Contribution ID: **273** Type: **Poster presentation**

What surfaces in dark matter detectors

Tuesday 19 July 2022 19:00 (1 hour)

Dual-phase noble liquid time-projection chambers have a long application history in searches for rare low-energy events like interactions with dark matter particles. Because of scalability and existing support infrastructure, they are expected to serve in large future projects. Our analysis of data and models for electrons and ions extraction from the liquid into the gas phase and data for the dwelling time of unextracted electrons at the liquid surface indicates that several remarkable effects, including Wigner crystallization of unextracted electrons on the liquid surface, which can be present. Not checking for these effects could lead to systematic uncertainties in particle physics results analysis. Though additional studies on the detector's physics are required, we can suggest some detector design improvements.
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-ABS-834584-DRAFT

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Session Classification: Poster session