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Detection of special nuclear material by observation of delayed neutrons with a novel fast neutron composite detector MICHAEL MAYER, JASON NATTRESS, AMIRA BARHOUMI MEDDEB, ALBERT FOSTER, CORY TRIVELPIECE, Pennsylvania State University, PAUL ROSE, ANNA ERICKSON, Georgia Institute of Technology, ZOUBEIDA OUNAIES, IGOR JOVANOVIC, Pennsylvania State University — Detection of shielded special nuclear material is crucial to countering nuclear terrorism and proliferation, but its detection is challenging. By observing the emission of delayed neutrons, which is a unique signature of nuclear fission, the presence of nuclear material can be inferred. We report on the observation of delayed neutrons from natural uranium by using monoenergetic photons and neutrons to induce fission. An interrogating beam of 4.4 MeV and 15.1 MeV gamma-rays and neutrons was produced using the ^{11}B(d,n-γ)^{12}C reaction and used to probe different targets. Neutron detectors with complementary Cherenkov detectors then discriminate material undergoing fission. A Li-doped glass-polymer composite neutron detector was used, which displays excellent n/γ discrimination even at low energies, to observe delayed neutrons from uranium fission. Delayed neutrons have relatively low energies ($\sim$0.5 MeV) compared to prompt neutrons, which makes them difficult to detect using recoil-based detectors. Neutrons were counted and timed after the beam was turned off to observe the characteristic decaying time profile of delayed neutrons. The expected decay of neutron emission rate is in agreement with the common parametrization into six delayed neutron groups.

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