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Experimental result on measuring the Migdal effect with neutron-induced nuclear recoils at the keV level in liquid xenon

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The sensitivity of current dark matter experiments to sub-GeV mass dark matter candidates can be substantially improved by the Migdal effect, which predicts a finite probability for a nuclear recoil interaction to be accompanied by atomic excitation or ionization. The additional Migdal energy deposition enhances observable signals in experiments that measure scintillation and ionizations, and can elevate a fraction of nuclear recoil interactions below the detector thresholds to above thresholds. We carried out a direct search for the Migdal effect in liquid xenon using $\mathcal{O}(10^5)$ xenon recoils in the keV region produced by scatters of 14.1MeV neutrons in a compact xenon time projection chamber. This data is predicted to contain thousands of Migdal interactions, of which a few hundred should produce observable signatures. We search for these signals in a way that is minimally impacted by uncertainties in nuclear cross section data or inaccuracies from modeling the detector response to nuclear recoils. The result of this search and the implications for dark matter experiments will be discussed.

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