### Società Italiana di Fisica

106° Congresso nazionale

# Composti organici per la fisica degli eventi rari

### Ghislandi Stefano



Società Italiana di Fisica

Università degli Studi di Milano-Bicocca

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# Neutrinoless double-beta decay $(0v\beta\beta)$ search



Why it's interesting?

- Lepton number violation process
- Neutrino nature: Dirac or Majorana
- Neutrino mass hierarchy
- Neutrino masses absolute scale
- New mass mechanism scenarios, leptogenesis

 $0v\beta\beta$  experimental detection sensitivity:

$$S^{0
u} = \ln 2\epsilon rac{1}{C.L.} rac{x \mathcal{A} N_A}{\mathcal{M}_A} \sqrt{rac{MT}{B\Delta}}$$
- Very low background B

- Great masses
- High energy resolution
- High isotopic abundance

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All needed!

# Experimental Approach with TeO<sub>2</sub>



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### Work focused on the **<u>y</u> ROI background reduction**



Setup construction and data acquisition at Università degli Studi di Milano-Bicocca

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## Measurements Setup

### Setup preparation

### Mounting construction:

- Copper and PMMA components production
- **Components washing**
- **G** Structures mounting
- NTD gluing
- Readout preparation (Pin and gold wires solderings)

### Cryostat related operations:

- Hanging and wiring mountings into the cryostat
- Cryostat closing
- Cool-down



<sup>3</sup>He-<sup>4</sup>He dilution opened cryostat

232<u>Th calibration</u>
 source positioned
 below the cryostat.



PMMA and copper mountings hanged below the mixing chamber and wired to the cryosat. Crystals dimension 1×1×1 cm.

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# Data Analysis and Results I



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# ROI comparison, PMMA vs Copper

#### Different copper energy spectra normalization to 2615 keV plastic intensity



## Monte Carlo Simulation



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# Application on CUORE experiment

CUORE (Cryogenic Underground Observatory for Rare Events):

- Situated at LNGS and in data acquisition from 2017
- $0v\beta\beta$  calorimetric experiment
- 988 TeO<sub>2</sub> crystals for a total active mass of 260 kg Most stringent limits on  $0\nu\beta\beta^{130}$ Te half-life  $(T_{0\nu}^{1/2} > 3.2 \cdot 10^{25} \text{yr} \text{ and } m_{\beta\beta} < 75 350 \text{ meV})$



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# Conclusions

#### Laboratory measurements:

- > PMMA presents good mechanical properties;
- > Faster signals than with copper but no information losses;
- ➤ High energy resolution (5 keV @ 2615 keV);
- > ROI background is lower but high uncertainties doesn't allow to be conclusive.

### PMMA substitution simulation on CUORE experiment:

ROI background reduction factor 3.5 and 4.5 respectively for γ's coming from material next to crystal and outside the experiment inner part.

### Next steps:

- > Understand how PMMA thermal properties scale to greater masses;
- > Evaluate the possibility to make the PMMA an active shield.

# **THANKS FOR THE ATTENTION!**