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Detection of coherent scatter of reactor antineutrinos on nuclei with dual-phase Xe or Ar detectors.

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Noble liquid ionization and scintillation detectors have come into their own in the last decade, with increasing larger mass detectors setting new and increasingly stringent limits on popular dark matter candidates. Advances in understanding of the detector physics in these devices should make it possible to use them at the limit of their sensitivity, at the ~1-10 ionization electron level. In this regime, it is possible to detect coherent scatter of low energy solar neutrinos and reactor antineutrinos, and to make significant inroads in the mass-coupling phase space for light dark matter particles and other so-called 'dark sector' interactions. Coherent scatter detection at reactors may lead to small scale devices capable of monitoring the reactor's fissile content for nonproliferation applications, a key interest of our laboratory.

To accomplish these goals, the response of these detectors must be calibrated in the range of ~1-10 ionization electrons, corresponding to sub –keV to ~1 keV nuclear recoil energies. At LLNL, an effort is underway to measure ionization yield in this regime, using dedicated small Xe detectors and quasi-monoenergetic low-energy pulsed neutron beams. Beyond calibration, it is essential to understand and suppress backgrounds in the few-electron regime. LUX and other experiments have already begun to characterize low energy backgrounds arising from the gas-liquid interface in in the bulk liquid. A focus for our group is the study of metal-liquid interfaces, at which condensed matter effects are likely to contribute to the total rate of events, and alter the noise spectrum. In my talk, I will describe our work on beam calibrations, and discuss possible condensed matter mechanisms for noise production in noble liquids.

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