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Characterisation of Neutron-Gamma Discrimination in CLYC-6 Detectors for the Dual Gamma-Neutron Imaging System: GN-Vision

Hadron therapy, whilst precise in treating complex cancer cases, encounters challenges in verifying ion-beam ranges and real-time dose monitoring. Moreover, conventional neutron monitoring measures ambient doses off-field, providing approximations rather than yielding precise point-dose measurements. Compton imaging, integrated with neutron imaging, has the potential to enhance both the efficacy and safety of hadron therapy. Additionally, its development bolsters localisation and comprehensive assessment of radioactive sources. The intrinsic ionising properties of neutron and ɣ radiation mandate strict control measures to guarantee their safe decommissioning from reactors and other sources. Furthermore, the potential for sources emitting both types of radiation to be weaponised highlights the critical importance of stringent regulations for national security.

This work presents the initial steps in the development of GN-Vision, a dual gamma-neutron imager designed for the aforementioned applications. In particular, the characterisation of the CLYC-6 scintillation crystal will be reported, which constitutes the core element of the system. The characterisation process begins with an optimisation of the energy resolution and pulse shape discrimination (PSD) capabilities of the CLYC-6 crystals, where the PSD capabilities are quantified using the figure of merit (FOM) metric. A comparative analysis was conducted between two CLYC-6 crystals sourced from different manufacturers. Subsequently, using the most effective CLYC-6 crystal, we compared the performance of conventional PMTs with that of pixelated SiPMs, both of which are necessary to achieve position sensitivity. The contribution will delve into the GN-Vision collimator's capabilities for discriminating between fast and thermal neutrons, as well as assess the performance of the neutron-absorbing material. This analysis aims to illuminate their potential to enhance the overall performance of GN-Vision.

Author: HALLAM, James (University of Surrey)

Co-authors: GAMEIRO, Bernardo (IFIC); DOMINGO-PARDO, C (Instituto de Física Corpuscular (IFIC), CSIC - Univ. Valencia, Valencia, Spain); LADARESCU PALIVAN, Ion (Univ. of Valencia and CSIC (ES)); BALIBREA--CORREA, J (Instituto de Física Corpuscular (IFIC), CSIC - Univ. Valencia, Valencia, Spain); LERENDEGUI MARCO, Jorge (Univ. of Valencia and CSIC (ES)); BABIANO SUAREZ, Victor (Universidad de Valencia)

Presenter: HALLAM, James (University of Surrey)

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