Contribution ID: **3** Type: **Oral**

Metastable Water: Breakthrough Technology for Neutrinos & Dark Matter

Wednesday 6 October 2021 12:15 (7 minutes)

We will present a discussion of a new detector technology, the "Snowball Chamber,"which is based on the phase transition (of liquid to solid) for metastable fluids. A water-based supercooled detector has great potential for dark matter, but here we will focus on neutrino physics, utilizing the CEvNS interaction on Oxygen. It is likely possible to reach operational conditions wherein such a detector will respond to Oxygen nucleus recoils. The detector would thus be sensitive to the CEνNS interaction, but with a low-mass even-even nucleus. Precision tests of the Standard Model cross-section (e.g., Non-standard Interactions) would then be possible, devoid of the complicating uncertainties due to the nuclear form factor, and the less-well-predicted axial current contributions to neutrino cross-section. For homeland security applications, a (compact) water CEνNS detector could detect reactor neutrinos. Lastly, a detector using deuterated water could be a viable technology for normalizing low-energy neutrino fluxes from stopped-pion beams. Unfortunately, as it is only a threshold detector, each supercooled liquid module provides no spectral information on the nuclear recoils. This deficiency could be mitigated, however, through the use of a large modular array, with modules at slightly different thresholds, or with doping, in future work.

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Session Classification: CEvNS Experiments