

Monte Carlo simulation of thermal neutron detection using boron-doped graphene films coupled with SiPM sensors

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Efficient neutron detection is crucial in areas such as nuclear security, medical physics, and materials research. This work presents the simulation of a thermal neutron detection system using the Geant4 toolkit. The design includes an Americium-Beryllium (AmBe) source as a neutron emitter, a paraffin block for neutron thermalization, a boron-10 enriched graphene film, a scintillating material for detection of the products of the neutron-boron interaction, and a SiPM for signal readout. The simulation will be performed in three different phases: first neutrons emitted by the AmBe source and are thermalized in the paraffin. The second phase consists of neutron capture by the boron-10, which produces lithium and alpha particles or gammas, and the third phase consists of the final detection in the scintillator-SiPM system. Preliminary results focus on system efficiency, optimization of the paraffin geometry, and signal-to-noise ratio analysis. This design demonstrates the potential of graphene-boron compounds as efficient and lightweight converters for thermal neutron detection, offering valuable perspectives for the development of advanced detectors.

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