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Separation of signals from neutrons and gamma quanta by the method of normalized signals

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The solution of the problem how to register fast neutrons in the presence of intense gamma radiation is required when solving such fundamental and applied problems as registration of the neutron and gamma background in underground low-background experiments (the low background detectors of the neutrino and dark matter); beam diagnostic at particle accelerators; radiation monitoring at nuclear facilities, nuclear medicine; environmental monitoring. To separate signals from neutrons and gamma quanta, scintillation detectors with organic scintillators are used. The best scintillators are organic crystals of stilbene and p-terphenyl. The efficiency of separating signals from neutrons and gamma quanta can be increased through the use of various methods of digital signal processing of the pulse shapes of the registered signals. A parameter traditionally called the Figure of Merit (FOM) is used to compare these methods. The experimental setup consisted of a Pu-Be neutron source, a scintillation detector with organic monocrystal p-terphenyl, a Hamamatsu R6094 photomultiplier, a CAEN DT5730 Digitizer (500 MHz, 14bit), which store the shape of each pulse for the following digital processing. A new "method of normalized signals" was developed. Four variants of the new method of normalized signals are described, which give the following FOM values: 1.6, 1.7, 1.75 and 2.1. The traditional method of signals separation on the same array of experimental data showed the efficiency FOM = 1.6. Note for comparison that for the widely used liquid scintillator BC-501A this value is FOM≈1. The new method of signal separation is used to register fast neutrons in the installation dedicated for the development of a compact neutron generator, which is necessary for the calibration of low-background detectors of neutrinos and dark matter particles.

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