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The Search for the Migdal Effect and the Modeling of Nuclear Recoil with DD Neutrons in LUX-ZEPLIN (LZ) Experiment

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WIMP dark matter particles are expected to interact with liquid xenon producing nuclear recoils (NRs). It is critical for dark matter experiments to have accurate calibration of the detector response and correct modeling of xenon microphysics. The Migdal effect theorizes that when an atom is recoiling, an electron could be emitted, leading to ionization and greater energy deposition. This effect is crucial for dark matter experiments as it improves the sensitivity to sub-GeV dark matter. In this talk, we report the direct measurement of the rate of Migdal-effect events in liquid Xe for NR in the energy range of 5–74 keVnr, resulting from interactions of 2.45 MeV DD neutrons with xenon nuclei. We also present the NR yield calibration for the first science run of the LUX-ZEPLIN (LZ) experiment. The analysis of high-statistics data motivates significant revision of the model for xenon microphysics. We will discuss the impact of such revision on the search for the coherent scattering of boron-8 neutrinos.

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