Performance and optimization simulations of a GEM-based neutron detector

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In this study, we are investigating the performance and optimization of a GEM-based detector to measure thermal neutrons from a nuclear reactor by means of computer simulation, using Geant4 and Garfield++. Due to the shortage of helium isotope, widely used in neutron gaseous detectors, alternatives need to be studied to continue producing this kind of detectors. The GEM detectors are a type of Micro-Pattern Gaseous Detectors (MPGD), widely used in particle tracking systems, as the Time Projection Chamber of the ALICE experiment in the LHC-CERN, and proposed for many other applications, including neutron detection. The detection of neutrons occurs through a nuclear reaction, where the products are energetic charged particles. In our application, we are using ^{10}B as a neutron converter to induce the nuclear reaction $^{10}B(n,\alpha)^{7}Li$. Monte Carlo simulations play an important step in the development and optimization of this kind of detectors. We are using a combination of simulation tools. At first, Geant4 is used to calculate the interaction between neutrons and the boron converter layer, as well as the transport of its products inside the converter. Then the interaction of the reaction products with the gas volume, leading to ionization or excitation of atoms, is done in Garfield++. This allows us to study the GEM in various conditions and with a detailed description of electron avalanche through the gas and its induced signals in order to achieve a tool to obtain optimized detector configurations for different applications, as beam monitors.