

## **Phoswich detector for discrimination of thermal and fast neutron**

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Single crystals of  $\text{LaCl}_3$  have shown promising performance for the detection of fast neutrons due to the presence of  $\text{Cl-35}$  isotopes [1]. On the other hand Ce doped  $\text{Gd}_3\text{Ga}_3\text{Al}_2\text{O}_{12}$  (GGAG) single crystals have been used to detect thermal neutrons very efficiently [2]. A phoswich detector having GGAG and  $\text{LaCl}_3$  crystals coupled on single PMT was developed to detect thermal neutrons as well as fast neutrons. Thin disk of GGAG crystal was coupled with one inch thick single crystal of  $\text{LaCl}_3$ . The scintillation light from GGAG crystal around 550 nm lies in the transmission range of  $\text{LaCl}_3$  crystal and falls on PMT. The decay times of both crystals are also differ significantly as the major component of GGAG crystal is 55 ns while it is about 3 microsec. for  $\text{LaCl}_3$  crystal. Thermal neutrons, gamma and fast neutrons from various neutron sources, like Am-Be, D-D and D-T are clearly distinguished using this combination with a very high figure of merit. The proton peak induced by the  $^{35}\text{Cl}(n, p)^{35}\text{S}$  reaction can be used for direct neutron spectroscopy because proton energy is proportional to incident neutron energy. Thermal neutron induced peak around 77 keV in GGAG crystals, due to low energy X-rays and conversion electrons, was used to detect thermal neutrons. Detailed results along with variation of fast and thermal neutron fluxes using moderators, will be presented.

1. Phan Quoc Vuong, Hongjoo Kim, Nguyen Thanh Luan, Sunghwan Kim, Neutron spectroscopy using pure  $\text{LaCl}_3$  crystal and the dependence of pulse shape discrimination on Ce-doped concentrations, Nuclear Engineering and Technology, Volume 53, Issue 11, 2021, Pages 3784-3789, ISSN 1738-5733, <https://doi.org/10.1016/j.net.2021.05.020>.
2. Kalyani, Mohit Tyagi, Sheetal Rawat, Awadh K. Singh, Tarun Patel, P.S. Sarkar, Sharaddha S. Desai and G. Anil Kumar, "Thermal neutron discrimination using a novel phoswich detector of  $\text{Gd}_3\text{Ga}_3\text{Al}_2\text{O}_{12}:\text{Ce,B}$  and  $\text{CsI:Tl}$  Single Crystals", IEEE Transc. Nucl. Sci., vol. 67, no. 11, pp. 2415 -2420, Nov. 2020.