



Further developments in the Cuoricino Experiment

Stefano Pirro

Dipartimento di Fisica dell' Università di Milano Bicocca and Sez. INFN di Milano- Milano - Italy



on behalf of the CUORE collaboration

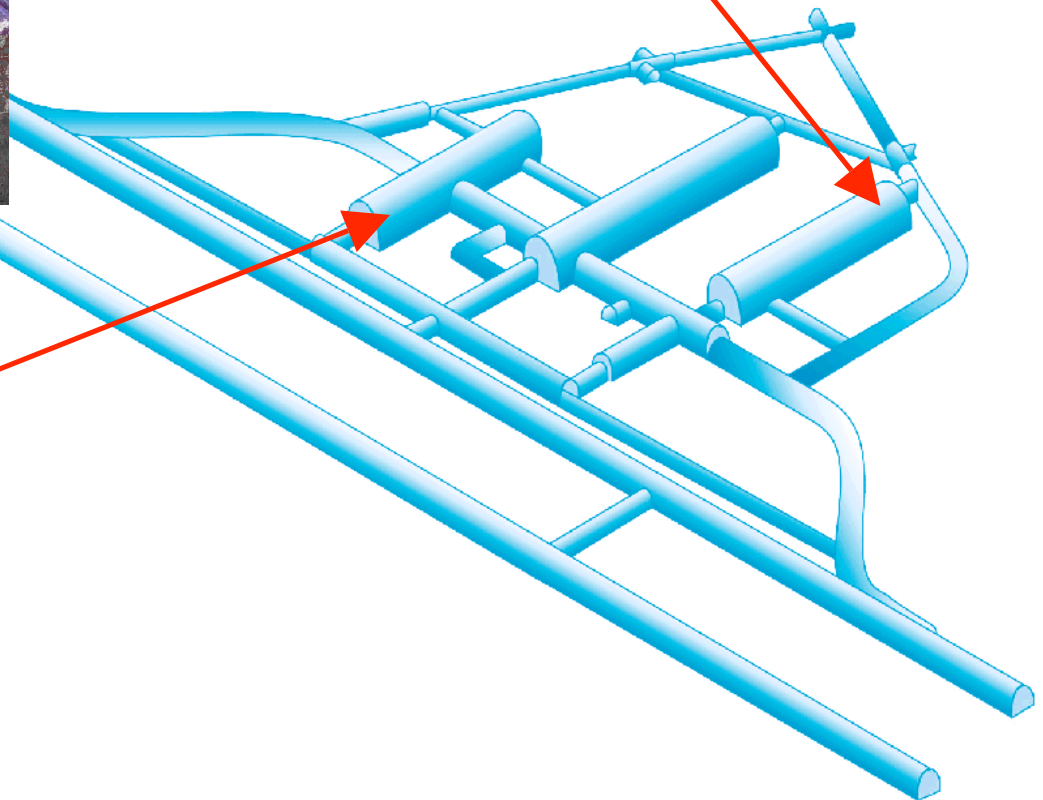


CUORicino @ LNGS

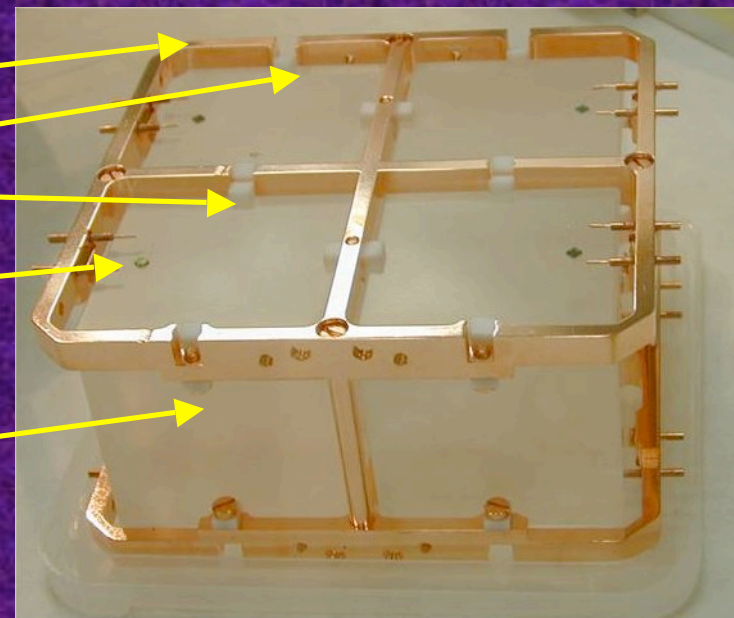
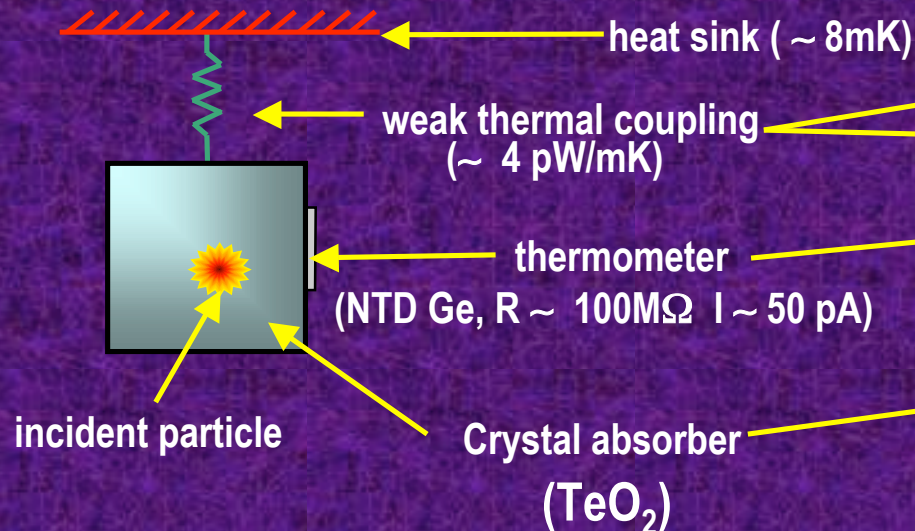


CUORE R&D (Hall C)

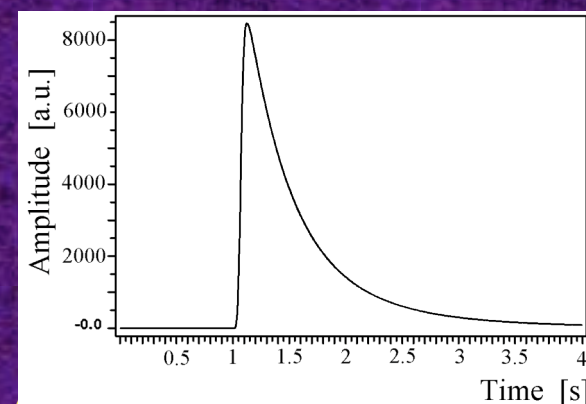
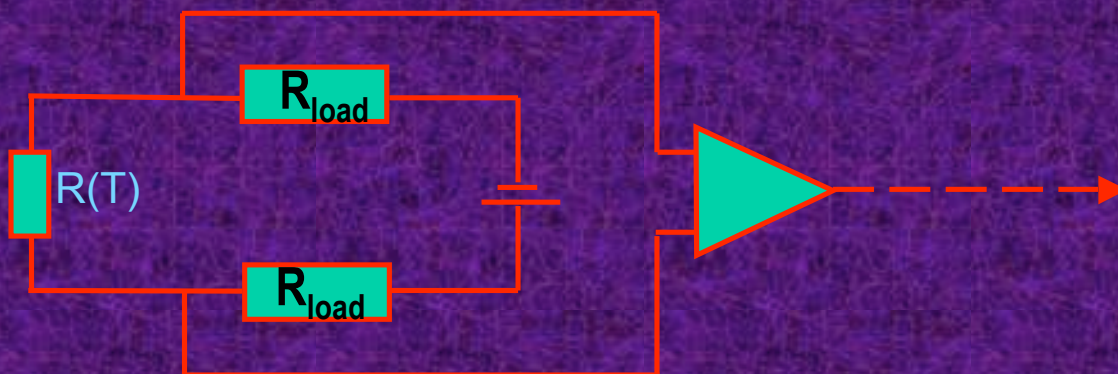
Cuoricino (Hall A)



CUORICINO Detectors

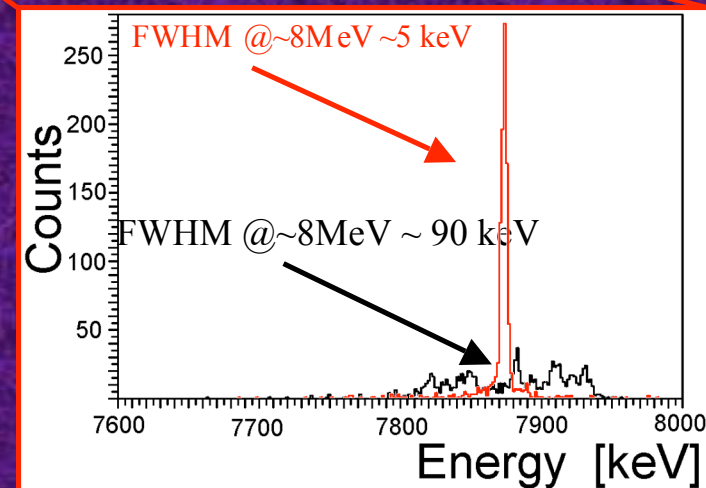
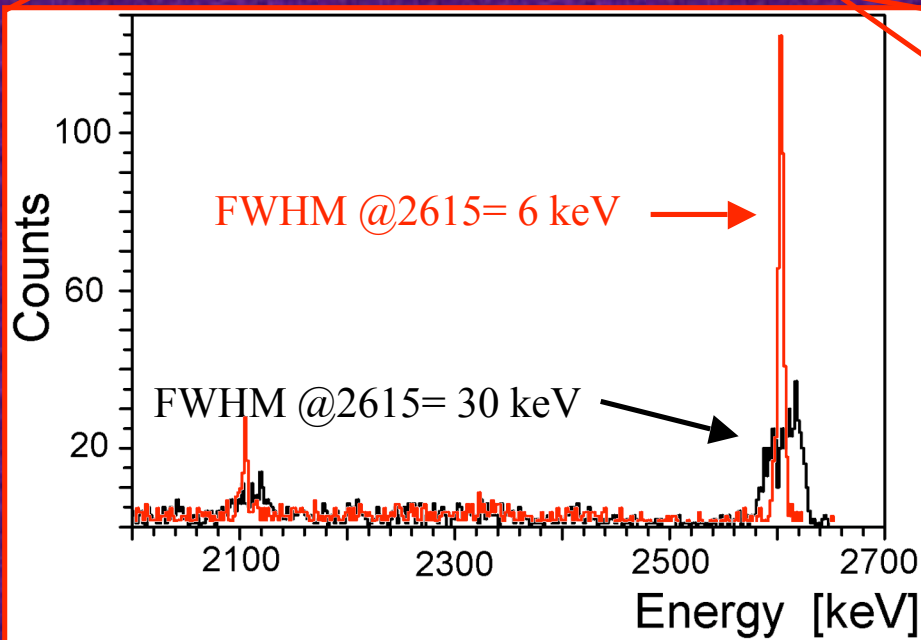
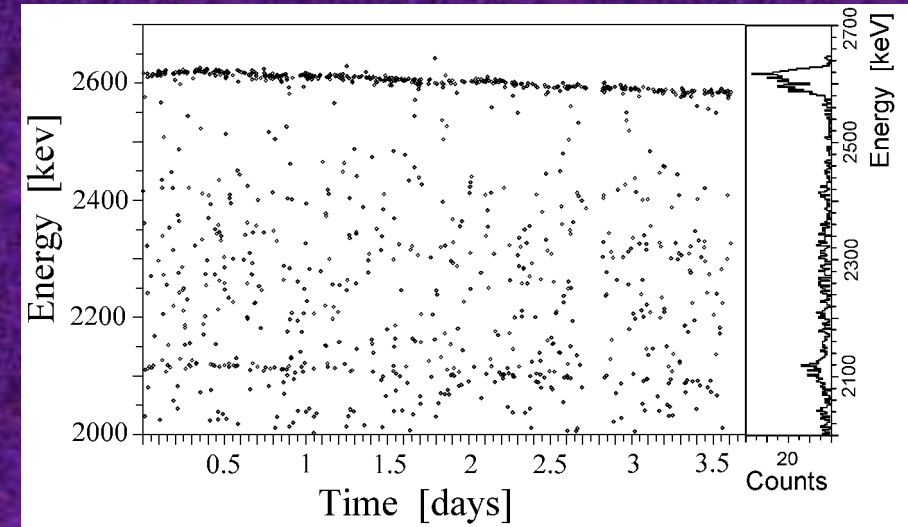
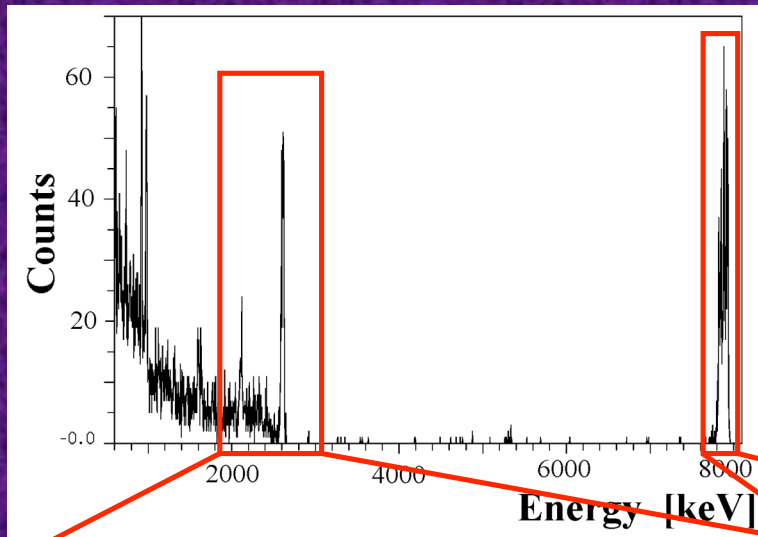


$$dR/dE \cong 20\text{ k}\Omega/\text{keV}$$

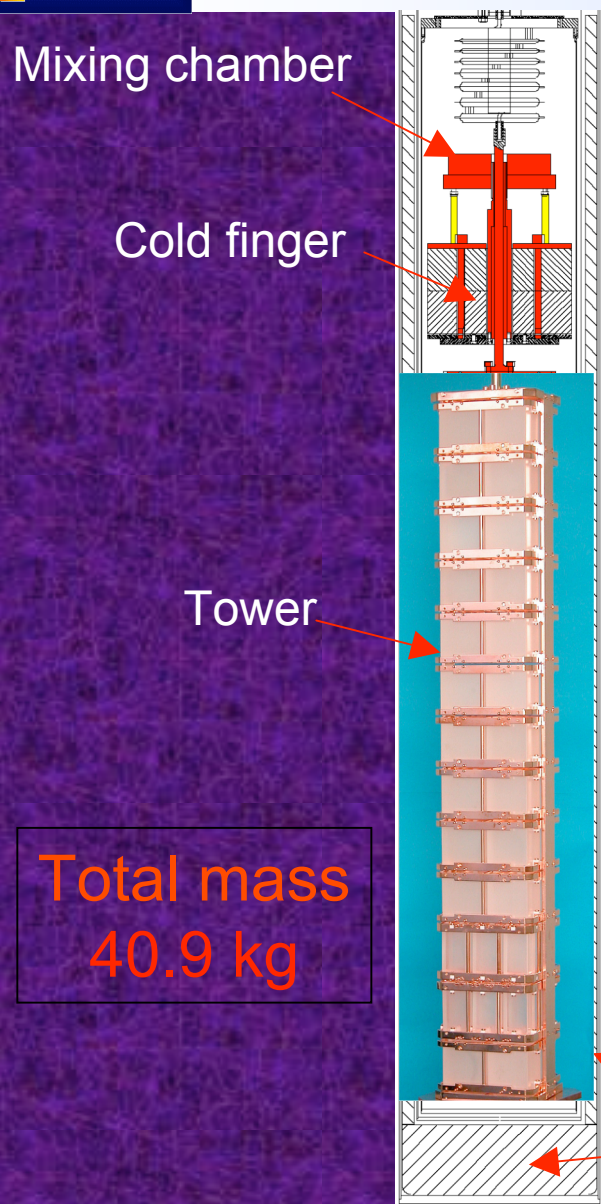




Thermal Detectors-stability



CUORICINO



CUORICINO: 62 detectors array.
11 module of 4 detectors
2 modul of 9 detectors

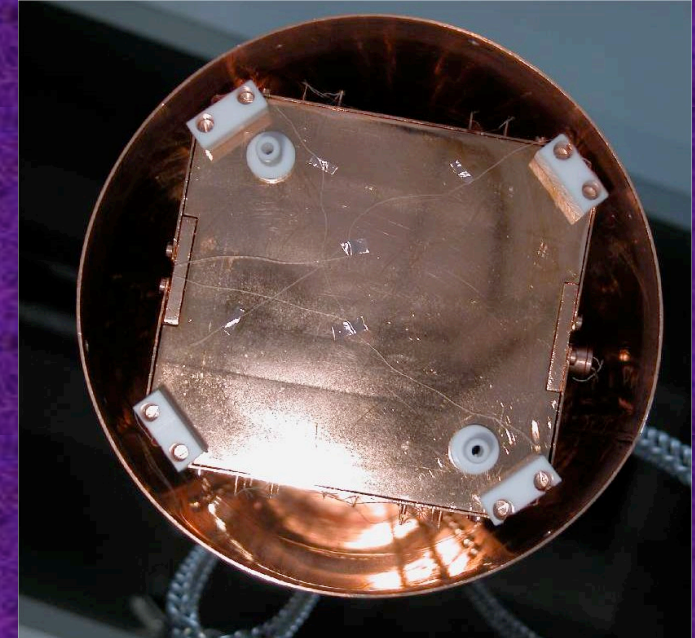
4 detectors $5 \times 5 \times 5 \text{ cm}^3$, 790 g each

9 detectors $3 \times 3 \times 6 \text{ cm}^3$, 340 g each

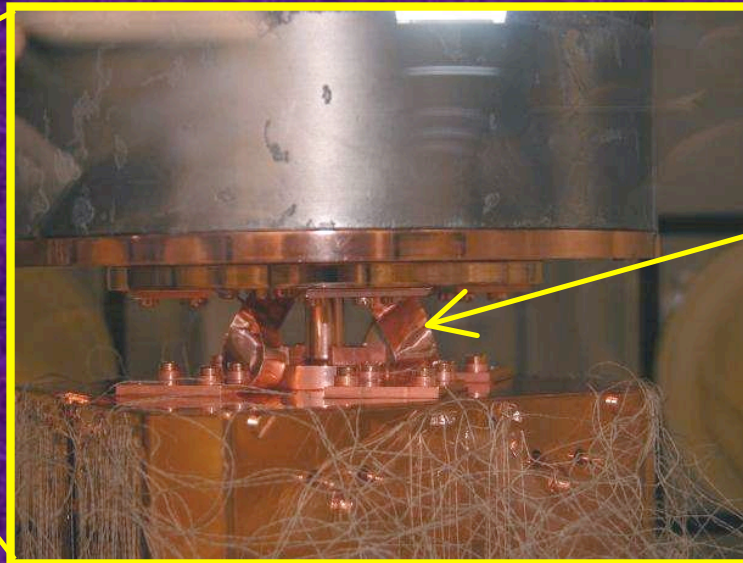
Cuoricino setup



Lead shield in IVC



Cuoricino inside 50 mK shield

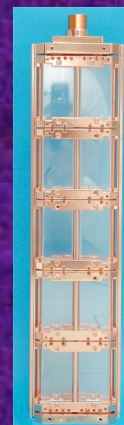


*2x 4x1x0.05 mm
Cu strips*

$G \sim 4.2 \cdot 10^{-5} \text{ W/K @8 mK}$

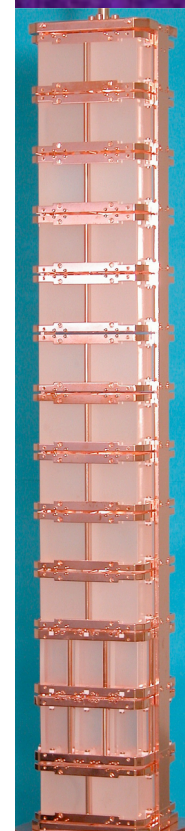
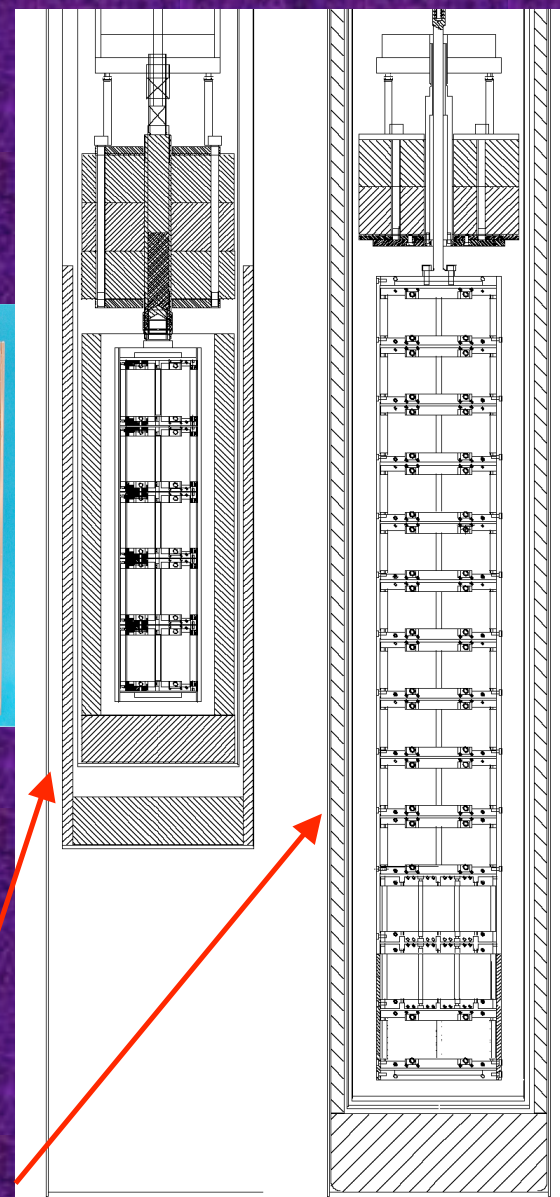
LTD-11, Tokyo - July 31, 2005

Overall Layout



MIBETA

CUORICINO





Cryostat Improvements

Cool down: february 2003

Detectors: 14 electrical connection were lost during the cooling of the tower, as a result 14 detectors cannot be read-out (to recover the electrical connections it is necessary to warm up the cryostat)

4x11 = 44 large size crystals ($\sim 5 \times 5 \times 5$ cm³ av. mass = 790 g) → 32 working

9x2 = 18 small size crystals ($\sim 3 \times 3 \times 6$ cm³ av. mass = 330 g) → 16 working

Run I → April 2003-October 2003 LT ~ 23% 73 % working

We changed the thermalization stages and upgraded the acquisition

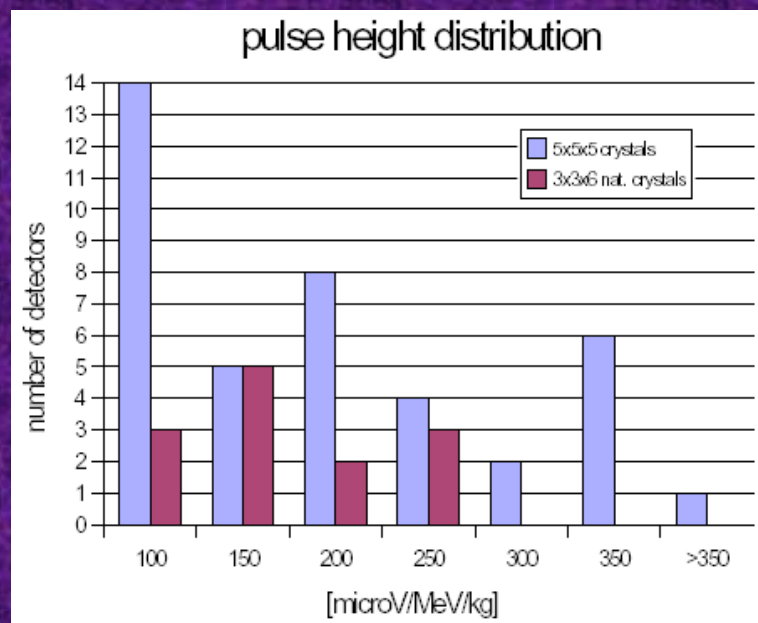
We mounted a temperature feedback on the tower

This time we have 2 5x5x5 crystals lost and 2 not used for excess noise 94 % working

Run II → October 2004-April 2005 LT ~ 64%

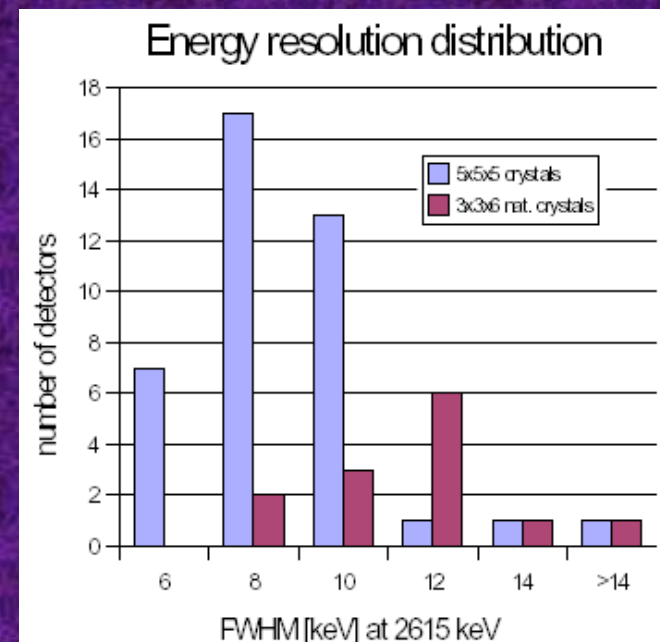
Detectors performances

Pulse height distribution $\mu\text{V}/\text{MeV}$ (normalized to 1 kg of TeO_2)



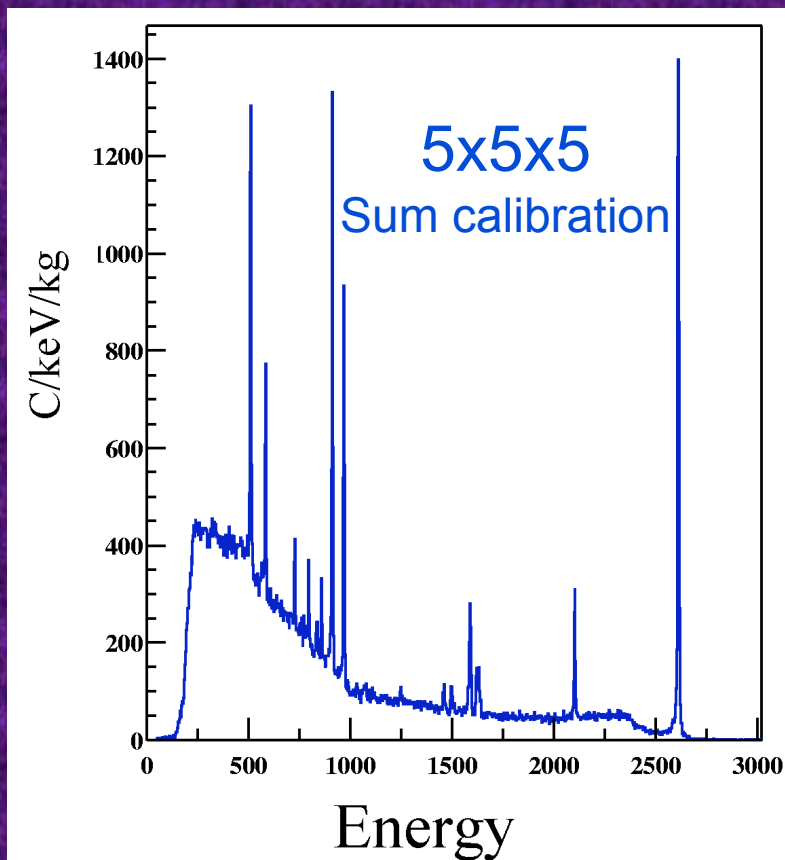
average pulse height
for 5x5x5 crystals = 215 $\mu\text{V}/\text{MeV}$
average pulse height
for 3x3x6 crystals = 430 $\mu\text{V}/\text{MeV}$

FWHM @ 2615 keV

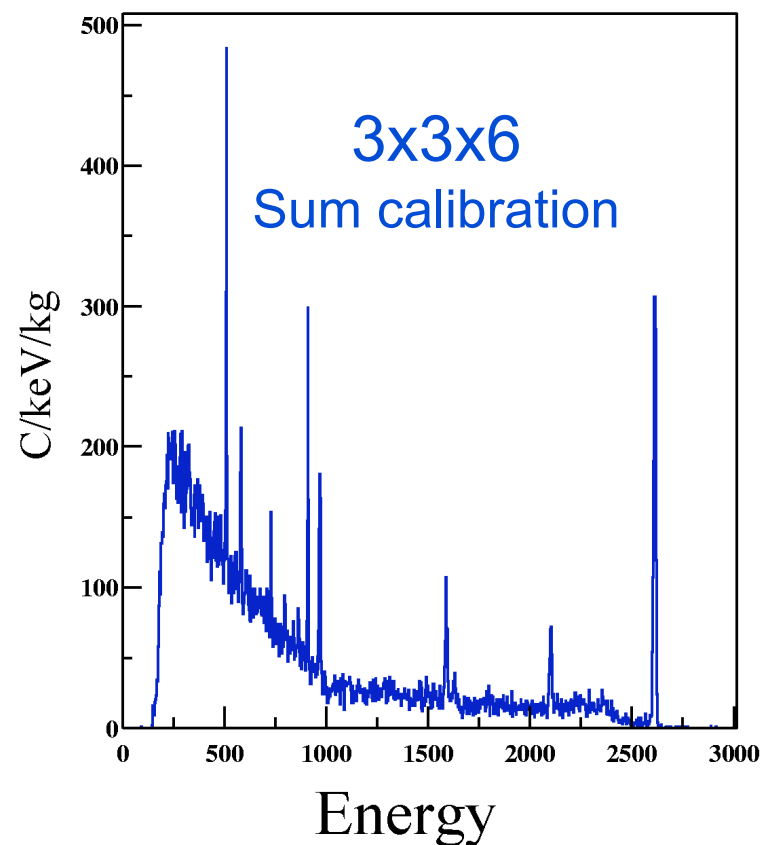


FWHM [keV] of the 2615 keV
gamma line of ^{208}Tl (calibration with a
 ^{232}Th source ~ 3 days)
average 5x5x5 cm^3 crystals ~ 7.5 keV
average 3x3x6 cm^3 crystals ~ 9.6 keV

^{232}Th Calibration

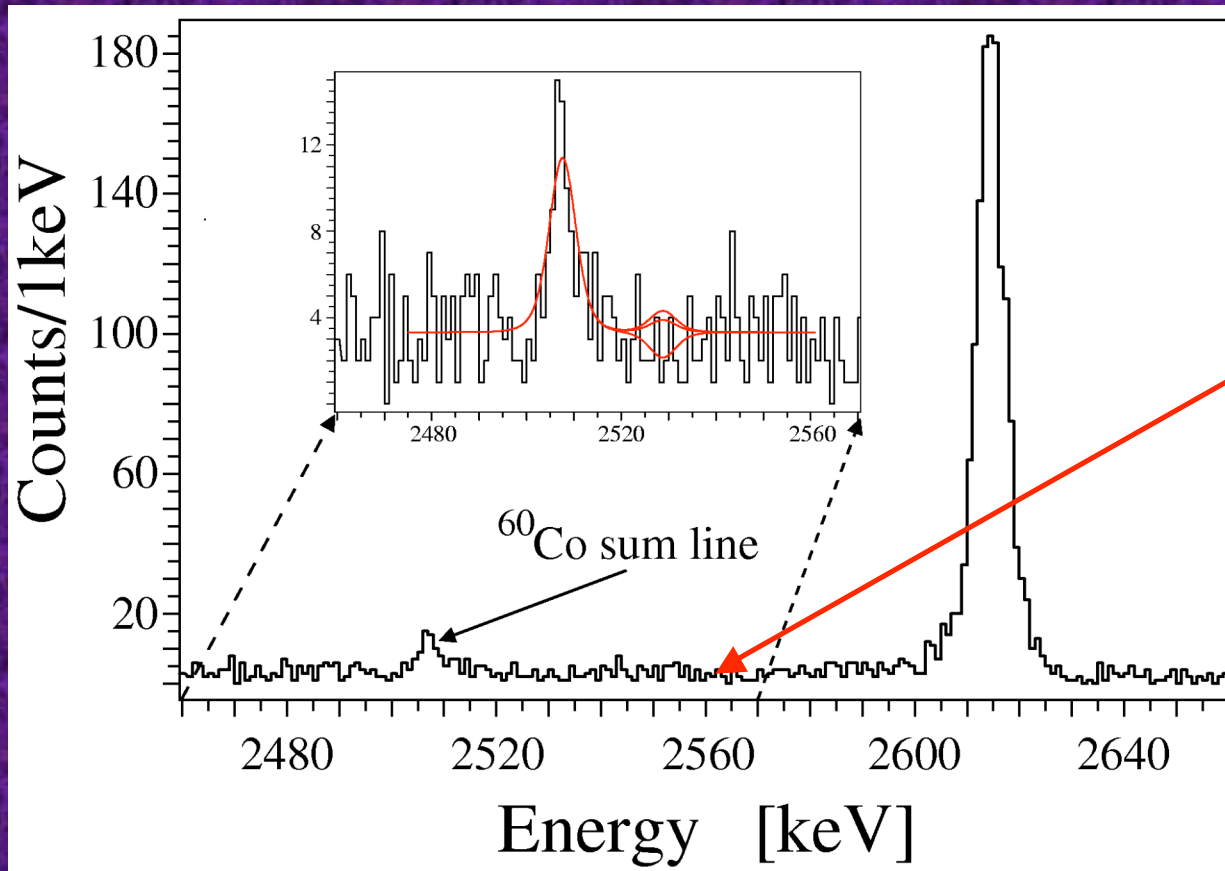


$$\Delta E_{\text{FWHM}} = 7.5 \text{ keV @ } 2615 \text{ keV}$$



$$\Delta E_{\text{FWHM}} = 9.6 \text{ keV @ } 2615 \text{ keV}$$

result on ^{130}Te $0\nu-\beta\beta$ decay



Sum spectra of all the detectors

Statistic collected: $14.7 \text{ kg} \times \text{y}$



$\tau_{1/2}^{0\nu} \geq 1.8 \cdot 10^{24} \text{ y} \quad (90\% \text{ CL})$



$0.18 \pm .01 \text{ c/keV/kg/y}$

$\langle m_\nu \rangle < 0.2 - 1.1 \text{ eV}$

CUORICINO TO CUORE

CUORICINO proves the feasibility of a large bolometric array with the tower-like structure
 Detector performances are not affected by the increase in crystal size (from 340 g to 790 g)

Array of 988 detectors:

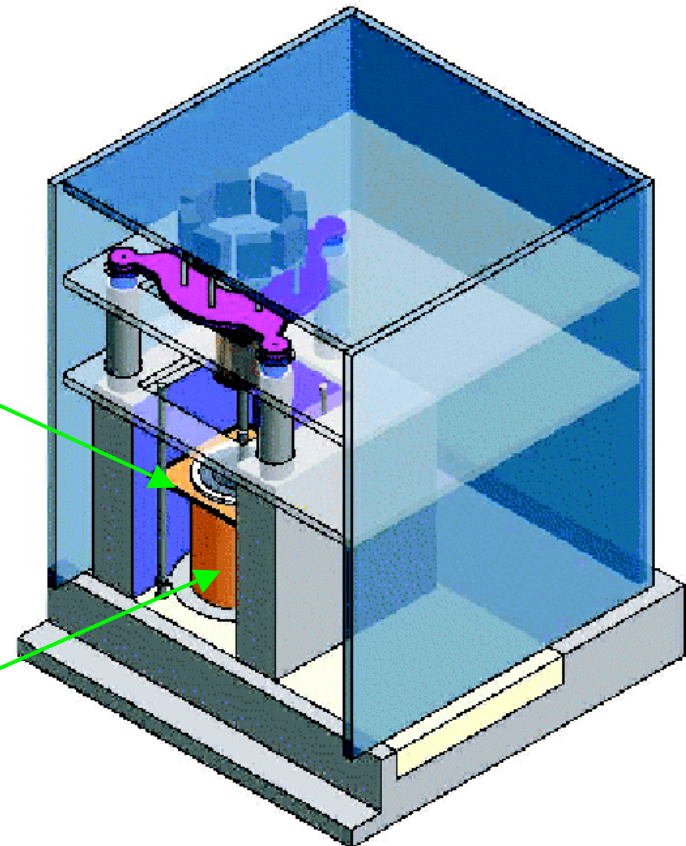
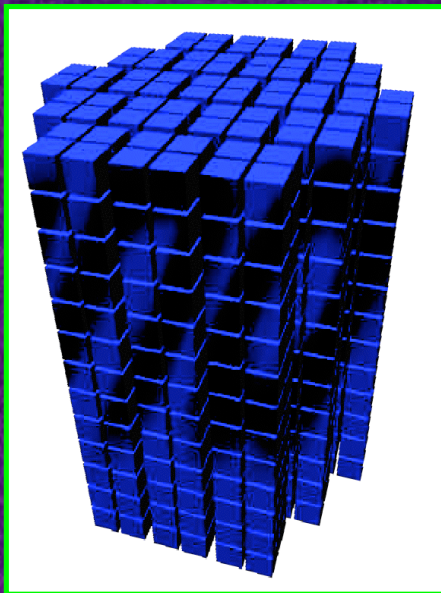
19 towers - 13 modules/tower -

4 detectors/module

Funded officially

$M = 0.75 \text{ ton}$

70 cm



Conclusions

- CUORICINO is giving very encouraging results
- It also demonstrated the feasibility of a larger Experiment
- We already achieved the milestone of crystals surface cleaning

