Comparative Study of Dual Neutron/Gamma Scintillation Detectors

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It is important to detect neutrons and gamma rays in environments, where both radiations coexist, such as nuclear powder plants, some cancer therapy facilities, and decomission sites of nuclear facilities. The improvement of sensor technologies and electronics enabled to sparately detect neutrons and gamma rays with a single radiation detector. Monitoring the facilities and detecting special nuclear materials (SNMs) to prevent diversion of nuclear materials are crucial issues in the safeguards point of view. Gamma rays and neutrons are emitted at high flux from fission products (i.e, Cs, Eu), and tranuranic isotopes of spent nuclear fuels. Because gamma rays are mainly emitted from fission products, neutron and gamma should be distinguishably detected in order to monitor SNMs. There are various detectors for neutron/gamma detection based on scintillators, such as liquid, plastic scintillators, currently developed CLLB, NaIL, and CLYC. The purposes of this study are to evaluate and compare the performance of various scintillation detectors. Also it is intended to aqcuire the raw data of pulse shape for developement of a novel neutron/gamma PSD techniques based on machine learning algorithms. This study focuses on the performance evaluation of the scintillation detectors with conventional PSD methods, such as charge comparison method (CCM).
A liquid scintillator (BC501A), a plastic scintillator (EJ-276), CLLB, and NaI scintillator were prepared, and a CAEN DT5730 digitizer (500 MS/s, 14 bit resolution) and CoMPASS software were used for DAQ, PSD, and acqusition of raw data of the pulse shape. The performance parameters, such as PSD figure of merit (FOM), energy resolution, and efficiency, were evaluated with CCM for the detectors. Several neutron and gamma emitting radioisotopes (i.e, ^{137}Cs,, ^{252}Cf, ^{60}Co) will be measured, analyzed and presented as preliminary results.

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