Cryogenic Detectors with Superconducting Thermometers for Low-Mass Dark Matter Searches

Lucia Canonica[1]

[1]Max-Planck-Institut für Physik, München, Germany

Email: canonica@mpp.mpg.de

***Abstract*—The nature of Dark Matter (DM) is one of the most important open questions in physics, astrophysics, and cosmology. Among different approaches, one possibility is to directly search for hypothetical DM particles, detecting the nuclear recoils arising from elastic scattering between DM particles and target nuclei.**

CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) is a cryogenic experiment aiming at the direct detection of DM particles. It is located at the Gran Sasso underground laboratory (LNGS, Italy) where an overburden of 1400 m of rock (3800 m water equivalent) provides an efficient reduction of the cosmic radiation background.

In CRESST scintillating $CaWO_4$ crystals, operated as cryogenic calorimeters at millikelvin temperature, are used as target material for elastic DM-nucleus scattering. With this approach, nuclear recoils with energy below 100 eV can be detected, allowing for unprecedented sensitivity in the search for sub-GeV/c^2 dark matter candidates. To detect such a tiny amount of energy, each detector is equipped with a tungsten TES (Transition Edge Sensor) thermometer. The thin tungsten films are evaporated onto the absorber crystals and they are stabilized in the transition between the normal-conducting and super-conducting states, allowing the detection of tiny variation in temperature by measuring the change in resistance of the TES.

In the current phase of the experiment, CRESST-III Phase 1, an array of 10 $CaWO_4$ scintillating crystals of ~25 g each, paired with cryogenic light detectors (also equipped with TES), is operated. The light detectors measure the scintillation light produced in particle interaction in the main absorber and make possible an event-by-event particle identification for background suppression.

In this contribution the features of cryogenic detectors and the most recent results from CRESST will be presented, including the results of the search for the sub-GeV/c^2 mass region and the perspective for the next phase of the experiment.

***Keywords (Index Terms)*— Dark matter, cryogenic detector, low-mass dark matter particles.**

IEEE CSC & ESAS SUPERCONDUCTIVITY NEWS FORUM (global edition), No. 46, February 2019.
Received December 14, 2018; selected December 14, 2018. Reference STP634; Category 4.
Invited presentation 5EOr1B-02 given at ASC 2018, 28 October – 2 November 2018, Seattle (USA).