



Contribution ID: 124

Type: Contributed Poster Presentation

Development of monoenergetic β -source for evaluation of GAGG scintillator's performance

The rapid neutron capture process (r-process) has been thought to be the origin of elements heavier than iron, such as gold and platinum.[1] Although the r-process is predicted to terminate in the fission of actinide nuclides, theoretical predictions for the decay properties of the endpoint nuclides have large uncertainty because of depending strongly on the mass model[2] and the astronomical environment. This is due to the lack of experimental data on the decay modes of the neutron-rich nuclides at the termination point of the r-process, and in particular to the lack of understanding of these fission barriers.

We started developing a new detector system to measure the fission barrier and mass distribution of neutron-rich actinide nuclides with the purpose of clarifying the decay mode of nuclides located at the termination point of the r-process. Neutron-rich actinide nuclides produced by nuclear reactions stop at the capture foil and undergo β -decay. If the excitation energy of the daughter nuclide is higher than the fission barrier, β -delayed fission will occur. Therefore, the fission barrier can be obtained by subtracting the maximum energy of the β -decay from the mass difference between the parent and daughter nuclides. In this study, Ce:GAGG (Ce-doped $\text{Gd}_3(\text{Al}, \text{Ga})_5\text{O}_{12}$) scintillator[3] was employed to detect β -rays, and since GAGG is sensitive to both γ -rays and β -rays, it can measure both β -rays due to β -decay and γ -rays due to deexcitation after β -decay during the β -delayed fission. This makes it possible to determine both the fission barrier and the excited levels that transitioned after β -decay or fission. Also, GAGG crystals are not deliquescent, so they can be placed directly in a vacuum without a window, and β/γ -ray energies can be measured with high precision. The GAGG scintillator is undergoing performance evaluation for γ -ray spectroscopy, but their response for β -ray is poorly understood. Therefore, we are planning to test the energy/position resolution and response characteristics using an electron accelerator and a β -ray source.

Although a monoenergetic β -ray is necessary for determining the response function of β -decay, standard β -ray sources have continuous energy spectra. Therefore, this study aims to develop a β -source that emits the monoenergetic β -source to evaluate the performance of the GAGG detector for electrons. A standard β -source is combined with two neodymium magnets, and the energy of the β -ray selected by the magnetic field.

As the first step of this study, we have performed simulations using the Geant4 toolkit and tried various conditions such as the strength of the magnetic field, shielding material, and thickness for considering the optimal setup. Based on these results, we started developing the monoenergetic β -source. In this talk, we will report on the progress and prospects of developing the monoenergetic β -source and GAGG scintillator.

[1] M. Tanaka, et al., Publications of the Astronomical Society of Japan 69, 102 (2017).

[2] I. V. Panov, et al., Phys. Atom. Nuclei 76, 88 (2013).

[3] T. Yanagida, et al., Optical Materials 35, 2480 (2013).

Primary author: FUJII, Tomoki (Kyushu Univ.)

Co-authors: NIWASE, Toshitaka (Kyushu Univ.); TANAKA, Yusuke (Kyushu Univ.); KITAGAWA, Naoyuki (Kyushu Univ.); MICHIMOTO, Yuya (Kyushu Univ.); MIYASHITA, Naoto (Kyushu Univ.); YAMANOUCHI, Yuki (Kyushu University); SAKAGUCHI, Satoshi (Kyushu Univ.); HIRAYAMA, Yoshikazu (WNSC, IPNS, KEK); WATANABE, Yutaka (WNSC, IPNS, KEK); MIYATAKE, Hiroari (WNSC, IPNS, KEK)

Presenter: FUJII, Tomoki (Kyushu Univ.)

Session Classification: Poster Session

Track Classification: New Facilities and Instrumentation