

MODERN NEUTRON DETECTORS BASED ON INORGANIC SCINTILLATORS AND THEIR APPLICABILITY FOR LOW NEUTRON FLUX MEASUREMENTS

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The crystals CLLB (Cs₂LiLaBr₆: Ce), CLYC (Cs₂LiYCl₆: Ce), NaIL(NaI:(TI + Li)) are a new basis for modern radiation detectors. With such detectors it is possible to measure not only gamma radiation, but also neutron fluxes. Neutron's detection become possible thanks to the lithium in the crystals which has huge 940 barn cross section for thermal neutron's capture in the reaction $n + {}^6\text{Li} \rightarrow \text{T} + \alpha$. Because of such the advantage, these double purpose detectors are becoming common in a various number of experiments. Their applicability for measuring gamma and neutron backgrounds in low-background experiments yet to be properly studied. In such experiments, detectors must satisfy for more strong requirements: in particular, they have be able to measure low neutron and gamma fluxes, that could be partly achieved by highly efficient Pulse shape discrimination (PSD) of neutrons from gammas. In the same time, their intrinsic radiation background is crucial.

With this in mind, measurement of ambient neutron background is anything adequate test of the detectors. In this work characteristics of CLLB [1], CLYC [2] and NaIL [1] detectors were investigated from measurements of the natural ambient neutron background at JINR (which is on the level of $\sim 10^{-3} \text{ n cm}^{-2} \text{ s}^{-1}$). The detectors' shape is right cylinder crystal with following sizes: 38 mm for the CLYC in which ⁶Li enrichment is 96%, 51 mm for the CLLB that is loaded with natural lithium and 102 mm for NaIL in which the ⁶Li atomic mass content is $\sim 1\%$. The efficiency of neutron registration and possibility for PSD of neutron pulses from gamma and alpha events for each of the detectors and their contamination by radioactive isotopes were thoroughly studied during the measurements.

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1. Produced by Saint-Gobain Crystals: <https://www.crystals.saint-gobain.com>

2. Produced by Scionix: <https://scionix.nl>