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Fast neutron measurement for homeland security using PSD of neutrons and X-rays generated by LINAC

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To classify dangerous materials for homeland security, the structure of baggage can be identified through X-ray images, which are non-destructive testing (NDT). When an X-ray image and a neutron image are used together, various materials can be distinguished by the difference in the reaction mechanism of X-rays and neutrons in the material. It is intended to measure neutrons and X-rays through an integrated generator that simultaneously produces neutrons and X-rays using a high-energy linear electron accelerator. If the energy of the X-ray is greater than 8 MeV, a photonuclear interaction occurs in the tungsten target and generates neutrons. Organic, liquid, and plastic scintillators are generally used to obtain fast neutron images. These detectors have a high scattering cross-section for fast neutrons because it is composed of hydrogen and carbon, such as a low atomic number. Nevertheless, since the organic scintillator is also affected by the Compton scattering of X-rays, radiation signals generated in the scintillator should be distinguished. The method used in this case is the pulse shape discrimination (PSD) method. However, it is difficult to measure neutrons because the pile-up signals are produced in an environment where the X-ray flux generated from the electron accelerator is high. X-ray flux was reduced by lead shielding, and neutrons were measured through pile-up rejection to distinguish neutrons from X-rays. After the pile-up rejection process for the neutron region, the number of neutrons decreased from 15,477 to 8,983, and 6,494 counts were the pile-up signals.

Primary author: SONG, Gyohyeok (Korea Advanced Institute of Science and Technology)

Co-authors: LEE, Sangho (Korea Advanced Institute of Science and Technology); HWANG, Jisung (Korea Advanced Institute of Science and Technology); KIM, Junhyeok (Korea Advanced Institute of Science and Technology); KO, Kilyoung (korea Advanced Institute of Science and Technology); PARK, Jaehyun (korea Advanced Institute of Science and Technology); Prof. CHO, Gyuseong (Korea Advanced Institute of Science and Technology)

Presenter: SONG, Gyohyeok (Korea Advanced Institute of Science and Technology)

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