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Fast neutron detection with GAGG/SiPM matrix detector

Monday 26 July 2021 17:00 (15 minutes)

The spectacular progress in the improvement of scintillation properties of Ce doped Gd-based crystalline compounds was demonstrated in the last decade. That makes possible use of these materials for neutron detection, similarly to Li-based inorganic scintillators. Particularly, the materials of interest are compositionally disordered $\text{Gd}_3\text{Al}_2\text{Ga}_3\text{O}_{12}$ (GAGG) garnets, which are tolerant to a different kind of ionizing radiation, exhibit a high light yield of up to ~ 50000 photons/MeV, have scintillation decay time shorter than 80 ns, time resolution of annihilation γ -quanta ~ 160 ps. Their emission band peaks at ~ 520 nm matching the sensitivity spectrum of the silicon photomultipliers (SiPMs). Recently we demonstrated the response of GAGG based detector to neutrons of Am(Pu)-Be sources [1,2]. Natural gadolinium is a mixture of six stable isotopes, two of which, ^{155}Gd and ^{157}Gd , have a high cross-section of the thermal neutron capture, 61000 and 254000 barns, respectively. Moreover, Gd nuclei possess a set of resonances providing resonance integral ~ 400 bn. The capture of the neutrons is accompanied by the emission of γ -quanta of different energy, which can be detected in the same scintillation material. The role of the neutron capture by Gd is diminished when their energy reaches a few MeV, and an interaction with ^{69}Ga , ^{71}Ga via new channels ((n,p) and (n, α)) becomes dominating. Here we report on results of the measurement of neutrons obtained at the bombardment of the Pb 5 cm thick target with a 200 MeV proton beam. The capabilities of the Time-Off-Flight measurement at the short base 0.5m and Pulse Shape Discrimination of the different secondaries were demonstrated. Our results prove the GAGG-based detectors are promising to construct short-flight-base neutron spectrometers utilizing the PSD signals analysis.

1. M Korjik, KT Brinkmann, G Dosovitskiy, V Dormenev, A Fedorov, D Kozlov, Compact and Effective Detector of the Fast Neutrons on a Base of Ce-doped $\text{Gd}_3\text{Al}_2\text{Ga}_3\text{O}_{12}$ Scintillation Crystal., IEEE Transactions on Nuclear Science 66 (1)(2019), 536-540, 7
2. A Fedorov, V Gurinovich, V Guзов, G Dosovitskiy, M Korzhik, V Kozhemyakin, A Lopatik, D Kozlov, V Mechinsky, V Retivov, Sensitivity of GAGG based scintillation neutron detector with SiPM readout, Nuclear Engineering and Technology 52(2020) 2306-2312

First author

Mikhail Korzhik

Email

mikhail.korjik@cern.ch

Collaboration / Activity

Crystal Clear Collaboration

Primary author: Prof. KORZHIK, Mikhail (NRC Kurchatov Institute)

Co-authors: Prof. BRINKMANN, Kai-Thomas (Giessen University); Dr BUZANOV, Oleg (FOMOS-MATERIALS); Dr DOSOVITSKIY, George (NRC Kurchatov Institute); Dr DORMENEV, Valery (Giessen University); Mr FEDOROV, Andrei (NRC Kurchatov Institute); Dr MECHINSKY, Vitaly (NRC Kurchatov Institute); KORNOUKHOV,

Vassily (FOMOS-MATERIALS); Mr KOZLOV, Dmitriy (INP BSU); Dr RETIVOV, Vasilli (NRS Kurchatov Institute-IREA); Mr VASILIEV, Vladimir (FOMOS-MATERIALS); Dr ZAUNICK, Hans-Georg (Giessen, University); ALENKOV, Vladimir (FOMOS-MATERIALS)

Presenter: Prof. KORZHIK, Mikhail (NRC Kurchatov Institute)

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