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Ion space-charge effects in multi-GEM detectors: challenges and possible solutions for future applications

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Graphene is a single layer of carbon atoms arranged in a honeycomb lattice with remarkable mechanical, electrical and optical properties. It can be regarded as the thinnest and narrowest conductive mesh with a reported strong asymmetry in transmission of low energetic electrons and ions. Ideally this would make graphene a membrane transparent to electrons and opaque to ions, therefore solving the problem of ion back-flow in Micro Pattern Gaseous Detectors (MPGD).
Graphene layers with an area of the order of a square centimetre were transferred onto metal support structures with holes of diameters from 30 to 70 micrometres and pitches of the order of twice the diameter of the holes, so that the graphene was freely suspended in the holes.
The graphene samples were installed into the conversion volume of a triple Gaseous Electron Multiplier (GEM), allowing a study of the transparency of the graphene to electrons and ions in gas as a function of the electric fields applied.
We describe the transfer techniques of the graphene layers from the substrate to the experimental setup as well as the procedures to measure the charge transfer properties. Results will be presented with special attention to the challenges arising from defects in the graphene layers. We furthermore describe solutions to study the intrinsic transmission properties of this material and discuss applications where these techniques can be used to improve the state of the art of gaseous detectors.

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