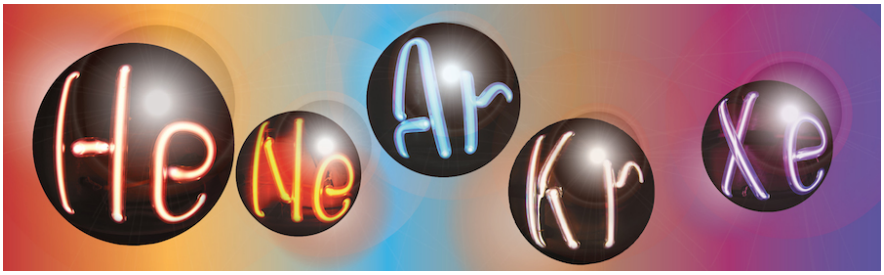

Contribution ID: **61** Type: **Presentation**

Progress with the bubble-free Liquid Hole-Multiplier for dual-phase scintillation- & electroluminescence-photon detectors

Wednesday, 21 September 2022 13:55 (15 minutes)

The bubble-free Liquid Hole-Multiplier (bf-LHM) has been proposed as a novel sensor for recording both scintillation- and electroluminescence-photons in dual-phase detectors. The new concept follows that of the bubble-assisted one investigated over the past years.

In this contribution, we will discuss the progress made with this new, simpler concept –in which the gas bubble is replaced by a liquid-to-vapor interface located between two perforated (e.g. THGEM) electrodes. The bottom one, fully immersed in the liquid (L-THGEM), has a CsI VUV photocathode deposited on its bottom face, while the top (uncoated) THGEM is located in the gas (G-THGEM), with photo-sensors above. Ionization electrons deposited in the drift volume below the L-THGEM and S1-induced photoelectrons emitted from the photocathode are focused into the holes and transmitted through with nearly no losses. An intense field between the two electrodes (taking here the role of the "gate"in conventional dual-phase TPCs) ensures efficient transmission of the electrons into the vapor phase, where they induce fast EL signals (after being collected) primarily within the G-THGEM holes.

The main advantages of this concept are
- the independence of any liquid-to-gas interface fluctuations and instabilities and the detection capability of both ionization electrons and single-VUV photons (the latter with expected high PDE)
- the possibility of using SiPMs or CMOS sensors as the single-photon induced electroluminescence flashes are expected to be far above the dark noise of current photo-sensors.

We will describe the basic operation principles of the new concept and summarize our current experimental results in LXe. We will demonstrate the high transfer efficiency of ionization electrons and photoelectrons from CsI across the L-THGEM as well as their detection efficiency in the gas phase. Although preliminary, the results already demonstrate a significant improvement in the sensitivity of this detector concept to VUV photons compared to the bubble-assisted LHM.

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Session Classification: Light and charge readout

Track Classification: Light/charge readout (PMT, SiPM, WLS, electronics etc.)