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for the CRESST collaboration

Cryogenic Rare Event Search with Superconducting Thermometers
CRESST located at LNGS (Laboratori Nazionali del Gran Sasso) in Italy

- Cryogenic scintillating calorimeter
- Target material is CaWO₄
- Read out channels: phonon and scintillation light

Shielding:
- polyethylene;
- lead;
- copper;
- muon veto system.

CRESST-III Phase 1
The CRESST experiment

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

- target material: CaWO$_4$ single crystals
- particle interaction
  - heat (phonon) signal
    read-out with thermometer
  - light signal
    read-out with light detector
- reflective and scintillating housing

Target crystals operated as cryogenic calorimeters (~15mK)
Event discrimination

Light Yield = \frac{\text{Light signal}}{\text{Phonon signal}}

Characteristic of the event type

Excellent discrimination between potential signal events (nuclear recoils) and dominant radioactive background (electron recoils)

ROI: region of interest for dark matter search
CRESST-III Phase 1 low-threshold detectors

- Cuboid crystals of \((20 \times 20 \times 10)\text{mm}^3\) \((\approx 24\text{g})\) \(\times\) 10 modules
- Design goal: **100 eV threshold**
- Fully scintillating housing (holding with CaWO\(_4\) sticks)
- Instrumented sticks (iSticks) for holding main crystal (veto for events happening in sticks)

Data taking from July 2016 to January 2018
Optimum thresholds

5 detectors reach/exceed the CRESST-III design goal - threshold < 100eV
Optimum thresholds: Detector Module A

**Detector A**  the lowest threshold!  New benchmark point in low mass dark matter search.

- **Data taking period:** 10/2016 – 01/2018
- **Non-blind data (dynamically growing):** 20% randomly selected
- **Target crystal mass:** 23.6g
- **Gross exposure (before cuts):** 5.7 kg days
- **Nuclear recoil threshold:** 30.1 eV

Acceptance region fixed before unblinding

99.5% W recoils above
50% O recoils below

Analysis optimized for very low energies: 30eV → 16keV

Valentyna Mokina - HEPHY OEAW October 25, 2018
Energy spectrum of accepted events

Yellin 1D optimum interval method

Energy spectrum expected for DM

(preliminary) Result

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(Yellin 1D optimum interval method)

Energy spectrum expected for DM
(preliminary) Result

Extended reach from $0.5\text{GeV/c}^2 \rightarrow 0.16\text{GeV/c}^2$

One order of magnitude improvement at $0.5\text{ GeV/c}^2$
Conclusions

First CRESST-III run 07/2016 - 02/2018

Unprecedented low nuclear recoil thresholds of 30eV

Leading sensitivity over one order of magnitude: $160\text{MeV/c}^2 \rightarrow 1.8\text{GeV/c}^2$

LUX Migdal

$0.4\text{GeV/c}^2$
CRESST-III Phase 1 new run: Just starting

Key innovation
Upgraded detector modules with dedicated hardware changes to understand backgrounds

New feature
Active magnetic field compensation with three air coils for x,y & z-axes
Waiting for dark matter