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Monte Carlo Simulation of a Phoswich Detector for Beta-Gamma Coincidence Measurements

The well-known radioxenon systems are based on multichannel beta-gamma spectroscopy. Therefore, there always are some technical problems in and periodical calibrations and maintenance. On the other hand, phoswich detectors are simply based one channel. Appropriate design of a phoswich detector is based on accurate evaluations for different phenomena appearing in response generation. Geant4 is a toolkit that have required capabilities for a front end simulation of scintillation spectroscopy systems. The current study resulted in a proposed design which consists of a plastic beta counting cell made of BC404 coupled to a CsI(Tl) scintillation crystal. It is well-known that there is a correspondency between linearity of spatial dependence of response function and the intrinsic resolution. The main objective is to achieve a linear response function, mainly based on optimization of both of scintillation cells from radiation and optical transport points of view. The study was performed to render a complete evaluation of geometrical and optical effects dealing with the response functions. A detailed pulse shape analysis methodology has been implemented via Geant4 toolkit to evaluate particle discrimination efficiency. Based on the current study, it is expected that the proposed system to have a reasonable energy resolution in comparison to current systems.

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