

Neutron-Induced Gamma-Ray Cross Section Standards and ^{56}Fe Inelastic Scattering

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An accurate knowledge of neutron-induced gamma-ray production cross sections is important in enabling the determination of absolute cross sections from relative measurements of gamma-ray yields. Such data have a variety of uses, for example, in determining reaction cross sections for activation of materials used as integral neutron flux detectors, and in measuring photon production necessary to evaluate gamma-ray heating in nuclear systems. Such data also find application in neutron-induced gamma-ray detection and assay systems and in planetary exploration where cosmic-ray-neutron-induced photon production is used to determine elemental composition of soils. In our work using the GEANIE gamma-ray spectrometer at the WNR facility of LANSCE, we observed discrepancies outside of the error estimates for evaluations of the $^{nat}\text{Fe}(n,n_1'\gamma)$ cross section for the 847-keV gamma ray and for other reactions that are taken as standards. We have performed (1) measurements relative to the $^{nat}\text{Cr}(n,n_1'\gamma)$ 1434-keV gamma ray (2) absolute cross section measurements using the $^{235}\text{U}(n,f)$ and $^{238}\text{U}(n,f)$ reactions to determine the neutron fluence, and (3) comparisons using measured total and elastic scattering cross sections to refine our knowledge of the Fe inelastic gamma-ray cross sections and the closely related inelastic channel cross section for Fe. Our results suggest that revision of the data libraries is needed to improve the calculated neutron transport in Fe. This conclusion is supported by the results of recent integral measurements of neutron scattering on Fe.¹

1. Thomas N. Massey, *et al.*, "Measurement of Neutron Transmission Through Iron Spheres," Proceedings of the International Conference on Nuclear Data for Science and Technology, Sept 26 – Oct. 1, 2004, Santa Fe, NM, USA, AIP Conference Proceedings (2005) in press, and Michael T. Wenner, *et al.*, "Development of a Methodology for Analysis of the Fe-56 ENDF-B/VI Cross Sections with a Time-of-Flight Experiment," Proceedings of the International Conference on Nuclear Data for Science and Technology, Sept 26 – Oct. 1, 2004, Santa Fe, NM, USA, AIP Conference Proceedings (2005) in press.