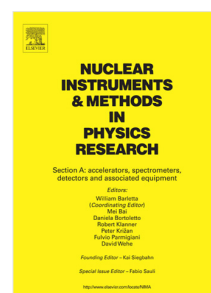


Accepted Manuscript

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PII: S0168-9002(17)30760-X
DOI: <http://dx.doi.org/10.1016/j.nima.2017.07.020>
Reference: NIMA 59969

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date: 25 April 2017
Revised date: 3 June 2017
Accepted date: 12 July 2017

Please cite this article as: B. Ayaz-Maierhafer, C.G. Britt, A.J. August, H. Qi, C.E. Seifert, J.P. Hayward, Design optimization for a wearable, gamma-ray and neutron sensitive, detector array with directionality estimation, *Nuclear Inst. and Methods in Physics Research, A* (2017), <http://dx.doi.org/10.1016/j.nima.2017.07.020>

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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 LiCaAlF₆ (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 ⁴⁰K 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 ³He was also investigated for both designs.

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

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