Contribution ID: **51** Type: **Invited**

SBC's 10 kg Argon Bubble Chambers for Dark Matter and Reactor CEvNS

Tuesday, 21 July 2020 10:00 (15 minutes)

The Scintillating Bubble Chamber (SBC) collaboration is in the process of building the first of a set of bubble chambers with 10 kg superheated liquid argon target masses. Superheated dark matter detectors containing freons such as C_3F_8 are well-studied and can be operated in thermodynamic states which make the detector intrinsically insensitive to electron recoils (ERs), but provide no event-by-event energy information for nuclear recoils (NRs) above the bubble nucleation-energy threshold. Noble liquids, especially argon and xenon, are well-studied scintillators, but are subject to ER backgrounds at low thresholds when searching for WIMPs or neutrinos. A prototype xenon-filled bubble chamber containing a 30 gram target mass has demonstrated that these two technologies can be combined, resulting in a bubble chamber with simultaneous scintillation (calorimetry) and bubble nucleation from neutron-induced NRs, while maintaining intrinsic insensitivity to ER bubble nucleation. We are now constructing our argon-filled R&D detector at Fermilab, where we will take calibration data with spontaneous fission and photoneutron sources, as well as gamma sources, to constrain the sensitivity of such a detector to NR and ER events at energy thresholds of O(100) eV, where the detector is projected to be sensitive to O(1-10) GeV/c^2 dark matter and reactor neutrino CEνNS. The detector can then be moved to a deep-underground site or nuclear reactor to take dark matter or neutrino data, respectively.

Summary

Fermilab report number

FERMILAB-SLIDES-20-033-PPD

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Session Classification: Tuesday Morning 1