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Simulation of single, double, and triple layer GEM detectors

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Originally Micro-Pattern Gas Detectors (MPGDs), a type of gaseous ionization detector, were developed for high energy physics. However applications have expanded to astrophysics, neutrino physics, neutron detection, and medical imaging. Over the past 20 years this led to the development of novel MPGD devices: the Micro-Strip Gas Chamber, Gas Electron Multiplier (GEM), Micromegas and many others, revolutionizing cell size limits for many gas detector applications and considerably improving reliability and radiation hardness. In a gaseous detector an astronomical particle enters a gas cell and collides with an atom of gas, which emits a high energy electron. This electron creates an ionization tract whose electrons are drifted by a small electric potential across a gas cell onto a plate consisting of a double layered conductor separated by an insulator with a strong electric field difference between them. This bottom plate, called a GEM, has an array of tiny holes and the ionization tract electrons fortunate enough to pass though the holes are strongly accelerated causing them to create secondary cascades in the direction of a pixel readout array such as a CMOS ASIC chip. The major advantage of the GEM technology is that multiple GEMs (so far up to 5) can be stacked together yielding a very high effective gain while each individual GEM layer works at a lower electric potential thus avoiding discharge problems. Here we present a simulation study of single, double, and triple GEMs's to characterize the properties of gain, spatial resolution, energy resolution, efficiency, etc. using Garfield++ and ANSYS field solver to compare between the results of published experiments and simulations.

Keywords

Gas Electron Multiplier (GEM), Micro-Pattern Gas Detector (MPGD), Garfield++, ANSYS

Collaboration

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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