



Search for Low Energy Events with CUORE-0 and CUORE

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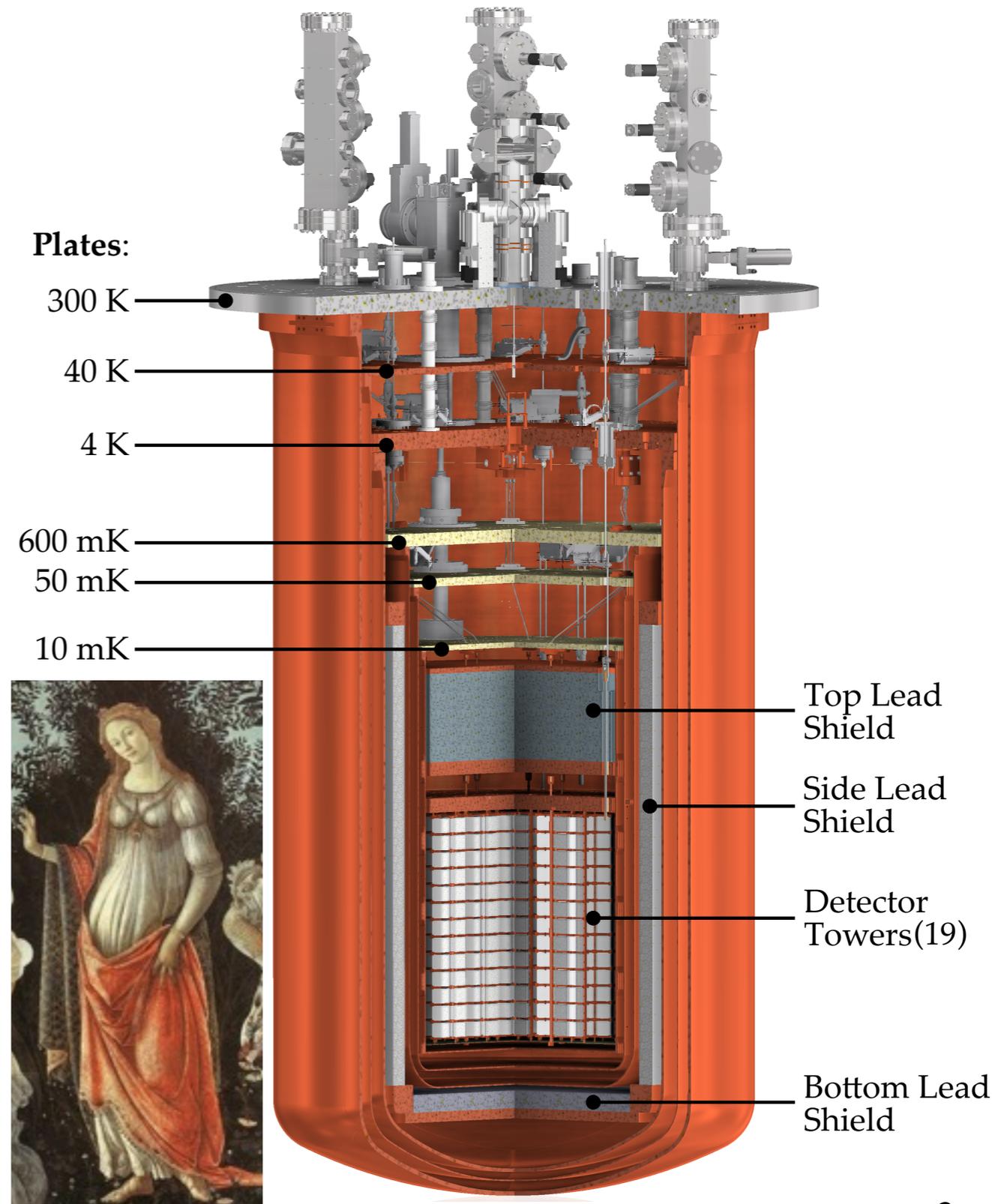
Oct. 30. 2015, APS Division of Nuclear Physics meeting, Santa Fe, NM



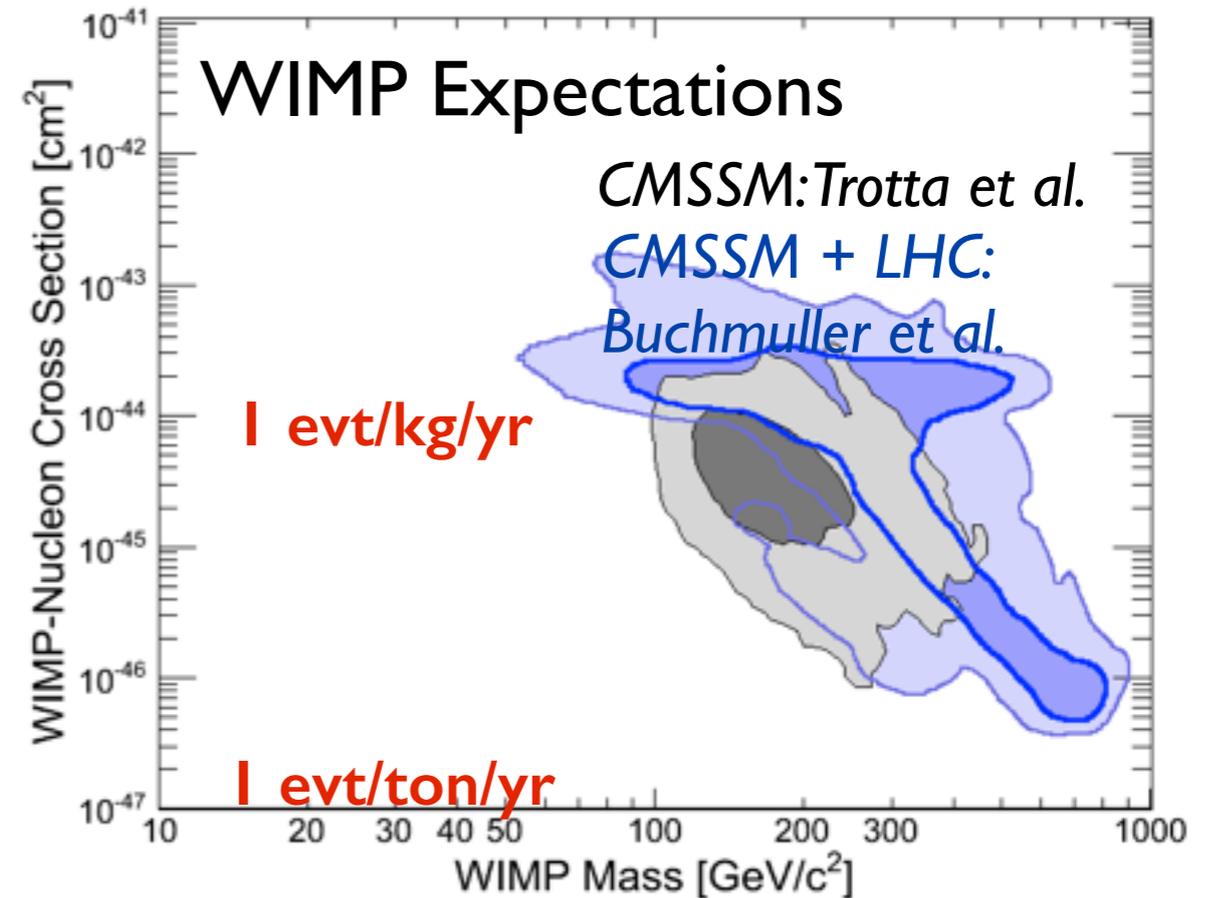
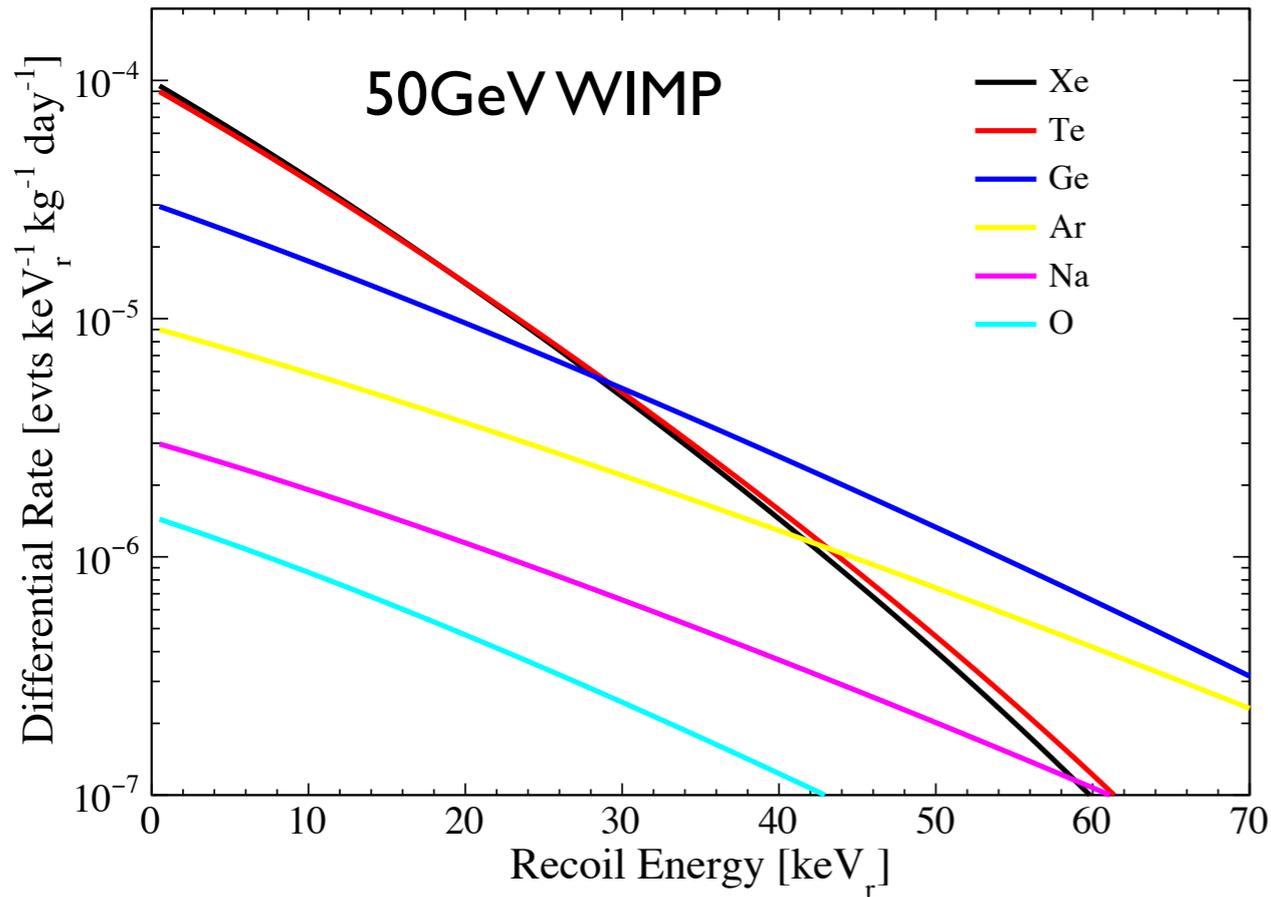
The CUORE Experiment



- CUORE is a cryogenic detector consisting of 988 TeO_2 bolometers
- Primarily search for $0\nu\beta\beta$ decay
- Located at LNGS in Italy
- In the final stages of construction, data-taking will begin in early 2016
- With 5 years of data accumulation,
 $T_{1/2}^{0\nu\beta\beta}({}^{130}\text{Te}) > 9.5 \times 10^{25} \text{ y (90\% C.L.)}$
 $m_{\beta\beta} < 50\text{-}130 \text{ meV}$
- Also suitable for Dark Matter Search



WIMP Direct Detection Search



Summary:
**Exponentially Falling
Tiny Rates**

- Large total mass
- Stable detector operation
- Low energy threshold
- Very low background

WIMP Search with CUORE



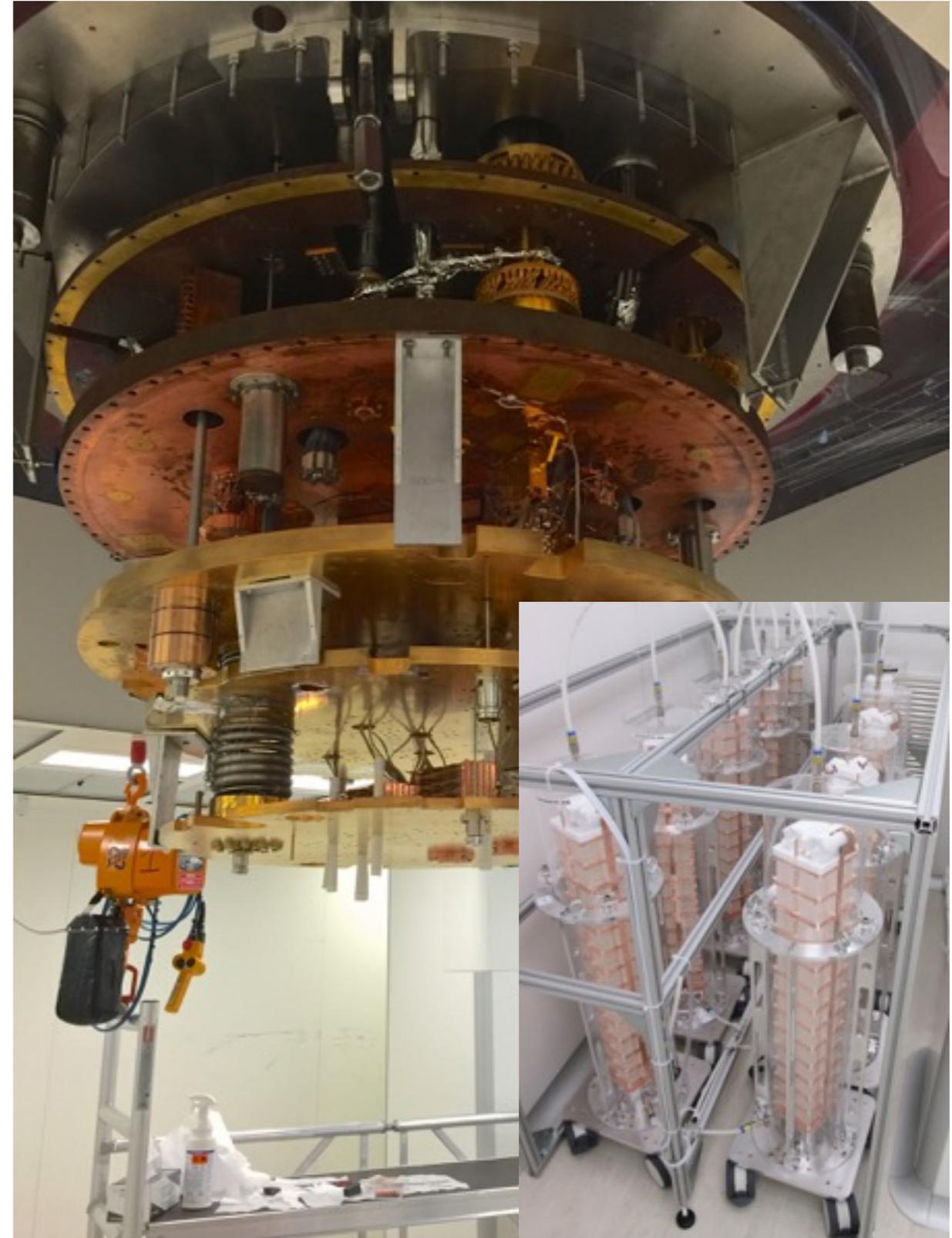
- Total target mass of 741 kg
- Stable detector operation expected with pulse tube and dilution refrigerators
- Bolometer offers low energy threshold and good energy resolution
- Quenching factor ~ 1 benefits detection of nuclear recoil events



WIMP Search with CUORE



- Total target mass of 741 kg
- Stable detector operation expected with pulse tube and dilution refrigerators
- Bolometer offers low energy threshold and good energy resolution
- Quenching factor ~ 1 benefits detection of nuclear recoil events
- First dark matter search with Te

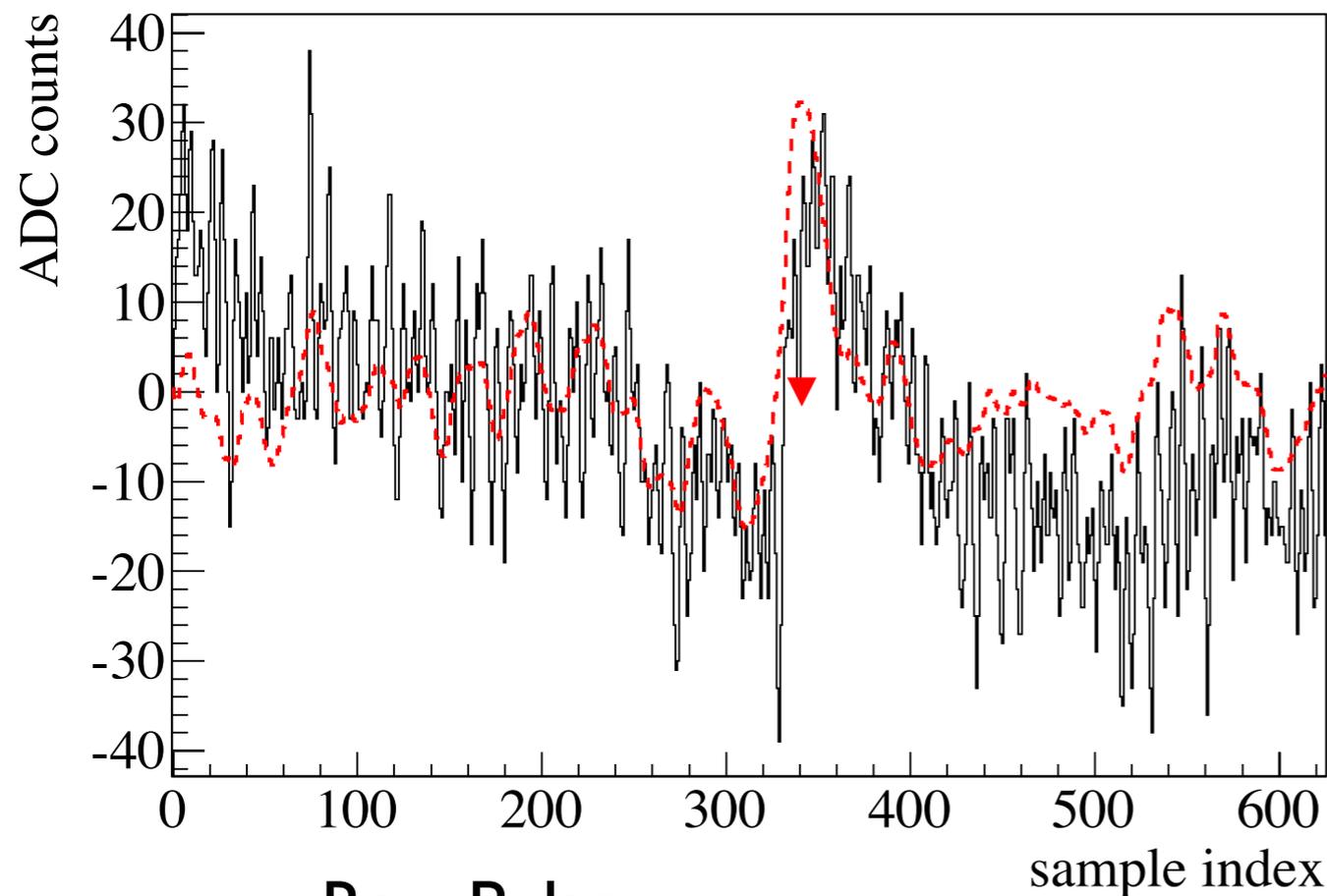


Energy Threshold

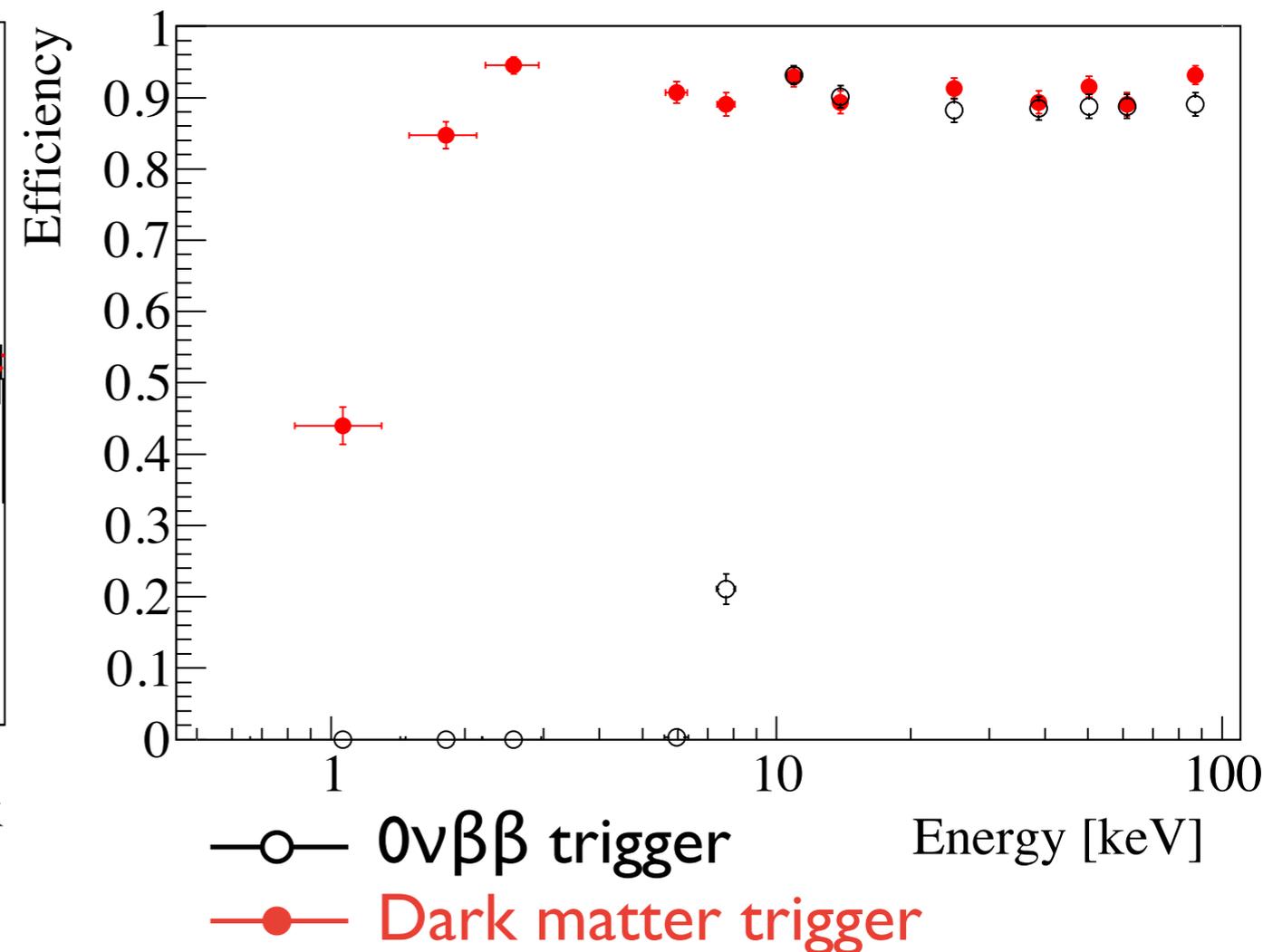


- Continuous Data Acquisition provides access to the low energy events
- Optimal Filter can identify low energy events

3 keV signal



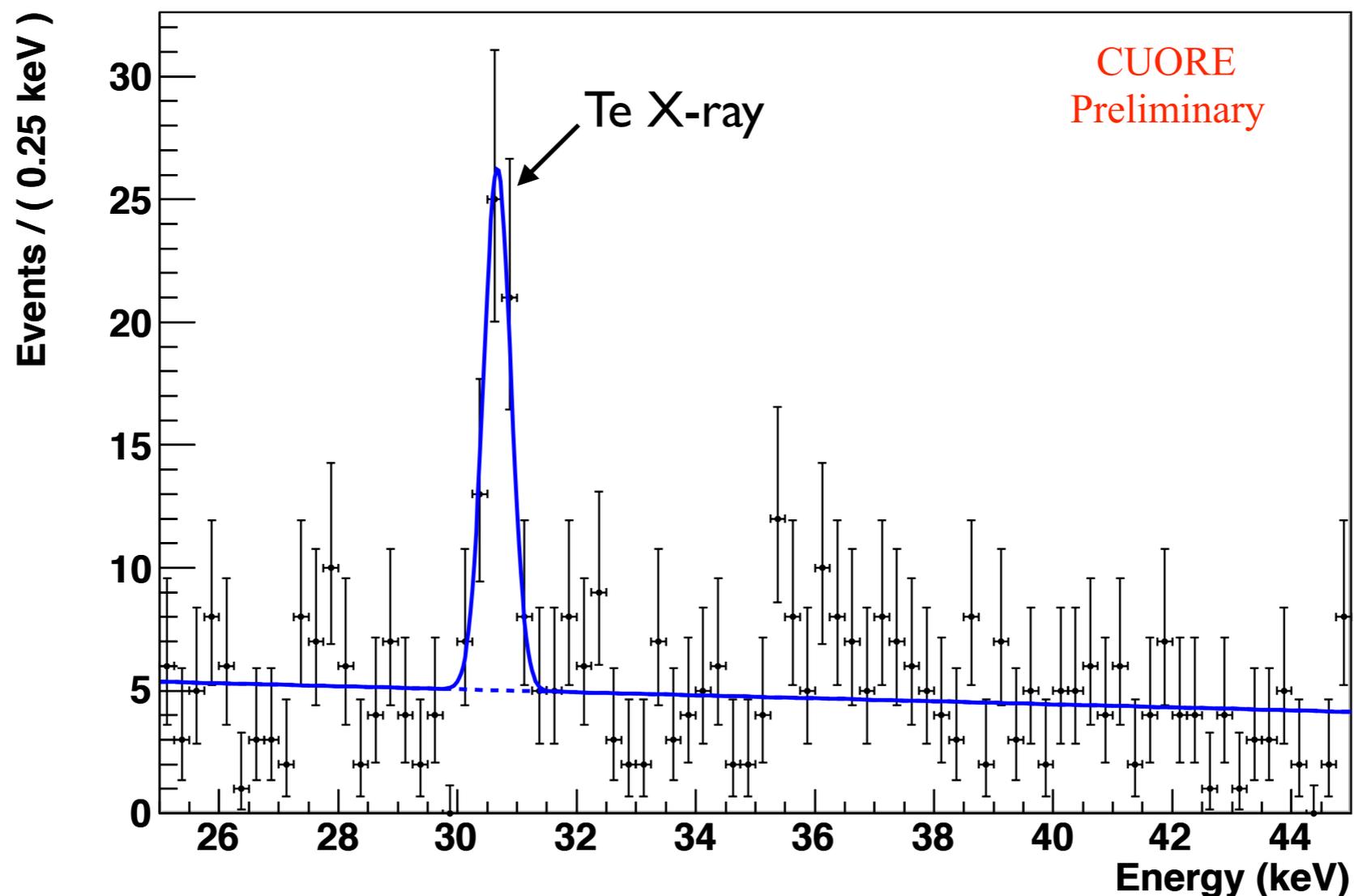
Detection Efficiency



Energy Resolution



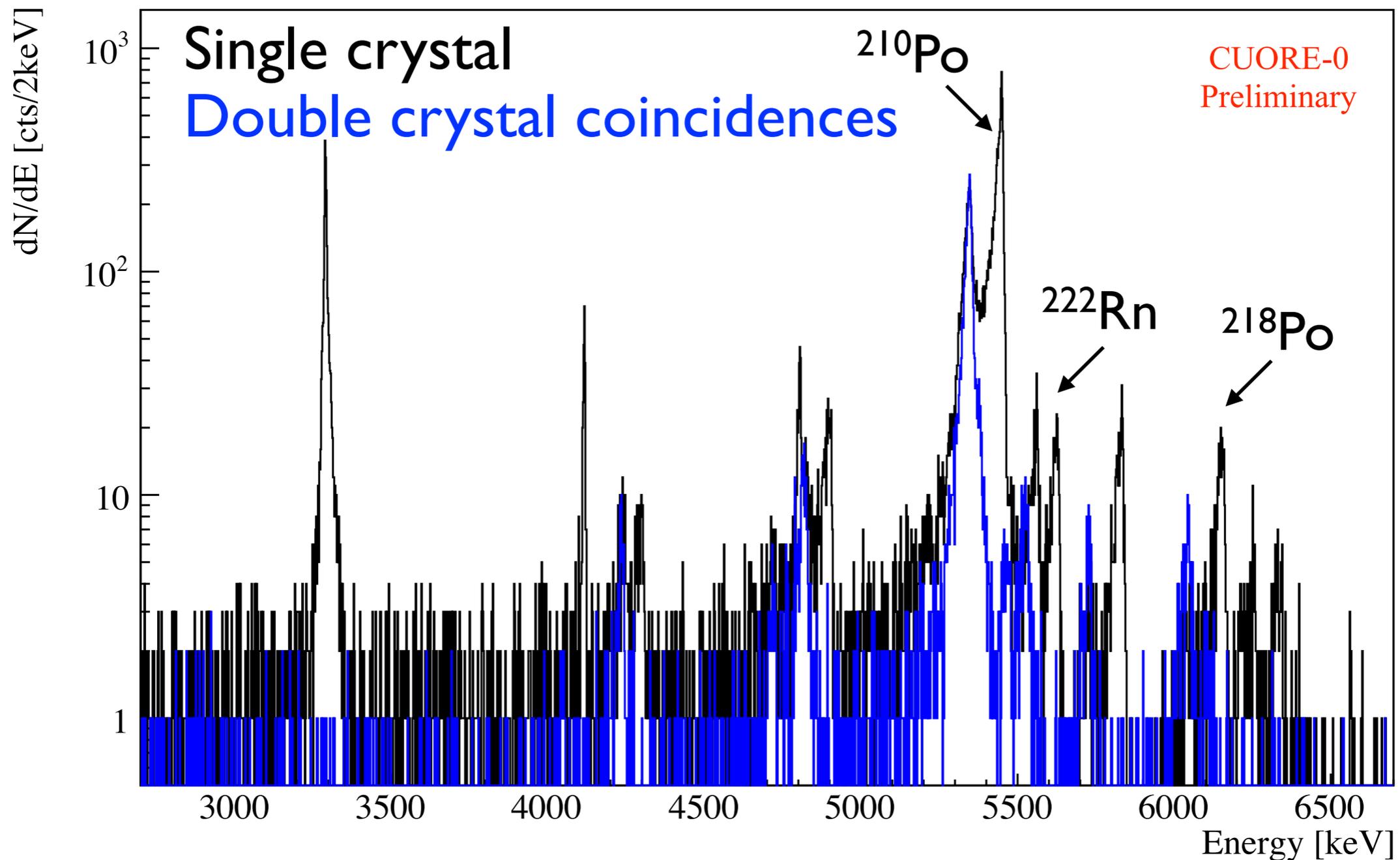
- 30 keV peak shows as low as 0.5 keV FWHM resolution
- Provides possibility of spectral background study at the dark matter region of interest



Nuclear Recoil Quenching



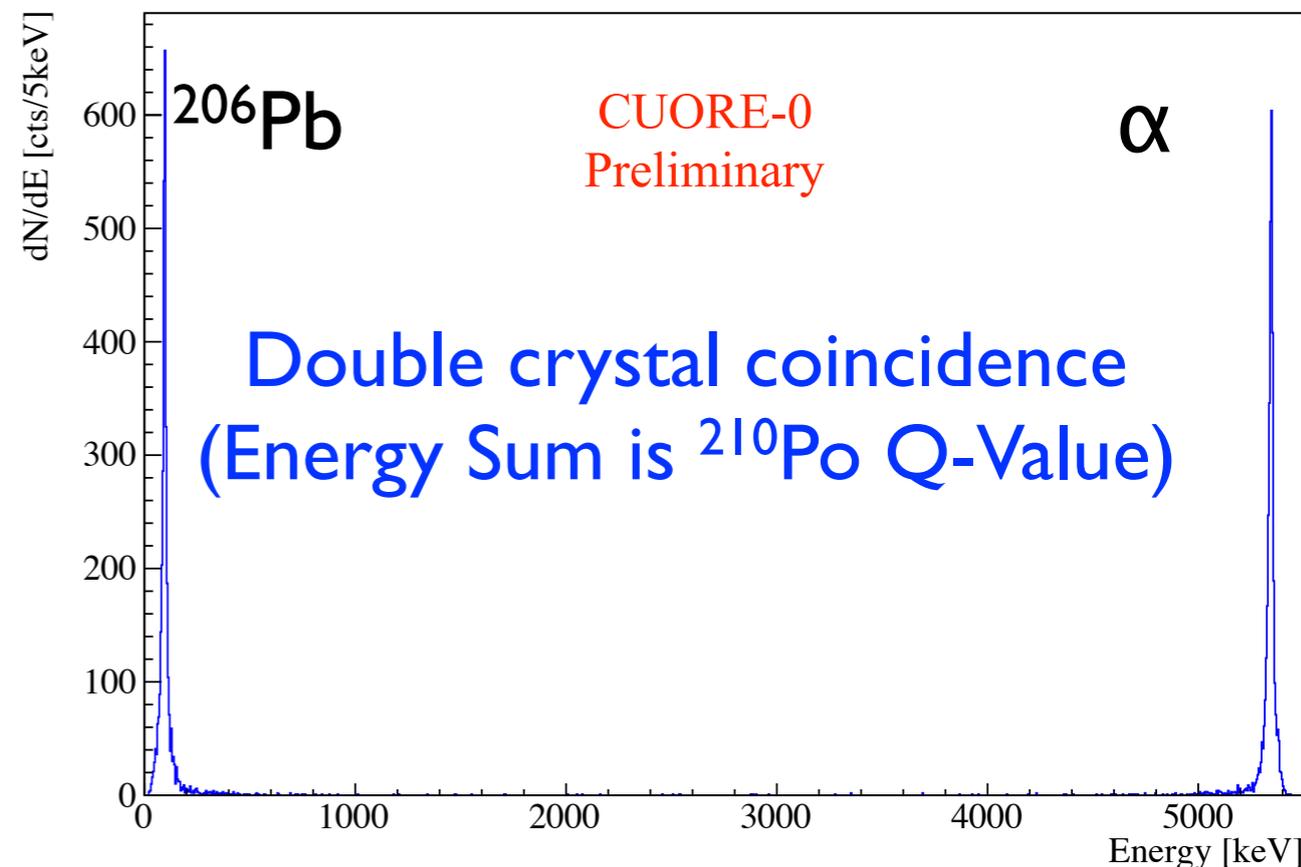
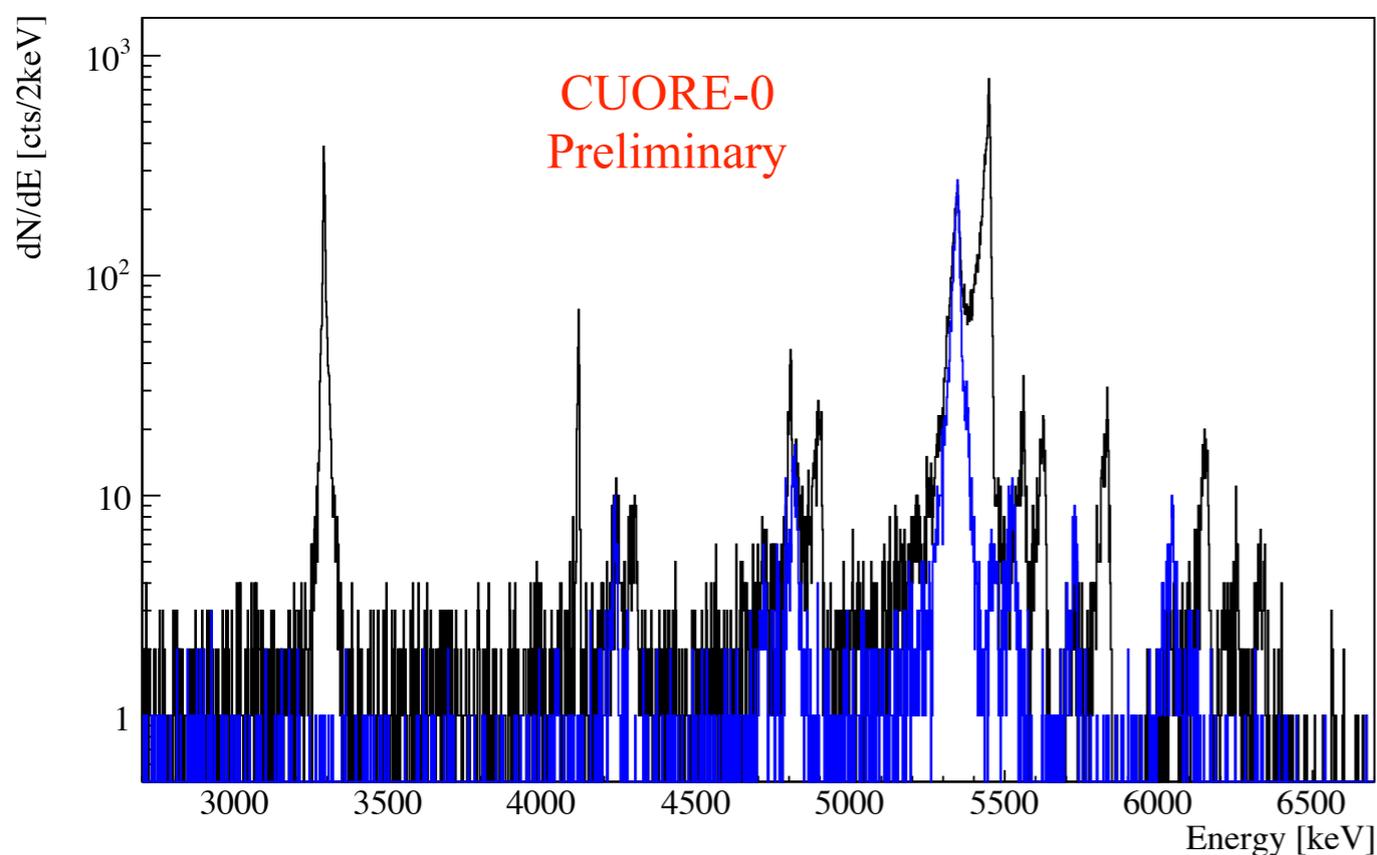
- Using surface alpha events, it is possible to measure nuclear quenching of recoiling nuclei from ^{210}Po , ^{218}Po , ^{222}Rn decays



Nuclear Recoil Quenching



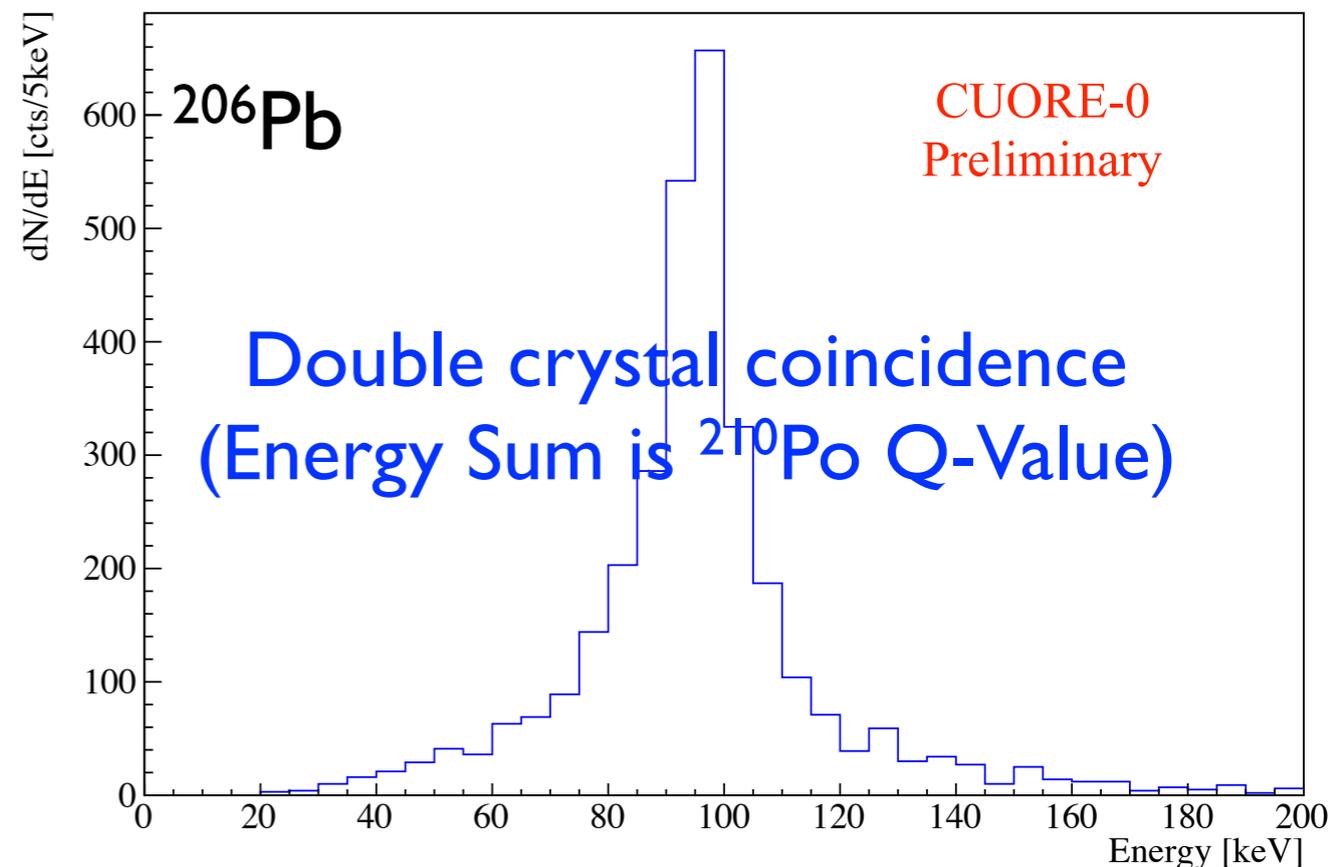
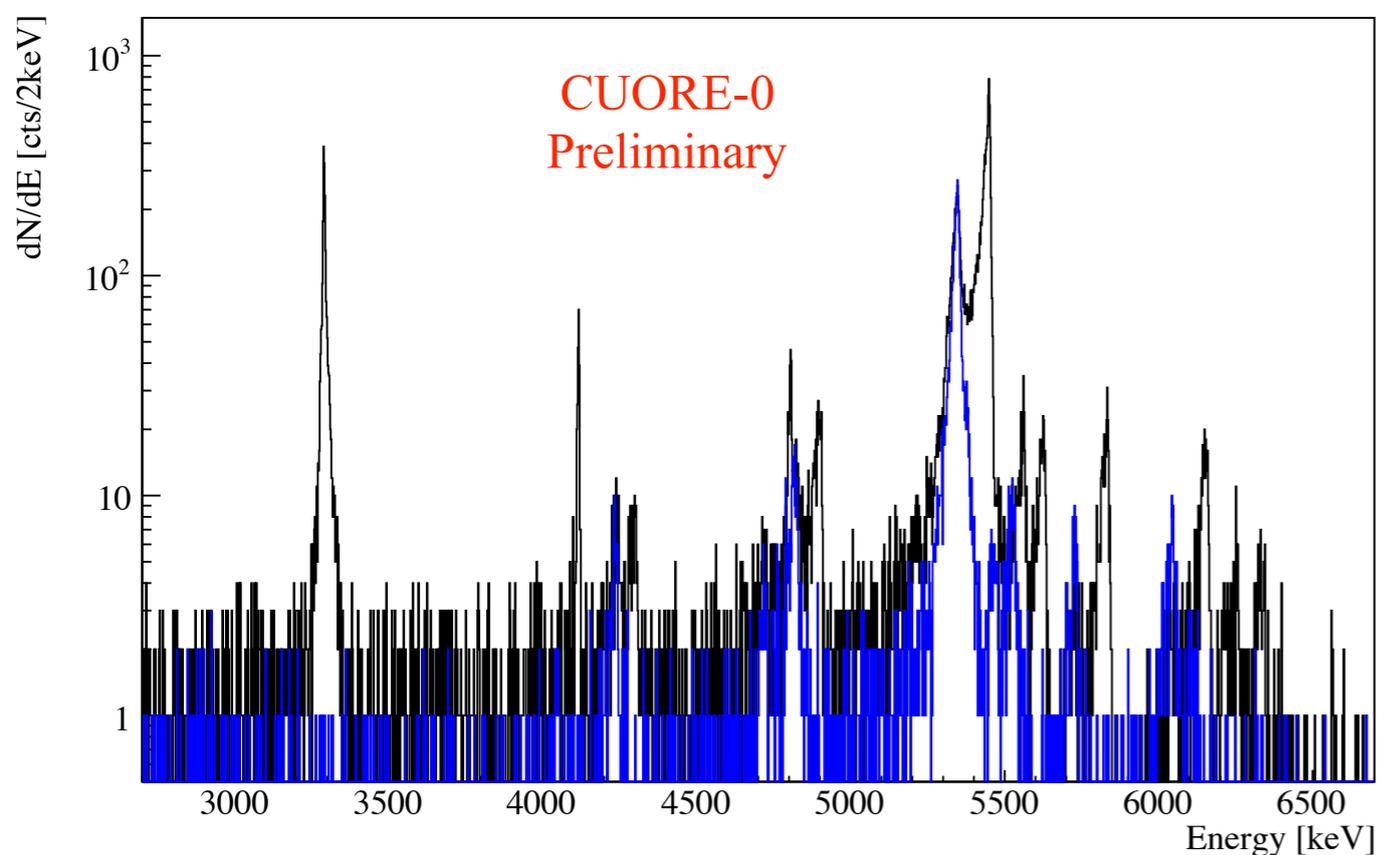
- Using surface alpha events, it is possible to measure nuclear quenching of recoiling nuclei from ^{210}Po , ^{218}Po , ^{222}Rn decays
- Nuclear quenching factor of phonon detector is expected to be 1
- The largest deviation from 1 measured by ^{206}Pb was integrated as uncertainty on the nuclear recoil energy scale



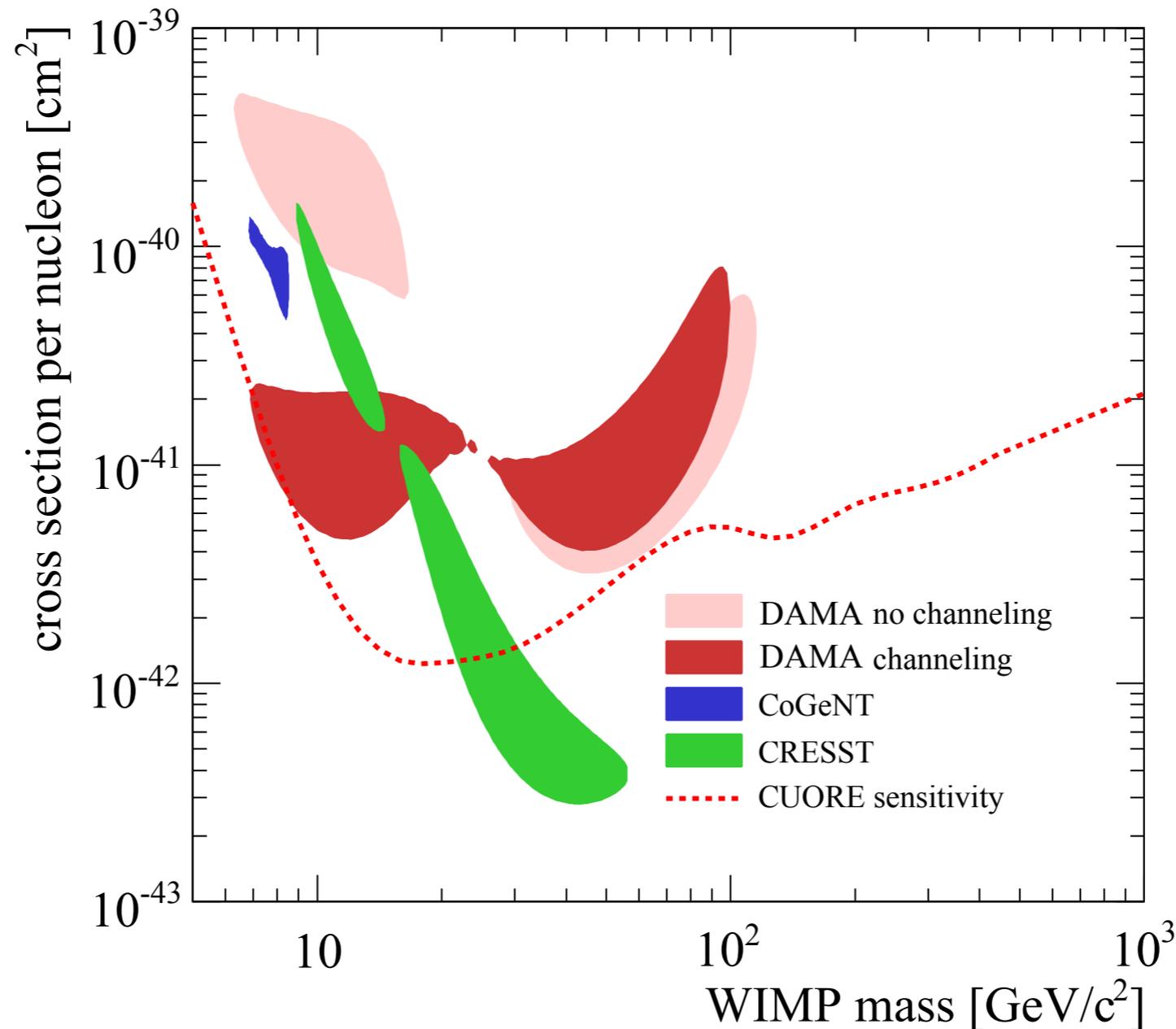
Nuclear Recoil Quenching



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CUORE Sensitivity



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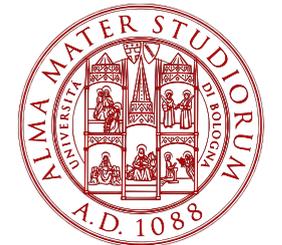
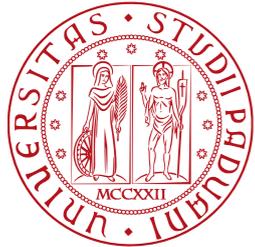
- CUORE is expected to test the DAMA WIMP observation claim with 5 years of data accumulation

Summary



- CUORE, a competitive $0\nu\beta\beta$ decay search using 741 kg of TeO_2 crystals, is also suitable for low energy event searches
- Low energy threshold and excellent energy resolution demonstrated by crystal validation measurements
- Nuclear recoil quenching using CUORE-0, the predecessor of CUORE, has been measured using surface alpha events
- Annual modulation analysis of CUORE-0 is on-going and will report dark matter results using Te as a target material for the first time soon
- CUORE is expected to probe the DAMA WIMP observation region with 5 years of data-taking
- CUPID, beyond CUORE using particle discrimination to further suppress the background will be a competitive dark matter search

CUORE Collaboration



UNIVERSITY OF SOUTH CAROLINA

(Oct. 2, 2015 @ LNGS)

