Status and performance of the CUORE-0 detector

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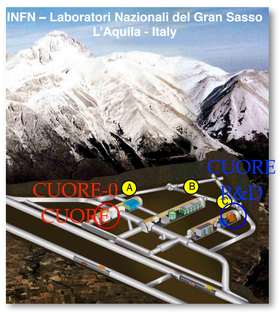
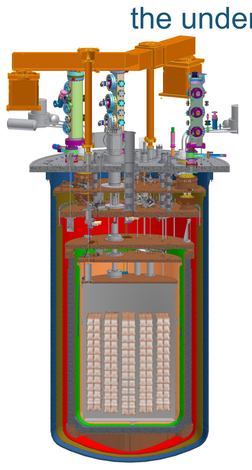
CUORE-0 is the most sensitive experiment currently searching for the 0νββ decay of ^{130}Te. The CUORE-0 setup consists in an array of 52 tellurium dioxide crystals, operated as bolometers at a temperature of ~10mK, with a total mass of about 39 kg of TeO_2. It has been built to test and demonstrate the performance of the upcoming CUORE experiment. CUORE-0 is running in the Gran Sasso National Laboratory (Italy) since March 2013. Here will be presented the most recent results, including the background rate, the detector performance and the sensitivity.

The CUORE experiment

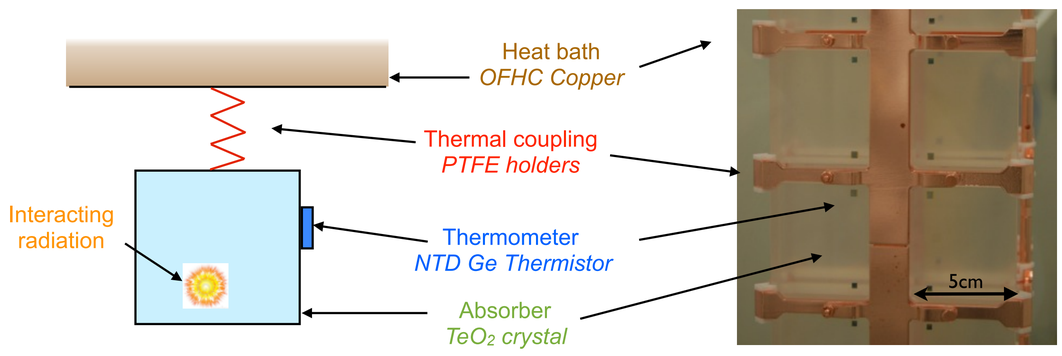
CUORE (**C**ryogenic **U**nderground **O**bservatory for **R**are **E**vents) is a 1-ton scale bolometric experiment that will search for neutrinoless double beta decay of ^{130}Te. Data taking is foreseen to start in 2015 at the underground Gran Sasso National Laboratories (LNGS), Italy.





- 988 TeO_2 crystals, 5x5x5cm^3 each, arranged in 19 towers
- **Total active mass:** 741 kg (~200 kg of ^{130}Te)
- **Energy resolution:** 5 keV @ 2615 keV (FWHM)
- **Background goal:** < 0.01 counts/keV/kg/year

The CUORE bolometers

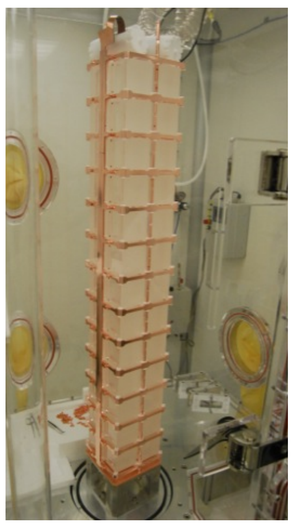


Absorber:
- M ~ 0.75 kg
- C ~ 10^{-9} J/K
- ΔT/ΔE ~ 100μK/MeV

Sensor:
- $R = R_0 \exp[(T_0/T)^{1/2}]$
- R ~ 100 MΩ
- ΔR/ΔE ~ 3 MΩ/MeV

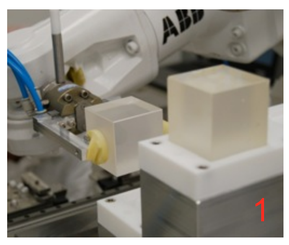
Output signal:
- ΔV/ΔE ~ 100μV/MeV
- Signal bandwidth ~12Hz
- Signal duration ~ 5sec

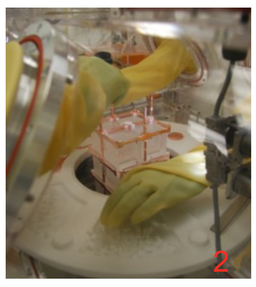
CUORE-0 construction

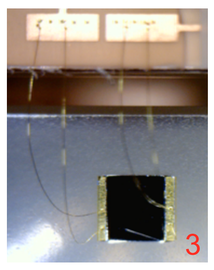


- CUORE-0 is the first tower realised using the CUORE Tower assembly line.
- All steps of the assembly were performed inside nitrogen-flushed glove boxes, to minimize exposure to Rn in air.
- The assembly process is divided into 3 main stages:
  1. gluing of NTD thermistors to crystals
  2. assembly of instrumented crystals into a tower
  3. wire bonding of the crystals' chips to the readout cables

- 52x750g bolometers
- 13 floor of 4 crystals each
- TeO_2: 39 kg - ^{130}Te: 11 kg



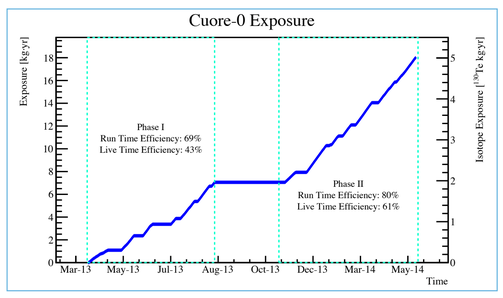


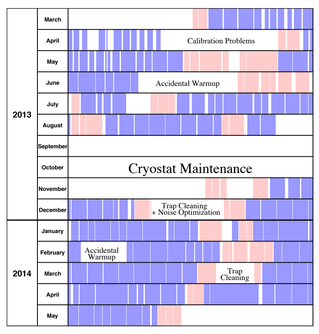


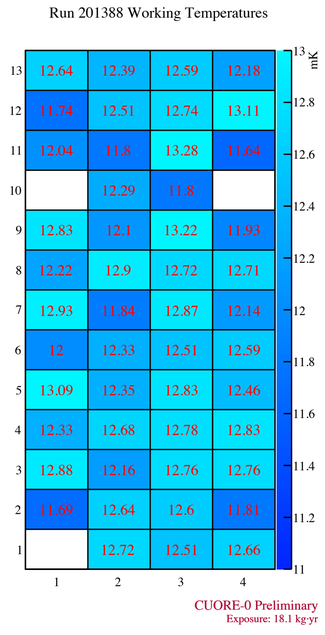
CUORE-0 Operations

CUORE-0 is taking data since March 2013. The statistic collected so far is **18.06 kg·y**.

CUORE-0 bolometers are operating at a temperature of ~12.5 mK.

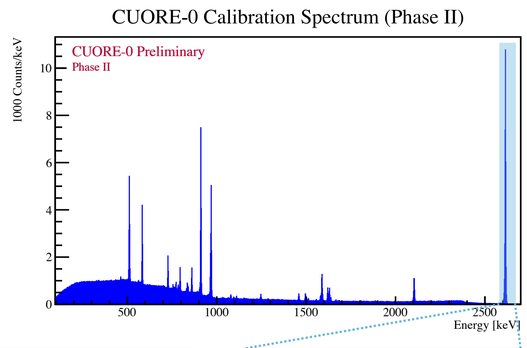


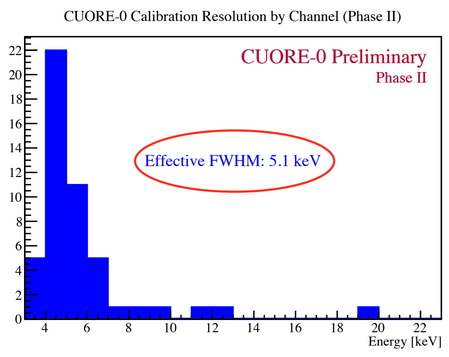


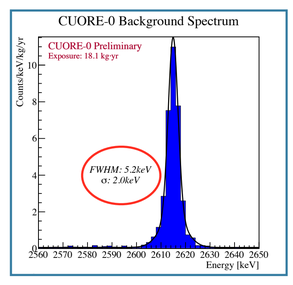


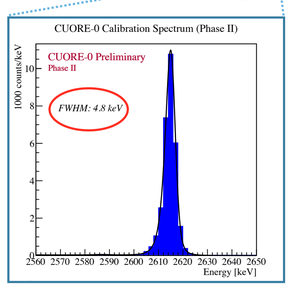
Energy resolution

We evaluate the energy resolution for the detector using a ^{232}Th source placed outside the cryostat, inside the external lead shield

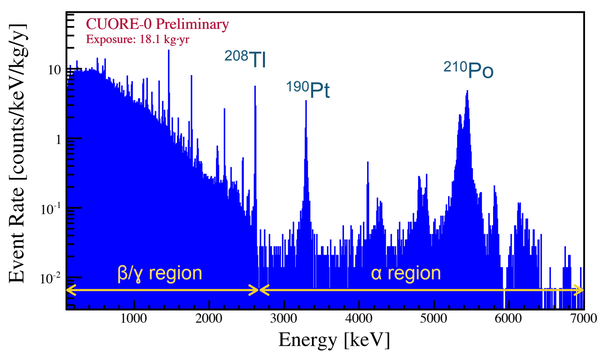


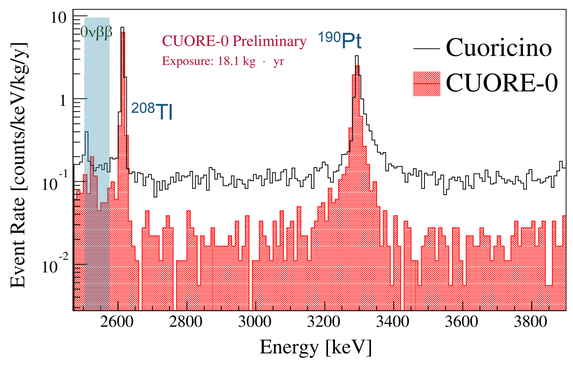






CUORE-0 Background

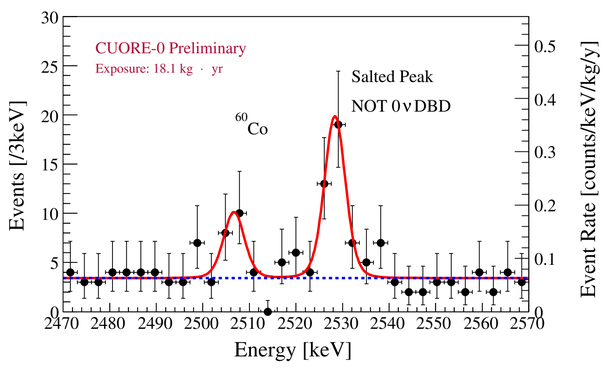




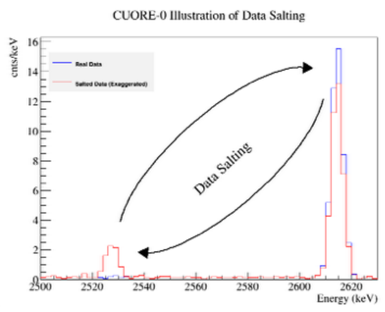
	Avg. flat bkg. [counts/keV/kg/y]		Signal eff. [%]
	0νββ region	2700-3900 keV	(detector + cuts)
CUORICINO	0.153 ± 0.006	0.110 ± 0.001	83 ± 1
CUORE-0	**0.063 ± 0.007**	**0.020 ± 0.001**	**77.6 ± 1.3**

- factor of ~ **2.5** reduction in the 0νββ region
- factor of ~ **6** reduction in the α continuum region

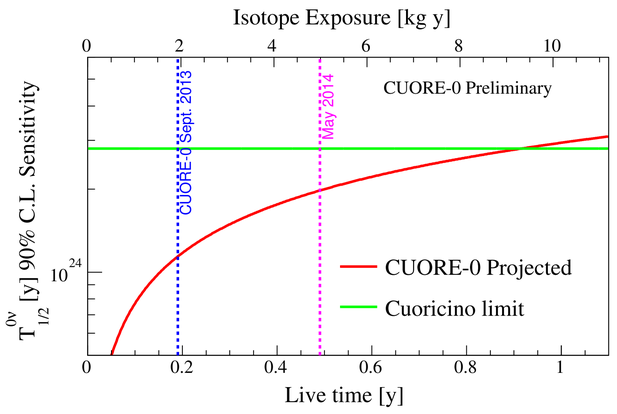
0νββ region (blinded)



Blinding:
- Exchange a small (and blinded) fraction of ^{208}Tl events (2615 keV) with events in the 0νββ region
- produce a fake peak at $Q_{\beta\beta}$



CUORE-0 sensitivity



$$T_{0\nu} \propto i.a.\sqrt{\frac{M \cdot T}{\Delta E \cdot b}}$$

- ΔE ~ 5.2 keV
- b = (0.063 ± 0.007) counts/keV/kg/y

CUORE-0 is expected to surpass Cuoricino sensitivity ($T_{1/2} > 2.8\ 10^{24}$y) with ~1 year of Live time.

Still work in progress on noise and duty cycle optimisation: **CUORE-0 sensitivity may improve in the future.**

The XXV International conference on Neutrino Physics and Astrophysics

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