ACCESS

Array of Cryogenic Calorimeters to Evaluate Spectral Shape of β decays

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Why study forbidden β decays?

Understanding the nature of neutrinos is one of the key open challenges in modern physics.
The observation of **neutrinoless double beta decay (0νββ)** would reveal that neutrinos are Majorana particles and provide access to their absolute mass scale.
However, the interpretation of 0νββ results is currently limited by **nuclear physics uncertainties**, in particular:

- Nuclear Matrix Elements (NME)
- The effective axial coupling constant **g_a**

Why forbidden βdecays are special?

In **forbidden non-unique β decays**, the shape of the emitted electron spectrum is:

- highly sensitive to nuclear structure
- strongly dependent on g_a

Small changes in nuclear parameters lead to **large distortions of the spectral shape**, making these decays ideal probes of nuclear models relevant for 0νββ.

The ACCESS project

ACCESS (Array of Cryogenic Calorimeters to Evaluate Spectral Shapes) uses **cryogenic calorimeters** to perform high-precision measurements of **β-decay spectra.**
For some isotopes (e.g. **Indium**), the detector crystal itself contains the **β-emitting isotopes** and acts as both source and detector, while for others the **β source** is deposited on **high-performance cryogenic detectors**.

Cryogenic calorimetry in a nutshell

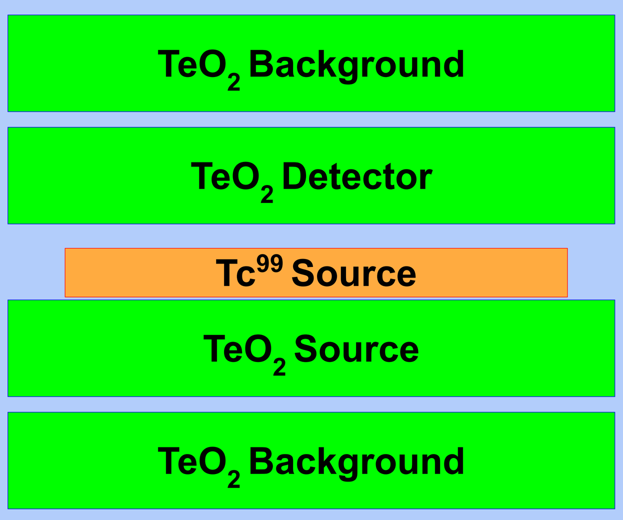
- detector operated a ~ 10 mK
- energy deposition produces a tiny temperature rise
- thermal sensors (**Ge-NTD/TES**) converts it into an electrical signal

Key advantages

- excellent energy resolution (< 1%)
- low energy threshold (few keV)
- direct measurement of the full decay energy

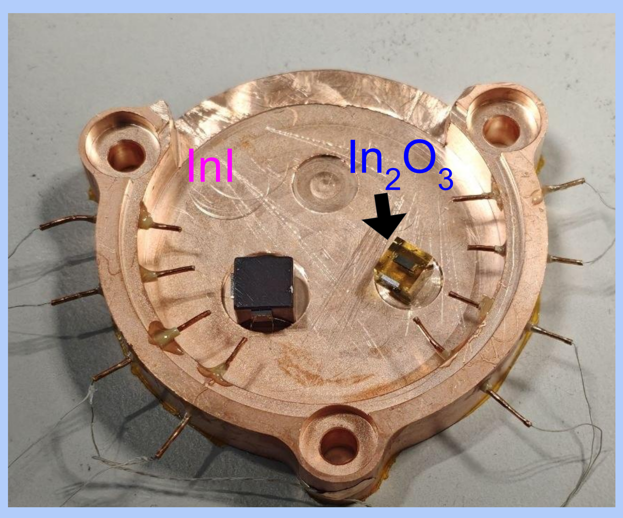
Preliminary measurements of forbidden β decays

^{99}Tc source + TeO_2 absorber

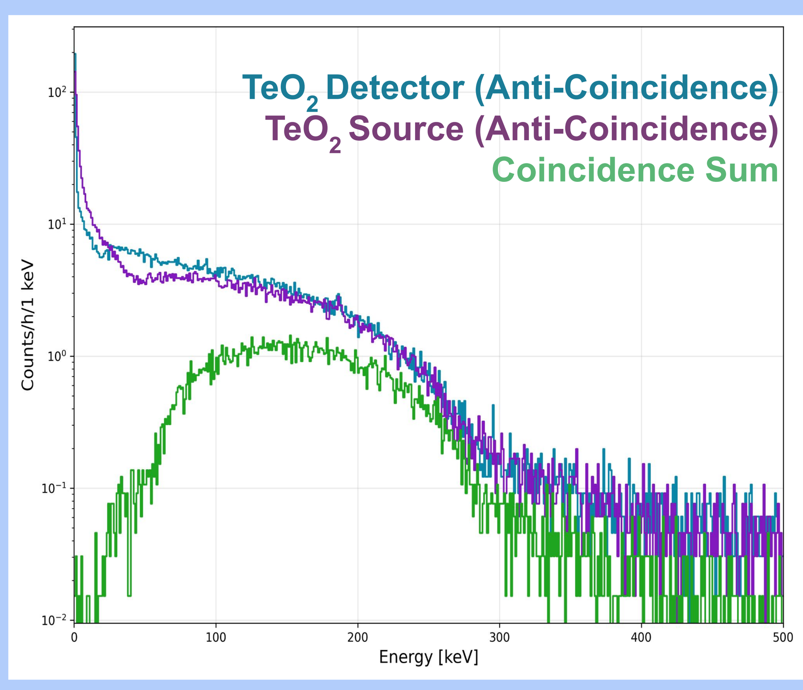


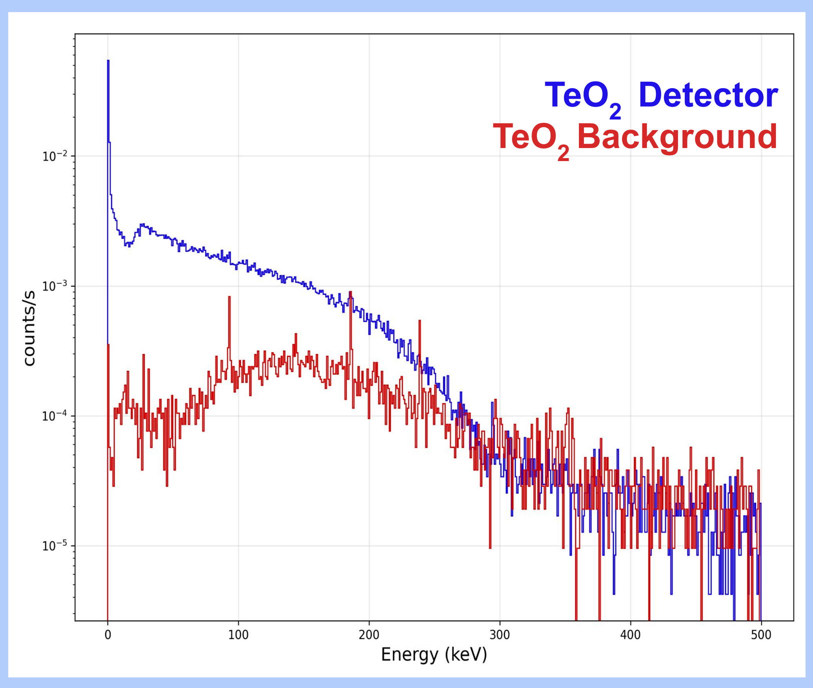
^{99}Tc β decay measured with an **external source** and TeO_2 cryogenic calorimeters.
Coincidence techniques allow **signal** and **background** contributions to be characterized.

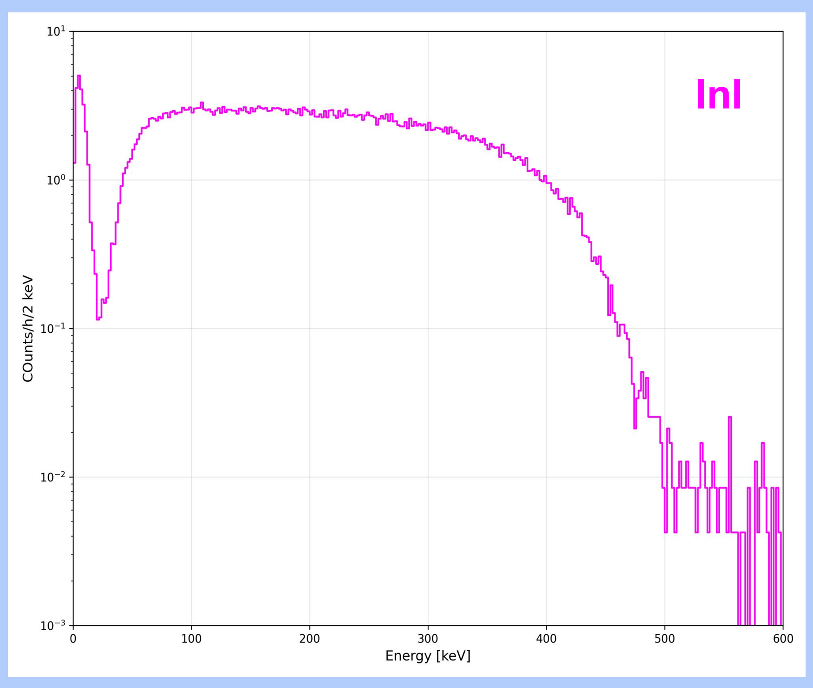
In crystals

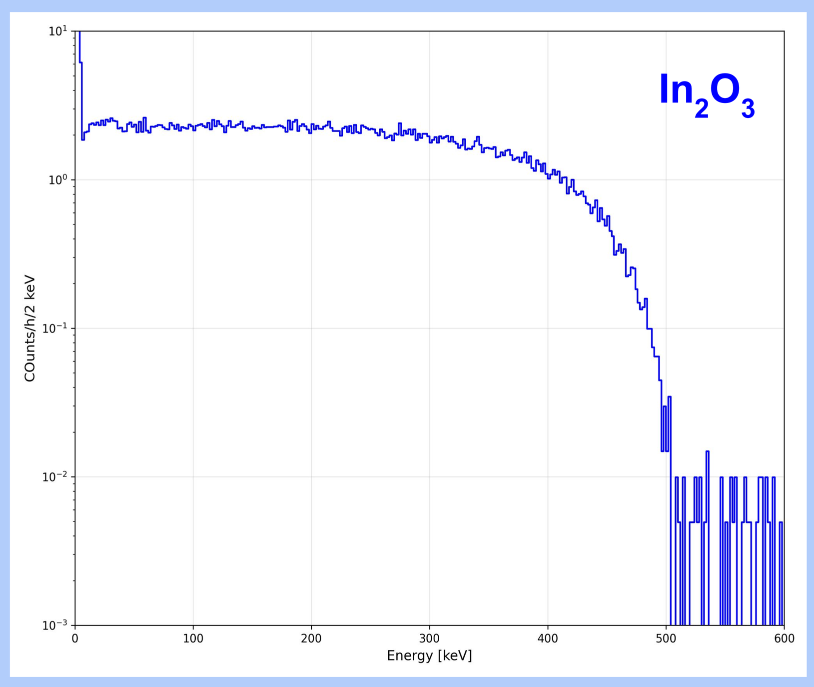


In-containing crystals provide a *source = detector* configuration, enabling a **low-systematic measurement** of the ^{115}In β spectrum.









	TeO_2 Detector	TeO_2 Source	TeO_2 Background	InI	In_2O_3
THRESHOLD	2 keV	4.5 keV	0.7/0.4 keV	1.5 keV	15 keV

Next steps

- Replacement of part of the lead shield with **Roman lead shield**.
- New copper thick pot to **reduce external background**.
- New dedicated run for In crystals and TeO_2 with ^{99}Tc source.
- ^{36}Cl with **NaCl** irradiated with thermal neutron at reactor