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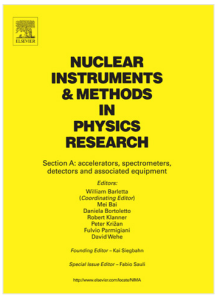

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Design Optimization for a Wearable, Gamma-Ray and Neutron Sensitive, Detector Array with Directionality Estimation

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Abstract

In this study, we report on a constrained optimization and tradeoff study of a hybrid, wearable detector array having directional sensing based upon gamma-ray occlusion. One resulting design uses CLYC detectors while the second feasibility design involves the coupling of gamma-ray-sensitive CsI scintillators and a rubber $LiCaAlF_6$ (LiCAF) neutron detector. The detector systems' responses were investigated through simulation as a function of angle in a two-dimensional plane. The expected total counts, peak-to-total ratio, directionality performance, and detection of ^{40}K for accurate gain stabilization were considered in the optimization. Source directionality estimation was investigated using Bayesian algorithms. Gamma-ray energies of 122 keV, 662 keV, and 1332 keV were considered. The equivalent neutron capture response compared with ^{3}He was also investigated for both designs.

Keywords: Backpack detectors; Nonproliferation; Gamma-ray and neutron detectors; kNN; MCNP; Directionality estimation