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Modernization of the pulse shape discrimination method for neutron and gamma quanta in scintillation detector

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Detectors based on organic scintillators are widely used in the tasks when fast neutrons in the presence of gamma radiation are necessary to detect. Such tasks are control of spent nuclear fuel, measurement of the yield of fast neutrons from neutron generators, monitoring of neutron and gamma background in underground low-background experiments (neutrino and dark matter detectors), and environmental monitoring. There are fast, slow components of scintillator de-excitation in such detectors and an intensity of slow component depends on the type of the detected particle. In this paper, we investigated the efficiency of several known and two new methods of digital pulse shape discrimination for neutrons and gamma quanta. Experimental data were obtained on a setup consists of a Pu-Be neutron source, organic monocrystalline p-terphenyl scintillation detector and 14 bits, 500 MHz sampling rate flash-ADC with capability to store and upload to the host computer long waveforms for further analysis. A comparison is made in between the results of using traditional and new methods for calculating the signal separation efficiency of Figure of Merit (FOM). The best known from the literature value of the efficiency of neutron and gamma quanta discrimination for the Pu-Be source is FOM = 1.5. We obtained the separation efficiency FOM = 1.77 in the scintillation detector with the p-terphenyl crystal, by a new method. Note also that for the known liquid scintillator BC-501A FOM≈1. A new method of scintillation detector pulse shape discrimination from neutrons and gamma quanta is used to detect the neutron yield from compact neutron generator that is created on the basis of carbon nanotubes.

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