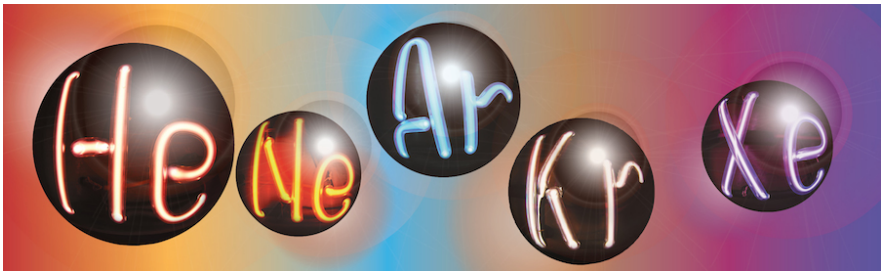

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Wavelength-shifting optical amplification structures for future Dark Matter searches.

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Driven by growing astrophysical and cosmological evidence supporting the existence of dark matter (DM), numerous direct detection experiments have been developed to search for particle DM candidates, such as DarkSide, XENON, LZ. The use of noble elements as the target medium are commonly adopted in the field for their intrinsic characteristics, and where vacuum ultraviolet (VUV) scintillation or scintillation and ionization, induced by elastic scattering of WIMPs on nuclei, is detected.

One of the main challenges in argon-based detectors is the relatively low efficiency of commercially available VUV-optimized photosensors. This limitation makes light collection and detection of S1 and S2 light in liquid argon (LAr) challenging. Therefore, efficient wavelength-shifting (WLS) materials are needed to enhance light collection efficiency. In recent years, substantial progress has been made in the development of WLS materials and MPGD-based light amplification structures, such as the Field-Assisted Transparent Gaseous Electron Multiplier (FAT-GEM). These advances, together with the growing importance of effects in the liquid-gas phase interface in the performance of such detectors as well as the scalability of such detectors, have led to the development of the WLS wavelength-shifting FAT-GEMs, a novel floating optical amplification structure that enhances scintillation light detection and can be easily tiled, making it inherently scalable. This makes it a promising approach for next-generation experiments.

In this work, we present the current status of the project related with the development of these new FAT-GEM structures with wavelength-shifting capability, including the assessment of their performance, carried out using two different experimental setups available at Astrocent (Poland) and IGFAE (Spain).

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