New results on low mass dark matter from the CRESST-II experiment

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Federica Petricca
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on behalf of the CRESST collaboration
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F. Petricca on behalf of the CRESST collaboration
The CRESST experiment

Cryogenic Rare Event Search with Superconducting Thermometers

Direct detection of dark matter particles via their scattering off target nuclei

Scintillating CaWO$_4$ crystals as target

Target crystals operated as cryogenic calorimeters (~15mK)

Separate cryogenic light detector to detect the scintillation light signal
Energy deposition in the crystal:

- mainly phonons
  (independent of the type of particle)

**Measurement of deposited energy**

- small fraction into scintillation light
  (characteristic of the type of particle)

**Particle discrimination**

**Two simultaneous signals** from the two transition edge sensors (TES)
Excellent discrimination between potential signal events (nuclear recoils) and dominant radioactive background (electron recoils).
CRESST II Phase 2

Data taking: July 2013 – August 2015

First Phase 2 results on low mass dark matter particles:
- July 2014
- Single module TUM40
- Self grown crystal
- Best overall performance
- 29 kg days of exposure
- Non-blind 2013 dataset

Trigger thresholds of several modules lowered

Final Phase 2 results on low mass dark matter particles:
- September 2015
- Single module Lise
- External supplier
- Lowest threshold
- 52 kg days of exposure
- Full blind data set

arXiv:1509.01515

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Detector design: Conventional
No veto for surface alpha decays

Crystal: Lise (external supplier)
Background level ~8.5 counts/keV kg day

Threshold: 307eV
Resolution: 62eV at zero energy

- Average overall performance
- Lowest threshold
Data

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50% O recoils below

99.5% W recoils above
All accepted events considered as potential signal

- Standard assumptions on dark matter halo
- Helm form factors
- Yellin one-dimensional optimum interval method
Explore masses in the sub-GeV/c^2 range

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Modules for CRESST III

Detector layout optimized for low mass dark matter

- Available self grown crystals (background level ~3 counts/keV kg day)
- 100 eV threshold
- Cuboid crystal of (20×20×10)mm³ (~ 25g)
- Fully scintillating housing
- Light detector (20×20)mm²

Prototype successfully tested
Production of modules ongoing

Start of CRESST III end of 2015

For details see poster Strauss, Pröbst, Petricca
Phase 1

- 50 kg-days
- 1 year of running with 10 small modules

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CRESST III projections

Phase 2
- 1000 kg-days
  2 years of running with
  100 small modules
- factor 100 reduction
  in background

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CRESST has an outstanding potential to explore the low mass region.

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