



Contribution ID : 276

Type : Poster

Registration of neutrons using scintillation detectors in the magnetic field of the HELIS facility

Thursday, 24 October 2024 16:30 (30)

Scintillation detectors are successfully used to register fast neutrons in the presence of background gamma radiation. However, when scintillation detectors operate near particle accelerators, a problem arises due to the presence of a magnetic field near the accelerator. In this paper we investigate the influence of the magnetic field of the HELIS accelerator facility on the parameters of scintillation detector signals and on the efficiency of separating signals from neutrons and gamma quanta. Each detector contains organic monocrystal p-terphenyl and a Hamamatsu R6094 photomultiplier tube. The signals from the photomultiplier tube outputs are digitized using a CAEN DT5730 Digitizer. The gamma-quantum sources Cs-137 and Co-60 were used to study the change in the amplitude and shape of the detector signals at different locations of the PMT dynode system relative to the magnetic field. The presence of a magnetic field leads to a decrease in the amplitude of the signals and distortion of their shape. Using the Cf-252 neutron source, the dependence of the efficiency of signal separation from neutrons and gamma quanta on the magnetic field strength was studied. In the absence of a magnetic field, the coefficient of efficiency of signal separation Figure of Merit is $FOM=1.5$. At a magnetic field of 0.5 mT, the efficiency of signal separation from neutrons and gamma quanta (detectors without a magnetic shield) decreases to $FOM=1$, and at a field of ≈ 1 mT, it becomes impossible to separate the signals. The use of PMTs with magnetic shields allows neutrons to be registered without deterioration of the efficiency of signal separation in magnetic fields up to 5 mT. It has been demonstrated that scintillation detectors with magnetic screens effectively register fast neutrons at the HELIS accelerator facility.

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Session Classification : Poster session

Track Classification : Facilities and advanced detector technologies