



International Atomic Energy Agency

INDC(PAK)-2/G

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INTERNATIONAL NUCLEAR DATA COMMITTEE

Progress Report

March 1979 - April 1980

Pakistan Institute of Nuclear
Science and Technology
Rawalpindi, Pakistan

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May 1980

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

Reproduced by the IAEA in Austria
May 1980

80-02358

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PROGRESS REPORT

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PAKISTAN INSTITUTE OF NUCLEAR
SCIENCE AND TECHNOLOGY
RAWALPINDI PAKISTAN

14.8 MeV Neutron Induced Fission Studies of
 ^{239}Pu , ^{240}Pu , ^{241}Pu , ^{242}Pu , ^{244}Pu and ^{241}Am

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Muscovite mica track detectors have been employed for measurements of (a) fission cross-sections, (b) the angular anisotropy of the fission fragments induced by 14.8 MeV neutrons. A new approach has been attempted to extract the above mentioned angular distribution information from experiments carried out in 2π -geometry instead of the conventional vacuum chamber measurements. The cross-sections and the anisotropy results are found to be in close agreement with those theoretically predicted or reported earlier. Some of the results are shown in table I. Other results and details are being published in a special issue of Nuclear Instruments and Methods on Nuclear Track Detectors to appear in June-July 1980.

Table I
Fission cross-sections of ^{240}Pu , ^{241}Pu , ^{242}Pu ,
 ^{244}Pu and ^{241}Am for 14.8 MeV neutrons.

Target	Number of Tracks	* Cross-sections (barn)		
		Present Work	Previous Work	
Pu-240	$1743/\text{cm}^2$	2.06 ± 0.21	2.27 ± 0.07	White and Wagner (1)
			2.40 ± 0.30	Kazarinova et al (2)
Pu-241	$1350/\text{cm}^2$	1.84 ± 0.19	2.43 ± 0.08	White and Wagner (1)
			2.05 ± 0.1	Kazarinova et al (2)
Pu-242	$1843/\text{cm}^2$	1.37 ± 0.14		
Pu-244	$414/\text{cm}^2$	0.91 ± 0.09		
^{241}Am	$1061/\text{cm}^2$	3.68 ± 0.8	2.59 ± 0.15	Kazarinova et al (2)
			2.35 ± 0.15	Protapopov et al (3)

* The present cross-sections have been determined relative to the fission cross-section of Pu 239 which was taken as 2.52 barn¹.

References

1. P.H. White and G.P. Wagner, J. Nucl. Eng. 21 (1967) 671.
2. M.I. Kazarinova, Y.S. Zamyatnin and V.M. Gorbachev, Atomn. Energy 8 (1960) 139.
3. A.N. Protopopov, IA Selitskii and S.M. Solovev, Atomn. Energy 4 (1958) 190.

Double Differential Neutron Scattering Cross-Sections
of Carbon, Aluminium and Iron for 14.7 MeV Neutrons

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Measurements of neutron emission cross-sections for 14 MeV neutrons are of interest for fusion technology¹⁾. Extensive measurements have been reported by Hermsdorf et al²⁾. Similar measurements with better energy resolutions have been reported by Kammerdiener³⁾, Iwasaki et al⁴⁾, and Beyerle et al⁵⁾. Significant disagreement has been reported between the results of experiments and NEDF/B-V⁶⁾.

In the present work neutron emission cross-sections of C, Al and Fe have been measured for 14.7 MeV neutrons at 11 angles between 30 and 130° for energy range 3-14 MeV. The energies of neutrons have been measured by the time-of-flight technique based on associated particle method. The data is still in process of analysis. Some typical results are shown in Table I and Table II.

References

1. Proceedings of the Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology, Vienna 11-15 December 1978 IAEA-TEC-DOC-223.
2. D. Hermsdorf, A. Meister, S. Sassonoff, D. Seeliger, K. Siedel and F. Shahin, ZfK-277 (U), ZENTRAL INSTITUT FUR KERNFORSCHUNG, DRESDEN (1975).

3. J.L. Kammerdiener, UCRL-51232 (1972).
4. S. Iwasaki, M. Sugimoto, T. Tamura, T. Suzuki, H. Takahashi and K. Sugiyama 'Neutron Energy Spectra and angular distributions for Al and Nb (n, xn') reaction at 15.4 MeV' presented in the International Conference on Nuclear Cross-sections for Nuclear Technology held at Knoxville, USA 22-26 October 1979.
5. A. Beyerle, C. Gould, W. Seagondollar, P. Thambidurai, S. Elkadi, G. Glemdining, C.E. Nelson, F.O. Purser and R.L. Walter. 'Double Differential Scattering Cross-sections for Fe, Cu, Vi and Pb between 8 and 12 MeV'. Presented in International Conference on Nuclear Cross-sections for Nuclear Technology held at Knoxville, USA, 22-26 October 1979.
6. D.M. Hetrick, D.C. Larson and C.Y. Fu, ORNL/TM-6637 (1979).

Table I

Double differential scattering cross-sections of Carbon at
90° in C.M. System for 14.7 MeV incident neutron energy

<u>E_n (MeV)</u>	<u>$\frac{d^2\sigma}{dEd\theta}$ (mb/Sr-MeV)</u>	<u>% Error Statistical</u>	<u>E_n (MeV)</u>	<u>$\frac{d^2\sigma}{dEd\theta}$ (mb/Sr-MeV)</u>	<u>% Error Statistical</u>
3.0	4.06	5	4.15	2.11	
3.05	4.02		4.20	2.23	
3.10	4.19		4.25	2.10	
3.15	4.02		4.30	2.00	
3.20	3.53		4.35	2.01	
3.25	3.57		4.40	1.92	
3.30	3.64		4.45	1.93	
3.35	3.63		5.0	1.80	22
3.40	3.21		5.1	0.981	
3.45	3.18		5.2	1.09	
3.50	3.00	14	5.3	1.06	
3.55	2.82		5.4	1.51	
3.60	2.45		5.5	1.69	15
3.65	2.47		5.6	1.79	
3.70	2.58		5.7	1.65	
3.75	2.65		5.8	1.52	
3.80	2.68		5.9	1.21	
3.85	2.29		6.0	0.88	28
3.90	2.18		6.1	0.86	
3.95	2.05		6.2	0.963	
4.00	2.51		6.3	1.17	
4.05	2.81		6.4	1.21	
4.10	2.20		6.5	1.29	

E_n (MeV)	$\frac{d^2\sigma}{dEd\Omega}$ (mb/Sr-MeV)	% Error Statistical	E_n (MeV)	$\frac{d^2\sigma}{dEd\Omega}$ (mb/Sr-MeV)	% Error Statistical
6.6	1.24		9.1	2.52	
6.7	1.34		9.2	2.20	
6.8	1.61		9.3	2.16	
6.9	1.54		9.4	2.03	
7.0	1.93	15	9.5	2.09	8
7.1	2.01		9.6	1.94	
7.2	2.54		9.7	1.91	
7.3	2.50		9.8	1.70	
7.4	3.08		10.0	1.67	8
7.5	3.01	7	10.1	1.83	
7.6	3.56		10.2	2.02	
7.7	3.51		10.3	2.33	
7.8	3.78		10.4	2.69	
7.9	4.28		10.6	3.02	
8.0	3.77	4	10.8	4.3	
8.1	3.79		11.0	5.7	3
8.2	3.80		11.2	6.76	
8.3	3.88		11.4	7.77	
8.4	3.80		11.6	8.41	
8.5	3.46	5	11.8	9.56	
8.6	3.33		12.0	9.01	2
8.7	3.22		12.20	9.12	
8.8	2.84		12.40	8.94	
8.9	2.95		12.60	8.72	
9.0	2.76	6	12.80	7.10	

E_n (MeV)	$\frac{d\sigma}{dEd\Omega}$ (mb/Sr-MeV)	% Error Statistical	E_n (MeV)	$\frac{d\sigma}{dEd\Omega}$ (mb/Sr-MeV)	% Error Statistical
13.00	7.39	2	13.8	4.26	
13.2	6.91		14.0	2.99	5
13.4	5.30		14.2	2.79	
13.6	4.74		14.4	2.41	

E_n (MeV)	$\frac{d^2\sigma}{dEd\theta}$ (mb/Sr-MeV)	% Error Statistical	E_n (MeV)	$\frac{d^2\sigma}{dEd\theta}$ (mb/Sr-MeV)	% Error Statistical
12.8	5.67		13.6	5.50	
13.0	5.97	3	13.8	5.44	
13.2	5.34		14.0	5.1	3
13.4	5.45		14.2	4.86	