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Analysis of Gd(n,gamma) reaction with 155, 157 and natural Gd targets taken with JPARC-ANNRI and development of Gd(n,gamma) decay model for Gd-doped neutron/neutrino detectors

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The importance of a good model for the γ-ray energy spectrum from the radiative thermal neutron capture on Gadolinium (Gd) is specially increased in the present era of Gd-enhanced $\bar{\nu}_e$-search detectors. Its an essential prerequisite for MC studies to evaluate the neutron tagging efficiency, in order to enhance signal sensitivity in the Gd-loaded $\bar{\nu}_e$-search detectors.
The γ-ray spectra produced from the thermal neutron capture on enriched gadolinium targets (^{155}Gd, ^{157}Gd and Natural Gd) in the energy range 0.11 MeV to 8.0 MeV, were measured using the ANNRI Germanium Spectrometer at MLF, J-PARC [1, 2, 3]. Based on the data acquired and a GEANT4 simulation of the ANNRI detector, we reported the energy spectrum of ^{157}Gd(n, γ) and
developed a γ-ray emission model of ^{157}Gd(n, γ) in our previous publication [1].
We now present the analysed data of ^{155}Gd(n, γ) and $^{\mathrm{nat}}$Gd(n, γ) reactions, the energy spectra of γ-rays and an improved model for ^{155}Gd(n, γ), ^{157}Gd(n, γ) and $^{\mathrm{nat}}$Gd(n, γ) reactions. The consistency of the results from the devised model is checked among all the 14 germanium crystals, at the level of 15% spectral shape deviation at 0.2 MeV binning.

Author: ALI, Ajmi

Co-authors: SAKUDA, Makoto (Okayama University); TANAKA, T.; HAGIWARA, K.; SUDO, T.; REEN, M.; DAS, P.; DIR, R.; YAMADA, Y.; OU, I.; MORI, T.; KAYANO, T.; KOSHIO, Y.; YANO, T.; KIMURA, A.; NAKAMURA, S.; IWAMOTO, N.; HARADA, H.; LORENZ, S.; WURM, M.; FOCILLON, W.; GONIN, M.; COLLAZUOL, Gianmaria (Universita e INFN, Padova (IT))

Presenter: ALI, Ajmi

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