Contribution ID: **5** Type: **not specified**

Measuring the Low Energy Nuclear Quenching Factor in Liquid Argon for a Coherent Neutrino Scatter Detector

Coherent neutrino-nucleus scattering (CNS) is an as-yet undetected, flavor-independent neutrino interaction predicted by the Standard Model. One primary reason the CNS interaction has yet to be observed is the very low energy depositions (less than ˜1 keV for MeV-scale neutrinos). Another challenge is that in argon and many other detection media, nuclear recoils produce less observable energy per unit energy deposited than electron recoils. This ratio of observed nuclear and electronic energy depositions is unknown in argon at energies involved in CNS interactions. CNS has a predicted cross section in argon, which for the energies of 1-10 MeV is ˜2 orders of magnitude greater than that of inverse-beta decay and thus offers the potential for a compact, flavor-blind neutrino detector. There are a variety of applications that could benefit from detecting the CNS interaction, such as antineutrino-based nuclear reactor monitoring, and astrophysics (solar and supernova neutrino detection). Our goal is to deploy a dual-phase detector with a 10 kg active mass (or 10/1.4 active volume) at a nuclear reactor to observe the CNS interaction. We are currently developing a small dual phase argon detector prototype for the purpose of measuring the ratio of nuclear to electronic observed energy deposition (nuclear quenching factor). We discuss the commissioning of the detector and the progress towards measuring the nuclear quenching factor for liquid argon at recoil energies of a few keV.

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