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The MPGD-based bubble-free Liquid Hole-Multiplier concept for charge and light detection in dual-phase noble-liquid TPCs

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The Bubble-free Liquid Hole-Multiplier (Bf-LHM) concept has been proposed for the simultaneous detection of scintillation-photons and ionization electrons, in dual-phase noble-liquid detectors. In a simpler version of the Bubble-assisted Liquid Hole-Multiplier (Ba-LHM), the gas bubble trapped under a perforated electrode is replaced by a liquid-to-vapor interface located between two perforated (e.g., THGEM) ones. The bottom electrode (L-THGEM) is immersed in the noble liquid with a CsI VUV photocathode deposited underneath, and the top one (G-THGEM) is located in the gas phase. Ionization electrons deposited in the liquid and scintillation-induced photoelectrons emitted from the photocathode are focused into the L-THGEM holes and efficiently transmitted to the vapor phase under an intense field where they are collected into the G-THGEM holes and induce fast electroluminescence photons that are detected by photosensors located above. In this contribution, we will describe the basic operation principles of the new concept and summarize our current experimental results in LXe, emphasizing on the high transfer efficiency of ionization electrons and photoelectrons across THGEM holes, their detection efficiency in the gas phase and the enhanced photon detection efficiency (PDE) of the Bf-LHM compared to the Ba-LHM.

Presenter: ROY, Arindam (Ben Gurion University)

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