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Calibrating Low-Energy Nuclear Recoils with Dual-Phase Argon TPC for Future Light Dark Matter Searches

The dual-phase argon time projection chamber (DAr-TPC) has shown significant advantages in detecting Weakly Interacting Massive Particles (WIMPs) in low mass ranges (sub GeV/c^2 - 10 GeV/c^2). However, due to the lack of energy calibration measurements for scintillation and ionization yields with nuclear recoil energy below 7.1 keV, the current analysis for constraining spin-independent dark matter interactions with nucleons is influenced by the accuracy of theoretical models and limited by searching sensitivity. To address this issue, we are preparing to build a small DAr-TPC to conduct a liquid argon calibration experiment of nuclear recoil response using a low-energy neutron beam. The goal is to obtain calibrated data for the 1.0 to 7.1 keV energy range of nuclear recoil. This poster will introduce the research background and the setup design of the calibration experiment, as well as showcase the progress of tests on the PMT arrays to be implemented in the apparatus, both at room temperature and in a liquid argon cryogenic environment.

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