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PROMPT γ-RAY SPECTRA AND INTEGRATED CROSS SECTIONS FOR THE RADIATIVE CAPTURE OF 14 MeV NEUTRONS FOR 28 NATURAL TARGETS IN THE MASS REGION FROM 12 to 208

by

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This report is an extension and continuation of INDC(YUG)-5

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Abstract

Prompt γ-ray spectra and integrated cross sections of the radiative capture of 14.6 MeV neutrons in Mg, ^{27}Al, Si, ^{31}P, S, Ca, ^{45}Sc, ^{51}V, Cr, ^{55}Mn, Fe, ^{59}Co, Cu, Se, Br, Sr, ^{89}Y, In, Sb, ^{127}I, Ba, ^{141}Pr, ^{165}Ho, ^{181}Ta, W, Tl, Pb, ^{209}Bi are presented. Data are obtained by the use of the telescopic scintillation pair spectrometer, allowing the measurement of the spectra integrated over 4π solid angle for light nuclei and over 2π solid angle for heavy nuclei.

Introduction

There are two techniques to measure radiative capture cross sections of energetic neutrons: the activation method and the measurement of prompt γ-ray spectra.

The drawback of the activation technique is that it gives only the cross section which is angle and energy integrated, and that it is difficult to avoid the contribution of the capture events caused in the target material by the neutrons, energy degraded in target itself and its surrounding[15].

The registration of prompt primary γ-rays belonging to the transitions to bound final states allows the determination of differential capture cross section $\sigma(E_\gamma,\theta)$, or in our case $\sigma(E_\gamma)$. To avoid the measurement of γ-rays from the surrounding the timing discrimination should be applied[17].

The integral of the spectra over the range of the γ-ray transitions to the bound states is the integrated cross section, which could be compared with the results of the activation measurements if the cascade deexcitations via unbound states could be neglected. From the very recent activation measurements it follows that the cross sections resulting from the two techniques generally agree within the experimental error[15].

It should be noted that the resolution of the γ-ray spectrometer (NaI/Tl/ and others) used to detect γ-rays is not good enough to isolate the transitions to different final states, which is desired because it could facilitate the theoretical treatment of the capture reactions.

In this report the prompt γ-ray spectra and integrated cross sections of the radiative capture of 14.6 MeV neutrons, in Mg, ^{27}Al, Si, ^{31}P, S, Ca, ^{45}Sc, ^{51}V, Cr, ^{55}Mn, Fe, ^{59}Co, Cu, Se, Br, Sr, ^{89}Y, In, Sb, ^{127}I, Ba, ^{141}Pr, ^{165}Ho, ^{181}Ta, W, Tl, Pb, ^{209}Bi measured in our laboratory are presented. These data are, in most cases reevaluated values of the results reported elsewhere (see Table I). Reevaluation is based on the results of recent analysis[14] of different background contributions.

Experimental procedure

Spectra were measured by the so called telescopic scintillation pair spectrometer. Experimental procedure is, in detail, described in ref. 14. Here is presented only the lay-out of the experimental arrangement (Fig. 1). It is this geometry, which allows the measurement of the γ-ray spectra which are integrated over 4π solid angle for light nuclei (spherical sample) and 2π solid angle for heavy nuclei (hemispherical sample). In this later case the reported spectra are obtained under the supposition that the cross section in the forward hemisphere is equal to that (measured) in the backward hemisphere. Essential data about the experiment and the treatment of the measured values are given in the appendix.

Results

Data about the samples and measured integrated cross sections are presented in table 1, while the spectral values are shown in table 2.

Mass dependence (Fig. 2) of the integrated cross section is rather smooth, and resembles saturation like curve having a saturation value of about 1 mb, which is reached at $A \approx 60$. Data for nuclei around closed neutron shells (e.g. Sr, Y, Ba) are for up to 50 % higher than the cross sections for neighbouring nuclei. Such an increase of the values is observed only in results of prompt γ-ray measurements but not in the activation measurement cross sections. To clarify this point additional measurements should be performed.

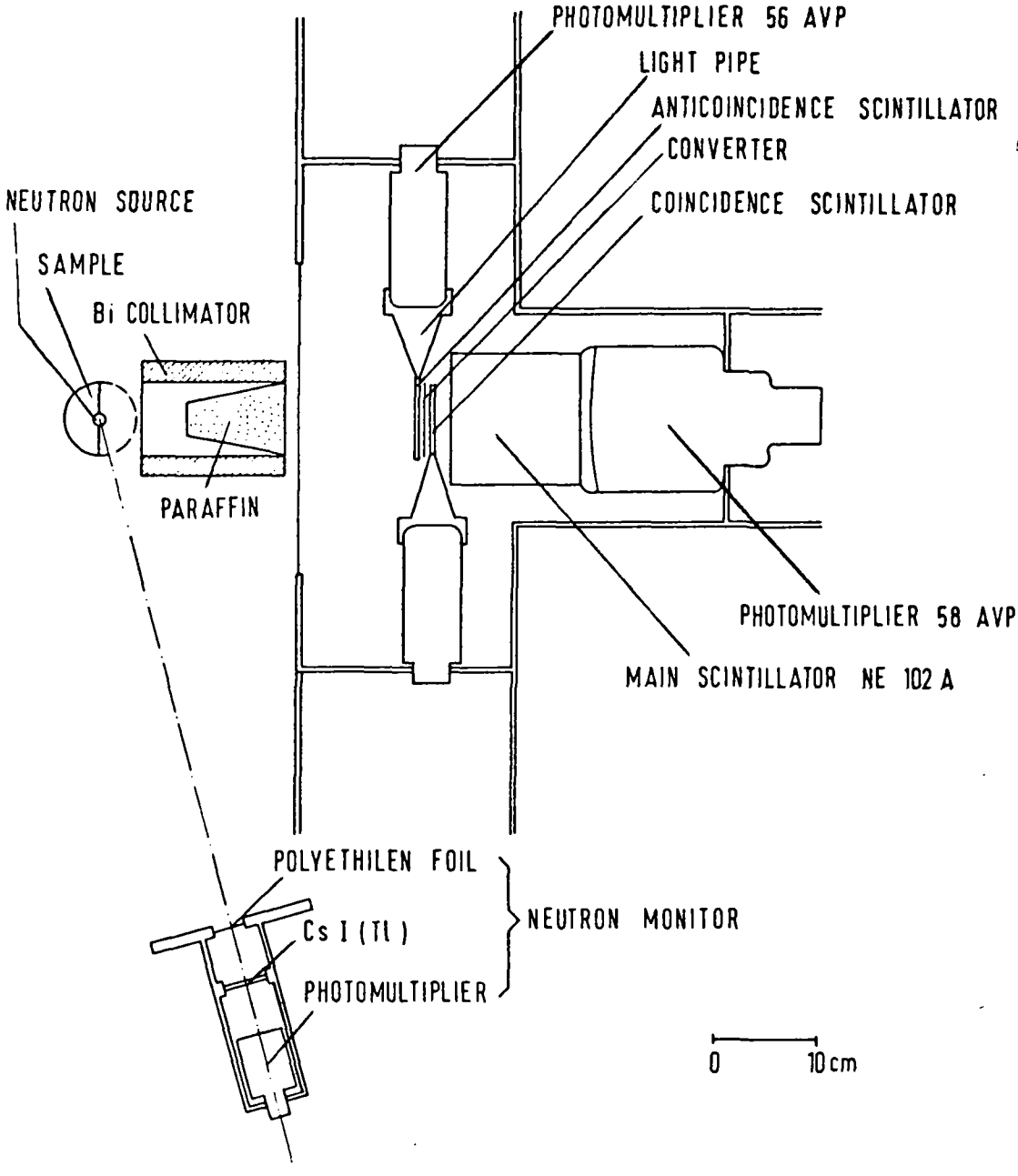

Fig. 1: Experimental set-up of the telescopic pair spectrometer and neutron monitor in measurements of γ -ray spectra from the radiative capture of 14.1 MeV neutrons.

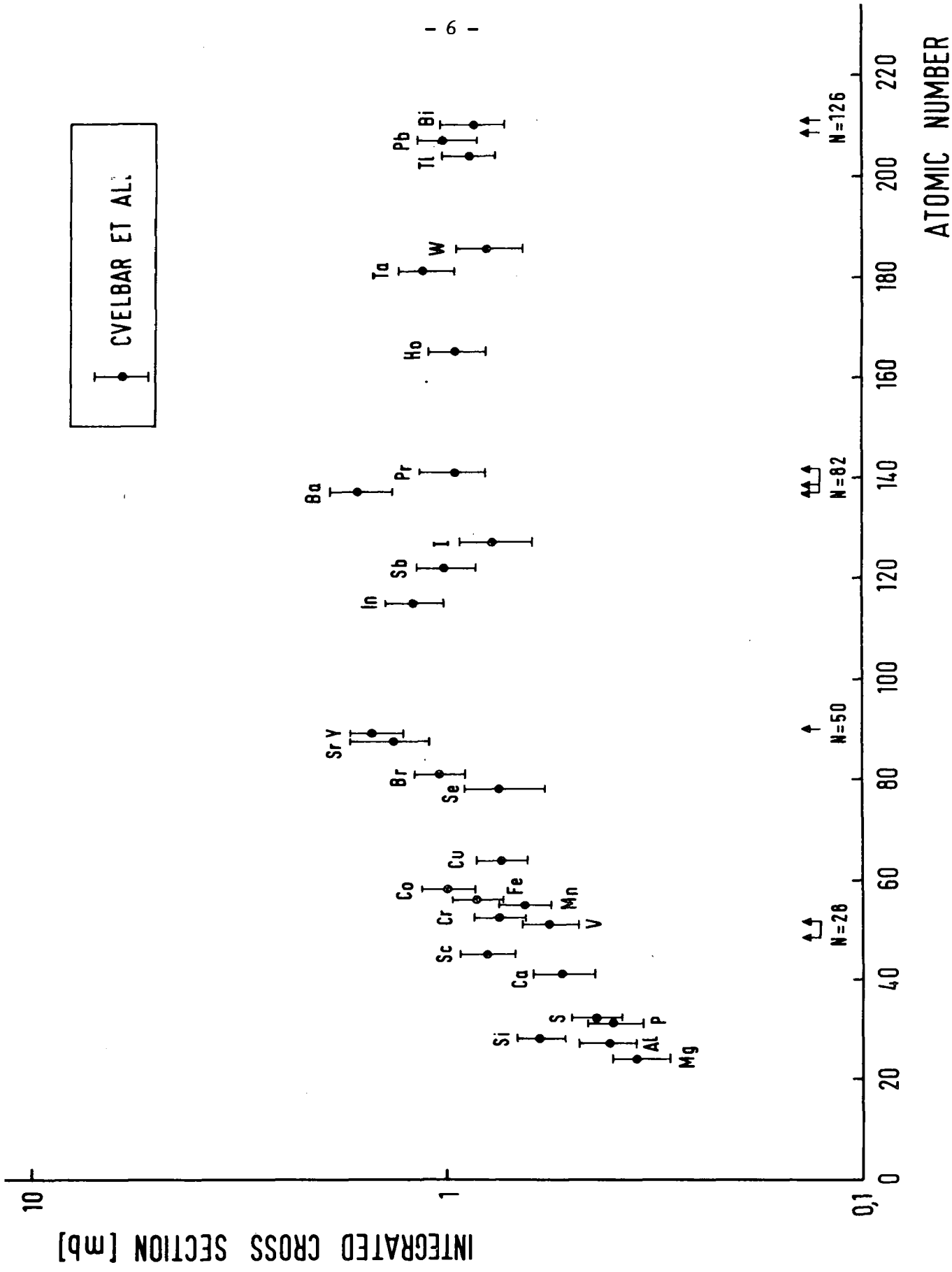

Fig. 2: Mass dependence of the integrated cross section for the radiative capture of 14 MeV neutrons measured in our laboratory.

Table I: Samples and integrated cross sections

Element	Isotopic abundance	Shape	Preparation	Density g/cm³	Diameter cm	σ_{int} μb	σ_{int}	Ref. spectr.
$^{12}_{}$Mg	natural	sphere	rasped out	1.73	6.00	350 ± 40	8) 9)	8)
$^{27}_{13}$Al	100 %	sphere	rasped out	2.70	6.00	415 ± 60	7) 4) 1) 9) 6) 10)	7) 4) 1)
$^{14}_{}$Si	natural	sphere in 0.2 mm Fe	pressed-canned into Fe can	1.68	6.20	600 ± 85	8) 5) 11) 9)	8) 5) 11)
$^{31}_{15}$P	100 %	sphere in Alum. foil	pressed-canned into Al foil	1.70	6.20	400 ± 70	8) 9) 6) 10)	8)
$^{16}_{}$S	natural	sphere	pressed	2.01	6.80	440 ± 65	7) 4) 9)	7) 4)
$^{20}_{}$Ca	natural	sphere	rasped out	1.34	6.20	530 ± 90	9) 8) 5) 11)	8) 5) 11)
$^{45}_{21}$Sc	100 %	sphere in 0.2 mm Aluminium	machined-canned into Al can	3.27	4.56	800 ± 115	14)	14)

Element	Isotopic abundance	Shape	Preparation	Density g/cm³	Diameter cm	σ_{int} μb	σ_{int}	Ref. spectr.
$^{51}_{23}$V	100 %	sphere in 0.2 mm Fe	pressed-canned into Fe can	3.03	6.00	575 ± 95	7) 4) 3) 2) 10) 9) 6)	7) 4) 3) 2)
Cr 24	natural	sphere in 0.2 mm Fe	pressed-canned into Fe can	3.42	5.90	750 ± 110	7) 4) 2) 3) 9)	7) 4) 2) 3)
$^{55}_{25}$Mn	100 %	sphere in 0.2 mm Fe	pressed-canned into Fe can	3.73	5.90	655 ± 95	3) 7) 10) 6) 9) 2) 4)	3) 7) 2) 4)
Fe 26	natural	sphere	rasped out	7.86	4.00	850 ± 120	3) 2) 4) 7) 9)	3) 2) 4) 7)
$^{59}_{27}$Co	100 %	sphere in 0.2 mm Fe	powder poured into Fe can	2.56	3.00	1005 ± 155	3) 2)	3) 2)
Cu 29	natural	sphere	rasped out	8.92	4.00	745 ± 105	9) 6) 10) 13)	13)

Element	Isotopic abundance	Shape	Preparation	Density g/cm³	Diameter cm	σ_{int} μb	σ_{int}	Ref. spectr.
$_{34}$Se	natural	sphere in 0.2 mm glass	powder poured into glass mould	1.42	6.00	750 ± 160	9) 13)	13)
$_{35}$Br	natural	sphere in 0.2 mm glass	liquid poured into glass mould	3.09	6.00	1045 ± 160	9) 13)	13)
$_{38}$Sr	natural	hemisphere in 0.2 mm glass	bits poured into glass mould	1.90	6.00	1345 ± 250	11)	11)
$^{89}_{39}$Y	100 %	sphere in 0.2 mm Alluminium	machined--canned into Al can	4.55	5.96	1490 ± 210	14)	14)
$_{49}$In	natural	hemisphere	casted	7.28	4.00	1210 ± 180	6) 10) 9) 13)	6) 13)
$_{51}$Sb	natural	hemisphere	casted	6.69	4.00	1010 ± 165		
$^{127}_{53}$I	100 %	sphere in 0.2 mm glass	powder poured into glass mould	3.10	6.00	770 ± 160	10) 9) 13)	13)

Element	Isotopic abundance	Shape	Preparation	Density g/cm³	Diameter cm	σ_{int} μb	Ref. σ_{int}	Ref. spectr.
Ba 50	natural	hemisphere	casted	3.50	4.00	1625 ± 280	11) 12)	11) 12)
141 Pr 59	100 %	sphere in 0.2 mm Aluminium	machined--canned into Al can	6.74	5.96	980 ± 165	14)	14)
165 Ho 67	100 %	hemisphere in 0.2 mm Aluminium	machined--canned into Al can	8.83	5.96	950 ± 165	14)	14)
181 Ta 73	100 %	hemisphere in 0.2 mm copper	powder poured into Cu can	7.95	6.00	1130 ± 170		
W 74	natural	hemisphere in 0.2 mm copper	powder poured into Cu can	7.40	6.00	800 ± 155	12)	12)
Tl 81	natural	hemisphere in 0.2 mm copper	casted into Cu can	11.85	6.00	890 ± 135		
Pb 82	natural	hemisphere	casted	11.35	4.00	1015 ± 170	12)	12)
209 Bi 83	100 %	hemisphere	casted	9.75	4.00	880 ± 165	12)	12)

Table II: Spectral data

γ-ray energy (MeV)	^{12}Mg		^{13}Al		^{14}Si		^{15}P		^{16}S		^{20}Ca	
	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error
	[μb / MeV]											
11.75	1658	187	-	-	8327	324	14	85	177	127	-	-
12.25	356	95	-	-	2144	146	14	67	95	79	3	57
12.75	89	53	-	-	505	75	1	11	39	38	11	84
13.25	84	54	310	67	166	49	7	30	19	22	25	95
13.75	37	38	114	34	87	39	37	54	33	24	35	84
14.25	46	37	58	21	91	40	21	32	55	26	24	54
14.75	53	34	33	15	59	30	41	34	27	17	27	45
15.25	35	22	23	12	42	22	48	33	22	15	39	43
15.75	78	30	27	12	80	27	25	20	28	15	78	52
16.25	59	24	38	12	80	25	59	27	36	15	46	38
16.75	67	22	34	11	98	24	60	26	48	17	57	37
17.25	43	17	35	10	89	19	45	20	37	14	43	26
17.75	50	15	36	10	96	15	94	24	50	15	51	20
18.25	30	10	35	10	90	11	51	16	42	12	52	14
18.75	33	10	47	10	70	9	57	15	41	10	50	11
19.25	38	10	50	9	58	7	65	14	47	9	55	10
19.75	33	8	43	7	50	6	47	11	49	9	56	9
20.25	20	6	40	6	54	6	40	10	58	9	64	9
20.75	19	6	42	5	55	7	24	8	72	10	63	9
21.25	14	5	34	5	50	6	29	9	69	10	72	9
21.75	21	7	32	5	36	5	24	8	55	9	86	9
22.25	10	4	27	5	24	4	10	5	44	8	82	9
22.75	7	4	22	4	11	3	10	5	38	8	60	8
23.25	5	4	33	5	3	2	11	6	21	7	32	6
23.75	3	3	44	7	1	1	12	7	21	8	9	3
σ_{int} (μb)	350 ±	40	415 ±	60	600 ±	85	400 ±	70	440 ±	65	530 ±	90

γ-ray energy (MeV)	$^{45}_{21}$Sc		$^{51}_{23}$V		$^{59}_{24}$Cr		$^{59}_{25}$Mn		$^{59}_{26}$Fe		$^{59}_{27}$Co	
	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error
	[μb/MeV]											
11.75	329	137	442	279	-	-	-	-	1096	215	149	228
12.25	163	82	14	49	-	-	-	-	338	107	114	164
12.75	119	65	8	38	1654	154	-	-	137	69	199	184
13.25	84	49	18	51	750	98	32	49	106	60	130	124
13.75	104	46	26	49	244	54	46	51	96	51	73	77
14.25	115	43	46	48	104	34	16	24	125	49	108	75
14.75	119	40	58	43	67	29	31	28	61	29	131	69
15.25	109	32	82	43	66	27	29	24	124	35	142	63
15.75	126	34	143	48	79	29	52	28	138	31	148	56
16.25	173	40	112	40	68	26	48	24	113	28	141	49
16.75	159	36	93	32	55	22	61	25	90	24	166	48
17.25	136	25	107	30	63	22	58	23	100	23	169	42
17.75	113	17	90	25	62	20	63	22	73	17	163	36
18.25	98	13	79	21	73	19	57	19	104	16	149	32
18.75	121	15	70	18	109	20	71	19	128	17	128	29
19.25	94	13	65	17	117	18	92	18	125	15	141	30
19.75	18	5	58	17	104	16	102	17	123	15	112	27
20.25	88	12	48	16	69	13	91	14	88	12	81	23
20.75	55	10	42	16	64	12	95	15	71	12	69	22
21.25	16	5	21	11	60	12	92	14	56	10	64	22
21.75	3	3	6	6	53	11	77	13	58	11	30	15
22.25	2	3	5	6	44	10	54	11	49	10	16	12
22.75	3	5	5	5	48	10	49	11	32	9	18	13
23.25	2	4	4	4	53	12	72	14	12	5	11	11
23.75	1	3	2	3	68	16	80	17	5	4	5	8
σint(μb)	800	±115	575	±95	750	±110	655	±95	850	±120	1005	±155

γ-ray energy (MeV)	Cu 29		Se 34		Br 35		Sr 38		^{89}Y 39		In 49	
	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error
	[μb / MeV]											
11.75	121	152	660	1244	822	534	1442	575	1234	405	282	172
12.25	110	105	470	755	484	302	20	66	405	169	223	126
12.75	139	92	73	246	367	214	199	209	241	139	241	112
13.25	188	85	122	263	260	154	148	169	166	98	284	105
13.75	93	53	109	203	246	125	12	42	119	66	276	90
14.25	118	49	92	150	127	79	157	128	172	63	388	97
14.75	133	44	86	115	195	81	155	108	222	54	396	88
15.25	113	35	118	109	207	71	379	145	262	49	195	60
15.75	88	29	179	112	158	55	441	148	280	43	191	58
16.25	87	27	137	87	110	42	307	117	344	41	153	52
16.75	54	18	129	75	198	51	304	107	411	41	180	55
17.25	85	20	97	60	140	38	186	78	439	35	90	36
17.75	129	21	96	49	172	37	304	91	337	27	153	40
18.25	114	18	95	38	135	30	143	61	175	18	140	33
18.75	82	13	101	32	138	27	86	54	108	17	111	27
19.25	112	15	72	23	94	19	24	32	95	14	85	23
19.75	96	14	45	17	100	20	20	31	63	13	92	24
20.25	63	11	73	20	61	14	122	83	28	8	81	23
20.75	48	10	54	17	61	15	12	25	15	6	74	24
21.25	58	12	48	16	60	15	2	5	4	4	51	21
21.75	34	9	29	12	44	13	2	6	2	3	17	13
22.25	26	7	14	9	25	10	2	6	2	4	7	9
22.75	18	6	7	7	17	9	28	45	5	6	5	9
23.25	8	5	14	11	13	9	6	8	3	6	-	-
23.75	3	3	-	-	4	5	12	12	3	7	-	-
σ_{int} (μb)	745	±105	750	±160	1045	±160	1345	±250	1490	±210	1210	±180

γ - ray energy (MeV)	^{51}Sb		^{53}I^{127}		^{56}Ba		^{59}Pr^{141}		^{67}Ho^{65}	
	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error	$\frac{d\sigma}{d\varepsilon}$	error
	[μb/MeV]									
11.75	277	183	16	293	282	312	364	820	332	132
12.25	142	110	81	380	524	344	162	418	239	92
12.75	291	137	119	292	338	239	117	277	132	62
13.25	298	121	324	354	260	186	104	201	132	57
13.75	138	75	126	181	142	119	165	187	175	59
14.25	176	76	178	168	502	192	302	179	141	48
14.75	172	67	146	126	820	219	227	121	150	45
15.25	391	92	191	120	260	118	211	97	119	37
15.75	192	59	151	93	209	105	191	78	258	52
16.25	300	76	158	88	221	109	196	66	332	59
16.75	198	63	103	68	130	81	202	53	265	55
17.25	150	36	145	69	253	107	176	38	131	40
17.75	27	23	36	31	388	120	151	29	181	42
18.25	63	32	101	41	188	79	120	25	129	33
18.75	101	36	67	26	170	77	86	21	92	29
19.25	31	20	48	20	41	41	50	16	27	16
19.75	34	19	53	19	1	3	14	9	35	23
20.25	50	25	53	17	12	31	9	8	13	12
20.75	58	26	38	16	7	24	12	11	2	4
21.25	24	18	26	13	25	49	7	9	4	8
21.75	25	18	21	13	16	42	2	5	4	8
22.25	23	20	9	9	3	20	1	3	10	12
22.75	2	7	6	8	-	-	1	2	3	6
23.25	-	-	2	4	-	-	-	-	4	10
23.75	3	18	5	9	-	-	-	-	4	9
σ_{int} (μb)	1010	±165	770	±160	1625	±280	980	±165	950	±150

γ - ray energy (MeV)	$^{181}_{73}$Ta		$^{}_{74}$W		$^{}_{81}$Tℓ		$^{}_{82}$Pb		$^{209}_{83}$Bi	
	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error	$\frac{d\sigma}{dE}$	error
	[μb / MeV]									
11.75	358	159	93	207	399	199	486	237	245	227
12.25	102	69	20	72	275	127	736	238	670	284
12.75	252	94	89	132	333	114	386	156	400	185
13.25	203	73	181	138	195	74	114	79	285	139
13.75	276	74	216	127	275	76	304	115	321	135
14.25	268	66	107	78	338	73	269	99	166	91
14.75	218	56	245	104	199	51	278	91	334	119
15.25	138	41	240	93	288	58	98	51	199	87
15.75	254	52	179	81	296	57	342	89	124	68
16.25	274	53	308	101	222	50	295	83	92	59
16.75	261	54	119	60	180	44	214	72	172	78
17.25	225	48	25	26	111	33	109	50	136	65
17.75	202	42	173	66	62	24	129	51	203	72
18.25	191	40	51	33	39	21	179	57	163	61
18.75	69	25	43	34	19	17	32	25	79	42
19.25	71	24	52	37	12	13	14	18	23	25
19.75	19	13	27	20	1	3	8	12	29	30
20.25	13	16	7	10	1	2	49	30	15	15
20.75	1	4	1	3	5	7	4	4	8	10
21.25	14	12	1	3	1	3	7	12	16	20
21.75	6	8	1	3	2	4	3	6	4	8
22.25	12	11	3	7	7	10	2	4	1	3
22.75	25	18	1	2	6	9	1	3	1	3
23.25	4	7	5	8	9	12	3	8	1	3
23.75	1	4	4	8	-	-	2	4	-	-
σ_{int} (μb)	1130	±170	800	±155	890	±135	1015	±170	880	±165

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APPENDIX: EXFOR FORMAT DESCRIPTION OF THE EXPERIMENT

THIS DESCRIPTION APPEARS AS EXFOR 30364.

TITLE	GAMMA-RAY SPECTRA AND (N, GAMMA) CROSS-SECTIONS AT 14 MEV FOR MG, AL, SI, P, S, CA, SC, V, CR, MN, FE, CO, CU, SE, BR, SR, Y, IN, SB, I, BA, PR, HO, TA, W, TL, PB, BI
AUTHOR	M.BUDNAR, F.CVELBAR, E.HODGSON, A.HUDOKLIN, V.IVKOVIĆ, A.LIKAR, R.MARTINČIĆ, M.V. MIHAILOVIĆ, M.NAJŽER, A.PERDAN, M.POTOKAR, V.RAMŠAK
INSTITUTE	INSTITUT JOZEF STEFAN, LJUBLJANA
EXIP-YEAR	(75) MEASUREMENTS FROM 1974 TO 1976
REFERENCE	.NUCL.INSTR. METHODS OCT. 1966 (J, NIM, 44, 292, 6610) IMPROVED SPECTROMETER DESCRIBED .REPORT NIJS-R-470, NOV. 1965 (R, NIJS-R-470 , 6511) SAME AS NUCL.INS. METHODS 44(1966) 292 .NUCL.PHYS.A 130, 1969 (J, NP/A, 130, 401, 6903) DESCRIBES THE METH. NO DATA .REPORT NIJS-R-502 , JUN. 1967 (R, NIJS-R-502, 6706) DESCRIBES THE METH. NO DATA
SAMPLE	NATURAL OR PURE ISOTOPIC COMPOSITIONS TARGETS ARE SPHERES AND/OR HEMISPHERES OF 4-6 CM DIAMETER PLACED CLOSE TO THE TRITIUM TARGET. THEREFORE THE NEUTRON ENERGY IS SPREAD OVER A RANGE FROM 13.5 TO 14.7 MEV. DUE TO THIS GEOMETRY THE SPECTRA OBTAINED ARE INTEGRATED OVER A SOLID ANGLE OF 2(4) PI
STANDARD	ABSOLUTE MEASUREMENTS
FACILITY	(CCW) COCKROFT-WALTON ACCELERATOR ENERGY OF INCIDENT DEUTERONS IS=100 KEV
N-SOURCE	(D-T) ; T(D,N)ALPHA REACTION
INC-SPECT	THE "ENERGY-SPREAD" IS 1.35 MEV, THAT IS + - 0.675 MEV
DETECTOR	(BPAIR) SCINTILLATION PAIR SPECTROMETER WHICH RESOLUTION HAS BEEN MEASURED TO BE 12.5, 9.5 AND 8.0 PER CENT FOR GAMMAS OF ENERGIES 12.1, 16.5 AND 20.4. MEV RESPECTIVELY. EFFICIENCY , ALSO MEASURED FOR THESE GAMMA ENERGIES, HAS BEEN FOUND TO BE 0.45, 0.55 AND 0.65 PER CENT.

METHOD

GAMMA SPECTRA ARE MEASURED BY THE TELESCOPIC SCINTILLATION PAIR SPECTROMETER
RECOIL PROTON SPECTROMETER HAS BEEN USED FOR THE NEUTRON MOMITORING

CORRECTION

SPECTRA ARE CORRECTED

- FOR BACKGROUND
- FOR THE SPECTROMETER RESPONSE FUNCTION
- FOR THE GAMMAS CREATED AND ABSORBED IN THE SAMPLE
- FOR ABSORPTION OF GAMMAS IN THE PARAFFIN-COLLIMATOR
- FOR NEUTRON NONELASTIC PROCESSES IN THE TARGET

ERR-ANALYSIS

THE OVERALL ERROR INCLUDES THE UNCERTAINITY

- DUE TO STATISTICAL ERRORS
- ON THE BACKGROUND CORRECTION
  = 7 PER-CENT FOR SPHERES
  = 1 PER-CENT FOR HEMISPHERS
- DUE TO SPECTROMETER RESPONSE FUNCTION
  = ENLARGES STATISTICAL ERROR BY THE FACTOR 1.3
- ON THE ENERGY SCALE
  = 2 PER CENT AT 14 MEV
  = 3 PER CENT AT 22 MEV
- ON THE SPECTROMETER EFFICIENCY
  = 11 PER CENT
- ON THE CORRECTION FOR ABSORPTION OF GAMMAS
  = 1 PER CENT
- ON THE CORRECTION FOR NEUTRON NONELASTIC PROCESSES IN THE TARGET
  = 2 PER CENT
- ON THE NEUTRON FLUX
  = 6 PER CENT
- ON THE ANISOTROPY OF GAMMAS
  = 3 PER CENT
- DUE TO EQUAL SOLID ANGLE FOR THE WHOLE TARGET
  = 1 PER CENT

THE RESULTING ERROR FOR THE CROSS-SECTIONS IS ABOUT 15 PER CENT

ENERGY RESOL.

THE ENERGY RESOLUTION IS DETERMINED

- BY THE ENERGY WIDTH OF THE SPECTROMETER RESPONSE FUNCTION (1.65 ± 0.05) MEV
- BY THE ENERGY SPREAD OF THE NEUTRON BEAM (1.35 MEV)

THE RESULTING VALUES ARE
= 14 PER CENT AT 15 MEV
= 10 PER CENT AT 21 MEV

ANALYSIS

THE CROSS-SECTIONS ARE OBTAINED BY INTEGRATION OF THE FULLY CORRECTED GAMMA SPECTRUM OVER THE EXCITATION ENERGY INTERVAL UP TO THE BINDING ENERGY OF THE LAST NEUTRON IN THE FINAL NUCLEUS

STATUS

(APRVD)APPROVED BY BUDNAR (1/12/76)

DATA CONSTANTS

EN	EN-RSL
MEV	MEV
14.1	0.675

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	(n,γ) cross-sections	(n,γ) spectra	Main Ref. (CINDA coding)
Mg	30184.002	30184.003	NP/A 138 (1969) 412
Al-27	30147.002 30083.004	30147.003 30083.005	PL 3 (1963) 364 NP/A 130 (1969) 401
Si	30184.004	30184.005	NP/A 138 (1969) 412
P-31	30184.006	30184.007	NP/A 138 (1969) 412
S	30083.010	30083.011	NP/A 130 (1969) 401
Ca	30184.008	30184.009	NP/A 138 (1969) 412
Sc-45	30364.003	30364.002	INDC(YUG)-5 (1976)
V-51	30083.014	30083.015	NP/A 130 (1969) 401
Cr	30083.016	30083.017	NP/A 130 (1969) 401
Mn-55	30083.018	30083.019	NP/A 130 (1969) 401
Fe	30083.020	30083.021	NP/A 130 (1969) 401
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Y	30364.005	30364.004	INDC(YUG)-5 (1976)
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Ba	30185.006	30185.007	FIZ 4 (1972) 53 CVELBAR (1972)
Pr-141	30364.007	30364.006	INDC(YUG)-5 (1976)
Ho-165	30364.009	30364.008	"
Ta-181	30185.016	30185.017	CVELBAR (1973)
W	30185.008	30185.009	"
Tl	30185.018	30185.019	"
Pb	30185.010	30185.011	"
Bi-209	30185.012	30185.013	NP/A 213 (1973) 525

Please note that above EXFOR entries as distributed in 1979 and earlier, are partly superseded by the present report. Up-to-date revised EXFOR entries will be available early in 1980.