

# Optical negative ion drift operation at nearly atmospheric pressure

*Thursday 15 December 2022 12:10 (20 minutes)*

We are going to present for the first time Negative Ion Drift (NID) operation in He:CF<sub>4</sub>:SF<sub>6</sub> at nearly atmospheric pressure within a Time Projection Chamber (TPC) with optical readout via PMTs and scientific CMOS camera (sCMOS). These results have been obtained in the context of the CYGNO/INITIUM project, for the development of high precision 3D TPC for directional direct Dark Matter searches. NID operation is a peculiar modification of the TPC principle by which, thanks to the addition of an highly electronegative dopant to the gas mixture, anions act as image carriers rather than electron, reducing down to the thermal limit the diffusion during drift. This characteristics allows for the use of longer drift distances, combined with improved tracking. We are going to illustrate the analysis of both PMTs and sCMOS data, that are not only able to reproduce He:CF<sub>4</sub>:SF<sub>6</sub> mobility as from previously published papers with charge readout, but also display an impressive reduction of the diffusion during drift, as much as half of classical electron drift with He:CF<sub>4</sub> along 12.5 cm. We are going to present NID measurements with various concentration of the elements in the He:CF<sub>4</sub>:SF<sub>6</sub> mixture and a preliminary explanation of the observed extremely low diffusion from classical arguments. The observed features can significantly boost the performances of any experimental approach that requires high precision imaging TPCs, such as, among the others, X-ray polarimetry, neutron spectroscopy, Migdal effect measurements and tracking in high energy physics.

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**Session Classification:** Session 10