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Study of spatial resolution of low-material GEM tracking detectors

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Spatial resolution of GEM based tracking detectors is simulated and measured. The simulation includes GEANT4 based transport of high energy electrons with careful accounting of atomic relaxation processes including emission of phluorescent photons and Auger electrons and custom post-processing, including accounting of diffusion, gas amplification fluctuations, distribution of signals on readout electrodes, electronics noise and particular algorithm of final coordinate calculation (center of gravity). The simulation demonstrates that the minimum of spatial resolution of about 10 um can be achieved at a strips pitch of 250 um to 300 um. At a larger pitch the resolution is quickly degrading reaching 80-100 um at a pitch of 500 um.

Spatial resolution of low-material triple-GEM detectors for the DEUTRON facility at VEPP-3 storage ring is measured at the extracted beam facility of VEPP-4M collider. The amount of material in these detectors is reduced by etching of copper at GEMs electrodes and using the readout structure on thin kapton foil rather than on glass fiber plate. The exact amount of material in one DEUTRON detector is measured by studying multiple scattering of 100 MeV electrons in it and the result of these measurements is X/X0 = 2.4x10^-3 that corresponds to the thickness of copper layer on GEMs of 3 um. Spatial resolution of one DEUTRON detector is measured with 500 MeV electrons and the measured value is equal to 35 um for orthogonal tracks.

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