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Progress Report to  
The International Nuclear Data Committee

K. Gul  
INDC Liaison Officer  
Pakistan

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May 1981

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

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A. Precise Energy Measurements of Gamma-rays for  
 $^{56}\text{Fe}$  (n,n' $\gamma$ ) Reaction at 14.7 MeV Neutron Energy  
(Naeem A. Khan, M. Anwar, M. Ahmad, S.M. Saleem  
and K. Gul)

Gamma-ray production cross-sections for structure materials on bombardment with 14 MeV neutrons are of interest to fusion technology and their precise energy measurements are useful for nuclear structure studies. Such measurements have also been reported previously by Lachkar et al.<sup>1)</sup> The present measurements of gamma-rays were carried out with Ge(Li) detector used in combination with a 4"x 4" NaJ (Tl) spectrometer. The spectra were analysed by fitting multiple peaks using a standard computer code<sup>2)</sup>. The gamma-rays lying in energy range upto 8.2 MeV were analysed and a total of about 700 lines were attributed to coming from the deexcitation of levels in  $^{56}\text{Fe}$ . The rest of about 800 lines were explained as to arise from other isotopes of Fe and interaction of degraded neutrons with Ge-crystal. The lines attributed to  $^{56}\text{Fe}$  were verified from their presence in spectra from Fe(p,p' $\gamma$ ) reaction taken on Uppsala Tandem accelerator and analysed at Pinstech. Gamma-ray production cross-sections of some intense lines of  $^{56}\text{Fe}$  are shown in Table A.1. These cross-sections have been derived relative to that of 846 keV line and taking its cross-section value as 66 mb/Sr at 90° reported by Lachkar et al.<sup>1)</sup>.

Table A.1. Differential scattering cross-sections of some prominent lines of  $^{56}\text{Fe}$  at 90° for 14.7 MeV incident neutron.

Gamma-ray Energy	Present value (mb/Sr)	Reported value 1) mb/Sr
846.8	65.5	65.5±6.6
1238.3	17.0±5	32.3±7.0
1810.8	3.2±1	5.0±0.6
1037.9	3.8±1.2	6.9±0.6
2598.6	5.1±1.5	3.0±0.5
2602.5	1.7±0.5	3.0±0.5

## References

- 1) J. Lachkar et al, Nucl. Sci. Eng. 55 (1974) 68.
- 2) V. Haase, Kernforschungszentrum Karlsruhe report KFK-730 (1968).

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## B. Neutron Energy Spectra For C, Al and Fe (n,xn ) Reactions at 14.7 MeV (K. Gul, M. Anwar, M. Ahmad, S.M. Saleem and Naeem A. Khan)

Measurements of the spectra of neutrons emitted following neutron bombardment of nuclei are of both theoretical and practical interest. Theoretically these are of importance for understanding nuclear reaction mechanism and their practical importance lies in the design calculations for fusion reactor blankets and wall structures. Measurements for 14.7 MeV neutrons on nuclei ranging from beryllium to bismuth have been reported by Hermsdorf et al<sup>1)</sup>. However these measurements were taken with rather poor resolution. Consequently interest has arisen for repeating these measurements with better energy resolution<sup>2,3)</sup>. We made measurements on C, Al and Fe for 14.7 MeV incident neutrons for outgoing neutron energy range of 3-14 MeV in angular range 30°- 130°. Whereas the data on Al and Fe has been partially analysed, those on C have been completely analysed<sup>4)</sup>. The integrated cross-sections obtained in these measurements for carbon are shown in Table B.1.

Table B.1. Integrated scattering cross-sections of the various states of <sup>12</sup>C and their comparison with published data. The cross-section values are in millibarn.

Levels	Present	Haouat et al 57)	Glasgow et al 6)	Bouchez et al 7)	Grin et al	Clark & Cross 9)
Ground State	830 ± 15	730	887 ± 52	810 ± 40	735 ± 35	730 ± 70
4.43 MeV	214 ± 8	146.4 ± 8	202 ± 8.8	215 ± 40	215 ± 15	209 ± 20
7.65 MeV	9.3 ± 1.6	-	-	16 ± 10	8.5 ± 2	-

## References

- 1) D. Hermsdorf et al zfk-277, 1975.
  - 2) A. Beyerle et al., Proceedings of the International Conference on Nuclear Cross-sections for Technology, Held at University of Tennessee, Knoxville TN, October 22-26, 1979, edited by Fowler and Johnson, NBS special publication 594, September, 1980.
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  - 4) Submitted for publication in Physical Review C.
  - 5) G. Haouat et al. Nucl. Sci. Eng. 65 (1978) 331.
  - 6) D.W. Glasgow et al. Nucl. Sci. Eng. 61 (1976) 521.
  - 7) R. Bouchez et al. Nucl. Phys. 43 (1963) 628.
  - 8) G.A. Grin et al. Helv. Phys. Acta 42 (1969) 990.
  - 9) R.L. Clark and W.G. Cross, Nucl. Phys. 53 (1964) 117.
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