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19. Impact of a strong electric field below the GEM on light yield and saturation in a He:CF4 based Time Projection Chamber

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CYGNO is an international collaboration working on the development of a directional detector whose main goal is the direct detection of rare events, such as Dark Matter (DM) in the mass range below few tens of GeV/c2, by means of a gaseous detector. It consists in a Time Projection Chamber (TPC) filled with a He:CF4 gas mixture at atmospheric pressure (900 to 1000 mbar) equipped with an amplification stage composed of a triple Gas Electron Multiplier (GEM) structure. Given the scintillating properties of the gas, the readout is optical, based on sCMOS cameras and photomultiplier tubes. The intrinsic information provided by the TPC technology coupled to the spatial granularity and time resolution of the GEM and of the optical sensor combination allows to image the three-dimensional energy deposition of electron and nuclear recoils down to few keV of energy.

In low energy rare event searches, the detection of the smallest energy deposition possible is of the utmost importance to improve directional capabilities and DM sensitivity. Besides, while the optical readout can cover wide readout areas with a limited number of sensors, the solid angle coverage strongly suppresses the number of photons they can collect. As a result, extremely large avalanche gains are required from the amplification stage which is limited by the onset of space-charge saturation effects.
The possibility of introducing a strong electric field, above 10 kV/cm, below the last GEM to distort the electric field and increment the light yield was tested with a CYGNO prototype.
We will present the studies of the effect of such field on the GEM hole electric field and the experimental results on the light yield, intrinsic diffusion estimation and space-charge saturation level suppression.
Achieving large gains in rare event searches detectors optically readout is an extremely relevant problem wherein advancements and new developments could pave the way for the realisation of large-scale experiments.

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