± 0.35	27 ± 4	cf. 7-14a1	V ₂ O
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23-51b2	P61 IV	—	14.8	53 ± 5	—	—
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$$V^{51}(n, p) Ti^{51} + V^{51}(n, pn) Ti^{50}$$

23-51d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{12.5^\circ} =$ a) 20 ± 7.0 b) 23 ± 7.0	cf. 11-23d1	
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$$V^{51}(n, He^3) Sc^{49}$$

23-51f1	B62 II	57 min	14.7	< 0.33	—	—
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$$V^{51}(n, 2p) Sc^{50}$$

23-51h1	B62 II	1.7 min	14.7	< 0.30	—	—
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$$V^{51}(n, \alpha) Sc^{48}$$

23-51i1	P53	1.8d	14.5 ± 0.35	28.6 ± 7.8	cf. 7-14a1	
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23-51i2	K58 III	—	14.8	43.2 ± 8.5	cf. 16-i1	Element,
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23-51i3	B61 III	44h	14.4 ± 0.3	43 ± 3	cf. 29-65a8	2.54 mg/cm^2
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I	II	III	IV	V	VI	VII	VIII	IX
$V^{51}(n, nz) Sc^{47}$								
23-51k1	B62 I	81-4 <i>h</i>	14.1 \pm 0.1* ¹	3 \pm 2	ref. : cf. 13-27 <i>i</i> $Al^{27}(n, z) = 118$ mb	cf. 29-65 <i>aB</i>	V_2O_3 powder	
23-51k2	B62 II	3.4 <i>d</i>	14.7	< 5	—	—	—	—

*¹ Also measured from threshold to 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
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C H R O M I U M

$\text{Cr}^{50}(n, 2n) \text{ Cr}^{49}$

24-50a1	R58 II	38.5 min	14	25.4		cf. 7-14a2		
24-50a2	M61 II	—	14.8	32 ± 3		cf. 11-23i2		
24-50a3	R61 II	38.5 ± 1.5 min*	14.4 ± 0.3	26.4 ± 2.2		cf. 7-14a7		Element
24-50a4	K61 II	41.6 min	14.8 ± 0.5	27 ± 6.8		cf. 17-35a5m		

$\text{Cr}^{50}(n, p) \text{ V}^{50} + \text{Cr}^{50}(n, pn) \text{ V}^{49}$

24-50d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 265 ± 21 b) 277 ± 20		cf. 11-23d1		
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$\text{Cr}^{50}(n, np) \text{ V}^{49}$

24-50e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ 153 ± 21		cf. 11-23d1		
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$\text{Cr}^{52}(n, 2n) \text{ Cr}^{51}$

24-52a1	W61 I	—	15.0	280 ± 50	rel.: cf. 13-27i10 $\text{Al}^{27}(n, \alpha) = 116$ mb	γ -activity. Measuring of the area under the photo-peak and K-electron capture	Total error	—
24-52a2	H62 I	—	14.9	280 ± 50		cf. 20-48a1		

$\text{Cr}^{52}(n, p) \text{ V}^{52}$

24-52b1	P53	3.9 min	14.5 ± 0.35	77.7 ± 11		cf. 7-14a1		
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
24-52b2	K59 III	—	$14.0 \pm 0.4^*$	133 ± 15		cf. 13-27i7		
			14.2 ± 0.4	109 ± 13				
			14.5 ± 0.4	106 ± 10				
			14.7 ± 0.4	113 ± 12				
			15.0 ± 0.4	114 ± 11				
			15.0 ± 0.4	101 ± 10				
24-52b3	M61 II	—	14.8	105 ± 10		cf. 11-23i2		
24-52b4	F58 II	—	—	~ 103	—	—	—	—
24-52b5	C61 II	—	—	83 ± 10	—	—	—	—
$\text{Cr}^{52}(n, p) \text{ V}^{52} + \text{Cr}^{52}(n, pn) \text{ V}^{51}$								
24-52d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 74 ± 10 b) 67 ± 10		cf. 11-23d1		
$\text{Cr}^{53}(n, p) \text{ V}^{53}$								
24-53b1	C61 II	—	14.8	37 ± 4	—	—	—	—
$\text{Cr}^{53}(n, p) \text{ V}^{53} + \text{Cr}^{53}(n, pn) \text{ V}^{52}$								
24-53d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 44 ± 6.6 b) 48 ± 7.2		cf. 11-23d1		

* Also measured for $12.33 \text{ MeV} \leq E_n \leq 18.24 \text{ MeV}$

I

II

III

IV

V

VI

VII

VIII

IX

M A N G A N E S E

$\text{Mn}^{55}(n, 2n) \text{ Mn}^{54}$

25-55 <i>a1</i>	W61 I	—	14.1	600 ± 120	cf. 24-51 <i>a1</i>
25-55 <i>a2</i>	W60 II	291 <i>d</i>	14.5 ± 0.5	825 ± 190	cf. 29-65 <i>a10</i>
25-55 <i>a3</i>	H62 I	—	14.1	600 ± 120	cf. 20-48 <i>a1</i>

$\text{Mn}^{55}(n, p) \text{ Cr}^{55} + \text{Mn}^{55}(n, pn) \text{ Cr}^{54}$

25-55 <i>d1</i> diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 43 ± 7 b) 45 ± 7	cf. 11-23 <i>d1</i>
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$\text{Mn}^{55}(n, \text{He}^3) \text{ V}^{53}$

25-55 <i>f1</i>	B62 II	1.7 min	14.7	< 0.42	—	—	—	—
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$\text{Mn}^{55}(n, p + n, pn + n, np + n, d) \text{ Cr}$

25-55 <i>g1</i>	A58 III	—	14	110 ± 15	rel. : cf. 28- <i>b, d</i> $\text{Ni}^{nat}(n, p) = 440 \text{ mb}$	Nuclear plate	—	12 mg/cm ² thickness
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$\text{Mn}^{55}(n, 2p) \text{ V}^{54}$

25-55 <i>h1</i>	B62 II	55 sec	14.7	< 0.36	—	—	—	—
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$\text{Mn}^{55}(n, \chi) \text{ V}^{52}$

25-55 <i>i1</i>	P53	3.9 min	14.5 ± 0.35	52.5 ± 7.9	cf. 7-14 <i>a1</i>	MnO ₂
25-55 <i>i2</i>	K58 III	—	14.8	39.4 ± 8	cf. 16- <i>i1</i>	3.3 mg/cm ² thickness

I	II	III	IV	V	VI	VII	VIII	IX
25-55 <i>i</i> 3	G61 IV	—	14.3 \pm 0.1*	31 \pm 2	—	—	—	—
			14.7 \pm 0.2	33 \pm 3				
			14.9 \pm 0.2	34 \pm 2				
25-55 <i>i</i> 4	F61 I	—	14.8	11.8 \pm 0.7	—	—	—	—

* Also measured for $12.4 \text{ MeV} \leq E_\eta \leq 17.7 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
IRON								
Fe⁵⁴(n, 2n) Fe⁵³								
26-54a1	R58 II	9.8 min	14	16.7		cf. 7-14a2		
26-54a2	P61 III	8.3 ± 0.5 min*	14.1 ± 0.1	11 ± 2		cf. 13-27b8	Element	
26-54a3	C61 I	8.4 ± 0.4 min*	14.8 ± 0.9	7.9 ± 0.8		cf. 27-59a1g	Fe ₂ ⁵⁴ O ₃ enriched (99.6 %) thickness 10-55 mg/ cm ²	
26-54a4	D60 II	—	15 ± 0.4	~7		cf. 26-56b11	thickness ~27 mg/ cm ²	
26-54a5	R61 II	8.80 ± 0.24 min*	14.4 ± 0.3	15.0 ± 1.3		cf. 7-14a7	Element	
Fe⁵⁴(n, p) Mn⁵⁴								
26-54b1	P61 III	260 ± 15d*	14.1 ± 0.1	254 ± 28		cf. 13-27b8	Element	
Fe⁵⁴(n, p) Mn⁵⁴ + Fe⁵⁴(n, pn) Mn⁵³								
26-54d1	A57 II	—	14.1	460 ± 92		cf. 13-27d1	Fe ⁵⁴ enriched, thick- ness 5-12 mg/cm ²	
26-54d2 diff.	A59	—	14.1	a) $4 \frac{d\sigma}{d\Omega} = 395$ for $d\Omega = 90^\circ - 180^\circ$ b) $2 \frac{d\sigma}{d\Omega} = 415$ for $d\Omega = 0^\circ - 180^\circ$	abs. : α-from T(d, n) He ⁴	Shielded nuclear plate surrounded by several targets arranged on a cir- cle. Separation of n,p- and n,np-processes by stat. theory	—	Fe ⁵⁴ enriched : ~88.4 %; thickness 27 mg/cm ²
26-54d3 diff.	A61 I	—	14.1	4π $\left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 382 ± 13 b) 382 ± 13		cf. 11-23d1		

* Measured by the authors

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Fe}^{56}(n, p) \text{ Mn}^{56}$								
26-56b1	P53	<i>2.6h</i>	14.5 ± 0.35	96.7 ± 11.6		cf. 7-14 <i>a1</i>		Element
26-56b2	F52	<i>2.59h</i>	14.1	124 ± 12		cf. 13-27 <i>b2</i>		
26-56b3	Y57	<i>2.57h</i>	14.1 ± 0.15	144 ± 19		cf. 26-56 <i>b3</i>		
26-56b4	P61 III	$2.58 \pm 0.03h^{*1}$	14.1 ± 0.1	112.5 ± 5.6		cf. 13-27 <i>b8</i>		
26-56b5	C61 I	$2.56 \pm 0.11h^{*1}$	14.8 ± 0.9	128 ± 13		cf. 27-29 <i>a1g</i>		Element-nat. Fe_2O_3 enriched : $\text{Fe}^{54}(78.4\%)$ $\text{Fe}^{57}(76.7\%)$ thickness 10-25 mg/ cm^2
26-56b6	C55	—	14	72 ± 7	—	Activation	—	—
26-56b7	D60 II	—	15 ± 0.4	128 ± 13	rel. : cf. 29-63 <i>a3</i> $\text{Cu}^{63}(n, 2n) = 556 \text{ mb}$ Sandwich-method	β -activity, prop. counter, nearly 2π geometry	—	Foils of 1.8 cm^2 , thickness 27 mg/ cm^2
26-56b8	K59 III	—	15.27 ± 0.33	131 ± 15		cf. 13-27 <i>i7</i>		
26-56b9	T58	Rel. measurement. Experimental* ² curve was fitted by $\sigma = 110 \pm 10 \text{ mb}$ for $E_n = 14.3 \text{ MeV}$				β -activity, geiger counter	—	Fe nat 10" long $\frac{1}{2}''\varnothing$
26-56b10	B62 I	Rel. measurement. Experimental curve* ³ was fitted by $\sigma = 112.5 \text{ mb}$ for $E_n = 14.1 \text{ MeV}$ cf. 26-56 <i>b4</i>				cf. 13-27 <i>b8</i>		
$\text{Fe}^{56}(n, p) \text{ Mn}^{56} + \text{Fe}^{56}(n, pn) \text{ Mn}^{55}$								
26-56d1	A57 II	—	14.1	190 ± 38		cf. 13-27 <i>d1</i>		
26-56d2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ a) 82 ± 7.3 b) 86 ± 7		cf. 11-23 <i>d1</i>		

*¹ Measured by the authors

*² Measured for $3.4 \text{ MeV} \leq E_n \leq 8.2 \text{ MeV}$ and $12.4 \text{ MeV} \leq E_n \leq 17.9 \text{ MeV}$

*³ Measured for $13 \text{ MeV} \leq E_n \leq 19 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
26-56d3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 90 \pm 18$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27d3		
26-56d4 diff.	A58 I	—	13.5 ± 0.1	75 for isotr. part 95 for total		cf. 26-54d5	Fe ⁵⁶ enriched : 99.9 %, thickness 4.5 mg/cm ²	

$$\text{Fe}^{56}(n, np) \text{ Mn}^{55}$$

$$26\text{-}56eV \text{ diff.} \quad A61 \quad - \quad 14.1 \quad 4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} = \\ 35 + \dots \quad \text{cf. 11-23d1}$$

$$\text{Fe}^{57}(n, p) \text{ Mn}^{57}$$

26-57b1	P61 III	1.4 ± 0.2 min*	14.1 ± 0.1	50 ± 8	cf. 13-27b8	
26-57b2	C61 I	1.5 ± 0.1 min*	14.8 ± 0.9	71 ± 7	cf. 27-59a1g	cf. 26-56b5

$$\text{Fe}^{57}(n, pn \pm n, np \pm n, d) \text{Mn}^{56}$$

cf. 26-56b5

$$\text{Fe}^{58}(n, p) \text{Mn}^{58}$$

26-58b1 C61 I 1.1 ± 0.1 min* 14.8 ± 0.9 23 ± 3.5 cf. 27-59a1g cf. 26-56b5

$$\text{Fe}^{58}(n, \gamma) \text{ Cr}^{55}$$

26-58cl C61 I 3.5 ± 0.1 min* 14.8 ± 0.9 21.5 ± 2 cf. 27-59a lg cf. 26-56b5

$\text{Fe}^{nat}(n, 2n)$

26-a1 A58 II — 14.1 500 \pm 40 cf. 1-2a1

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
26-d1 diff.	H62 III	—	14.4 \pm 0.2	102 \pm 10 for $E_p > 2.8$ MeV		cf. 12-d1		
26-g1 diff.	V57	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 90 \pm 15$ means for $\theta = 30^\circ, 45^\circ, 60^\circ, 90^\circ, 120^\circ,$ $135^\circ, 150^\circ$, and $E_p >$ 6 MeV		cf. 12-g1		

I	II	III	IV	V	VI	VII	VIII	IX
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C O B A L T

$\text{Co}^{59}(n, 2n) \text{ Co}^{58}$ - tot.

27-59a1t	W60 II	—	14.5 ± 0.5	855 ± 190		cf. 29-65a10		
27-59a2t	B61 III	$70 \pm 2d^{*1}$ for Co^{58g}	$14.4 \pm 0.3^{*2}$	640 ± 64		cf. 29-65a8		CoO
27-59a3t	H61 I	—	14.1	630 ± 126		cf. 20-48a1		
27-59a4t	G61 IV	—	$14.25 \pm 0.05^{*3}$	870 ± 130	—	—	—	—
			14.5 ± 0.1	930 ± 100				
			14.75 ± 0.1	1020 ± 120				
			15 ± 0.15	970 ± 100				
27-59a5t	W62	$71.4d$ for Co^{58g}	13.86 ± 0.10	727 ± 58		cf. 29-63a11		
			14.11 ± 0.10	776 ± 62				
			14.37 ± 0.15	767 ± 61				
			14.59 ± 0.20	823 ± 66				
			14.77 ± 0.25	827 ± 66				

$\text{Co}^{59}(n, 2n) \text{ Co}^{58g}$

27-59a1g	P60 I	72d	14.8 ± 0.9	145 ± 5	rel. : cf. 29-65a $\text{Cu}^{63}(n, 2n) = 1000$ mb ; cf. 13-27i : $\text{Al}^{27}(n, \alpha) =$ 115 mb ; cf. 29-63a3 : Cu^{63} $(n, 2n) = 556$ mb Sandwich method	β - and γ -activity a) β -activity : cf. 13-27b4 b) γ -activity : $1 \times 1.5''$ NaI crystal Corrections for abs. γ -counting cf. B55 I Chemical separation	cf. 13-27b4	Element, discs, thickness : $3\text{-}35$ mg/cm ²
27-59a2g	W60 II	71d	14.5 ± 0.5	473 ± 120		cf. 29-65a1		

*1 Measured by the authors

*2 Also measured for $12.6 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

*3 Also measured for $12.6 \text{ MeV} \leq E_n \leq 17.1 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Co}^{59}(n, 2n) \text{ Co}^{58m}$								
27-59a1m	P60 I	9.0 \pm 0.2h* ¹	14.8 \pm 0.9	4 \pm 2			ef. 27-59a1g	
27-59a2m	B62 I	9h	14.5 \pm 0.5* ²	385 \pm 100			ef. 29-65a8	
$\text{Co}^{59}(n, p) \text{ Fe}^{59}$								
27-59b1	P60 I	45d	14.8 \pm 0.9	82 \pm 8			ef. 27-59a1g	
27-59b2	W60 II	—	14.5 \pm 0.5	80 \pm 23			ef. 29-65a10	
$\text{Co}^{59}(n, p) \text{ Fe}^{59} + \text{Co}^{59}(n, pn) \text{ Fe}^{58}$								
27-59d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 81 \pm 10 b) 61 \pm 10			ef. 11-23d1	
27-59d2 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 75 \pm 15$ for $d\Omega = 0^\circ - 180^\circ$			ef. 13-27d3	
27-59d3 diff.	H62 III	—	14.4 \pm 0.2	48 \pm 5 for $E_p > 3 \text{ MeV}$			ef. 12-d1	
$\text{Co}^{59}(n, np) \text{ Fe}^{58}$								
27-59e1 diff.	H62 III	—	14.4 \pm 0.2	\sim 11 for $E_p > 3 \text{ MeV}$			ef. 12-d1	
$\text{Co}^{59}(n, \text{He}^3) \text{ Mn}^{57}$								
27-59f1	B62 II	1.7 min	14.7	< 0.10	—	—	—	—

*¹ Measured by the authors

*² Also measured for $12.6 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Co}^{59}(n, \gamma) \text{Mn}^{56}$								
27-59 <i>i</i> 1	P53	$2.6h$	14.5 ± 0.35	39.1 ± 7.5		cf. 7-14 <i>a</i> 1		
27-59 <i>i</i> 2	P60 I	$2.57 \pm 0.02h^{*1}$	14.8 ± 0.9	30 ± 3		cf. 27-59 <i>a</i> 1 <i>g</i>		
27-59 <i>i</i> 3	B58	$2.59h$	14.05 ± 0.55	31 ± 3	rel. : cf. 26-56 <i>b</i> $\text{Fe}^{56}(n, p) = 110 \text{ mb}$ Sandwich-method	β -activity, prop.-counter. Corrections for abs. β -counting : cf. N52, J50. Chemical separation	Estimated total error	Powder $3/4'' \times 1 1/2''$ thickness : $3/4$ -1 mg/ cm^2
27-59 <i>i</i> 4	K58 III	—	14.8	25 ± 5		cf. 16- <i>i</i> 1		
27-59 <i>i</i> 5	W60 II	$2.58h$	14.5 ± 0.5	29 ± 6		cf. 29-65 <i>a</i> 10		
27-59 <i>i</i> 6	G61 IV	—	14.3^{*2} 15.0	36 ± 4 30 ± 4	—	—	—	—
27-59 <i>i</i> 7	B61 III	$2.57h$	$14.4 \pm 0.3^{*3}$	29 ± 3		cf. 29-65 <i>a</i> 8		

*1 Measured by the authors

*2 Also measured for $12.6 \text{ MeV} \leq E_n \leq 17.1 \text{ MeV}$

*3 Also measured for $12.6 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

N I C K E L

Ni⁵⁸(n, 2n) Ni⁵⁷

28-58a1	P53	36h	14.5 ± 0.35	40.6 ± 12		cf. 7-14a1	
28-58a2	P61 I	$37 \pm 1 h^{*1}$	14.8 ± 0.8	52 ± 2.6		cf. 27-59a1g	Element, Ni ⁵⁸ enriched: 99.63% ; thickness : 3-5 mg/cm ²
28-58a3	R59 I	44h	14	33.4 ± 2.7		cf. 17-35a3m	
28-58a4	P59 II	36h	14.1	38.8 ± 8.2	rel. : cf. 29-65a Cu ⁶⁵ (n, 2n) = ?	β^+ activity; 0.511 MeV annihilation radiation measured in coinc. with 2 scintillation-counters. Calibration with Na ²²	Neutron-flux : 7 %, Element, nat. calibration : 12 %
28-58a5	P61 I	36h	$13.88 \pm 0.10^{*2}$ 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.81 ± 0.31	21.4 ± 1.1 23.5 ± 1.3 31.1 ± 1.6 34.3 ± 1.7 39.3 ± 2.0		cf. 22-46a2	
28-58a6	R61 II	$43.7 \pm 0.9 h^{*1}$	14.4 ± 0.3	34.2 ± 2.6		cf. 7-14a7	
28-58a7	G62	37h	13.86 ± 0.10 14.11 ± 0.10 14.24 ± 0.10 14.37 ± 0.15 14.49 ± 0.20 14.59 ± 0.20 14.69 ± 0.25 14.77 ± 0.25 14.88 ± 0.30	18.7 ± 1.5 22.9 ± 1.8 27.2 ± 2.2 29.3 ± 2.3 31.7 ± 2.5 33.5 ± 2.7 35.9 ± 2.9 36.2 ± 2.9 39.5 ± 3.2		cf. 29-63a11	

*1 Measured by the authors

*2 Also measured from 12.2 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
28-58a8	M52		Only relative measurement* ¹			β -activity : geiger-counter	—	—
					$\text{Ni}^{58}(n, p) \text{ Co}^{58}$			
28-58b1	P59 II	—	14.1	560 ± 110		cf. 28-58a4		
					$\text{Ni}^{58}(n, p) \text{ Co}^{58g}$			
28-58b1g	P60 I	72d	14.8 ± 0.9	237 ± 20		cf. 27-59a1g		
						NiO powder enriched : $\text{Ni}^{51}(83.1\%)$; $\text{Ni}^{52}(97.8\%)$; $\text{Ni}^{54}(95.9\%)$		
						Element, powder enriched : $\text{Ni}^{60}(99.1\%)$		
						Element, foils enriched : $\text{Ni}^{58}(99.6\%)$		
						Thickness 3-35 mg/cm ²		
28-58b2g	G62	71.4d	13.86 ± 0.10	436 ± 35		cf. 29-63a11		
			14.11 ± 0.10	435 ± 35				
			14.24 ± 0.10	437 ± 35				
			14.37 ± 0.15	424 ± 34				
			14.49 ± 0.20	401 ± 32				
			14.59 ± 0.20	385 ± 31				
			14.69 ± 0.25	363 ± 29				
			14.77 ± 0.25	355 ± 28				
			14.88 ± 0.30	333 ± 27				
					$\text{Ni}^{58}(n, p) \text{ Co}^{58m}$			
28-58b1m	P60 I	$9.0 \pm 0.2h^{**}$	14.8 ± 0.9	40 ± 15		cf. 27-59a1g		cf. 28-58b1g
					$\text{Ni}^{58}(n, pn + n, np + n, d) \text{ Co}^{57}$			
28-58c1	P59 II	270d	14.1	160 ± 40		cf. 28-58a4		

*¹ Measured for $12 \text{ MeV} \leq E_n \leq 18.5 \text{ MeV}$

** Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
28-58c2	G62	270d		13.86 ± 0.10 14.11 ± 0.10 14.24 ± 0.10 14.37 ± 0.15 14.49 ± 0.20 14.59 ± 0.20 14.69 ± 0.25 14.77 ± 0.25 14.88 ± 0.30	490 ± 49 560 ± 56 520 ± 52 530 ± 53 600 ± 60 580 ± 58 560 ± 56 580 ± 58 580 ± 58	cf. 28-58a4		
28-58d1	A57 II	—	14.1	310 ± 60		cf. 13-27d1		
28-58d2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{12^{\circ}} =$ a) 440 ± 26 b) 430 ± 26		cf. 11-23d1		
28-58d3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 534 \pm 100$ for $d\Omega = 0^{\circ}$ — 180°		cf. 13-27d3		
28-58d4 diff.	G61 II	—	14.8 ± 0.3	$4\pi \left[\frac{d\sigma}{d\Omega} \right] =$ a) 430 ± 18 for isotr. part b) 490 ± 21 for total Means for 10 angles between 0° and 150° with $d\theta = \pm 7^{\circ}$ — $\pm 4^{\circ}$	abs. : α -from T(d, n) He ⁴ and proton- recoil- telescope	Telescope : 2 prop.-counters and CsI crystal in coincidence with α from T(d, n) He ⁴ . Separation of d,n processes. Separation of n, p - and n,np -processes by stat. theory. Protons with $E_p > 1.8$ MeV measured. Protons with $E_p < 1.8$ MeV computed by stat. theory	Mean total error	Ni ⁵⁸ enriched : 95.6 %, 2.7 cm \varnothing ; thickness 10 mg/cm ²
28-58d5 diff.	K60 I	—	14.8 ± 0.8	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 287 \pm 29$ Means for 8 angles between 0° and 180°	abs. : α from T(d,n) He ⁴	8 nuclear plates cyl. arranged around the target. Separation of a,p -and n, np -processes by stat. theory. σ probably contains n,d -processes	—	Ni ⁵⁸ enriched 99.6% ; thickness 17.3 mg/cm ²

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ni}^{58}(n, np) \text{ Co}^{57}$								
28-58e1	A57 II	—	14.1	220 ± 44			cf. 13-27d1	
28-58e2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 343 ± 27			cf. 11-23d1	
28-58e3 diff.	G61 II	—	14.8 ± 0.3	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 340 \pm 30$ Means for 10 angles between 0° and 150°			cf. 28-58d4	
28-58e4 diff.	K60 I	—	14.8 ± 0.8	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 150 \pm 15$ Means for 8 angles between 0° and 180°			cf. 28-58d5	
$\text{Ni}^{58}(n, d) \text{ Co}^{57}$								
28-58f1 diff.	G61 II	—	14.8 ± 0.3	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 25 \pm 6$ Means for 10 angles between 0° and 150°			cf. 28-58d4	
$\text{Ni}^{60}(n, p) \text{ Co}^{60m}$								
58-60b1m	P60 I	10.5 ± 0.2 min*	14.8 ± 0.9	9 ± 2			cf. 27-59a1g	cf. 28-58b1g
$\text{Ni}^{60}(n, p) \text{ Co}^{60} + \text{Ni}^{60}(n, pn) \text{ Co}^{59}$								
28-60d1	A57 II	—	14.1	240 ± 50			cf. 13-27d1	
28-60d2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 124 ± 9 b) 134 ± 9			cf. 11-23d1	

* Measured by the authors

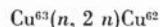
I	II	III	IV	V	VI	VII	VIII	IX
28-60d3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 158 \pm 32$ for $d\Omega = 0^\circ - 180^\circ$				
28-60d4 diff.	M58 II	—	13.5 ± 0.1	87 for isotr. part 155 for total part		cf. 26-54d5	Ni ⁶⁰ enriched 99.2 % ~ 1 cm ² thickness 7 mg/cm ²	
$\text{Ni}^{60}(n, np) \text{ Co}^{59}$								
28-60e1	A57 II	—	14.1	60 ± 12		cf. 13-27d1		
28-60e2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 51 ± 10		cf. 11-23d1		
28-60e3 diff.	M58 II	—	13.5 ± 0.1	68		cf. 26-54d5		cf. 28-60d4
$\text{Ni}^{61}(n, p) \text{ Co}^{61}$								
28-61b1	P53	1.75h	14.5 ± 0.35	181 ± 25		cf. 7-14a1		
28-61b2	P60 I	$1.70 \pm 0.05h^*$	14.8 ± 0.9	22 ± 2		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{61}(n, pn + n, np + n, d) \text{ Co}^{60m}$								
28-61clm	P60 I	10.5 ± 0.2 min*	14.8 ± 0.8	3.8 ± 1		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{62}(n, p) \text{ Co}^{62g}$								
28-62b1g	P60 I	13.8 ± 0.2 min*	14.8 ± 0.8	3.3 ± 1		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{62}(n, p) \text{ Co}^{62m}$								
28-62b1m	P60 I	1.9 ± 0.3 min*	14.8 ± 0.8	2.0 ± 0.5		cf. 27-59a1g		cf. 28-58b1g

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ni}^{62}(n, pn + n, np + n, d) \text{Co}^{61}$								
28-62e2	P60 I	$1.70 \pm 0.05 h^*$	14.8 ± 0.8	0.65 ± 0.15		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{64}(n, p) \text{Co}^{64g}$								
28-64b1g	P60 I	$7.8 \pm 0.2 \text{ min}^*$	14.8 ± 0.8	< 4.1		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{64}(n, p) \text{Co}^{64m}$								
28-64b1m	P60 I	2.0 ± 0.2	14.8 ± 0.8	> 0.43		cf. 27-59a1g		cf. 28-58b1g
$\text{Ni}^{nat}(n, p + n, pn) \text{Co}$								
28-d1 diff.	H62 III	—	14.4 ± 0.2	$255 \pm 6 \text{ for } E_p > 1.5 \text{ MeV}$		cf. 12-d1		
$\text{Ni}^{nat}(n, np) \text{Co}$								
28-e1 diff.	H62 III	—	14.4 ± 0.2	$240 \pm 50 \text{ for } E_p > 1.5 \text{ MeV}$		cf. 12-d1		
$\text{Ni}^{nat}(n, p + n, pn + n, np + n, d) \text{Co}$								
28-g1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 170 \pm 20$ Means for $0 = 30^\circ, 45^\circ, 60^\circ, 90^\circ, 120^\circ, 135^\circ, 150^\circ$ and $E_p > 6 \text{ MeV}$		cf. 12-g1		

*Measured by the authors

C O P P E R



29-63a1	P53	10 min	14.5 ± 0.35	482 ± 72		cf. 7-14a1		
29-63a2	F52	9.9 min	14.1	510 ± 36		cf. 13-27b2		
29-63a3	Y57	10.1 min	14.1 ± 0.15	556 ± 28		cf. 13-27b3		
29-63a4	B52 I	10 min	$14.25 \pm 0.25^{*1}$	650 ± 80	rel. : cf. B51 $\sigma T(d, n) \text{He}^4$ for $E_d = 10.5 \text{ MeV}$	β -activity, prop. counter, 2 π geometry. Calibration with $\text{Cu}^{63}\sigma \text{Cu}^{63}(n, \gamma)\text{Cu}^{62}$ $= 560 \text{ mb}$ for therm. neutrons	Error contains : differences for several measurements; neutron flux; calibration	Element : $2.54 \times 5.08 \text{ cm} : \text{thickness} : 0.0127 \text{ cm}$
29-63a5	D60 I	10 min	14.6	530 ± 26		cf. 8-16b5	Liquid scintillator Dioxane (201 gr) Naphthalene (14 gr) PPO (1 gr); H_2O (5 gr); $\text{Cu}(\text{NO}_3)_2 \cdot 3 \text{H}_2\text{O}$ (0.967 gr)	
29-63a6	P61 III	$9.8 \pm 0.2 \text{ min}^{*2}$	14.1 ± 0.1	490 ± 45		cf. 13-27b8		
29-63a7	F60	—	$13.77 \pm 0.20^{*3}$	378 ± 34		cf. 7-14a7		
			14.74 ± 0.27	507 ± 45				
29-63a8	F50	10 min	14^{*4}	330 ± 66	rel. : $\sigma D(d, n) \text{He}^3$	β -activity, geiger-counter. Calibration with Cu^{63} $\sigma \text{Cu}^{63}(n, \gamma)\text{Cu}^{62} = 560 \text{ mb}$ for therm. neutrons	—	Element
29-63a9	B62 I	$10.03 \pm 0.03 \text{ min}^{*2}$	$14.1 \pm 0.1^{*5}$	509 ± 56	rel. : cf. 26-56b4 $\text{Fe}^{65}(n, p)\text{Mn}^{64} = 112.5 \text{ mb}$		cf. 13-27b8	
29-63a10	S61 II	$9.90 \pm 0.04 \text{ min}^{*2}$	14.1 ± 0.2	458 ± 10		cf. 13-27b11		

^{*1} Also measured from threshold to 27 MeV^{*2} Measured by the authors^{*3} Also measured for $12.5 \text{ MeV} \leq E_n \leq 18 \text{ MeV}$ ^{*4} Also measured from threshold to 14 MeV^{*5} Also measured for $13 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
29-63a11	G62	—	13.86 \pm 0.10 14.11 \pm 0.10 14.37 \pm 0.15 14.59 \pm 0.20 14.77 \pm 0.25	424 \pm 21 455 \pm 23 488 \pm 24 519 \pm 26 550 \pm 27	abs. for $E_n = 14.77$ MeV \propto from $T(d, n)$ He ⁴	β^+ activity, 0.511 MeV annihilation radiation measured with 2 NaI crystals switched in coincidence	Standard deviation	Element, foils
29-63a12	M52		Relative measurement* ¹			β -activity, geiger counter	—	—
29-63a13	G56			cf. 12-24b8* ²				
					$\text{Cu}^{63}(n, p) \text{ Ni}^{63} + \text{Cu}^{63}(n, pn) \text{ Ni}^{62}$			
29-63d1	A57 II	—	14.1	120 \pm 24		cf. 13-27d1		
29-63d2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 118 \pm 9 b) 105 \pm 10		cf. 11-23d1		
29-63d3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 149 \pm 30$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27d3		
				$\text{Cu}^{63}(n, np) \text{ Ni}^{62}$				
29-63e1	A57 II	—	14.1	130 \pm 26		cf. 13-27d1		
29-63e2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 152 \pm 30		cf. 11-23d1		
				$\text{Cu}^{63}(n, \text{He}^3) \text{ Co}^{61}$				
29-63f1	B62 II	1.65h	14.7	< 0.08	—	—	—	—

*¹ Measured for 12 MeV $\leq E_n \leq$ 18.5 MeV

*² Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Cu}^{63}(n, \alpha) \text{ Co}^{60m}$								
29-63i1m	K62	10.4 min	14.8 ± 0.4	23 ± 3		cf. 15-31a4		
$\text{Cu}^{65}(n, 2n) \text{ Cu}^{64}$								
29-65a1	P53	12h	14.5 ± 0.35	1085 ± 175		cf. 7-14a1		Element
29-65a2	F52	12.8h	14.1	970 ± 80		cf. 13-27b2		
29-65a3	R58 I	13.4h	14	935		cf. 7-14a2		
29-65a4	P61 I	12.68h ^{*1}	$13.88 \pm 0.10^{**}$ 14.01 ± 0.10 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31	879 ± 33 906 ± 36 892 ± 36 937 ± 37 953 ± 38 968 ± 39 975 ± 39		cf. 22-46a2		
29-65a5	P61 III	$12.7 \pm 0.15h^{*1}$	14.1 ± 0.1	940 ± 85		cf. 13-27b8		
29-65a6	P59 I	$12.85 \pm 0.05h^{*1}$	14.8 ± 0.8	954 ± 130		cf. 13-27b4		
29-65a7	R61 II	$13.6 \pm 0.5h^{*1}$	14.4 ± 0.3	959 ± 79		cf. 7-14a7		Element
29-65a8	B61 IV	$12.75 \pm 0.04h^{*1}$	$14.1 \pm 0.1^{**}$	918 ± 80		cf. 13-27b8		
29-65a9	D60 II	—	15 ± 0.4	869 ± 100		cf. 26-56b11		
29-65a10	W60 II	12.87h	14.5 ± 0.5	1030 ± 95	rel. : cf. 29-63a $\text{Cu}^{63}(n, 2n) = 522 \text{ mb}$ Sandwich-method	γ -activity. Measuring of the area under the photo- peak with a $2 \times 1 3/4''$ NaI crystal; calibration with Co ⁶⁸ and Na ²²	—	—
29-65a11	G62	—	14.77	995 ± 70		cf. 29-63a11		

^{*1} Measured by the author

^{**2} Also measured for $10 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

^{**3} Also measured for $13 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Cu}^{65}(n, p) \text{ Ni}^{65}$								
29-65b1	F52	2.56 <i>h</i>	14.1	19 \pm 4		cf. 13-27 <i>b2</i>		Element $1\frac{1}{2}''$ \odot , thickness 120 mg/cm ²
29-65b2	S59 I	2.56 <i>h</i>	14.8 \pm 0.8	31 \pm 13		cf. 17-37 <i>b2</i>		Element 9.5-12.7 mm \odot thickness 45 mg/cm ²
29-65b3	P59 I	2.55 \pm 0.20 <i>h</i> * ¹	14.8 \pm 0.8	27 \pm 11		cf. 13-27 <i>b4</i>		Element 1.7-2.1 cm \odot thickness 3-6 mg/cm ²
29-65b4	P61 III	2.6 \pm 0.3 <i>h</i> * ¹	14.1 \pm 0.1	29 \pm 5		cf. 13-27 <i>b8</i>		CuO, powder
29-65b5	M61 II	—	14.8	29 \pm 3		cf. 11-23 <i>i2</i>		
29-65b6	D60 II	—	15 \pm 0.4	17 \pm 4		cf. 26-56 <i>b7</i>		
29-65b7	Z56	—	14.0	\sim 20	—	—	—	—
29-65b8	B62 II	2.6 <i>h</i>	14.7	29.3 \pm 3.2	—	—	—	—

$\text{Cu}^{65}(n, p) \text{ Ni}^{65} + \text{Cu}^{65}(n, pn) \text{ Ni}^{64}$						
29-65d1	A57 II	—	14.1	40 \pm 8		cf. 12-37 <i>d1</i>
29-65d2 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 30 \pm 6$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27 <i>d3</i>
29-65i1g	K62	13.9 min	14.8 \pm 0.4	7.5 \pm 2		cf. 15-31 <i>a4</i>

*¹ Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Cu}^{65}(n, nz) \text{ Co}^{61}$								
29-65k1	B62 I	99.6 \pm 2 min* ¹	14.1 \pm 0.1* ²	5.8 \pm 2		ef. 13-27b8		
29-65k2	K62	1.65h	14.8 \pm 0.4	2.8 \pm 0.3		ef. 15-31a4		
29-65k3	B62 II	1.6h	14.7	2.9 \pm 0.8	—	—	—	—
$\text{Cu}^{nat}(n, 2n) \text{ Cu}$								
29-a1	A58 II	—	14.1	760 \pm 60		ef. 1-2a1	Element	
$\text{Cu}^{nat}(n, p + n, pn) \text{ Ni}$								
29-d1 diff.	A59	—	14.1	a) $4 \cdot \frac{d\sigma}{d\Omega} = 98$ for $d\Omega = 90^\circ - 180^\circ$ b) $2 \cdot \frac{d\sigma}{d\Omega} = 118$ for $d\Omega = 0^\circ - 180^\circ$		ef. 26-54d2	Element	
29-d2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 46 \pm 5$: abs.: proton recoil telescope means for $\theta = 180^\circ$, 45° , 90° , 135° and $d\theta = 180^\circ$	Telescope, 2 prop. counters in coincidence with a CsI crystal and in anti-coincidence with a prop. counter before the target. Separation of n,p - and n,np -processes by stat. theory. σ probably contains n, d -processes	—	—	

*¹ Measured by the authors

*² Also measured from threshold to 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
Cu^{nat}(n, np) Ni								
29-e1 diff.	A59	—	14.1	128		cf. 26-54d2		Element
29-e2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 181 \pm 18,$ means for $\theta = 18^\circ,$ $45^\circ, 90^\circ, 135^\circ$ and $d\theta$ $= 18^\circ$		cf. 29-d2		

I	II	III	IV	V	VI	VII	VIII	IX
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Z I N C

$Zn^{64}(n, 2n) Zn^{63}$

30-64a1	P53	38 min	14.5 ± 0.35	224 ± 45		cf. 7-14a1	Element
30-64a2	Y57	38.5 min	14.1 ± 0.15	119 ± 18	-	cf. 13-27b3	
30-64a3	P60 I	36 ± 0.2 min* ¹	14.8 ± 0.9	254 ± 50		cf. 27-59alg	Element, discs ; thickness 3-35 mg/cm ²
30-64a4	R58 I	39.9 min	14	159		cf. 7-14a1	
30-64a5	R61 I	-	13.5	75		cf. 7-14a7	
30-64a5	R61 II	39.9 ± 0.8 min* ¹	14.4 ± 0.3	167 ± 13		cf. 7-14a7	Element
30-64a6	G61 IV	-	14* ² 14.5 15	120 ± 10 180 ± 15 230 ± 15	-	-	-
30-64a7	W62	38 min	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	96 ± 8 107 ± 9 136 ± 11 165 ± 13 182 ± 15		cf. 29-63a11	
30-64a8	K60 II	38 min	Relative measurement* ¹ . Exp. curve was fitted by $\sigma = 167$ mb for $E_n = 14.4$ MeV (cf. 30-64a5)		β -activity, geiger counter	-	Element, nat ; thickness ≈ range of the β

$Zn^{64}(n, p) Cu^{64}$

30-64b1	P53	12h	14.5 ± 0.35	386 ± 58		cf. 7-14a1	Element
30-64b2	P60 I	13.0 ± 0.2 h* ¹	14.8 ± 0.9	284 ± 20		cf. 27-59alg	Element, discs ; thickness 3-35 mg/cm ²

*¹ Measured by the authors

*² Also measured for $13 \text{ MeV} \leq E_n \leq 17.6 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
30-64b3	R61 I	—	13.5	215		cf. 30-64b3		
30-64b4	Z56	—	14.0	~216		cf. 30-66b4		
30-64b5	W62	12.85h	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	190 ± 15 191 ± 15 177 ± 14 164 ± 13 155 ± 12		cf. 29-63a11		
30-64b6	G61 IV	—	14* ¹ 14.25 14.5 14.75 ± 0.1 15 ± 0.1	220 ± 20 188 ± 15 220 ± 20 182 ± 16 196 ± 15	—	—	—	—
30-64b7	C56			cf. 12-24b8* ²				
				$\text{Zn}^{64}(n, p) \text{ Cu}^{64} + \text{Zn}^{64}(n, pn) \text{ Cu}^{63}$				
30-64d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 179 ± 18 b) 171 ± 17		cf. 11-23d1		
30-64d2 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 257 \pm 50$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27d3		
30-64d3 diff.	R56 II	—	14	~295	—	Nuclear plate	—	—
				$\text{Zn}^{64}(n, np) \text{ Cu}^{63}$				
30-64e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 281 ± 18		cf. 11-23d1		

*¹ Also measured for 12.4 MeV ≤ E_n ≤ 17.5 MeV

*² Measured for 12.5 MeV ≤ E_n ≤ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$Zn^{66}(n, 2n) Zn^{65}$								
30-66a1	H62 I	—	14.9	530 ± 130	cf. 20-48a1	K-electron capture in prop. counter	cf. 20-48a1	
$Zn^{66}(n, p) Cu^{66}$								
30-66b1	P53	5 min	14.5 ± 0.35	101 ± 17	cf. 7-14a1	Element		
30-66b2	Y57	5.13 min	14.1 ± 0.15	60.2 ± 7.2	cf. 13-27b3			
30-66b3	P60 I	5.2 ± 0.3 min*	14.8 ± 0.9	77 ± 10	cf. 27-59a1g	cf. 30-64b2		
30-66b4	Z56	—	—	~80	—	—	—	—
$Zn^{66}(n, p) Cu^{66} + Zn^{66}(n, pn) Cu^{65}$								
30-66d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 34 ± 4 b) 35 ± 4	cf. 11-23d1			
$Zn^{66}(n, np) Cu^{65}$								
30-66e1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 50 ± 4	cf. 11-23d1			
$Zn^{67}(n, p) Cu^{67} + Zn^{67}(n, pn) Cu^{66}$								
30-67d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ a) 41 ± 7 b) 33 ± 7	cf. 11-23d1			

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$Zn^{68}(n, p) Cu^{68}$								
30-63 <i>b1</i>	P60 I	36 ± 5 sec*	14.8 ± 0.9	25 ± 10		cf. 27-59 <i>a1g</i>		cf. 30-64 <i>b2</i>
$Zn^{68}(n, z) Ni^{65}$								
30-68 <i>i1</i>	P60 I	$2.25 \pm 0.02 h^*$	14.8 ± 0.9	51 ± 10		cf. 27-59 <i>a1g</i>		cf. 30-64 <i>b2</i>
30-68 <i>i2</i>	B55 III	$2.56 h$	14.05 ± 0.55	7.6 ± 0.8		cf. 27-59 <i>i3</i>		
$Zn^{70}(n, n'z) Ni^{66}$								
30-68 <i>k1</i>	B62 II	$55 h$	14.7	0.89 ± 0.40				
$Zn^{nat}(n, p + n, pn + n, np + n, d) Cu$								
30-g1 diff.	H62 III	—	14.4 ± 0.2	170 ± 20 for $E_p > 2.2$ MeV		cf. 12- <i>d1</i>		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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G A L L I U M

$\text{Ga}^{69}(n, 2n) \text{ Ga}^{68}$

31-69a1	P53	68 min	14.5 ± 0.35	552 ± 155	cf. 7-14a1	Element
31-69a2	R58 I	69.2 min	14	1089	cf. 7-14a2	
31-69a3	R61 II	69.2 ± 1.4 min* ¹	14.4 ± 0.3	923 ± 70	cf. 7-14a7	Element
31-69a4	K61 II	67.5 min	14.8 ± 0.5	1070 ± 107	cf. 17-35a5m	

$\text{Ga}^{69}(n, p) \text{ Zn}^{69m}$

31-69b1m	P53	14h	14.5 ± 0.35	24.4 ± 20	cf. 7-14a1	Element
31-69b2m	B62 I	13.8h	$15 \pm 0.5^{*2}$	42 ± 4	rel. : cf. 13-27i $\text{Al}^{27}(n, \alpha) = 118$ mb	cf. 13-27b8

$\text{Ga}^{69}(n, \alpha) \text{ Cu}^{66}$

31-69i1	P53	5 min	14.5 ± 0.35	105 ± 58	cf. 7-14a1	
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$\text{Ga}^{71}(n, 2n) \text{ Ga}^{70}$

31-71a1	P53	20 min	14.5 ± 0.35	700 ± 100	cf. 7-14a1	Element
31-71a2	K61 II	21.0 min	14.8 ± 0.5	2180 ± 218	cf. 17-35a5m	

$\text{Ga}^{71}(n, n\alpha) \text{ Cu}^{67}$

31-71k1	B62 I	$59.6 \pm 0.6h^{*1}$	15.2 ± 0.5	$6 \pm 2^{*2}$	rel. : cf. 13-27i $\text{Al}^{27}(n, \alpha) = 118$ mb	cf. 13-27b8
31-71k2	B62 II	61h	14.7	2 ± 1	—	—

*¹ Measured by the authors

*² Also measured for $15 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

*³ Also measured for $15.2 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

GERMANIUM

$\text{Ge}^{70}(n, 2n) \text{ Ge}^{69}$

32-70a1	P53	$40h$	14.5 ± 0.35	666 ± 230		cf. 7-14a1	Element
32-70a2	R59 I	$36.9h$	14	604 ± 48		cf. 17-35a3m	
32-70a3	R61 II	$38.6 \pm 0.8h^{*1}$	14.4 ± 0.3	598 ± 45		cf. 7-14a7	GeO_2
32-70a4	P61 I	$40.4h$	$13.83 \pm 0.10^{*2}$	509 ± 15		cf. 22-46a2	
			14.01 ± 0.10	508 ± 15			
			14.31 ± 0.13	607 ± 18			
			14.50 ± 0.20	621 ± 19			
			14.68 ± 0.26	664 ± 20			
			14.83 ± 0.31	716 ± 21			
			14.93 ± 0.36	681 ± 20			
32-70a5	K61 II	$41.0h$	14.8 ± 0.5	1600 ± 240		cf. 17-35a5m	

$\text{Ge}^{70}(n, p) \text{ Ga}^{70}$

32-70b1	P53	20 min	14.5 ± 0.35	129 ± 60		cf. 7-14a1	Element
32-70b2	Z56	—	—	~ 93	—	—	—

$\text{Ge}^{72}(n, p) \text{ Ga}^{72}$

32-72b1	P53	$14h$	14.5 ± 0.35	65.2 ± 26		cf. 7-14a1	Element
32-72b2	Z56	—	—	~ 32	—	—	—

$\text{Ga}^{73}(n, p) \text{ Ga}^{73}$

32-73b1	P53	$5h$	14.5 ± 0.35	136.6 ± 70		cf. 7-14a1	Element
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*1 Measured by the authors

*2 Also measured for $11.8 \text{ MeV} \leq E_n \leq 19.7 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ge}^{71}(n, z) \text{ Zn}^{71}$								
32-74 <i>i</i> 1	P53	2.2 min	14.5 ± 0.35	14.9 ± 6		cf. 7-14 <i>a</i> 1	—	Element
$\text{Ge}^{76}(n, 2n) \text{ Ge}^{75}$								
32-76 <i>a</i> 1	P53	82 min	14.5 ± 0.35	1820 ± 550		cf. 7-14 <i>a</i> 1		Element
32-76 <i>a</i> 2	K61 II	78 min	14.8 ± 0.5	1200 ± 240		cf. 17-35 <i>a</i> 3 <i>m</i>		
$\text{Ge}^{76}(n, nz) \text{ Zn}^{72}$								
32-76 <i>k</i> 1	B62 II	49 <i>h</i>	14.7	< 2	—	—	—	—

I	II	III	IV	V	VI	VII	VIII	IX
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A R S E N I C

$\text{As}^{75}(n, 2n) \text{ As}^{74}$

33-75a1	P61 I	17.8 ^{*1}	14.01 \pm 0.10 ^{*2}	1070 \pm 43			cf. 22-46a2
			14.31 \pm 0.13	1113 \pm 45			
			14.68 \pm 0.26	1149 \pm 46			
			14.93 \pm 0.36	1123 \pm 45			
33-75a2	P53	17d	14.5 \pm 0.35	545 \pm 160		cf. 7-14a1	Element

$\text{As}^{75}(n, p) \text{ Ge}^{75}$

33-75b1	P61 IV	—	14.01 \pm 0.10 ^{*2}	20.7 \pm 1.5		cf. 22-46a2	
			14.31 \pm 0.13	19.3 \pm 1.4			
			14.54 \pm 0.20	18.1 \pm 1.3			
			14.93 \pm 0.36	15.9 \pm 1.2			
33-75b2	P53	8.2 min	14.5 \pm 0.35	11.8 \pm 2.4		cf. 7-14a1	Element

$\text{As}^{75}(n, p) \text{ Ge}^{75g}$

33-75b1g	F61 II	—	14.1 \pm 0.2	25 \pm 5		cf. 13-27b12
33-75b1m	F61 II	—	14.1 \pm 0.2	10 \pm 2		cf. 13-27b12

$\text{As}^{75}(n, p) \text{ Ge}^{75} + \text{As}^{75}(n, pn) \text{ Ge}^{74}$

33-75d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} =$ 27 \pm 5		cf. 11-23d1
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*1 Measured by the authors

*2 Also measured for 10.3 MeV $\leq E_n \leq$ 19.8 MeV

*3 Also measured for 7 MeV $\leq E_n \leq$ 14.9 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\text{As}^{75}(n, \text{He}^3) \text{ Ga}^{73}$								
33-75f1	B62 II	5h	14.7	< 0.51	—	—	—	—
$\text{As}^{75}(n, p) \text{ Ge}^{75} + \text{As}^{75}(n, pn + n, np + n, d) \text{ Ge}^{71}$								
33-75g1	A58 III	—	14	115 ± 15	cf. 25-55g1			
$\text{As}^{75}(n, 2p) \text{ Ga}^{71}$								
33-75h1	B62 II	7.8 min	14.7	< 0.50	—	—	—	—
$\text{As}^{75}(n, \alpha) \text{ Ga}^{72}$								
33-75i1	P53	14h	14.5 ± 0.35	12.3 ± 2.2	cf. 7-14a1			Element
33-75i2	P61 IV	—	14.01 ± 0.10*	9.8 ± 0.7	cf. 22-46a2			
			14.31 ± 0.13	10.4 ± 0.7				
			14.68 ± 0.23	10.2 ± 0.7				
			14.93 ± 0.36	10.0 ± 0.7				
33-75i3	F61 I	—	14.8	4.59	—	—	—	—
33-75i4	P62	14h	14.7	9.3 ± 3.1	—	—	—	—

* Also measured for 7 MeV ≤ E_n ≤ 19.8 MeV

I

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III

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VII

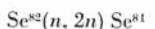
VIII

IX

S E L E N I U M



34-80 <i>I</i>	P53	59 sec; 12 h	14.5 ± 0.35	37.7 ± 15.4	cf. 7-14 <i>a1</i>	Element
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34-82 <i>a1</i>	P53	59 min	14.5 ± 0.35	1500 ± 500	cf. 7-14 <i>a1</i>	Element
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B R O M I N E

$\text{Br}^{79}(n, 2n) \text{ Br}^{78}$

35-79a1	P53	6.4 min	14.5 ± 0.35	1141 ± 285	cf. 7-14a1	LiBr; NaBr
35-79a2	R59 I	6.3 min	14	788 ± 63	cf. 17-35a3m	
35-79a3	R61 II	6.33 ± 0.13 min*	14.4 ± 0.3	835 ± 63	cf. 7-14a7	NaBr

$\text{Br}^{79}(n, z) \text{ As}^{76}$

35-79i1	B58	26.8h	14.05 ± 0.55	10 ± 1.8	cf. 27-59i3	
35-79i2	P62	27h	14.7	10.8 ± 2.4	—	—

$\text{Br}^{81}(n, 2n) \text{ Br}^{80} - \text{tot.}$

35-81a1t	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	1047 ± 98	cf. 37-87a1	
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$\text{Br}^{81}(n, 2n) \text{ Br}^{80m}$

35-81alm	P53	4.4h	14.5 ± 0.35	828 ± 165	cf. 7-14a1	LiBr; NaBr
35-81a2m	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	610 ± 93	cf. 37-87a1	
35-81a3m	R61 II	$4.49 \pm 0.09h^*$	14.4 ± 0.3	752 ± 72	cf. 7-14a7	NaBr
35-81a4m	F61 II	—	14.2 ± 0.2	510 ± 56	cf. 13-27b12	

$\text{Br}^{81}(n, 2n) \text{ Br}^{80g}$

35-81a1g	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	437 ± 29	cf. 37-87a1	
35-81a2g	F61 II	—	14.2 ± 0.2	470 ± 50	cf. 13-27b12	

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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 $\text{Br}^{81}(n, p) \text{ Se}^{81} - \text{tot.}$

35-81b1t	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	57 ± 10		cf. 38-86b2		
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 $\text{Br}^{81}(n, p) \text{ Se}^{81m}$

35-81b1m	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	32 ± 8		cf. 38-86b2		
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 $\text{Br}^{81}(n, p) \text{ Sc}^{81g}$

35-81b1g	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	25 ± 5		cf. 38-86b2		
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 $\text{Br}^{81}(n, z) \text{ As}^{78}$

35-81i1	P53	90 min	14.5 ± 0.35	103 ± 20		cf. 7-14a1		LiBr, NaBr
35-81i2	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	107 ± 20		cf. 38-86b2		—
35-81i3	P62	90 min	14.7	9.2 ± 1.2	—	—	—	—

 $\text{Br}^{81}(n, nz) \text{ As}^{77}$

35-81k1	B62 II	$39h$	14.7	< 1.0	—	—	—	—
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 $\text{Br}^{nat}(n, p + n, pn) \text{ Se}$

35-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{12^{\circ}} =$ < 14		cf. 11-23d1		
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R U B I D I U M

$\text{Rb}^{85}(n, 2n) \text{ Rb}^{84}$

37-85a1	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	687 ± 74	cf. 37-87a1
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$\text{Rb}^{85}(n, 2n) \text{ Rb}^{84} + \text{Rb}^{85}(n, 2n) \text{ Rb}^{84m}$

37-85a1+m	P61 I	$33d$	$14.09 \pm 0.10^{*1}$	1447 ± 72	σ does not contain the cf. 22-46a2
			14.50 ± 0.20	1498 ± 75	decay of Rb^{84m} by E. C.
			14.68 ± 0.26	1520 ± 76	
			14.81 ± 0.31	1530 ± 77	

$\text{Rb}^{85}(n, z) \text{ Br}^{82}$

37-85i1	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	143 ± 9	cf. 38-68b2
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37-85i2	P62	$36h$	14.7	145	—	—	—
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$\text{Rb}^{87}(n, 2n) \text{ Rb}^{86}$

37-87a1	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	835 ± 136	rel. : cf. 26-56b $\text{Fe}^{84}(n, p) = 110$ mb or cf. 13-27 <i>i</i> $\text{Al}^{87}(n, z) = 115$ mb Sandwich method	β - and γ -activity. Corrections for abs. β -counting cf. R56 III and Z50. γ -rays were counted with a $3 \times 3''$ NaI crystal; efficiency cf. L56. Chem. separation	Total error, without deviations in the decay scheme
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$\text{Rb}^{87}(n, 2n) \text{ Rb}^{86} + \text{R}^{87}(n, 2n) \text{ Rb}^{86m}$

37-87a1+m	P61 I	$18.66d$	$14.09 \pm 0.10^{*2}$	1170 ± 57	σ does not contain the cf. 22-46a2
			14.50 ± 0.20	1210 ± 61	decay of Rb^{86m} by E. C.
			14.68 ± 0.26	1194 ± 59	
			14.81 ± 0.31	1191 ± 59	

*1 Also measured for $10.5 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

*2 Also measured for $10.0 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Rb}^{87}(n, \alpha) \text{Br}^{84}$								
37-87 <i>i</i> 1	P53	33 min	14.5 ± 0.35	38.9 ± 16.3		cf. 7-14 <i>a</i> 1		Rb_2CO_3
37-87 <i>i</i> 2	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	59 ± 12		cf. 38-86 <i>b</i> 2		—
$\text{Rb}^{87}(n, n\alpha) \text{Br}^{83}$								
37-87 <i>k</i> 1	B62 II	$2.3h$	14.7	< 1.5	—	—	—	—

I II III IV V VI VII VIII IX

S T R O N T I U M

$\text{Sr}^{84}(n, 2n) \text{ Sr}^{83}$

38-84a1	P61 I	33 <i>h</i>	13.88 \pm 0.10*	115.9 \pm 5.8		cf. 22-46a2
			14.09 \pm 0.10	142.4 \pm 7.1		
			14.31 \pm 0.13	149.9 \pm 7.5		
			14.50 \pm 0.20	171.7 \pm 8.6		
			14.68 \pm 0.28	176.8 \pm 8.8		
			14.93 \pm 0.36	180.6 \pm 9.0		

38-84a2	S62	—	14.6 \pm 0.2 — 0.3	380 \pm 50	rel. : cf. 26-56b $\text{Fe}^{56}(n, p) = 110$ mb or cf. 13-27 <i>i</i> $\text{Al}^{27}(n, \alpha) = 115$ mb Sandwich method	γ -activity: 3 \times 3" NaI crystal. Efficiency cf. L56	Total error without Foils deviations in the decay scheme
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38-84a3	K61 II	33 <i>h</i>	14.8 \pm 0.5	1770 \pm 180		cf. 17-35a5 <i>m</i>
38-84a4	P62	33 <i>h</i>	14.7	140 \pm 80	—	—

$\text{Sr}^{86}(n, 2n) \text{ Sr}^{85g}$

38-86a1g	M61 I	65 <i>d</i>	14.1	680 \pm 109		cf. 38-86a1 <i>m</i>
38-86a2g	S62	—	14.6 \pm 0.2 — 0.3	280 \pm 10		cf. 38-84a2

$\text{Sr}^{86}(n, 2n) \text{ Sr}^{85m}$

38-86a1m	M61 I	70 min	14.1	21 \pm 8	rel. : cf. 13-27 <i>i</i> 10 $\text{Al}^{27}(n, \alpha) = 116$ mb	γ -activity, 1 1/2" \times 1" NaI-crystal. Efficiency cf. K54. Corrections for geometry, backscattering etc. exp. determinated	Total error	SrCO ₃ powder
38-86a2m	S62	—	14.6 \pm 0.2 — 0.3	312 \pm 50		cf. 38-84a2		

* Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Sr}^{86}(n, p) \text{ Rb}^{86}$								
38-86b1	P61 IV	—	14.01 \pm 0.10*	42.5 \pm 4.0		cf. 22-46a2		
			14.31 \pm 0.13	43.5 \pm 4.4				
			14.68 \pm 0.26	41.5 \pm 3.7				
			14.93 \pm 0.36	45.3 \pm 4.0				
38-86b2	S62	—	14.6 $\begin{matrix} +0.2 \\ -0.3 \end{matrix}$	64 \pm 7	rel. : cf. 26-56b Fe ⁵⁶ (n, p) = 110 mb or cf. 13-27i Al ²⁷ (n, z) = 115 mb Sandwich method	β -activity. Corrections for abs. β -counting cf. R56III and Z50. Chem. separa- tion	Total error without Foils deviations in the decay scheme	
$\text{Sr}^{88}(n, 2n) \text{ Sr}^{87}$								
38-88a1	S62	—	14.6 $\begin{matrix} +0.2 \\ -0.3 \end{matrix}$	215 \pm 24		cf. 38-84a2		
$\text{Sr}^{88}(n, p) \text{ Rb}^{88}$								
38-88b1	P53	17 min	14.5 \pm 0.35	17.7 \pm 3.5		cf. 7-14a1		SrCO_3
38-88b2	S62	—	14.6 $\begin{matrix} +0.2 \\ -0.3 \end{matrix}$	30 \pm 2		cf. 38-86b2	—	—
38-88b3	B62 II	18 min	14.7	11 \pm 3	—	—	—	—
$\text{Sr}^{88}(n, z) \text{ Kr}^{85m}$								
38-88i1m	P53	4.5h	14.5 \pm 0.35	64 \pm 20	—	cf. 7-14a1		SrCO_3
38-88i2m	S62	—	14.6 $\begin{matrix} +0.2 \\ -0.3 \end{matrix}$	87 \pm 31		cf. 38-86b2		
$\text{Sr}^{nat}(n, p) \text{ Rb} + \text{Sr}^{nat}(n, pn) \text{ Rb}$								
38-81 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{12^{\circ}} =$ 22 ± 17		cf. 11-23d1		

* Also measured for $13.4 \text{ MeV} \leq E_n \leq 14.93 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
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Y T T R I U M

$\text{Y}^{89}(n, 2n) \text{ Y}^{88}$

39-89a1	M61 I	—	14.1	540 ± 80		cf. 38-86a1 <i>m</i>		
39-89a2	T60	—	13.9* ¹	585	—	—	—	—
			14.0	680				
			14.6	685				
			15.1	1005				
39-89a3	S62	—	$14.6 \begin{matrix} +0.2 \\ -0.3 \end{matrix}$	542 ± 58		cf. 38-84a2		
39-89a4	P61 IV		Relative measurement* ²			cf. 22-46a2		

$\text{Y}^{89}(n, 2n) \text{ Y}^{88m}$

39-89a1 <i>m</i>	G61 I	14 ± 1 msec* ³	14.5	> 400		cf. 49-115a1 <i>m</i>		
39-89b1	P61 IV	—	14.01 $\pm 0.10^{*4}$	23.7 ± 1.7		cf. 22-46a2		
			14.09 ± 0.10	22.7 ± 1.6				
			14.31 ± 0.13	24.1 ± 1.7				
			14.54 ± 0.20	24.0 ± 1.7				
			14.68 ± 0.26	24.5 ± 1.8				
			14.81 ± 0.31	23.4 ± 1.7				
			14.93 ± 0.36	23.2 ± 1.7				
39-89b2	T60	—	13.9* ⁵	14 ± 3	—	—	—	—
			14.0	14.5 ± 3				

*¹ Also measured for $12.2 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

*² Measured for $11.5 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

*³ Measured by the authors

*⁴ Also measured for $7 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

*⁵ Also measured for $8.2 \text{ MeV} \leq E_n \leq 14.0 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Y}^{89}(n, 2n) \text{ Rb}^{88}$								
39-89 <i>i</i> 1	B62 II	18 min	14.7	< 0.020	—	—	—	—
$\text{Y}^{89}(n, z) \text{ Rb}^{86}$								
39-89 <i>i</i> 1	P53	19 <i>d</i>	14.5 \pm 0.35	69.7 \pm 42	cf. 7-14 <i>a</i> 1			
39-89 <i>i</i> 2	P61 IV	—	14.01 \pm 0.10 ^{*1} 14.31 \pm 0.13 14.50 \pm 0.20 14.81 \pm 0.31	5.0 \pm 0.5 5.5 \pm 0.5 5.0 \pm 0.5 5.4 \pm 0.5	cf. 22-46 <i>a</i> 2			
39-89 <i>i</i> 3	S62	—	14.6 $^{+0.2}_{-0.3}$	96 \pm 24	cf. 38-86 <i>b</i> 2			
39-89 <i>i</i> 4	T60	—	13.9 ^{*2} 14.0	1.6 \pm 0.3 2.0 \pm 0.3	—	—	—	—

^{*1} Also measured for 13.4 MeV $\leq E_n \leq$ 14.8 MeV

^{*2} Also measured for 8.2 MeV $\leq E_n \leq$ 14.0 MeV

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VIII

IX

Z I R C O N I U M

$Zr^{90}(n, 2n) Zr^{89}$

40-90a1	P61 I	79.3h	13.88 ± 0.10* ¹	585 ± 18		cf. 22-46a2
			14.01 ± 0.10	604 ± 18		
			14.09 ± 0.10	623 ± 19		
			14.31 ± 0.13	716 ± 21		
			14.50 ± 0.20	768 ± 23		
			14.68 ± 0.26	822 ± 25		
			14.81 ± 0.31	838 ± 25		
			14.93 ± 0.36	856 ± 26		
40-90a2	S62	—	14.6 ^{+ 0.2} _{- 0.3}	502 ± 36		cf. 38-84a2
40-90a3	R60	—	14.1	470 ± 22	—	Scintillation counter

$Zr^{90}(n, 2n) Zr^{89m}$

40-90a1m	P53	4.5 min	14.5 ± 0.35	> 79.8 ± 40	cf. 7-14a1	Zr(NO ₃) ₂	Element
40-90a2m	P62	4.4 min	14.7	84	—	—	—
40-90a3m	R60	—	14.1	74 ± 3	cf. 40-90a3		

$Zr^{90}(n, 2n) Zr^{89} + Zr^{90}(n, 2n) Zr^{89m}$

40-90a1+m	R61 II	79.4 ± 1.6h* ²	14.4 ± 0.3	677 ± 51	cf. 7-14a7	
40-90a2+m	R60	—	14.1	544 ± 22	cf. 40-90a3	

$Zr^{90}(n, p) Y^{90}$

40-90b1	P53	61h	14.5 ± 0.35	247 ± 100	cf. 7-14a1	Zr(NO ₃) ₂	Element
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*¹ Also measured for 12 MeV ≤ E_n ≤ 19.8 MeV

*² Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
40-90b2	P61 IV	—	14.01 \pm 0.10 ^{*1} 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26 14.81 \pm 0.31 14.93 \pm 0.36	45 \pm 2.5 44.5 \pm 2.5 48 \pm 2.5 46.5 \pm 2.5 45 \pm 2.0 45 \pm 2.0 44.5 \pm 2.0	cf. 22-16a2			
40-90b3	S62	—	14.6 \pm 0.2 $14.6 - 0.3$	233 \pm 29		cf. 38-86b2		
40-90b4	R60	—	14.1	43.1 \pm 2.0		cf. 40-90a3		
$Zr^{90}(n, \gamma) Sr^{87m}$								
40-90i1m	P53	2.75h	14.5 \pm 0.35	194 \pm 110		cf. 7-14a1		Element
40-90i2m	B55 III	2.80h	14.05 \pm 0.55	3.3 \pm 0.6		cf. 27-59i3		
40-90i3m	B55 II	—	14.1	3.1 \pm 0.2		cf. 29-63a4		
40-90i4m	R60	—	14.1	3.34 \pm 0.16		cf. 40-90a3		
40-90i5m	P62	2.8h	14.7	2.8 \pm 0.16	—	—	—	—
$Zr^{91}(n, p) Y^{91g}$								
40-91b1g	R60	—	14.1	14.2 \pm 1.4		cf. 40-90a3		
$Zr^{91}(n, p) Y^{91m}$								
40-91b1m	R60	—	14.1	17.5 \pm 0.8		cf. 40-90a3		
$Zr^{91}(n, p) Y^{91} - tot.$								
40-91b1t	S62	—	14.6 \pm 0.2 $14.6 - 0.3$	180 \pm 43		cf. 38-86b2		

^{*1} Also measured for 8 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
40-91b2t	B61 IV	—	14.8	~171	—	—	—	—
40-91b3t	S59 III	—	14.1	32	—	—	—	—
40-91b4t	R60	—	14.1	31.7 ± 1.4		cf. 40-90a3		
$Zr^{92}(n, p) Y^{92}$								
40-92b1	S62	—	14.6 ^{+ 0.2} — 0.3	76 ± 16		cf. 38-86b2		
40-92b2	B62 II	—	14.7	22 ± 4	—	—	—	—
40-92b3	R60	—	14.1	20.7 ± 0.9		cf. 40-90a3		
$Zr^{92}(n, \alpha) Sr^{89}$								
40-92i1	P61 IV	—	14.01 ± 0.10*	9.5 ± 0.40		cf. 22-46a2		
			14.31 ± 0.13	9.95 ± 0.45				
			14.68 ± 0.26	10.3 ± 0.46				
			14.93 ± 0.36	10.2 ± 0.46				
40-92i2	R60	—	14.1	21.8 ± 1.7		cf. 40-90a3		
$Zr^{94}(n, p) Y^{94}$								
40-94b1	P53	16.5 min	14.5 ± 0.35	10.6 ± 4.2		cf. 7-14a1		$Zr(NO_3)_2$, Element
40-94b2	S62	—	14.6 ^{+ 0.2} — 0.3	48 ± 12		cf. 38-86b2		
40-94b3	S59 III	—	14.1	~11	—	—	—	—
40-94b4	B62 II	17 min	14.7	7 ± 4	—	—	—	—
40-94b5	R60	—	14.1	10.8 ± 0.6		cf. 40-93a3		

* Also measured for 13.4 MeV ≤ E_n ≤ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$Zr^{91}(n, pn + n, np + n, d) Y^{93}$								
40-94cl	R60	—	14.1	$< 0.8 \pm 0.1$		cf. 40-90a3		
$Zr^{94}(n, z) Sr^{91}$								
40-94i1	B55 III	9.7h		14.05 ± 0.55	3.6 ± 0.5		cf. 27-59i3	
40-94i2	B55 II	—		14.1	4.9 ± 0.5		cf. 29-63	
40-94i3	P61 IV	—		$13.88 \pm 0.10^*$	5.0 ± 0.4		cf. 22-46a2	
				14.01 ± 0.10	5.1 ± 0.4			
				14.31 ± 0.13	5.7 ± 0.4			
				14.50 ± 0.20	5.5 ± 0.4			
				14.68 ± 0.26	6.0 ± 0.4			
				14.93 ± 0.36	6.2 ± 0.4			
40-94i4	R60	—	14.1	3.99 ± 0.16			cf. 40-90a3	
40-94i5	P62	9.7h		14.7	4.3 ± 1.1	—	—	—
$Zr^{96}(n, p) Y^{96}$								
40-96b1	B61 VI	—	14.8	< 5	—	—	—	—
$Zr^{96}(n, z) Sr^{93}$								
40-96i1	R60	—	14.1	$< 4.8 \pm 0.7$			cf. 40-93a3	
40-96i2	P62	7 min		14.7	5 ± 4	—	—	—
$Zr^{nat}(n, 2n) Zr$								
40-a1	S57	—	14.1	610 ± 100 for $E_n > 0.5$ MeV $d\Omega = 4\pi$	abs. : α -from $T(d, n) He^4$	Nuclear plates ; plates cyl. arranged around cyl. target ; recoil protons recorded. Plates shielded by a Fe-paraffin collimator	Estimated mean total error	Element, cylinder : $1 \frac{1}{2}'' \otimes 1 \frac{1}{2}''$ height

* Also measured for 12.1 MeV $\leq E_n \leq 19.8$ MeV

I II III IV V VI VII VIII IX

Zr^{nat}(n, p + n, pn) Y

40-d1 diff. A61 — 14.1 $4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ cf. 11-23d1

63 ± 12

N I O B I U M

$\text{Nb}^{93}(n, 2n) \text{ Nb}^{92g}$

41-93a1g	G61 I	$10.0 \pm 0.3d^{*1}$	14.5	560 ± 62			cf. 49-115a1m		
41-93a2g	M61 I	$9.9 \pm 0.1d^{*1}$	14.1	430 ± 76			cf. 38-86a1m		Powder Nb_2O_5
41-93a3g	B62 III	10.1d	14.5 ± 0.9	499 ± 91	rel. : cf. 29-63a3 $\text{Cu}^{63}(n, 2n) = 556$ mb cf. 29-65a6 $\text{Cu}^{64}(n, 2n) =$ 954 mb; cf. 13-27b4 $\text{Al}^{27}(n, \alpha) = 114$ mb Sandwich method	γ -activity, $3 \times 3''$ NaI crystal : measuring of the area under the photopeak	Probable total error	error	Powder
41-93a4g	P61 IV	—	Rel. measurement ^{*2}				cf. 22-46a2		
41-93a5g	T60	—	13.9 ^{*3} 14.0 14.6 15.1	385 395 410 420	—	—	—	—	—

$\text{Nb}^{93}(n, 2n) \text{ Nb}^{92m}$

41-93a1m	S62	—	$14.6 \begin{array}{l} + 0.2 \\ - 0.3 \end{array}$	318 ± 18		cf. 38-84a2			
41-93a2m	B62 III	13h	14.5 ± 0.9	< 1.2		cf. 41-93a3g			

$\text{Nb}^{93}(n, \text{He}^3) \text{ Y}^{91m}$

41-93f1m	B62 II	51 min	14.7	< 0.06	—	—	—	—	—
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^{*1} Measured by the authors

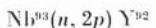
^{*2} Measured for $8.9 \text{ MeV} \leq E_n \leq 14.7 \text{ MeV}$

^{*3} Also measured for $9.9 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

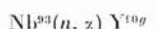
I	II	III	IV	V	VI	VII	VIII	IX
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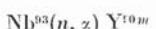
41-93g1 diff. V57 — 14 $4\pi \left[\frac{d\sigma}{d\Omega} \right] = 22 \pm 8$ cf. 12-g1
means for $\theta = 30^\circ, 45^\circ, 60^\circ, 120^\circ, 135^\circ, 150^\circ$ and $E_p > 6 \text{ MeV}$



41-93h1	B62 II	3.7h	14.7	< 0.50	\dots	\dots	\dots	\dots
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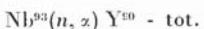


41-93i1g	B62 III	61h	14.5 ± 0.9	8.6 ± 2.5	cf. 41-93a3g	cf. 13-27b4	cf. 41-93a3g
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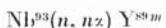
41-93i1m	B62 III	3.02h	14.5 ± 0.9	5.9 ± 2	cf. 41-93a3g	$\beta + \gamma$ -activity, β : cf. 13-27b4	cf. 41-93a3g
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γ : cf. 41-93a3g



41-93i1t	B58	61h	14.05 ± 0.55	9.0 ± 2.2	cf. 27-59i3
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41-93i2t	P61 IV	\dots	$14.01 \pm 0.10^{*1}$	9.3 ± 0.5	cf. 22-46a2
			14.31 ± 0.13	9.4 ± 0.5	
			14.50 ± 0.20	9.5 ± 0.5	
			14.68 ± 0.31	9.4 ± 0.5	



41-93k1m	B62 III	$16.3 \pm 1.3 \text{ sec}^{*2}$	14.5 ± 0.9	2.5 ± 1.1	cf. 41-93a3g
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*1 Also measured for $7 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

*2 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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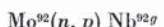
M O L Y B D E N U M



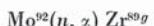
42-92a1g+m	R61 II	15.2 ± 0.3 min*	14.4 ± 0.3	211 ± 16		cf. 7-14a7	Element
42-92a2g+m	P53	75 sec for Mo^{91m} 15 min for Mo^{91g}	14.5 ± 0.35	190 ± 29		cf. 7-14a1	Element
42-92a3g+m	Y57	16.3 min for Mo^{91g}	14.1 ± 0.15	132 ± 21		cf. 13-27b4	
42-92a4g+m	B52	65 sec for Mo^{91m} 15 min for Mo^{91g}	14.25 ± 0.25	310 ± 87		cf. 29-63a4	Element 2.54×5.08 cm; thickness 0.0127 cm
42-92a5g+m	R58 I	15.2 min for Mo^{91g}	14	188		cf. 8-19a2	
42-92a6g+m	S62	—	$14.6 \begin{array}{l} + 0.2 \\ - 0.3 \end{array}$	315 ± 35		cf. 37-87a1	



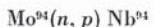
42-92a1g	P62	16 min	14.7	198 ± 40	—	—	—
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42-92b1g	B62 III	9.9d	14.5 ± 0.9	58 ± 30		cf. 41-93a3g
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42-92a1g	B62 III	79h	14.5 ± 0.9	16 ± 7		cf. 41-93a3g
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42-94b1	B62 II	6.6 min	14.7	6.0 ± 1.5	—	—	—
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Mo}^{96}(n, p) \text{ Nb}^{96}$								
42-96b1	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	21 ± 7		cf. 37-87a1		
42-96b2	B62 II	26h	14.7	36.6 ± 0.2	—	—	—	—
$\text{Mo}^{97}(n, p) \text{ Nb}^{97}$								
42-97b1	P53	76 min	14.5 ± 0.35	108 ± 10		cf. 7-14a1		Element
42-97b2	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	68 ± 14		cf. 37-87a1		
42-97b3	B61 VI	—	14.8	110 ± 20	—	—	—	—
$\text{Mo}^{98}(n, p) \text{ Nb}^{98}$								
42-98b1	B62 II	51 min	14.7	9.0 ± 1.5	—	—	—	—
$\text{Mo}^{100}(n, 2n) \text{ Mo}^{99}$								
42-100a1	P53	68h	14.5 ± 0.35	3790 ± 1900		cf. 7-14a1		Element
42-100a2	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	2039 ± 210		cf. 37-87a1		
24-10033	K61 II	67h	14.8 ± 0.5	1910 ± 190		cf. 17-35a5m		
$\text{Mo}^{100}(n, z) \text{ Zr}^{97}$								
42-100i1	S62	—	$14.6 \begin{array}{l} +0.2 \\ -0.3 \end{array}$	14 ± 6		cf. 38-86b2		
$\text{Mo}^{n\alpha\prime}(n, p + n, pn) \text{ Nb}$								
42-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} =$ 120 ± 20		cf. 11-23d1		

I	II	III	IV	V	VI	VII	VIII	IX
42-d2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 31 \pm 3$ means for $\theta = 180^\circ$, $45^\circ, 90^\circ, 135^\circ$ and $d\theta = 18^\circ$		cf. 29-d2		
42-e1 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 112 \pm 11$ means for $\theta = 180^\circ$, $45^\circ, 135^\circ$ and $d\theta = 18^\circ$		cf. 29-d2		

Mo^{nat}(n, np) Nb

R U T H E N I U M

Ru⁹⁶(*n*, 2*n*) Ru⁹⁵

44-96a1	P53	1.6 <i>h</i>	14.5 ± 0.35	478 ± 90	cf. 7-14a1	RuO ₂
44-96a2	K61 II	1.6 <i>h</i>	14	616 ± 50	cf. 17-35a5 <i>m</i>	
44-96a3	R61 II	$1.63 \pm 0.03^*$	14.4 ± 0.3	634 ± 55	cf. 7-14a7	Element

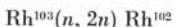
Ru¹⁰¹(*n*, *p*) Tc¹⁰¹

44-101b1	P53	15 min	14.5 ± 0.35	199 ± 140	cf. 7-14a1	RuO ₂
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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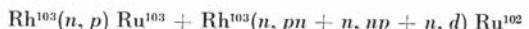
R H O D I U M



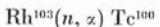
45-103a1	T60	—	13.9*	730 ± 80	—	—	—	—
			14.0	740 ± 80				
			14.6	770 ± 80				
			15.1	790 ± 80				



45-103f1	B62 II	14 min	14.7	< 0.09	—	—	—	—
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45-103g1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 15 \pm 4;$ means for $\theta = 30^\circ, 45^\circ, 60^\circ, 90^\circ, 120^\circ, 135^\circ, 150^\circ$ and $E_p > 7 \text{ MeV}$	cf. 12-g1		
45-103g2 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 4.8 \pm 0.5$ for $d\Omega = 0^\circ - 15^\circ$ and $E_p > 4 \text{ MeV}$	cf. 51-g1	Foil, thickness 30-40 mg/cm ²	



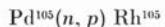
45-103i1	P53	80 sec	14.5 ± 0.35	63 ± 25	cf. 7-14a1	Rh ₂ O ₃
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* Also measured for $10.3 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

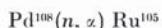
P A L L A D I U M



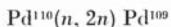
46-104blg+m	P53	44 sec for Rh^{104g}	14.5 ± 0.35	132 ± 66	cf. 7-14a1	Element
		4.3 min for Rh^{104m}				



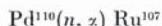
46-105b1	P53	$36.5h$	14.5 ± 0.35	743 ± 520	cf. 7-14a1	Element
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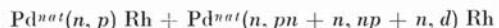
46-108i1	B58	$4.5h$	14.05 ± 0.55	2.3 ± 0.4	cf. 27-59i3	
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46-110a1	P53	$13h$	14.5 ± 0.35	1948 ± 1000	cf. 7-14a1	Element
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46-110i1	P53	4 min	14.5 ± 0.35	13.8 ± 6.2	cf. 7-14a1	Element
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46-g1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 7 \pm 2$	cf. 12-g1	
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means for $\theta = 30^\circ$,
 45° , 60° , 90° , 120° ,
 135° , 150° and $E_p >$
8 MeV

S I L V E R

 $\text{Ag}^{107}(n, 2n) \text{ Ag}^{106}$ I 24.5 min.

47-107a1 I	P53	25 min	14.5 ± 0.35	519 ± 260		cf. 7-14a1		Element
47-107a2 I	F53	24.5 min	14.1	560 ± 56		cf. 13-27b2		
47-107a3 I	Y57	24.3 min	14.1 ± 0.15	458 ± 50		cf. 13-27b3		
47-107a4 I	V61	24 min	14.1	740 ± 80	rel. : cf. 13-27i10 $\text{Al}^{17}(n, \alpha) = 116 \text{ mb}$	β -activity, 4π geometry, prop. counter	Total error	Foil, 20 mg/cm ² thick- ness
47-107a5 I	M61 II	24 min	14.8	662 ± 66		cf. 11-23i2		
47-107a6 I	R61 II	24.4 ± 0.5 min* ¹	14.4 ± 0.3	889 ± 65		cf. 7-14a7		Element
47-107a7 I	S61 II	24.5 min	14.1 ± 0.2	537 ± 15		cf. 13-27b12		
47-107a8 I	K61 II	24.2 min	14.8 ± 0.5	657 ± 100		cf. 17-35a5m		
47-107a9 I	T60	—	13.9* ² 14.0 14.6 15.1	325 340 360 390	—	—	—	—

 $\text{Ag}^{107}(n, 2n) \text{ Ag}^{106}$ II 8d

47-107a1 II	V61	8.4d	14.1	600 ± 78	rel. : cf. 13-27i10 $\text{Al}^{17}(n, \alpha) = 116 \text{ mb}$	K- γ -coincidence with 2 NaI crystals	Total error	Foil, 0.3 mg/cm ² thickness
47-107a2 II	M61 II	8.2d	14.8	~6500		cf. 11-23i2		
47-107a3 II	P61 IV		Rel. measurement* ³			cf. 22-46a2		

^{*1} Measured by the authors^{*2} Also measured for $10.3 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$ ^{*3} Measured for $9.5 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ag}^{107}(n, nz) \text{ Rh}^{103m}$								
47-107klm	B62 II	54 min	14.7	< 2.0	—	—	—	—
$\text{Ag}^{109}(n, 2n) \text{ Ag}^{108}$								
47-109a1	P53	2.3 min	14.5 ± 0.35	311 ± 150	cf. 7-14a1	Element		
47-109a2	F52	2.3 min	14.1	1000 ± 100	cf. 13-27b2			
47-109a3	Y57	2.35 min	14.1 ± 0.15	604 ± 66	cf. 13-27b3			
47-109a4	V61	2.4 min	14.1	840 ± 150	rel. : cf. 47-107a4 I $\text{Ag}^{107}(n, 2n) = 740 \text{ mb}$	β -activity, 2π geometry, Total error prop. counter	Foil thickness	20 mg/cm ²
47-109a5	K59 II	2.3 min	14.3 ± 0.5	619 ± 110	cf. 13-27b7			
47-109a6	M61 II	—	14.8	883 ± 88	cf. 24-50a2			
47-109a7	R59 I	2.3 min	14.8 ± 0.5	710 ± 110	cf. 17-35a3m			
$\text{Ag}^{109}(n, p) \text{ Pd}^{109}$								
47-109b1	C59 II	—	14.5	12.5 ± 1.9	cf. 49-115i2			
47-109b2	D58	14h	14	10.5 ± 1.8	cf. 48-112i2			
47-109b3	P61 IV	—	$14.31 \pm 0.13^*$ 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.31	14.3 ± 1.7 14.9 ± 1.8 14.9 ± 1.8 14.8 ± 1.8 14.7 ± 1.8	cf. 22-46a2			
47-109b4	M61 II	—	14.8	2.7 ± 0.5	cf. 11-23i2			
$\text{Ag}^{109}(n, z) \text{ Rh}^{106}$								
47-109i1	K59 II	140.8 min	14.3 ± 0.55	38 ± 6	cf. 13-27b7			

* Also measured for $7 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ag}^{109}(n, nz) \text{ Rh}^{105g}$								
47-109k1g	B62 II	36h	14.7	< 0.60	—	—	—	—
$\text{Ag}^{nat}(n, 2n) \text{ Ag}$								
47-a1	A58 II	—	14.1	1730 ± 130	cf. 1-2a1		Element	
$\text{Ag}^{nat}(n, p + n, pn) \text{ Pd}$								
47-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} < 14$	cf. 11-23d1			
47-d2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d\Omega} \right] = 28 \pm 3$ means for $\theta = 0^\circ, 45^\circ, 90^\circ, 135^\circ$ and $d\Omega = 180^\circ$	cf. 29-d2			
$\text{Ag}^{nat}(n, p + n, pn + n, np + n, d) \text{ Pd}$								
47-g1 diff.	E59 I	—	14	$\frac{\sigma}{\text{Sterad.}} = 3.5 \pm 0.7$ for $d\Omega = 0^\circ - 15^\circ$ and $E_p > 4 \text{ MeV}$	cf. 51-g1		Foil, 40-50 mg/cm ² thickness	

C A D M I U M

$\text{Cd}^{106}(n, 2n) \text{ Cd}^{105}$

48-106a1	R61 II	50.7 ± 1.0 min ^{*1}	14.4 ± 0.3	827 ± 63	cf. 7-14a7	Element
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$\text{Cd}^{106}(n, p) \text{ Ag}^{106}$

48-106b1	L58	24 min	14	76 ± 24	rel.: cf. 48-112i2 $\text{Cd}^{112}(n, \alpha) = 1.35$ mb	β -activity, geiger counter, chem. separation
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$\text{Cd}^{111}(n, p) \text{ Ag}^{111}$

48-111b1	L58	—	14	15 ± 4	cf. 48-106b1
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48-111b2	P61 IV	—	14.01 ± 0.10 ^{*2}	23.5 ± 1.4	cf. 22-46a2
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14.09 ± 0.10
 14.31 ± 0.13
 14.50 ± 0.20
 14.81 ± 0.31
 14.93 ± 0.36

22.5 ± 1.4

27.6 ± 1.7

28.8 ± 1.7

30.6 ± 1.8

36.5 ± 2.2

$\text{Cd}^{112}(n, p) \text{ Ag}^{112}$

48-112b1	L58	—	14	9.8 ± 3	cf. 48-106b1
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$\text{Cd}^{112}(n, \alpha) \text{ Pd}^{109}$

48-112i1	P61 IV	—	13.88 ± 0.10 ^{*3}	2.3 ± 0.1	cf. 22-46a2
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14.09 ± 0.10
 14.31 ± 0.13
 14.50 ± 0.20
 14.68 ± 0.26
 14.81 ± 0.31
 14.93 ± 0.36

2.8 ± 0.1

2.8 ± 0.1

3.1 ± 0.2

3.4 ± 0.2

3.3 ± 0.2

3.3 ± 0.2

^{*1} Measured by the authors

^{*2} Also measured for $7 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

^{*3} Also measured for $7 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
48-112 <i>i2</i>	D58	13 <i>h</i>	14.1	1.35 ± 0.27 Cu ⁶³ (<i>n</i> , 2 <i>n</i>) = 500 mb	rel. : cf. 27-63 <i>a</i> cf. 48-113 <i>b1</i>	β-activity, geiger-counter : chemical separation. Corrections for absolute β-counting exp. determined with standard sources and Al-foils of different thickness	Standard deviation	Thickness after chem. separation 2 mg/cm ²
48-113 <i>b1</i>	L58	—	14	7.2 ± 2.2		cf. 48-106 <i>b1</i>		
48-114 <i>ig</i>	D58	22 min	14.1	0.51 ± 0.13		cf. 48-112 <i>i2</i>		
48-114 <i>ilm</i>	D58	5.5 <i>h</i>	14.1	0.13 ± 0.06		cf. 48-112 <i>i2</i>		
48-116 <i>alt</i>	P61 1	—	14.01 ± 0.10* 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	1690 ± 118 1604 ± 115 1748 ± 124 1634 ± 116 1642 ± 117 1588 ± 113 1634 ± 116		cf. 22-46 <i>a2</i>		
48-116 <i>a1g</i>	K61 II	53.5 <i>h</i>	14.8 ± 0.5	690 ± 100		cf. 17-35 <i>a5m</i>		

* Also measured for 8.8 MeV ≤ E_n ≤ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
48-116a2g	P61 I	53h		14.01 \pm 0.10*	850 \pm 85 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26 14.81 \pm 0.31 14.93 \pm 0.36	cf. 22-46a2		
48-116alm	P61 I	43d		14.01 \pm 0.10*	840 \pm 84 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26 14.81 \pm 0.31 14.93 \pm 0.36	cf. 22-46a2		
48-116a2m	K61 II	43.5d		14.8 \pm 0.5	490 \pm 70		cf. 17-35a5m	
$\text{Cd}^{nat}(n, 2n) \text{ Cd}$								
48-a1	A58 II	—	14.1	1920 \pm 150		cf. 1-2a1		
$\text{Cd}^{nat}(n, p) \text{ Ag} + \text{Cd}^{nat}(n, pn) \text{ Ag}$								
48-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{120^\circ} < 14$		cf. 11-23d1		
$\text{Cd}^{nat}(n, p + n, pn + n, np + n, d) \text{ Ag}$								
48-g1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 3.8 \pm 0.4$ for $d\Omega = 0^\circ - 15^\circ$ and $E_p > 5 \text{ MeV}$		cf. 51-g1		Foil, 30-40 mg/cm ² thickness

* Also measured for $12 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
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I N D I U M

$\text{In}^{115}(n, 2n) \text{ In}^{111m}$ I 42 msec.

49-115alm I	G59 I	42 ± 2 msec ^{*1}	14.5	800 ± 400	rel. : cf. 29-63a $\text{Ca}^{62}(n, 2n) = 500$ mb	cf. 12-24b1m
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$\text{In}^{115}(n, 2n) \text{ In}^{114m}$ II 50d

49-115a2m II	P61 I	50.0d	$13.88 \pm 0.10^{*2}$	1523 ± 76		cf. 22-46a2
			14.01 ± 0.10	1557 ± 78		
			14.31 ± 0.13	1500 ± 77		
			14.50 ± 0.20	1539 ± 77		
			14.81 ± 0.31	1585 ± 79		
			14.93 ± 0.36	1503 ± 76		

$\text{In}^{115}(n, p) \text{ Cd}^{115}$

49-115b1	D58	—	14.5	15.5 ± 4		cf. 48-112i2
49-115b2	P61 VI	—	14	20 ± 9	—	—

$\text{In}^{115}(n, z) \text{ Ag}^{112}$

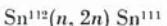
49-115i1	B55 III	3.2h	14.05 ± 0.55	2.5 ± 0.4		cf. 27-59i3
49-115i2	C59 II	—	14.5	2.89 ± 0.29	rel. : $\text{Al}^{27}(n, z) = ?$	β -activity, 4π geometry prop. counter. Activity measured after chem. se- paration with a foil of 20 $\mu\text{g}/\text{cm}^2$. Absorption and scattering of the β in the foil neglected Standard deviation contains : statistics; neutron flux; chem. separation

^{*1} Measured by the authors

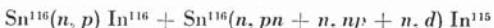
^{*2} Also measured for 9.3 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
In¹¹⁵(n, nz) Ag^{111g}								
49-115k1	B62 II	7.5d	14.7	< 0.055	—	—	—	—
In^{nat}(n, p + n, pn) Cd								
49-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{120^\circ} < 14$	—	cf. 11-23d1		
In^{nat}(n, p + n, pn + n, np + n, d) Cd								
49-g1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 1.6 \pm 0.3$ for $d\Omega = 0^\circ - 15^\circ$ and $E_p > 4.5$ MeV	—	cf. 51-g1	Foil. 30-40 mg cm ⁻² thickness	
49-92 diff.	V57	—	11	$4\pi \left[\frac{d\sigma}{d\theta} \right] = 20 \pm 9$ means for $0 = 30^\circ, 45^\circ, 60^\circ, 90^\circ, 120^\circ, 135^\circ, 150^\circ$ and $E_p > 8$ MeV	—	cf. 12-g1		

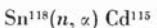
TIN



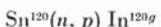
50-112a1	R59 I	32.5 min	14	1400 ± 110	cf. 17-35a3m			
50-112a2	R61 II	32.1 ± 0.6 min ^{*1}	14.4 ± 0.3	1508 ± 122	cf. 7-14a7			Element
50-112a3	P61 I	—	Rel. measurement ^{*2}	—	cf. 22-46a2			
50-112a4	T60	—	13.9^{*3}	725 ± 80	—	—	—	—



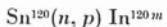
50-g1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} < 1$ for $d\Omega$ $= 0^\circ - 15^\circ$ and E_p > 4 MeV	cf. 51-g1		Sn^{116} enriched 98 % : thickness 10 mg/cm ²
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50-118i1	P61 IV	53h	$13.88 \pm 0.10^{*4}$ 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31	0.76 ± 0.05 0.93 ± 0.07 0.94 ± 0.07 1.14 ± 0.08 1.13 ± 0.08 1.23 ± 0.09	cf. 22-46a2		
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50-120big	P60 II	3 sec	14.8 ± 0.8	~ 1	cf. 27-59a1g		Sn^{120} enriched
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50-120b1m	P60 II	50 sec	14.8 ± 0.8	2.8 ± 1	cf. 27-591g		Sn^{120} enriched
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^{*1} Measured for the authors^{*2} Measured for $11.2 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$ ^{*3} Also measured for 11.8 MeV and 12.9 MeV^{*4} Also measured for $12 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
50-I20gI diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}}$ = 0° — 15° and E _p ≥ 4 MeV	< 1 for dΩ = 0° — 15° and E _p ≥ 4 MeV	cf. 50-gI	Sn ¹²⁰ enriched 98% thickness 10 mg/cm ²	
50-dI diff.	A61	—	14.1	Sn ^{nat} (n, p + n, pn) In	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{12^{\circ}0} < 15$	cf. 11-23dI		

ANTIMONY

$\text{Sb}^{121}(n, 2n) \text{ Sb}^{120}$ I 16 min.

51-121a1 I	P53	15 min	14.5 ± 0.35	750 ± 150	cf. 7-14a1	Element
51-121a2 I	R58 I	15.7 min	14	1000	cf. 7-14a2	
51-121a3 I	K59 III	16.2 min	14.3 ± 0.5	453 ± 41	cf. 13-27b7	
51-121a4 I	R61 II	15.7 ± 0.3 min* ¹	14.4 ± 0.3	1056 ± 80	cf. 7-14a7	Element
51-121a5 I	K61 II	16.5 min	14.8 ± 0.5	1180 ± 180	cf. 17-35a5m	

$\text{Sb}^{121}(n, 2n) \text{ Sb}^{120}$ II 5.8d

51-121a1 II	P61 I	Rel. measurement* ²	cf. 22-46a2
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$\text{Sb}^{123}(n, 2n) \text{ Sb}^{122g+m}$

51-123a1g+m	P53	2.8d	14.5 ± 0.35	1245 ± 300	cf. 7-14a1	Element
51-123a2g+m	K59 II	2.8d	14.3 ± 0.5	1706 ± 100	cf. 13-27b7	
51-123a3g+m	K61 II	2.8d	14.8 ± 0.5	1950 ± 200	cf. 17-35a5m	
51-123a4g+m	P61 IV	—	$14.00 \pm 0.10^{*3}$ 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	1280 ± 70 1336 ± 65 1263 ± 60 1342 ± 70 1255 ± 65 1280 ± 65 1192 ± 60	cf. 22-46a2	

*¹ Measured by the authors

*² Measured for 9.4 MeV $\leq E_n \leq$ 19.8 MeV

*³ Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
51-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{12^{\circ}} = 11 \pm 6$	Sb ^{nat} (n, p + n, pn) Sn	cf. 11-23d1		
51-g1 diff.	P59 III	—	14	$\frac{d\sigma}{d\Omega} = 22 \pm 4$ for abs. : proton recoil-telescope $d\Omega = 0^{\circ} - 60^{\circ}$ and $E_p > 5$ MeV	Telescope ; 2 prop. counters in coincidence with a CsI crystal	Stat. error	Thickness 7 mg/cm ²	
51-g2 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 40 \pm 2$ for $d\Omega = 0^{\circ} - 15^{\circ}$ and $E_p > 5$ MeV	cf. 50-g1		Thickness 30-40 mg/cm ²	

I	II	III	IV	V	VI	VII	VIII	IX
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T E L L U R I U M

$\text{Te}^{128}(n, 2n) \text{ Te}^{127}$

52-128a1	P53	9.3 <i>h</i>		14.5 ± 0.35	$< 779 \pm 230$		cf. 7-14a1	Element
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$\text{Te}^{128}(n, pn) \text{ Sb}^{127} + \text{Te}^{128}(n, np + n, d) \text{ Sb}^{127}$

52-128c1	B59 II	—	14.5	0.33 ± 0.05	rel. : ef. 13-27 <i>i</i> $\text{Al}^{13}(n, \alpha) = 111$ mb Sandwich method	Activation method, 4π counter; chemical separation. $\sigma(n, np)$ and $\sigma(n, d)$ are supposed to be small	—	Foils; 50 mg/cm ² thickness. Isotopically enriched targets
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$\text{Te}^{130}(n, 2n) \text{ Te}^{129g+m}$

52-130a1g+ <i>m</i>	P53	70 min, 32 <i>d</i>	14.5 ± 0.35	599 ± 120		cf. 7-14a1	
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$\text{Te}^{130}(n, pn) \text{ Sb}^{129} + \text{Te}^{130}(n, np + n, d) \text{ Sb}^{129}$

52-130c1	B59 II	—	14.5	0.17 ± 0.02		cf. 52-128e1	
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$\text{Te}^{130}(n, \alpha) \text{ Sn}^{127}$

52-130 i1	C59 II	—	14.5	0.37 ± 0.06		cf. 49-115i2	
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$\text{Te}^{nat}(n, p + n, pn) \text{ Sb}$

52-d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega} \right]_{12^{\circ}} < 5$		cf. 11-23d1	
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$\text{Te}^{nat}(n, p + n, pn + n, np + n, d) \text{ Sb}$

52-g1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} < 1$ for $d\Omega$ $= 0^{\circ} - 15^{\circ}$ and E_p > 5 MeV		cf. 51-g1	Powder 40 mg/cm ² thickness
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IODINE

$I^{127}(n, 2n) I^{126}$

53-127a1	P53	$13d$	14.5 ± 0.35	1120 ± 400		cf. 7-14a1		NH_4I ; LiI
53-127a2	M53	$13.1d$	14.1^{*1}	1300 ± 80	abs. : Long-counter calibrated with a Ra-Be source	β -activity; NaI crystal served as target and counter	Estimated total error	NaI crystal
53-127a3	B62 I	$13.05 \pm 0.08d^{*2}$	$14.1 \pm 0.1^{*3}$	13.20 ± 110		cf. 29-65a8		I_2O_5

$I^{127}(n, p) Te^{127}$

53-127b1	P53	$9.3h$	14.5 ± 0.35	$< 231 \pm 140$		cf. 7-14a1		NH_4I ; LiI
53-127b2	B60	$9h$	14.1 ± 0.1	25 ± 15		cf. 11-23b2		
53-127b3	D58	—	14.5	11.7 ± 1.8		cf. 48-112i2		

$I^{127}(n, p) Te^{127} + I^{127}(n, pn) Te^{126}$

53-127d1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta} \right]_{12n^0} = 5$		cf. 11-23d1		
53-127d2	B61 IV	—	$14.1 \pm 0.1^{*4}$	13.1 ± 1.3 by evaporation 2.1 ± 0.2 by direct-processes	rel. : cf. 3-6h5 $Li^6(n, \gamma) = 25.8$ mb and the assumption $\sigma_i^{127}(n, p) \approx \sigma_{cs}^{126}(n, p)$	CsI crystal served as target and counter. Separation of α , p - and γ -pulses by pulse shape discrimination. Separation of n, p - and n, np -processes and of evaporation- and direct-processes by stat. theory	Error contains : neutron flux; pulse shape discrimination; statistics.	CsI crystal

*1 Also measured for $9.5 \text{ MeV} \leq E_n \leq 18 \text{ MeV}$

*2 Measured by the authors

*3 Also measured for $12.8 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

*4 Also measured for $13 \text{ MeV} \leq E_n \leq 21 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{I}^{127}(n, np) \text{ Te}^{126}$								
53-127el	B61 IV	—	$14.1 \pm 0.1^{*1}$	1.3 ± 0.2	rel. : cf. 3-6 <i>h5</i> $\text{Li}^6(n, z) = 25.8 \text{ mb}$ and the assumption $\sigma_{i^{127}}(n, np) \approx \sigma_{cs^{123}}(n, np)$	cf. 53-127 <i>d2</i>		
$\text{I}^{127}(n, z) \text{ Sb}^{124}$								
53-127 <i>i1</i>	P53	20 min	14.5 ± 0.35	$< 18.4 \pm 2.8$		cf. 7-14 <i>a1</i>		NH ₄ I; LiI
53-127 <i>i2</i>	B61 IV	—	$14.1 \pm 0.1^{*}$	1.08 ± 0.13	cf. 53-127 <i>d2</i> and for <i>p</i> * say <i>z</i>			
$\text{I}^{127}(n, nz) \text{ Sb}^{123}$								
53-127 <i>k1</i>	B61 IV	—	$14.1 \pm 0.1^{*}$	0.02 ± 0.004	cf. 53-127el and for <i>p</i> say <i>z</i>			

*1 Also measured for $13 \text{ MeV} \leq E_n \leq 21 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
C E S I U M								
$\text{Cs}^{133}(n, 2n) \text{ Cs}^{132}$								
55-133a1	M61 I	—	14.1	1550 ± 250		ef. 38-86a1m		Cs_7CO_3 powder
55-133a2	B62 I	$6.44 \pm 0.05^{*1}$	$14.1 \pm 0.1^{*2}$	1289 ± 130		ef. 29-65a8		Cs_2CO_3
$\text{Cs}^{133}(n, p) \text{ Xe}^{133} + \text{Cs}^{133}(n, pn) \text{ Xe}^{132}$								
55-133d1	B61 IV	—	$14.1 \pm 0.1^{*3}$	13.1 ± 1.3 by evaporation 2.1 ± 0.2 by direct processes		ef. 53-127d2		
$\text{Cs}^{133}(n, np) \text{ Xe}^{132}$								
55-133e1	B61 IV	—	$14.1 \pm 0.1^{*3}$	1.3 ± 0.2		ef. 52-127e1		
$\text{Cs}^{133}(n, \text{He}^3) \text{ I}^{131}$								
55-133f1	B62 II	$8.1d$	14.7	< 0.15	—	—	—	—
$\text{Cs}^{133}(n, 2p) \text{ I}^{132}$								
55-133h1	B62 II	$2.3h$	14.7	< 0.005	—	—	—	—
$\text{Cs}^{133}(n, \alpha) \text{ I}^{130}$								
55-133i1	B58	$12.6h$	14.05 ± 0.05	1 ± 0.3		ef. 27-59i3		
55-133i2	C59 II	—	14.5	1.9 ± 0.2		ef. 49-115i2		
55-133i3	B61 IV	—	$14.1 \pm 0.1^{*3}$	1.08 ± 0.13		ef. 53-127i2		

*1 Measured by the authors

*2 Also measured for $13 \text{ MeV} \leq E_n \leq 19.6 \text{ MeV}$

*3 Also measured for $13 \text{ MeV} \leq E_n \leq 21 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Cs}^{133}(n, nz) \text{ I}^{129}$								
55-133 <i>kl</i>	B61 IV	—	$14.1 \pm 0.1^*$	0.02 ± 0.004		cf. 53-127 <i>kl</i>		

* Also measured for $13 \text{ MeV} \leq E_n \leq 21 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
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B A R I U M

$\text{Ba}^{134}(n, 2n) \text{ Ba}^{133m}$

56-134a1m	W60 I	$38.9 \pm 0.1h^*$	14.8 ± 0.8	940 ± 80		cf. 13-27b4		
							$\text{BaO}_2; \text{ BaCl}_2 \cdot 2\text{H}_2\text{O}$	$\text{Ba}(\text{NO}_3)_2; \text{thickness}$
							30-150 mg/cm ²	

$\text{Ba}^{136}(n, 2n) \text{ Ba}^{135m}$

56-136a1m	W60 I	$28.7 \pm 0.2h^*$	14.8 ± 0.8	700 ± 80		cf. 13-27b4		cf. 56-134a1m
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$\text{Ba}^{136}(n, p) \text{ Cs}^{136}$

56-136b1	W60 I	$13.5 \pm 0.5d^*$	14.8 ± 0.8	49 ± 10		cf. 13-27b4		cf. 56-134a1m
56-136b2	C59 II	—	14.5	38.3 ± 4		cf. 49-115i2		

$\text{Ba}^{138}(n, 2n) \text{ Ba}^{137m}$

56-138a1m	W60 I	$2.6 \pm 0.1 \text{ min}^*$	14.8 ± 0.8	1250 ± 100		cf. 13-27b4		cf. 56-134a1m
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$\text{Ba}^{138}(n, p) \text{ Cs}^{138}$

56-138b1	P53	33 min	14.5 ± 0.35	6.3 ± 2.2		cf. 7-14a1		BaCO_3
56-138b2	W60 I	$32.5 \pm 0.5 \text{ min}^*$	14.8 ± 0.8	2.5 ± 1.2		cf. 13-27b4		
56-138b3	C59 II	—	14.5	2.2 ± 0.3		cf. 49-115i2		

$\text{Ba}^{138}(n, \chi) \text{ Xe}^{138g}$

56-138i1g	F61 II	—	14.2 ± 0.2	13 ± 2		cf. 13-27b11		
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$\text{Ba}^{138}(n, \alpha) \text{ Xe}^{135m}$

56-138i1m	F61 II	—	14.1 ± 0.2	13 ± 2		cf. 13-27b11		
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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L A N T H A N U M

$\text{La}^{139}(n, p) \text{ Ba}^{139}$

57-139b1	P53	85 min	14.5 ± 0.35	5.7 ± 2.4		cf. 7-14a1	La(NO ₃) ₄
57-139b2	W60 I	85 ± 1 min*	14.8 ± 0.8	5 ± 1		cf. 13-27b4	La ₂ O ₃ ; La(NO ₃) ₃ . CH ₃ O; thickness 35- 180 mg/cm ²
57-139b3	C59 II	—	14.5	2.33 ± 0.35		cf. 49-115i2	—

$\text{La}^{139}(n, 2p) \text{ Cs}^{138}$

57-139h1	B62 II	32 min	14.7	< 0.032	—	—	—
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$\text{La}^{139}(n, \alpha) \text{ Cs}^{136}$

57-139i1	W60 I	$13.5 \pm 1.5d^*$	14.8 ± 0.8	1.3		cf. 13-27b4	cf. 57-139b2
57-139i2	C59 II	—	14.5	187 ± 20		cf. 49-115i2	—

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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C E R I U M

$\text{Ce}^{140}(n, 2n) \text{ Ce}^{139\text{ tot.}}$

58-140 alt	W60 I	—	14.8 ± 0.8	3000 ± 400		cf. 27-59 alg		cf. 58-140 alm
$\text{Ce}^{140}(n, 2n) \text{ Ce}^{139g}$								
58-140 alg	W60 I	$140 \pm 10d^*$	14.8 ± 0.8	1800 ± 400		cf. 27-59 alg		cf. 58-140 alm
$\text{Ce}^{140}(n, 2n) \text{ Ce}^{139m}$								
58-140 alm	W60 I	$65 \pm 10 \text{ sec}^*$	14.8 ± 0.8	1200 ± 400		cf. 27-59 alg		$\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$; thickness 30-120 mg/ cm^2
58-140 $a2m$	P61 III	$57 \pm 5 \text{ sec}^*$	14.1 ± 0.1	1440 ± 160		cf. 13-27 $b8$		
$\text{Ce}^{140}(n, p) \text{ La}^{140}$								
58-140 $b1$	W60 I	$40 \pm 2h^*$	14.8 ± 0.8	10 ± 2		cf. 27-59 alg		cf. 58-140 alm
58-140 $b2$	C59 II	—	14.5	12.1 ± 1.2		cf. 49-115 $i2$		
$\text{Ce}^{140}(n, \alpha) \text{ Ba}^{137m}$								
58-140 $i1m$	P53	2.5 min	14.5 ± 0.35	12.1 ± 6		cf. 7-14 $a1$		$\text{Ce}(\text{NO}_3)_3$
58-140 $i2m$	W60 I	$2.6 \pm 0.1 \text{ min}^*$	14.8 ± 0.8	9 ± 2		cf. 27-59 alg		cf. 58-104 alm
$\text{Ce}^{142}(n, 2n) \text{ Ce}^{141}$								
58-142 $a1$	W60 I	$32 \pm 2d^*$	14.8 ± 0.8	1600 ± 300		cf. 27-59 alg		cf. 58-140 alm

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Ce}^{142}(n, p) \text{ La}^{141}$								
58-142b1	W60 I	77 ± 3 min*	14.8 ± 0.8	5 ± 2		cf. 27-59a1g		cf. 58-140a1m
58-142b2	C59 II	—	14.5	9.4 ± 0.9		cf. 49-115i2		
$\text{Ce}^{142}(n, pn) \text{ La}^{141} + \text{Ce}^{142}(n, np + n, d) \text{ La}^{141}$								
58-142c1	B59 II	—	14.5	1.0 ± 0.2		cf. 52-128e1		
$\text{Ce}^{142}(n, z) \text{ Ba}^{139}$								
58-142i1	W60 I	85 ± 1 min*	14.8 ± 0.8	8 ± 2		cf. 27-59a1g		cf. 58-140a1m
58-142i2	C59 II	—	14.5	7.04 ± 0.7		cf. 49-115i2		

* Measured by the authors

P R A S E O D Y N I U M

$$\text{Pr}^{141}(n, 2n) \text{ Pr}^{140}$$

59-141a1	P53	3.4 min	14.5 ± 0.35	2060 ± 700		cf. 7-14a1	PrO_2
59-141a2	W60 I	3.5 ± 0.2 min* ¹	14.8 ± 0.8	2100 ± 300		cf. 13-27b4	Element, PrO_2 $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ thickness 20-130 mg/cm ²
59-141a3	R58 I	3.27 min	14	1768		cf. 7-14a2	
59-141a4	F60	—	$13.77 \pm 0.20^{*2}$	1386 ± 125		cf. 7-14a3	PrO_2
			14.74 ± 0.27	1591 ± 143			
59-141a5	R61 II	3.13 ± 0.09 min* ¹	14.4 ± 0.3	1801 ± 135		cf. 7-14a7	Pr_6O_{11}
59-141a6	K61 II	3.5 min	14.8 ± 0.5	1378 ± 206		cf. 17-35a5m	

$$\text{Pr}^{141}(n, p) \text{ Ce}^{141}$$

59-141b1	W60 I	$32 \pm 2d^{*1}$	14.8 ± 0.8	4.5 ± 1.0		cf. 13-27b4	cf. 59-141a2
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$$\text{Pr}^{141}(n, 2p) \text{ La}^{140}$$

59-141h1	B62 II	40.2h	14.7	< 0.84	—	—	—
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*¹ Measured by the authors

*² Also measured for $12.5 \text{ MeV} \leq E_n \leq 18 \text{ MeV}$

N E O D Y M I U M

$\text{Nd}^{142}(n, 2n) \text{ Nd}^{141}$

60-142a1	W60 I	$2.5 \pm 0.3h^*$	14.8 ± 0.8	2060 ± 200	cf. 27-59a1g	Nd_2O_3 nat. and iso-top. enriched Nd^{148} (84.59 ‰); Nd^{150} (93.5 ‰)
60-142a2	R59 I	$2.53h$	14	2480 ± 200	cf. 17-35a3m	
60-142a3	R61 II	$2.54 \pm 0.05h^*$	14.4 ± 0.3	2411 ± 200	cf. 7-14a7	Nd_2O_3

$\text{Nd}^{142}(n, p) \text{ Pr}^{142}$

60-142b1	C59 II	—	14.5	13.5 ± 2.7	cf. 19-115i2
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$\text{Nd}^{142}(n, z) \text{ Ce}^{139g}$

60-142i1g	W60 I	$140 \pm 10d^*$	14.8 ± 0.8	2 ± 1	cf. 27-59a1g	cf. 60-142a1
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$\text{Nd}^{142}(n, z) \text{ Ce}^{139m}$

60-142i1m	W60I	65 ± 10 sec*	14.8 ± 0.8	10 ± 2	cf. 27-59a1g	cf. 60-142a1
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$\text{Nd}^{143}(n, p) \text{ Pr}^{143}$

60-143b1	C59 II	—	14.5	11.5 ± 2.3	cf. 49-115i2
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$\text{Nd}^{146}(n, z) \text{ Ce}^{143}$

60-146i1	W60 I	$34 \pm 2h^*$	14.8 ± 0.8	8.3 ± 2	cf. 27-59a1g	cf. 60-142a1
60-146i2	C59 II	—	14.5	2.6 ± 0.4	cf. 49-115i2	

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
$\text{Nd}^{148}(n, 2n) \text{ Nd}^{147}$								
60-148a1	W60 I	11.5 \pm 0.5d*	14.8 \pm 0.8	2160 \pm 200		cf. 27-59a1g		cf. 60-142a1
$\text{Nd}^{148}(n, p) \text{ Pr}^{148}$								
60-148b1	W60 I	12 \pm 3 min*	14.8 \pm 0.8	3.5 \pm 0.8		cf. 27-59a1g		cf. 60-142a1
$\text{Nd}^{148}(n, z) \text{ Ce}^{145}$								
60-148i1	W60 I	3.1 \pm 0.2 min*	14.8 \pm 0.8	5 \pm 1		cf. 27-59a1g		cf. 60-142a1
$\text{Nd}^{150}(n, 2n) \text{ Nd}^{149}$								
60-150a1	W60 I	1.8 \pm 0.1h*	14.8 \pm 0.8	2200 \pm 300		cf. 27-59a1g		cf. 60-142a1

* Measured by the authors

I

II

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IV

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VI

VII

VIII

IX

S A M A R I U M

$$\text{Sm}^{144}(n, 2n) \text{ Sm}^{143}$$

62-144a1	W58	8.5 ± 0.3 min*	14.8 ± 0.9	1200 ± 300		cf. 13-27b4	Sm_2O_3 nat. and enriched : Sm^{144} : 97.2 % ; Sm^{152} : 99.7 % ; thickness 35-120 mg/cm ²
62-144a2	R61 II	9.4 ± 0.6 min*	14.4 ± 0.3	1484 ± 120		cf. 7-14a7	Sm_2O_3
62-152b1	W58	6.5 ± 0.5 min*	14.8 ± 0.9	3.7 ± 0.2		cf. 13-27b4	cf. 62-144a1
62-152i1	P53	1.7h	14.5 ± 0.35	8.9 ± 5		cf. 7-14a1	Sm_2O_3
62-152i2	W58	$1.6 \pm 0.3h^*$	14.8 ± 0.9	10 ± 2		cf. 13-27b4	cf. 62-144a1
62-154a1	P53	47h	14.5 ± 0.35	$< 2250 \pm 900$		cf. 7-14a1	Sm_2O_3
62-154a2	W58	$45 \pm 3h^*$	14.8 ± 0.9	1500 ± 300		cf. 13-27b4	cf. 62-144a1
62-154b1	W58	2.5 ± 0.5 min*	14.8 ± 0.9	3.5 ± 0.2		cf. 13-27b4	cf. 62-144a1
62-154i1	W58	17.3 ± 0.5 min*	14.8 ± 0.9	9 ± 3		cf. 13-27b4	cf. 62-144a1

* Measured by the authors

E U R O P I U M

$\text{Eu}^{151}(n, 2n) \text{ Eu}^{150g}$

163-151a1g	W60 I	$15 \pm 1h^*$	14.8 ± 0.8	500 ± 200	cf. 13-27b4	Eu_2O_3 thickness: 23 mg cm ⁻²
63-151a2g	K61 II	$13.4h$	14.8 ± 0.5	640 ± 64	cf. 17-35a5m	

$\text{Eu}^{153}(n, 2n) \text{ Eu}^{152m}$

63-153a1m	W60 I	$9.3 \pm 0.5h^*$	14.8 ± 0.8	750 ± 200	cf. 13-27b4	cf. 63-151a1g
63-153a2m	K61 II	$9.3h$	14.8 ± 0.5	164 ± 25	cf. 17-35a5m	

$\text{Eu}^{153}(n, p) \text{ Sm}^{153}$

63-153b1	C59 II	—	14.5	7.4 ± 0.7	cf. 49-115i2
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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G A D O L I N I U M

$\text{Gd}^{156}(n, \alpha) \text{ Sm}^{153}$

64-156i1	C59 II	—	14.5	3.22 ± 0.48		cf. 49-115i2
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$\text{Gd}^{157}(n, p) \text{ Eu}^{157}$

64-157b1	C59 II	—	14.5	11.3 ± 1.7		cf. 49-115i2
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$\text{Gd}^{160}(n, 2n) \text{ Gd}^{159}$

64-160a1	P53	$18h$	14.5 ± 0.35	1470 ± 820		cf. 7-14a1	Gd_2O_3
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64-160a2	W60 I	$18 \pm 0.3h^*$	14.8 ± 0.8	1450 ± 300		cf. 13-27b4	Gd_2O_3 enriched : $\text{Gd}^{160}; 95.3\%$; thick- ness 50-200 mg/cm ²
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64-160a3	K61 II	$17.4h$	14.8 ± 0.5	1725 ± 170		cf. 17-35a5m
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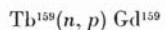
$\text{Gd}^{160}(n, \alpha) \text{ Sm}^{157}$

64-160i1	W60 I	0.5 ± 0.1 min*	14.8 ± 0.8	2 ± 1		cf. 13-27b4	cf. 64-160a2
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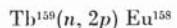
* Measured by the authors

I II III IV V VI VII VIII IX

T E R B I U M



65-159b1 B61 VI — 14.8 ~2.2 — — — —



65-159h1 B62 II 60 min 14.7 < 0.080 — — — —

I

II

III

IV

V

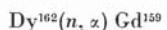
VI

VII

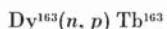
VIII

IX

D Y S P R O S I U M



66-162i1	C59 II		—	14.5	3.56 ± 0.36	cf. 49-115i2
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66-163b1	W60 I	7 ± 1 min*	14.8 ± 0.8	3 ± 1	cf. 13-27b4	Element, purity 98% thickness 80 mg/cm ² . Dy^{163} enriched 74%; thickness 35 mg/cm
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66-164i1	W60 I	3.7 ± 0.3 min*	14.8 ± 0.8	4.5 ± 0.8	cf. 27-59alg	cf. 66-163b1
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* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
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H O L M I U M

$\text{Ho}^{165}(n, 2n) \text{ Ho}^{164}$

67-165a1	K61 II	38.5 min	14.8 ± 0.5	2100 ± 210		cf. 17-35a5m
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$\text{Ho}^{165}(n, p) \text{ Dy}^{165g}$

67-165b1g	F61 II	—	14.1 ± 0.2	40 ± 10		cf. 13-27b11
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$\text{Ho}^{165}(n, p) \text{ Dy}^{165m}$

67-165b1m	F61 II	—	14.1 ± 0.2	< 1		cf. 13-27b11
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* Measured by the authors

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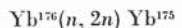
VI

VII

VIII

IX

Y T T E R B I U M



70-176a1	W60 I	$4.2 \pm 0.2d^*$	14.8 ± 0.8	430 ± 100		cf. 13-27b4	Element, thickness 40 mg/cm ²
70-176a2	K61 II	$99h$	14.8 ± 0.5	786 ± 80		cf. 17-35a5m	

* Measured by the authors

I II III IV V VI VII VIII IX

L U T E T I U M

Lu¹⁷⁵(*n, 2n*) Lu¹⁷⁴

71-175a1 W60 I 14.8 ± 0.8 1600 ± 300 cf. 27-59alg

Lu¹⁷⁵(*n, p*) Yb¹⁷⁵

17-175b1 C59 II — 14.5 3 42 ± 0.51 cf. 49-115i2

I

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V

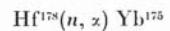
VI

VII

VIII

IX

H A F N I U M



72-178*i*1

C59 II

—

14.5

2.0 \pm 0.2

cf. 49-115*i*2

I

II

III

IV

V

VI

VII

VIII

IX

T A N T A L U M

$\text{Ta}^{181}(n, 2n) \text{ Ta}^{180}$ - tot.

73-181a $_{alt}$	A58 II	—	14.1	2640 ± 200	cf. 1-2a1	Element
73-181a $_{2t}$ diff.	R57	—	14.1	1800 ± 300 for $E_n > 0.5$ MeV; $d\Omega = 4\pi$	cf. 4-9a2	

$\text{Ta}^{181}(n, 2n) \text{ Ta}^{180m}$

73-181a $_{alm}$	P61 I	8.15h	13.88 \pm 0.10*	1118 ± 56	cf. 22-46a2	Element
			14.09 \pm 0.10	1132 ± 56		
			14.31 \pm 0.13	1115 ± 56		
			14.50 \pm 0.20	1116 ± 56		
			14.68 \pm 0.26	1087 ± 55		
73-181a $_{2m}$	P53	8h	14.5 \pm 0.35	867 ± 220	cf. 7-14a1	Element
73-181a $_{3m}$	P60 II	8h	14.8 \pm 0.8	2740 ± 30	cf. 50-120b1	

$\text{Ta}^{181}(n, p) \text{ Hf}^{181}$

73-181b1	S59 IV	—	14	2.5 ± 0.3	—	—	—
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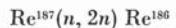
* Also measured for $12.1 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
T U N G S T E N								
$\text{W}^{182}(n, p) \text{ Ta}^{182}$								
74-182b1	S59 IV	—	14	2.3 ± 0.2	—	—	—	—
$\text{W}^{183}(n, p) \text{ Ta}^{183}$								
74-183b1	S59 IV	—	14	2.8 ± 0.3	—	—	—	—
$\text{W}^{184}(n, p) \text{ Ta}^{184}$								
74-184b1	C59 II	—	14.5	4.75 ± 0.95	cf. 49-115i2			
74-184b2	P61 IV	—	14.8	14 ± 4	—	—	—	—
$\text{W}^{186}(n, p) \text{ Ta}^{186}$								
74-186b1	C59 II	—	14.5	2.9 ± 0.6	cf. 49-115i2			
74-186b2	P61 IV	—	14.8	11 ± 4	—	—	—	—
74-186b3	B59 II	—	$13.7 \pm 0.25^*$	1.0 ± 0.2	cf. 52-128e1			
			14.5 ± 0.3	1.4 ± 0.3				
			14.85 ± 0.15	2.8 ± 0.5				
$\text{W}^{186}(n, pn) \text{ Ta}^{185} + \text{W}^{186}(n, np + n, d) \text{ Ta}^{185}$								
74-186c1	B59 II	—	$13.7 \pm 0.25^*$	< 0.04	cf. 52-128e1			
			14.5 ± 0.3	0.11 ± 0.05				
			14.85 ± 0.15	0.3 ± 0.15				

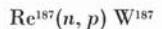
* Also measured for $18.0 \text{ MeV} \leq E_n \leq 21.2 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
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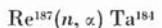
R H E N I U M



75-187 <i>a</i> 1	K61 II	89.0 <i>h</i>	14.8 ± 0.5	1675 ± 168		cf. 17-35 <i>a</i> 5 <i>m</i>
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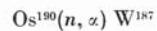
75-187 <i>b</i> 1	C59 II	—	14.5	3.93 ± 0.4		cf. 49-115 <i>i</i> 2
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75-187 <i>i</i> 1	C59 II	—	14.5	0.94 ± 0.14		cf. 49-115 <i>i</i> 2
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I II III IV V VI VII VIII IX

O S M I U M



76-190*i*1

C59 II

—

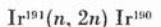
14.5

0.57 ± 0.09

cf. 49-115*i*2

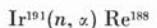
I	II	III	IV	V	VI	VII	VIII	IX
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I R I D I U M



7-191 <i>a</i> 1	K61 II	3.1 <i>h</i>	14.8 \pm 0.5	367 \pm 55				
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cf. 17-35*a*5*m*



77-191 <i>i</i> 1	C59 II	—	14.5	2.43 \pm 0.22				
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cf. 49-115*i*2



77-193 <i>b</i> 1	C59 II	—	14.5	2.7 \pm 0.5				
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cf. 49-115*i*2

I	II	III	IV	V	VI	VII	VIII	IX
P L A T I N U M								
$\text{Pt}^{194}(n, p) \text{ Ir}^{194}$								
78-194 <i>b1</i>	C59 II	—	14.5	3.92 ± 0.4			cf. 49-115 <i>i2</i>	
$\text{Pt}^{194}(n, z) \text{ Os}^{191}$								
78-194 <i>i1</i>	C59 II	—	14.5	1.26 ± 0.25			cf. 49-115 <i>i2</i>	
$\text{Pt}^{195}(n, p) \text{ Ir}^{195}$								
78-195 <i>b1</i>	C59 II	—	14.5	2.91 ± 0.3			cf. 49-115 <i>i2</i>	
$\text{Pt}^{196}(n, z) \text{ Os}^{193}$								
78-196 <i>i1</i>	C59 II	—	14.5	0.55 ± 0.11			cf. 49-115 <i>i2</i>	
$\text{Pt}^{198}(n, 2n) \text{ Pt}^{197}$								
78-198 <i>a1</i>	P53	—	14.5 ± 0.35	2770 ± 1500			cf. 7-14 <i>a1</i>	Element

I	II	III	IV	V	VI	VII	VIII	IX
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G O L D

$\text{Au}^{197}(n, 2n) \text{ Au}^{196}$ - tot.

								Element
79-197a1t	P53	5.5d		14.5 ± 0.35	1722 ± 460		cf. 7-14a1	
79-197a2t	A58 II	—		14.1	2600 ± 200		cf. 1-2a1	
79-197a3t	T60	—		13.9* ¹	1960	—	—	—
				14.0	1900			
				14.1	2110			
				14.6	2090			
				15.1	2110			
79-197a4t	P61 I	6.06d* ²		$14.01 \pm 0.10^{*2}$	2403 ± 120	cf. 22-46a2	cf. 79-197a1m	cf. 22-46a2
				14.31 \pm 0.13	2420 ± 120			
				14.50 \pm 0.20	2403 ± 120			
				14.81 \pm 0.31	2356 ± 120			

$\text{Au}^{197}(n, 2n) \text{ Au}^{196m}$

79-197a1m	P61 I	9.83h		$14.01 \pm 0.10^{*2}$	134.3 ± 6.7	cf. 22-46a2	γ -activity; calibrated NaI crystal	cf. 22-46a2
				14.31 \pm 0.13	137.1 ± 6.9			
				14.50 \pm 0.20	142.1 ± 7.1			
				14.81 \pm 0.31	145.1 ± 7.3			
79-197a2m	T60	—		13.9* ⁴	165	—	—	—
				14.0	165			
				14.1	195			
				14.6	210			
				15.1	195			

$\text{Au}^{197}(n, p) \text{ Pt}^{197}$

79-197b1	C59 II	—	14.5	2.42 ± 0.24		cf. 49-115i2	
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*¹ Also measured for $8.2 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

*² Also measured for $12.1 \text{ MeV} \leq E_n \leq 19.8 \text{ MeV}$

*³ Measured by the authors

*⁴ Also measured for $9.4 \text{ MeV} \leq E_n \leq 15.1 \text{ MeV}$

I	II	III	IV	V	VI	VII	VIII	IX
79-197 <i>b2</i>	P61 IV	—	14.01 \pm 0.10 ^{*1} 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26 14.81 \pm 0.31 14.93 \pm 0.36	1.8 \pm 0.1 2.0 \pm 0.1 2.0 \pm 0.1 2.2 \pm 0.1 2.6 \pm 0.1 2.4 \pm 0.1 2.6 \pm 0.1	cf. 22-46 <i>a2</i>	—	—	—
79-197 <i>f1</i>	B62 II	—	14.7	< 0.020	—	—	—	—
					Au ¹⁹⁷ (n, He ³) Ir ¹⁹⁵			
79-197 <i>i1</i>	P61 IV	—	14.01 \pm 0.10 ^{*2} 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26 14.81 \pm 0.31 14.93 \pm 0.36	0.27 \pm 0.02 0.27 \pm 0.02 0.28 \pm 0.02 0.35 \pm 0.02 0.38 \pm 0.02 0.46 \pm 0.02 0.44 \pm 0.02	cf. 22-46 <i>a2</i>	—	—	—
79-197 <i>i2</i>	C59 II	—	14.5	0.43 \pm 0.04	—	cf. 49-115 <i>i2</i>	—	—
					Au ¹⁹⁷ (n, nz) Ir ¹⁹³			
79-197 <i>k1</i>	B62 II	12 <i>d</i>	14.7	< 1.5	—	—	—	—

^{*1} Also measured for 12.1 MeV $\leq E_n \leq$ 19.6 MeV

^{*2} Also measured for 7 MeV and 12.1 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
M E R C U R Y								
$Hg^{200}(n, p) Au^{200}$								
80-200b1	C59 II	—	14.5	3.63 ± 0.36		cf. 49-115i2		
$Hg^{200}(n, \alpha) Pt^{197}$								
80-200i1	C59 II	—	14.5	1.77 ± 0.35		cf. 49-115i2		
$Hg^{201}(n, p) Au^{201}$								
80-201b1	C59 II	—	14.5	2.12 ± 0.32		cf. 49-115i2		
$Hg^{202}(n, \alpha) Pt^{199}$								
80-202i1	C59 II	—	14.5	1.01 ± 0.10		cf. 49-115i2		

I	II	III	IV	V	VI	VII	VIII	IX
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T H A L L I U M

$Tl^{203}(n, 2n) Tl^{202}$

81-203a1	P61 I	12.5d	13.88 \pm 0.10* ¹ 14.09 \pm 0.10 14.31 \pm 0.13 14.50 \pm 0.20 14.68 \pm 0.26	1302 \pm 58 1302 \pm 58 1329 \pm 60 1321 \pm 60 1305 \pm 58		ef. 22-46a2		
81-203a2	T60	—	13.9* ² 14.0 14.6 15.1	1450 1460 1560 1650	—	—	—	—
81-203a3	M52		Rel. measurement* ³			cf. 19-63a12		

$Tl^{203}(n, p) Hg^{203}$

81-203b1	P61 IV	—	14.8	30	—	—	—	—
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$Tl^{203}(n, \alpha) Au^{200}$

81-203i1	C59 II	—	14.5	0.37 \pm 0.04		cf. 49-115i2		
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$Tl^{203}(n, n\alpha) Au^{199}$

81-203k1	B62 II	3.15d	14.7	< 0.012	—	—	—	—
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$Tl^{205}(n, p) Hg^{205}$

81-205b1	P53	6 min	14.5 \pm 0.35	3.05 \pm 0.6		cf. 7-14a1		Element
81-205b2	C59 II	—	14.5	6.8 \pm 0.7		cf. 49-115i2		
81-205b3	P61 IV	—	14.8	3.0 \pm 0.3	—	—	—	—

$Tl^{205}(n, He^3) Au^{203}$

81-205f1	B62 II	55 sec	14.7	< 0.010	—	—	—	—
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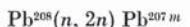
*¹ Also measured for 12.3 MeV $\leq E_n \leq$ 19.8 MeV

*² Also measured for 8.4 MeV $\leq E_n \leq$ 15.1 MeV

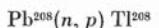
*³ Also measured for 12 MeV $\leq E_n \leq$ 18.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
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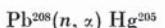
L E A D



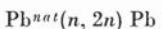
82-208alm	G61 I	0.81 ± 0.02 sec*	14.5	1700 ± 300	rel. : cf. 29-63a $\text{Cu}^{63}(n, 2n) = 620$ mb	cf. 12-24blm
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82-208b1	P53	3.1 min	14.5 ± 0.35	0.96 ± 0.96	cf. 7-14a1	Element
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82-208i1	G59 II	—	14.5	1.58 ± 0.27	cf. 49-115i2	
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82-a1	A58 II	—	14.1	2740 ± 200	cf. 1-2a1	Element
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* Measured by the authors

B I S M U T H

$\text{Bi}^{209}(n, 2n) \text{ Bi}^{208}$ + tot.

							Element
83-209a1t	A58 II	—	14.1	2600 ± 200		cf. 1-2a1	
83-209a2t	R57	—	14.1	2300 ± 300 for $E_\mu > 0.5$ MeV : $d\Gamma$ $\pm 4\pi \text{ Bi}^{209}(n, 2n) \text{ Bi}^{208m}$		cf. 4-9a2	
83-209a1m	G61 I	2.6 ± 0.1 msec*	14.5	660 ± 120	rel. : cf. 29-63a $\text{Cu}^{63}(n, 2n) \quad 620$ mb	cf. 12-24b1m	

$\text{Bi}^{209}(n, p) \text{ Pb}^{209}$

						Element, thickness
83-209b1	P59 I	3.31 ± 0.03 hr*	14.8 ± 0.8	0.83 ± 0.10	cf. 13-27b4	Element, thickness 34-56 mg/cm ²
83-209b2	C59 II	—	14.5	1.33 ± 0.26	cf. 49-115i2	
83-209b3	M61 II	—	14.8	0.7 ± 0.1	cf. 11-23i2	

$\text{Bi}^{209}(n, z) \text{ Tl}^{206}$

					Bi ₂ O ₃ ; Element
83-209i1	P53	4 min	14.5 ± 0.35	1.2 ± 1.0	cf. 7-14a1
83-209i2	P59 I	4.29 ± 0.05 min*	14.8 ± 0.8	1.1 ± 0.3	cf. 13-27b4
83-209i3	C59 II	—	14.5	0.52 ± 0.08	cf. 49-115i2
83-209i4	M61 II	—	14.8	0.6 ± 0.1	cf. 11-23i2

* Measured by the authors

T H O R I U M

Th²³⁰(n, α) Ra²²⁷

90-230i1	C59 II	—	14.5	4.5 ± 1.1	rel. : Al ²⁷ (n, α) = ?	β -activity, 2π geometry; prop. counter; chem. separation. Calibration by measurements in 4π geometry	Mean error contains : statistics, neutron flux chem. separation	—
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Th²³²(n, 2n) Th²³¹

90-232a1	P61 I	26.64h	$13.88 \pm 0.10^{*1}$	1580 ± 158		cf. 22-46a2		
			14.09 ± 0.10	1560 ± 156				
			14.31 ± 0.13	1520 ± 152				
			14.50 ± 0.20	1440 ± 144				
			14.68 ± 0.26	1400 ± 140				
			14.81 ± 0.31	1280 ± 128				
			14.93 ± 0.36	1255 ± 125				
90-232a2	T60	—	13.9^{*2}	1490	—	—	—	—
			14.0	1330				
			14.6	1400				
			15.1	980				
90-232a3	Z61	—	14.7	650 ± 150	rel. : $\sigma(\text{U}^{238}\text{fiss.}) = 1.16$	β -activity, 4π geometry. Chem. separation	Error contains : $\sigma(\text{U}^{238})$, Th(NO ₃) ₄ , 4H ₂ O f fiss.; statistics	
90-232a4	D59 VII	—	14.45 ± 0.20	1230 ± 60	rel. : cf. 16-32b2 S ² (n, p) = 229 mb Sandwich method	β -activity; chem. separation	Error contains : statistics; calibration	Metal discs of 3/16" Ø and 0.040" thickness
90-232a5	P61 VIII	—	14.5 ± 0.5	1200 ± 50	rel. : cf. 13-27i Al ²⁷ (n, α) = ?	γ -activity $2 \frac{1}{2}'' \times 2 \frac{1}{2}''$ NaI crystal. Calibration with standard sources	Error contains : statistics 1%; calibration 3%; neutron flux 3%; weight of the target 1%	Oxyd, 2 cm ² , 8.35 mg/cm ²

*¹ Also measured for 12.2 MeV $\leq E_n \leq$ 16.5 MeV

*² Also measured for 8.2 MeV $\leq E_n \leq$ 15.1 MeV

1

11

III

IV

v

VI

vii

VIII

ix

URANIUM

$$\text{U}^{235}(n, p) \text{ Pa}^{235}$$

92-235b1 C59 II — 14.5 1.86 ± 0.37 cf. 20-230*i*1

$$\text{U}^{238}(n, 2n) \text{ U}^{237}$$

92-238a1 P61 VIII — 14.5 ± 0.4 690 ± 40 rel. : cf. 29-65a
 $\text{Cu}^{65}(n, 2n) = ?$ cf. 90-232a5 Error contains : neutron flux 5 % ; thick source correction 2 % ; weight of the targ. 1 % ; calibration 2 %

$$\text{U}^{238}(n, \alpha) \text{ Th}^{235}$$

92-238*i*1 C59 II — 14.5 1.5 ± 0.3 cf. 90-230*i*1

I

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VIII

IX

N E P T U N I U M

$\text{Np}^{237}(n, 2n) \text{ Np}^{236}$

93-237 <i>a</i> 1	P61 VIII	$2.7 \pm 0.3y$	14.5 ± 0.4	390 ± 40	—	Counting of the α of Pu^{236}	—	Dioxyde 72 mg
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$\text{Np}^{237}(n, p) \text{ U}^{237}$

93-237 <i>b</i> 1	C59 II	—	14.5	1.3 ± 0.3	cf. 90-230 <i>i</i> 1	
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I

II

III

IV

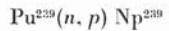
V

VI

VII

VIII

IX

P L U T O N I U M

94-239b1

C59 II

—

14.5

3.0 \pm 0.5ct 90-230*iI*

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