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# Development of a detection technique for nuclear fuel materials using photonuclear reactions/光核分裂反応を利用した核燃料物質検知技術の開発

*Thursday, 14 November 2024 16:00 (2 hours)*

Nuclear security at nuclear reactor facilities is a significant concern, particularly with regards to the theft and smuggling of nuclear material, as well as sabotage of the facilities. One crucial task to prevent these security incidents is the development of non-destructive detection techniques for identifying nuclear material. Although numerous techniques have been proposed, further study is still needed to meet the necessary requirements.
Previous research has proposed to employ a photon beam from the inverse Compton scattering using a large accelerator [1]. However, this approach requires a large accelerator facility.
In comparison to previous research, the present research aims to develop a new system using a small accelerator. This research uses the nuclear reaction $^{7}$Li(p, $\gamma$)$^{8}$Be that has never been focused upon in nuclear security fields. A non-destructive detection system using this high-energy $\gamma$-ray source is under development. When a high-energy photon interacts with nuclear material, such as uranium or plutonium, it induces nuclear fission and emits fast neutrons. In this way, the amounts of nuclear materials can be identified by measuring neutrons . Neutrons possess a high power of penetrability, enabling the detection of nuclear material even if it is concealed within a container made of high-Z materials [1]. As the first step, a neutron detection technique employing $^{7}$Li(p, $\gamma$)$^{8}$Be photon source is being studied. $^{197}$Au sample is used for a test experiment and neutrons from the photonuclear reaction are detected. When $^{197}$Au is irradiated with $\gamma$-rays, it produces both neutrons and $\gamma$-rays. To separate neutrons and $\gamma$-rays, the pulse shape discrimination technique is employed. Time-of-flight (TOF) can also be used for reducing background. The project outline and preliminary results of the study will be presented.

References:

[1] R. Kimura, et al., J. Nucl. Sci. Technol. **53**, 1978 (2016).

**Primary author:** KUNITOMO/國友, Risa/理紗 (Institute of Science Tokyo/東京科学大学)

**Co-authors:** ISHIZUKA/石塚, Chikako/知香子 (Institute of Science Tokyo/東京科学大学); TANABE/田辺, Hironori/鴻典 (3. National Research Institute of Police Science/科学警察研究所); SAGARA/相樂, Hiroshi/洋 (Institute of Science Tokyo/東京科学大学); KIATKONGKAEW, Krittanai (Institute of Science Tokyo/東京科学大学); KATABUCHI/片渕, Tatsuya/竜也 (Institute of Science Tokyo/東京科学大学)

**Presenter:** KUNITOMO/國友, Risa/理紗 (Institute of Science Tokyo/東京科学大学)

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