



Contribution ID: 8

Type: **not specified**

Progress Toward Low-Mass Dark Matter Detection with Superfluid He (HeRALD) and Polar Crystals (SPICE)

Thursday, 13 July 2023 10:15 (30 minutes)

We report on the recent progress of the SPICE/HeRALD (or TESSERACT) collaboration in developing detectors for dark matter masses down to 10MeV with the potential to upgrade for reach down to sub-MeV masses. SPICE and HeRALD are currently in an R&D phase of pushing the recoil energy thresholds of Transition Edge Sensors (TES) down to the sub-eV range, which can then be applied to well-motivated target materials. HeRALD uses superfluid 4He as a target, which has the advantage of a low-mass target nucleus and quantum evaporation-based detection of phonon energy. SPICE employs crystalline targets such as the polar crystals GaAs and Sapphire, which couple strongly to dark photon mediated DM. Both experiments are currently making pushes to reduce the ubiquitous low-energy excess background, which originates from spontaneous phonon emission by the calorimeter materials themselves and likely is the primary background in phonon-based detector experiments at eV-scales.

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