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#11-81 Optimal Design of Scintillator Neutron Detector

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Neutron radiation detectors are essential in various fields, such as the nuclear power industry, nuclear medicine, scientific experimental systems and homeland security. However, the world is experiencing a shortage of 3He, which has been traditionally used as a key element for the detectors. LiF:ZnS(Ag) scintillator is an optional alternative for these detectors. This alternative main obstacle is the opaque nature of the scintillator. The opacity limits the detector width and hence its sensitivity.

This work presents an optimal design configuration for a sensitive neutron detector. This detector is based on LiF:ZnS(Ag) particles spread in a configuration that offers maximal sensitivity and approximation of the neutron energy. Typically the grain sizes in the mixture are about 2-10μm for the ZnS(Ag) and 1-4μm for the LiF. Our study presents that theoretically the sensitivity could be improved by selecting different sizes for the grains and without changing the mixture weight ratio between the two compounds.

This study was made by an advanced simulation tool. The optimization considerate the neutron capture sensitivity, maximal excitation energy transfer, the light transport and the moderator, see the graph.

We have investigated the received excitation energy for several mixtures with the same weight ratio but different grain sizes. Our simulations have shown the potential for vast sensitivity improvement when consideration is given to the mixture arrangement. We have improved both the probability for the produced alpha and Triton to transfer energy for the ZnS(Ag) excitation and also to increase the probability to have higher excitation energy spectra.

We estimate that the present results to improve current LiF:ZnS(Ag) based detectors and that this method has the potential to offer an available and affordable alternative for 3He based neutron detector and the feasibility of this configuration for approximate neutron spectroscopy.

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