Abstract

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Detection of fast neutrons during photon active interrogation

Photon active interrogation techniques offer improved detection of shielded special nuclear material (SNM). The detection of shielded SNM, especially highly-enriched uranium, is challenging due to limited passive emissions. Photon active interrogation can address these challenges because an intense, high-energy photon beam can penetrate shielding materials and induce photonuclear reactions in SNM, greatly increasing radiation emissions. Although improved detection capabilities can be demonstrated, it is important that proposed active interrogation systems are economical and provide timely detection. The University of Michigan is developing active interrogation techniques using an off-the-shelf medical linear accelerator (linac), economical organic-scintillator-based detectors, and neural-network-based pulse shape discrimination algorithms. The neural-network-based pulse shape discrimination algorithm is being developed to enable recovery of pulse information from pile-up events. During active interrogation, prompt neutrons emitted by photonuclear reactions in the irradiation target may be lost during the intense photon flash emitted by the linac. By recovering pulse information from pile-ups, the inspection time needed to identify shielded SNM is reduced.