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Contribution ID: **1690** Type: **CLOSED - Oral (Non-Student) / orale (non-étudiant)**

Prospects and Challenges for the Detection of MeV-scale Dark Matter

Monday, 29 May 2017 14:15 (15 minutes)

Thermal relic dark matter models predict dark matter particles with masses of ~10 keV/c^2 to 10 TeV/c^2. As existing experiments are insensitive to the lowest masses in this range, new technologies for light dark matter searches are being pursued. The SuperCDMS, NEWS, DAMIC, and CRESST experiments are beginning to exploring the light dark matter regime while pushing towards the physical limits of ionization calorimetry with single photon or electron sensitivity. Future technologies measuring low-gap excitations will be required to search for the lightest possible thermal relic dark matter masses. Ideas for these future searches have recently been presented at the SLAC Dark Sectors and Lawrence Berkeley National Laboratory Sub-eV workshops.

These experiments face new challenges in understanding detector responses and backgrounds. Traditional nuclear recoil calibration techniques lack resolution at eV-scale energies and structure effects complicate the simple elastic recoil physics assumed by weak-scale dark matter searches. New mechanisms for backgrounds from radiation, leakage currents, and vibration in a cryogenic environment challenge the design of these low-threshold searches. A conceptual review of the prospects and challenges facing this frontier will be presented.

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Session Classification: M3-3 Cosmic Messengers (PPD/DNP/DTP) | Messagers cosmiques (PPD/DPN/DPT)

Track Classification: Particle Physics / Physique des particules (PPD)