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Registration of fast neutrons using a scintillation detector under conditions of background magnetic fields of the HELIS facility

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The task of detecting fast neutrons in the presence of gamma radiation is successfully solved using scintillation detectors with special organic scintillators. However, when operating with a scintillation detector near particle accelerators, there is a problem associated with the presence of a magnetic field near the accelerator. A new efficient detector for mixed neutron and gamma fields is installed at the HELIS accelerator facility. This scintillation detector contains an organic crystal p-terphenyl and a Hamamatsu R6094 photomultiplier tube (PMT). The signals from the PMT output are digitized using a Flash Digitizer (14 bit, 500 MHz). USB interface embedded in to the Digitizer is used to communicate with the personal computer. We studied the effect of the magnetic field of the HELIS accelerator facility on the parameters of the scintillation detector signals and on the efficiency of separating signals from neutrons and gamma quanta. Cs-137 and Co-60 gamma sources were used to study changes in the amplitude and shape of the detector signals for different positions of the PMT's dynode system relative to the magnetic field. The dependences of the amplitude and shape of the signals on the magnitude of the magnetic field are presented. It is shown that the magnetic field leads to a decrease in the amplitude and distortion of the signal shape. Using the Cf-252 neutron source, the efficiency of separating signals from neutrons and gamma quanta depending on the magnitude of the magnetic field was studied. Figure of Merit (FOM) is a measure of the efficiency of separating signals from neutrons and gamma rays. In the absence of a magnetic field, the efficiency of signal separation is FOM = 1.5. When a magnetic field is 0.5 mT, the signal separation efficiency decreases to FOM = 1. If a magnetic field is equal to ≈ 1 mT, it becomes impossible to separate the signals from neutrons and gamma quanta. The use of a PMT with a magnetic shield made of an amorphous alloy makes it possible to separate neutrons and gamma without deteriorating the FOM in magnetic fields up to 5 mT. It has been demonstrated that a new scintillation detector with a magnetic shield effectively detects fast neutrons in gamma background at the HELIS accelerator facility.

Primary author(s) : Dr. CHEPURNOV, Alexander; KIRSANOV, Mikhail (MEPhI)

Co-author(s) : Prof. DALKAROV, Oleg; Mr. KLIMANOV, Sergey; NEGODAEV, Mikhail (P.N. Lebedev Physical Institute of the Russian Academy of Sciences); RUSETSKII, Aleksei (P.N. Lebedev Physical Institute Russian Academy of Sciences)

Presenter(s) : Dr. CHEPURNOV, Alexander; KIRSANOV, Mikhail (MEPhI)

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