38th INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS
AUGUST 3 - 10, 2016
CHICAGO

Contribution ID: **1359** Type: **Poster**

Detecting dark matter with scintillating bubble chambers: Results from a 35-gram prototype xenon bubble chamber

Monday 8 August 2016 18:30 (2 hours)

The bubble chambers developed by the PICO collaboration for dark matter detection feature both unmatched electron recoil background rejection and the unique ability to work with a variety of target liquids, properties that have led to several world-leading direct detection limits on the WIMP-proton spin-dependent cross section. Existing bubble chambers, however, are threshold detectors with weak discrimination against those rare backgrounds that do meet bubble nucleation criteria. These backgrounds differ from the WIMP signal by orders of magnitude in total energy deposited in the detector, and can be eliminated if a liquid scintillator is chosen as the superheated target in a PICO-style device. We will present results from the 35-gram prototype liquid xenon bubble chamber at Northwestern University, which aims to achieve the first demonstration of simultaneous scintillation readout and bubble nucleation. If successful, this device will open the door to a new class of detectors with the electron rejection and position reconstruction of a bubble chamber, the energy resolution of a liquid scintillator, and the scalability of either.

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Session Classification: Poster Session

Track Classification: Detector: R&D and Performance