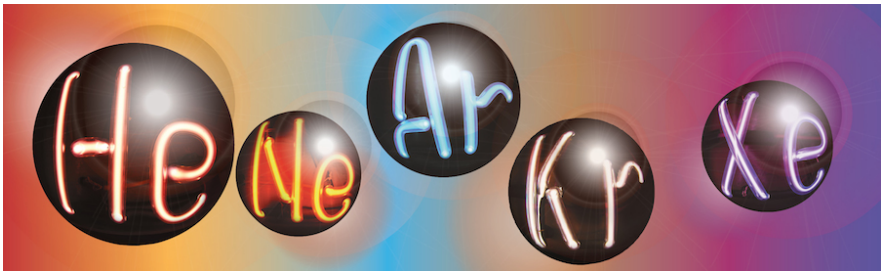

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Optimization of dual-phase doped argon TPCs for dark matter WIMP detection

Dual-phase argon Time Projection Chambers (TPCs) are a leading technology for rare-event searches including dark matter WIMP and neutrino interactions. Searching for dark matter candidates at lower masses requires detectors with lower energy thresholds than those of current noble liquid TPCs. Our research focuses on optimizing detector materials for very low energy deposition events, such as those expected from a WIMP-argon nuclear recoil. We will build a modular mini-TPC and use it to study the effect of doping LAr with Xe or photosensitive dopants to lower the ionization energy which can increase yield and lower the energy threshold, extending sensitivity to lower masses. While photosensitive dopants can increase the ionization yield, UV electroluminescence photons that enter the liquid phase can reionize the dopants and initiate a positive feedback loop. Our solution is to optically decouple the gas and liquid portions by constructing a barrier that is transparent to electrons and opaque to photons in place of the traditional wire mesh. We are also conducting tests on materials to improve electric field shaping such as the carbon-loaded Kapton DR-9 and a through-glass ground connection in the anode using cryogenic epoxy. Together, these studies aim to inform the development of a new generation of low-threshold dual-phase argon TPCs optimized for rare-event detection.

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