

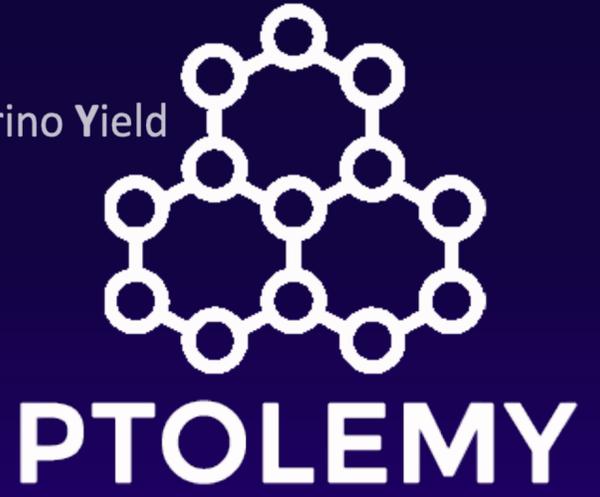
Neutrino Physics with PTOLEMY:

From the mass measurement to the CNB detection

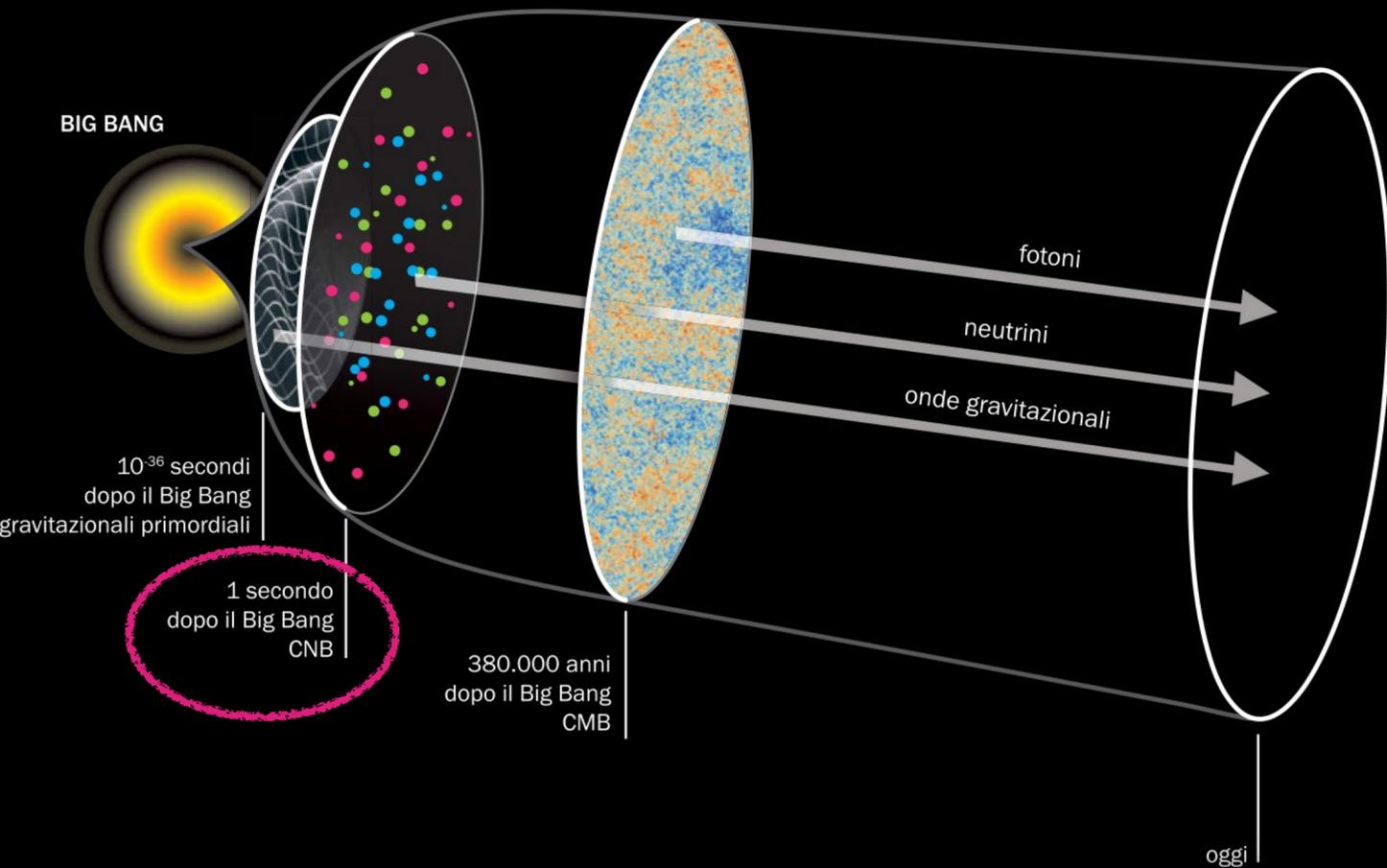
Presentation for GSSI Astroparticle Science Fair, 12 February 2026

Francesca Maria Pofi on behalf of the PTOLEMY Collaboration

PonTecorvo / PrinceTon Observatory for Light Early-universe Massive-neutrino Yield

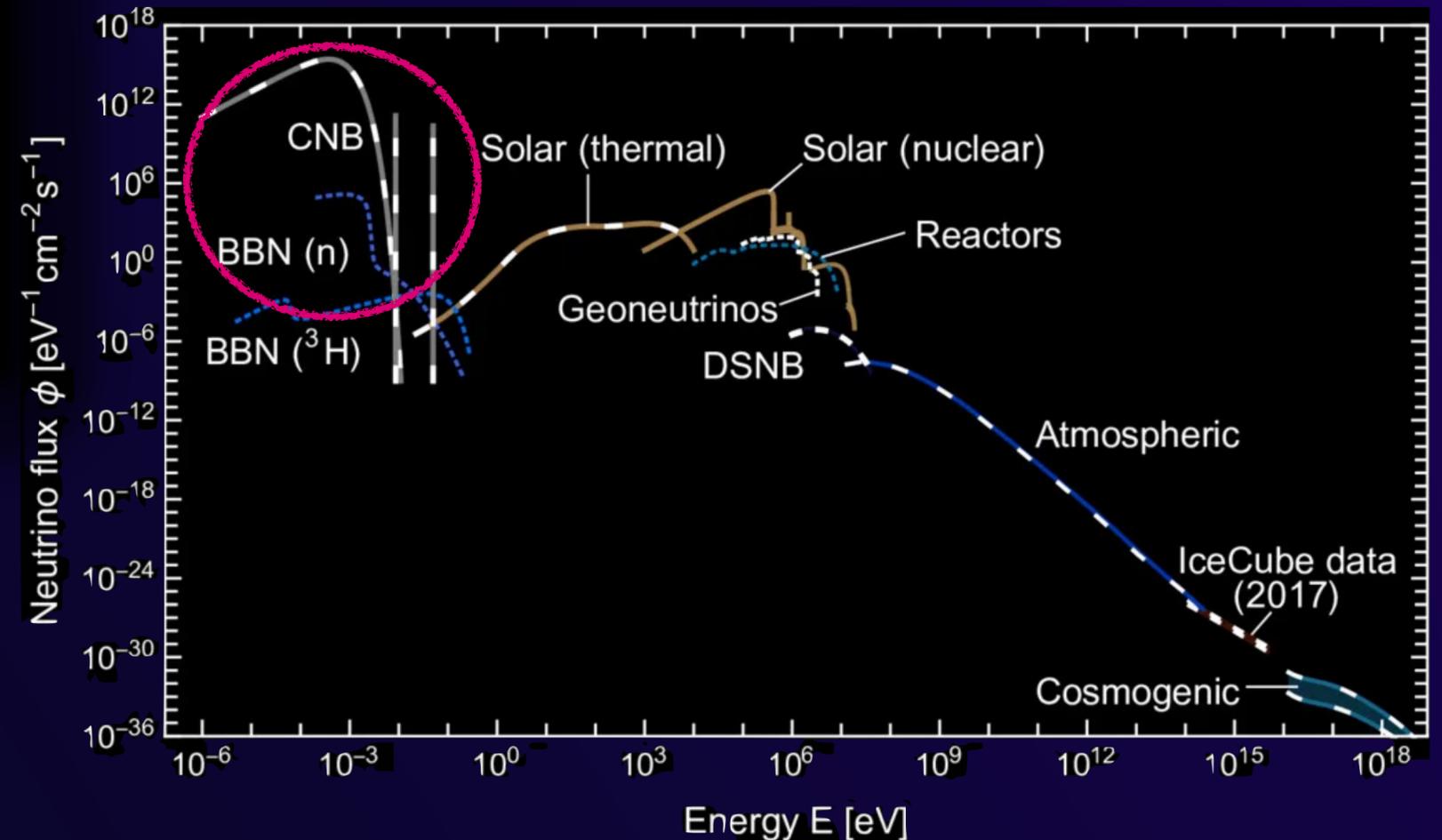
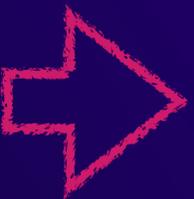


A Sea of 'Still' Neutrinos



Cosmic Neutrino Background (CNB)

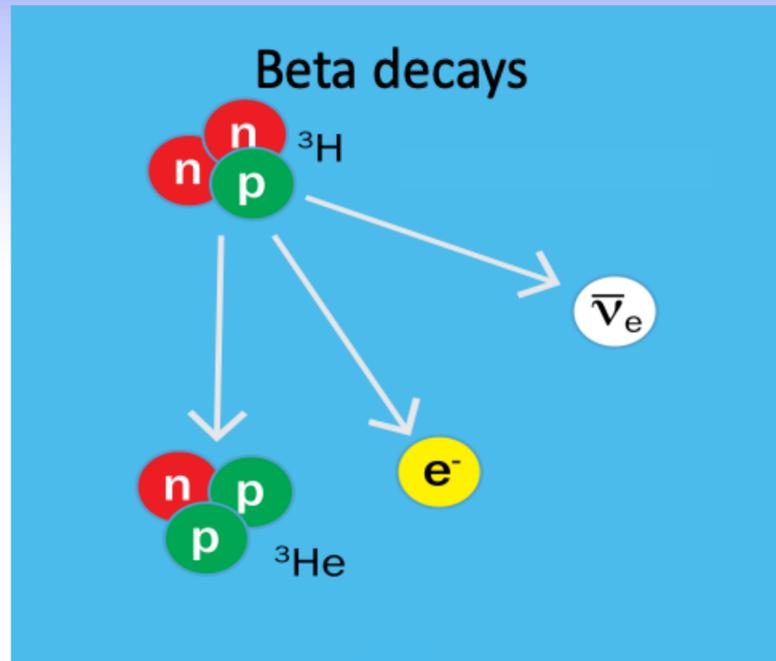
- Identikit:**
- ❖ Decoupling 1 sec after Big Bang
 - ❖ Density $n_\nu \simeq 300/\text{cm}^3$
 - ❖ Temperature $T_\nu \simeq 1.95 \text{ K}$



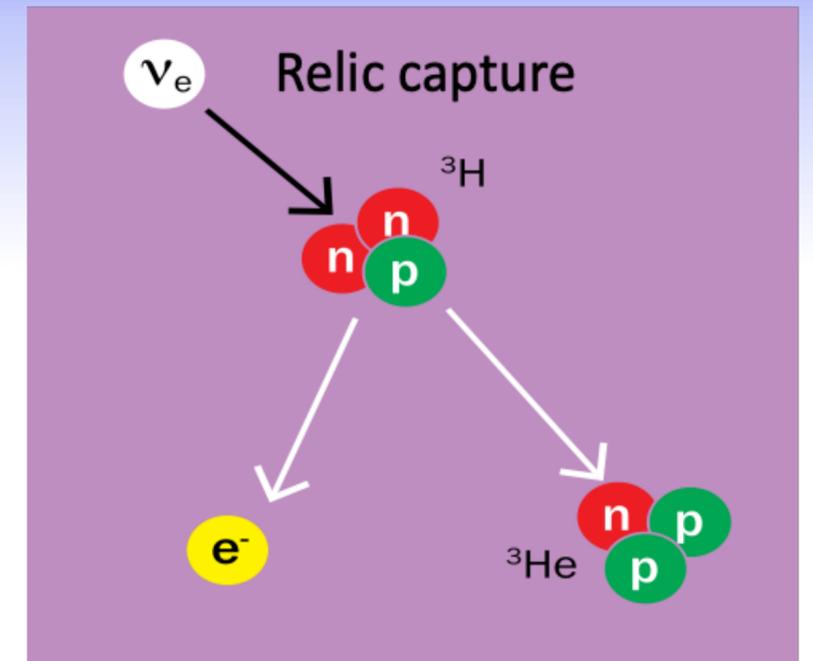
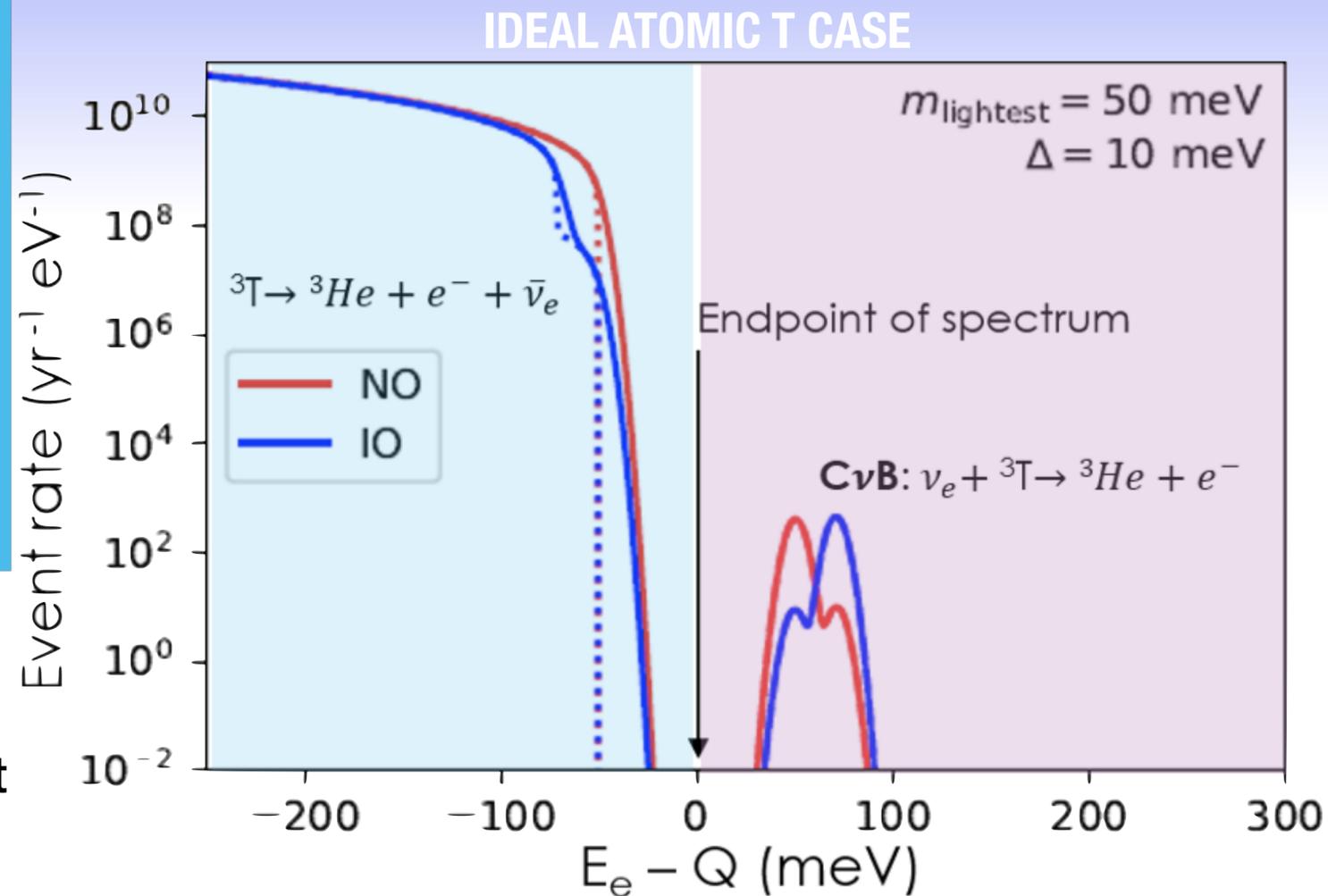
- ❖ Most abundant neutrinos' source
- ❖ Extremely low energy $E_\nu \simeq 10^{-4} \text{ eV}$
- ➔ Challenging detection: non-threshold reaction needed

Two Measurements with One Observable

☑ Let's take a β -unstable nucleus eg Tritium (^3H) \longrightarrow What can we obtain *for free*?

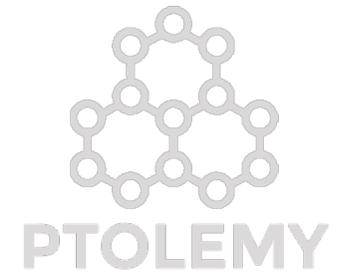


Neutrino Mass Measurement
from endpoint distortion
(1° goal)



First
Relic Neutrinos Detection
(Final goal)

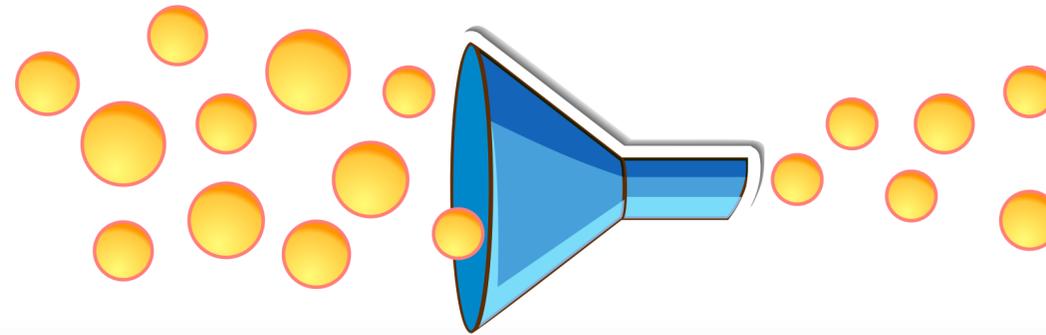
PTOLEMY Ingredients



✓ Extremely accurate measurement of electron energy

- $\mathcal{O}(50 \text{ meV})$ resolution

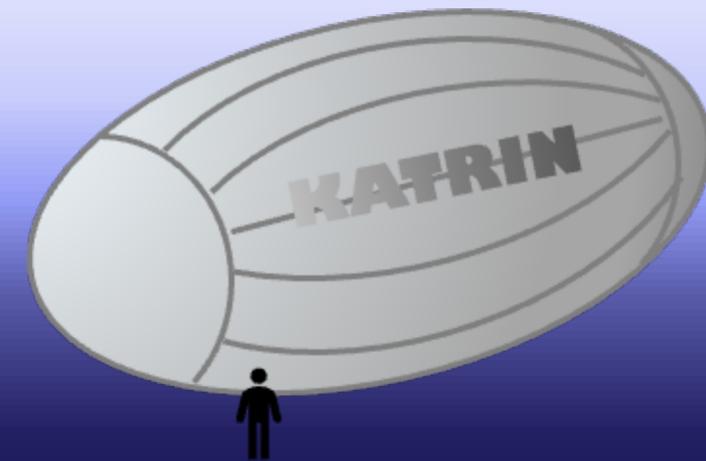
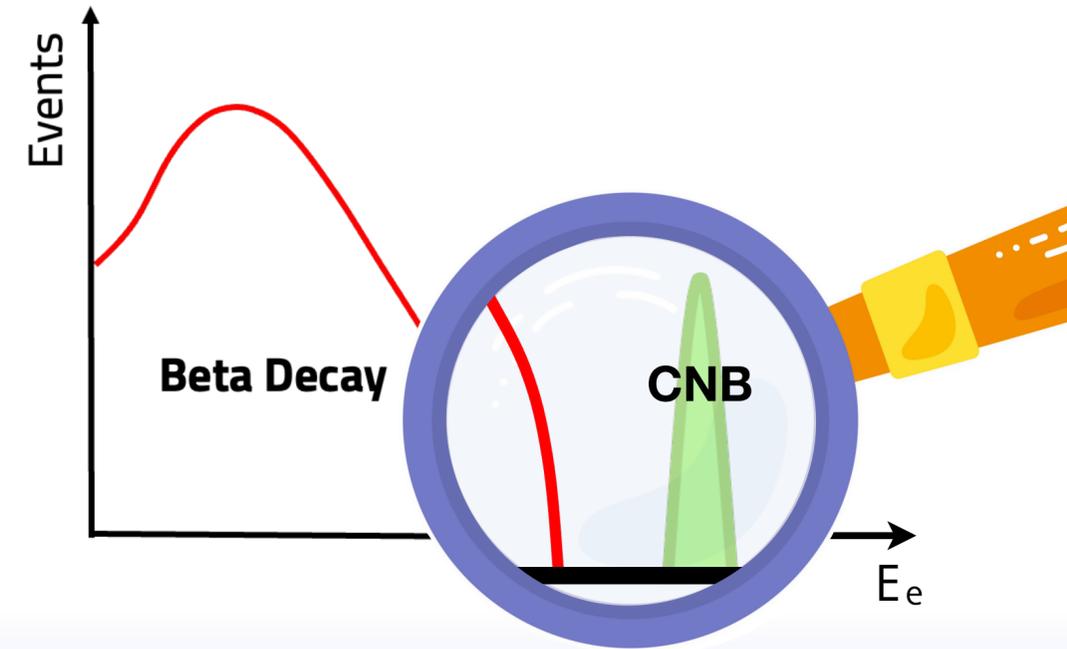
✓ Electron filtering



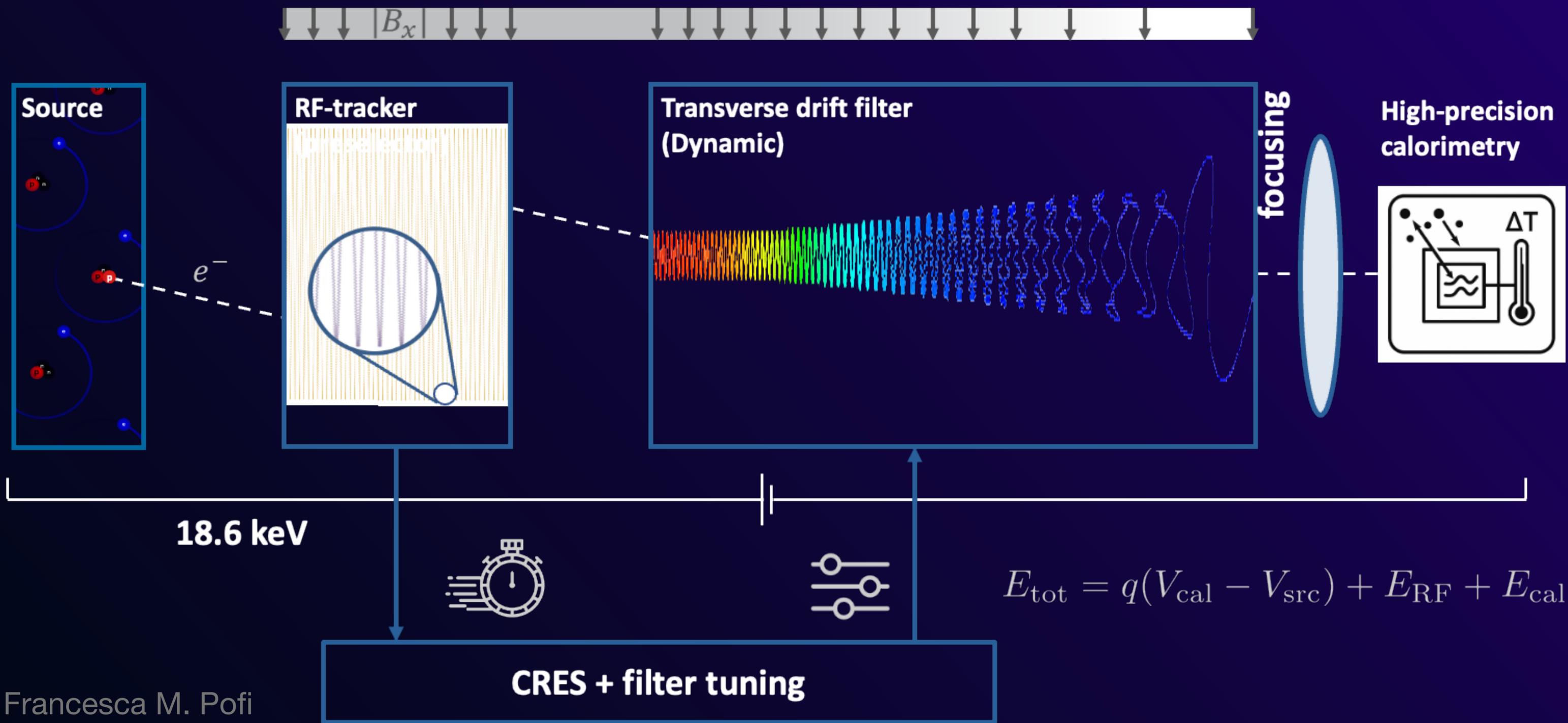
✓ Electron slowdown



✓ Large target mass (very low cross section for ν capture)

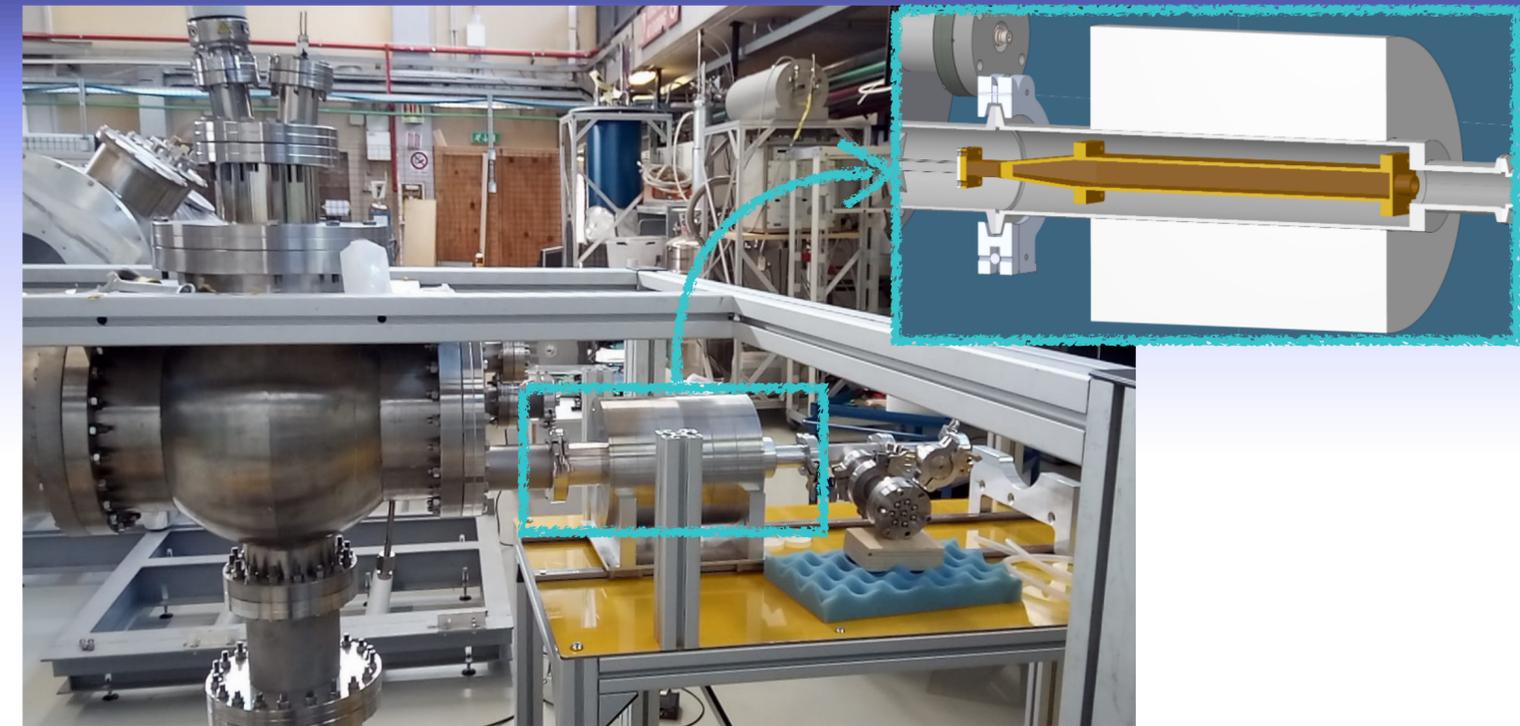
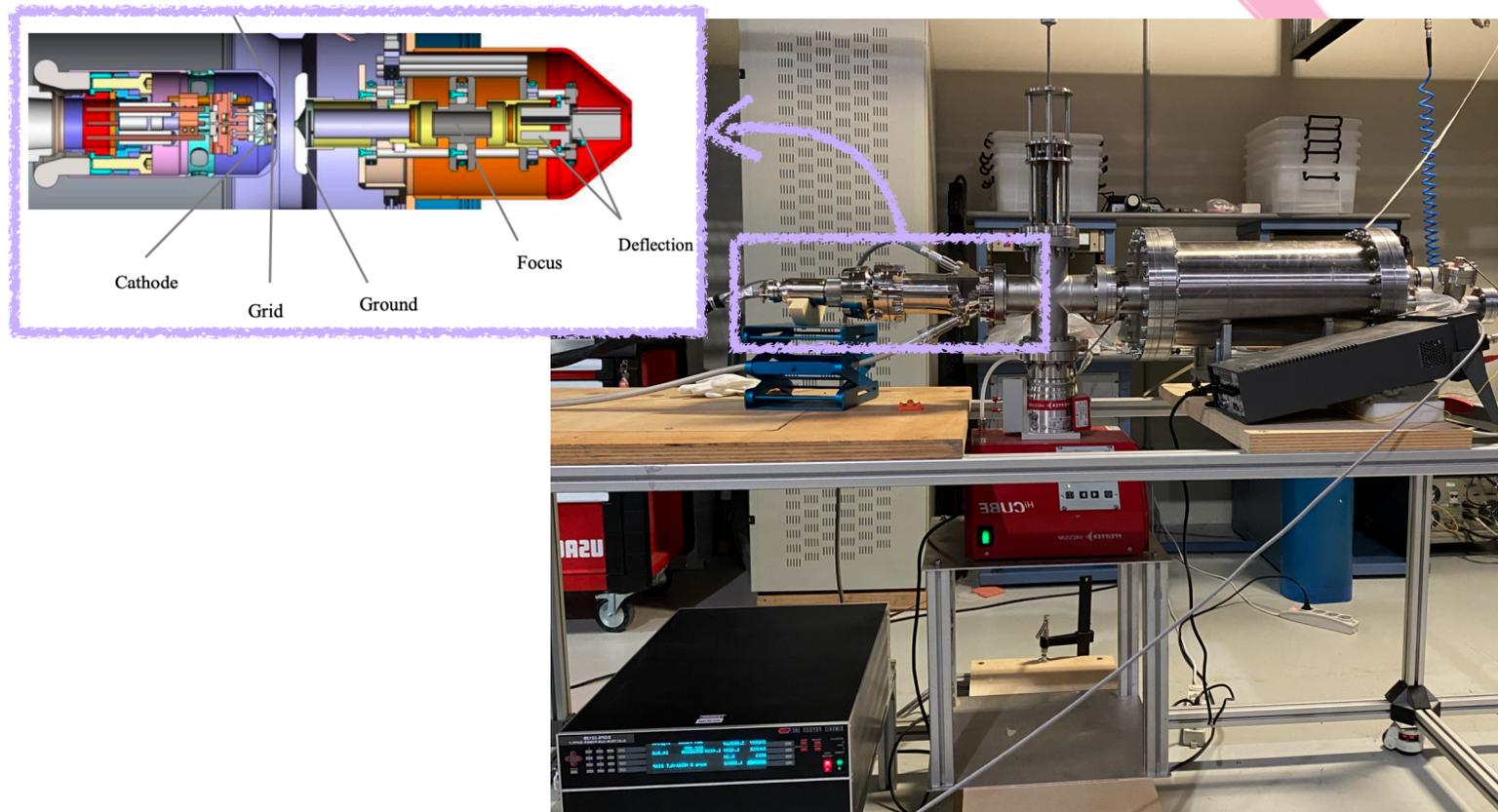


A Multi-Disciplinary Detector



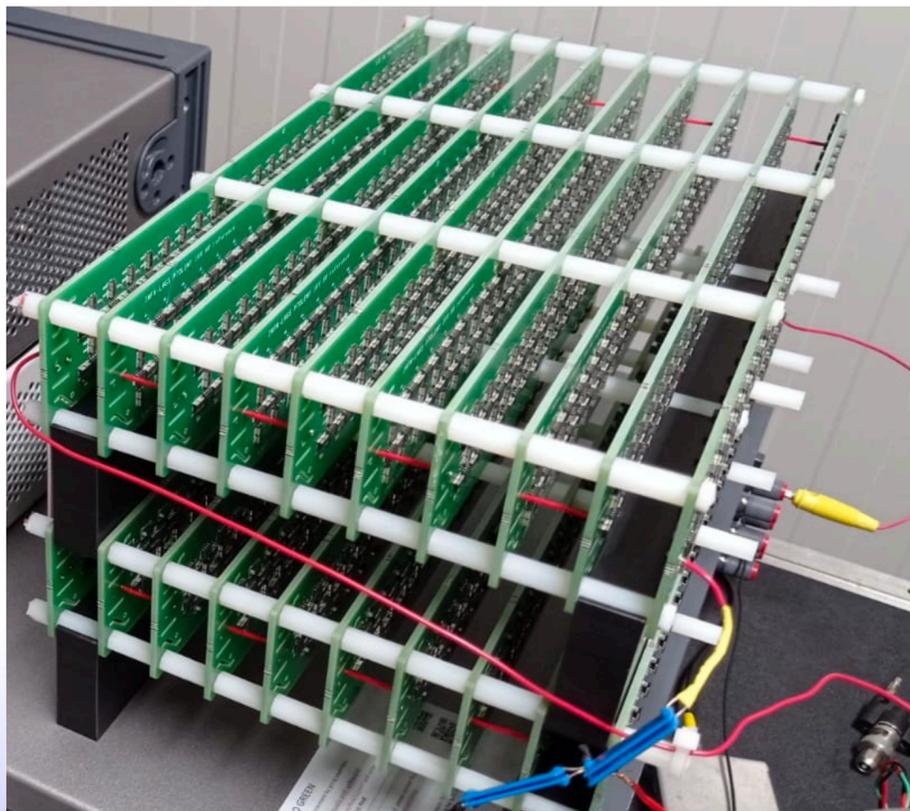
Towards PTOLEMY Demonstrator @ LNGS

✓ RF detection with ^{83m}Kr injection



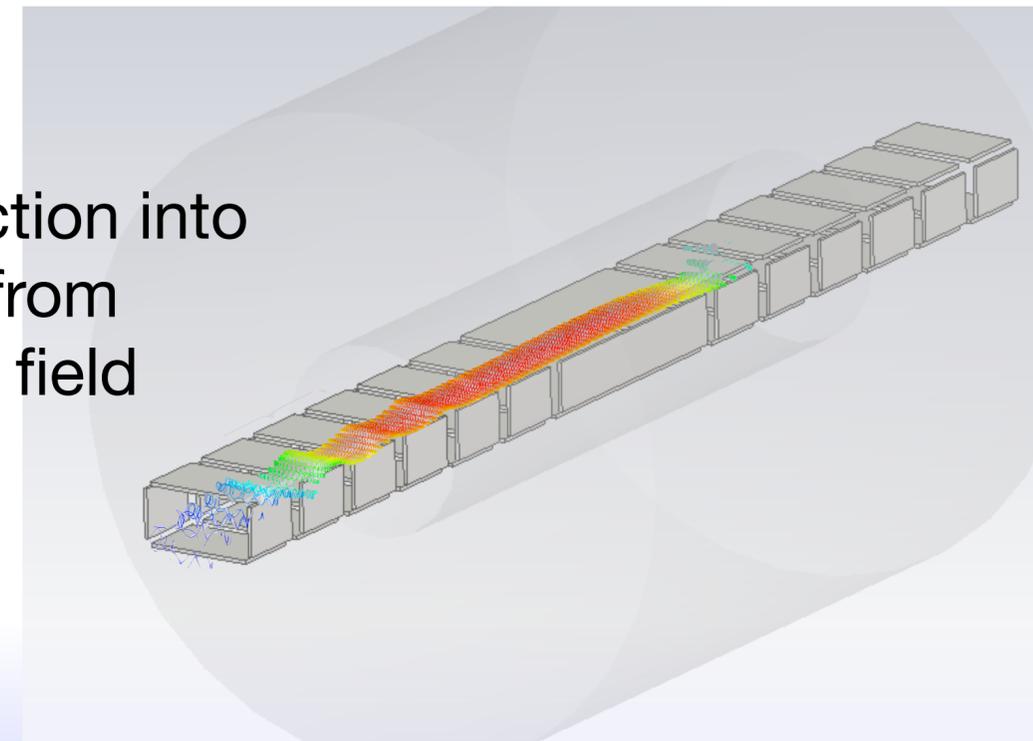
✓ Electron beam setup for transverse drift filter calibration

Towards PTOLEMY Demonstrator @ LNGS

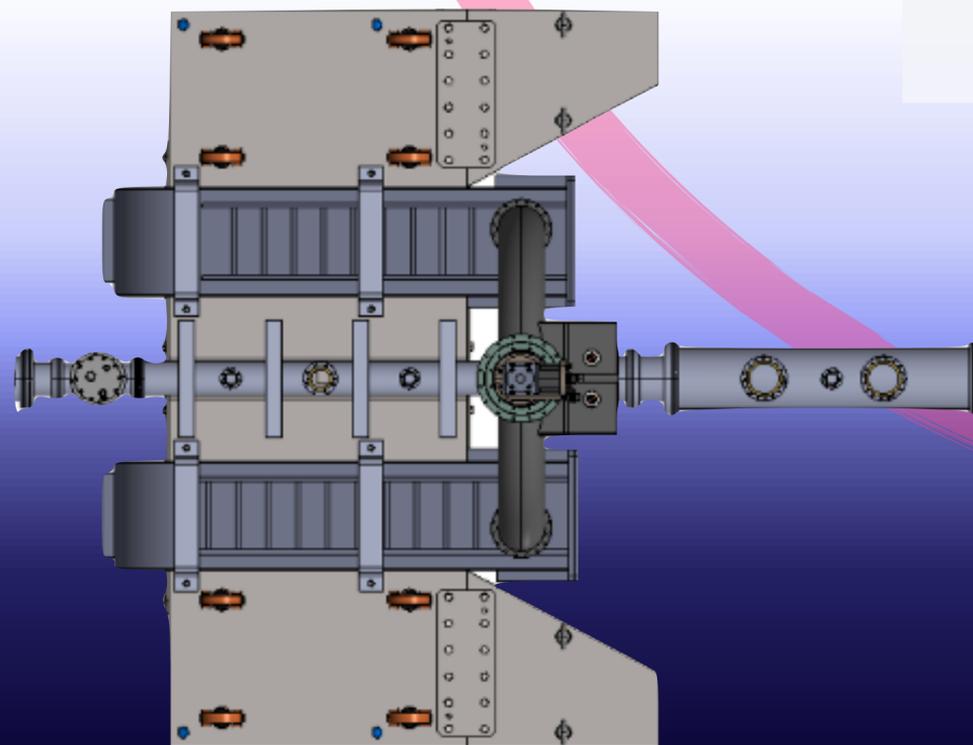


High stability HV system

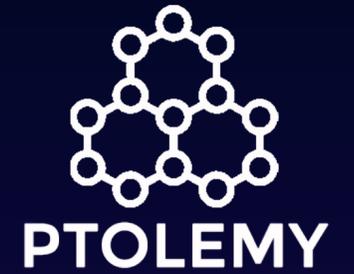
Electron injection into & extraction from 1 T magnetic field



Magnet for transverse drift filter summer 2026!



To Recap



▶ RF radiation detection, filter calibration setup & neutrino mass sensitivity studies ongoing @ LNGS

▶ **Demonstrator** under construction *from this year @ LNGS*

▶ First Goal: **Neutrino Mass Measurement**
Final Goal: **CvB Detection**

▶ The PTOLEMY LNGS group:

- > Giovanni Benato (GSSI)
- > Riccardo Biondi (GSSI)
- > Alfredo Cocco
- > Nicola D'Ambrosio
- > Alfredo Ferella
- > Marcello Messina
- > Serge Nagorny
- > Francesca Maria Pofi (GSSI)
- > Nicola Rossi
- > Federico Virzi

▶ To know more come to **visit us @ our poster!**
or just contact me to francescamaria.pofi@gssi.it

The poster titled "The PTOLEMY Project: How to Make a Screenshot of the very Early-Universe" by Francesca Maria Pofi on behalf of the PTOLEMY Collaboration - Gran Sasso Science Institute & INFN LNGS. It provides a detailed overview of the experiment's goals, components, and current status. Key sections include: Introduction (Cosmic Neutrino Background, PTOLEMY objectives), Signature (Neutrinos from C-12, low energy, small cross-section), Ingredients (Tritium Target, Preselector, Dynamic Filter, Electron Detector), Demonstrator @ LNGS (RF antenna, superconductive magnet, source and filter, TES microcalorimeters), and Home Look (funding, publications, website). The poster also features a diagram of the detector setup and a QR code for more information.