Performance and optimization of a GEM-based neutron detector using a parameterized fast simulator

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Neutrons can be detected indirectly through a nuclear reaction where the products are ionizing radiation. Due to the shortage of ^3He, most commonly used element for such measurements, several studies are searching alternatives, where the Gas Electron Multiplier (GEM) detector using a layer of ^{10}B as a neutron converter is a very promising option. 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. A common strategy to simulate this kind of detector is based on two frameworks: Geant4 and Garfield++. The first one provides the simulation of the nuclear interaction between neutrons and the ^{10}B layer, while the second allows the simulation of the interaction of the reaction products with the detector gas leading to the ionization and excitation of the gas molecules. Given the high ionizing power of this nuclear reaction products, a full simulation is very time consuming and must be optimized to become viable. We developed a fast simulator by means of parameterization strategy based on these two frameworks that allowed us to generate enough data to study an optimized version of this detector aiming for a better position resolution.