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Development of a Segmented GEM Readout (SGR) Detector

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Micromegas (Micro-MEsh GAseous Structures) detectors are a modern form of micro-pattern gaseous detectors. The primary charges are amplified by electron avalanches between a planar anode and a mesh 120 µm above the anode. For resistive strip type Micromegas detectors the signal is read out via readout strips below the anode. A 2D particle position is reconstructed using two perpendicular readout strip layers below the resistive anode structure.
Using a standard 2D resistive strip Micromegas readout structure, a unique 2D particle position reconstruction is only possible if the detector is hit by only one particle at the same time. Ambiguities will occur if multiple particles arrive at the same time. A unique X-Y assignment is not possible.
This issue can be resolved by replacing the mesh with a GEM (Gas Electron Multiplier) foil, which is segmented into 0.5 mm wide strips on one side. The GEM strips need to be turned by 45° with respect to the Micromegas readout strips. Thus the detector has three readout strip directions (X, Y and V).
A prototype of such a Segmented GEM Readout (SGR) detector is built with GEM strips and readout strips perpendicular to each other. Test beam measurements with this detector were performed using 120 GeV muons. The GEM and the Micromegas strips show a similar pulse height. For perpendicular incident particles a position reconstruction efficiency better than 90 % is reached on both the GEM strips and the readout strips. This detector achieves a resolution better than 80 µm for the GEM strips and readout strips.
Also the angle and position reconstruction for inclined tracks the works, achieving position reconstruction efficiencies of better than 90 %.

Collaboration

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