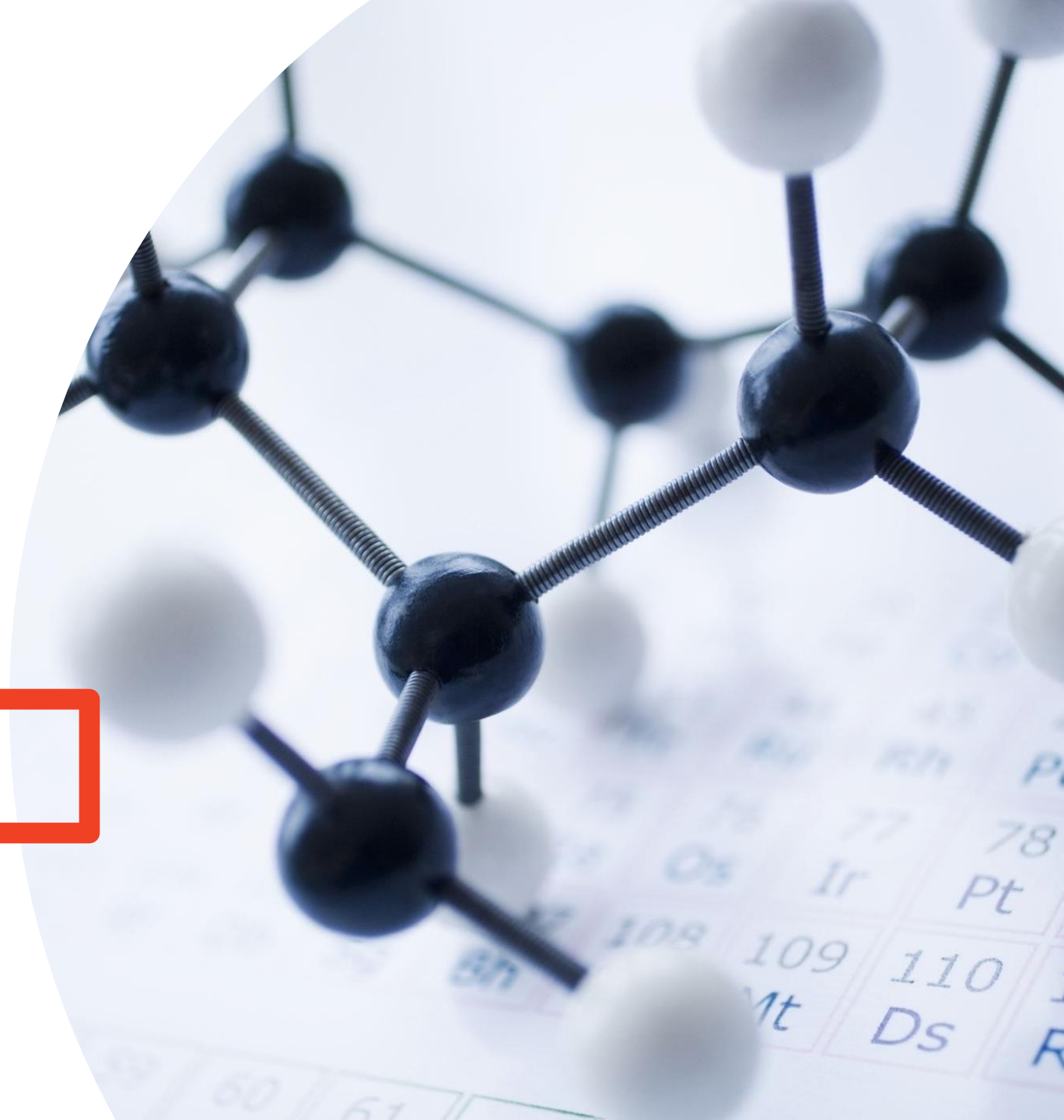


# Ptolemy and Isotope Production

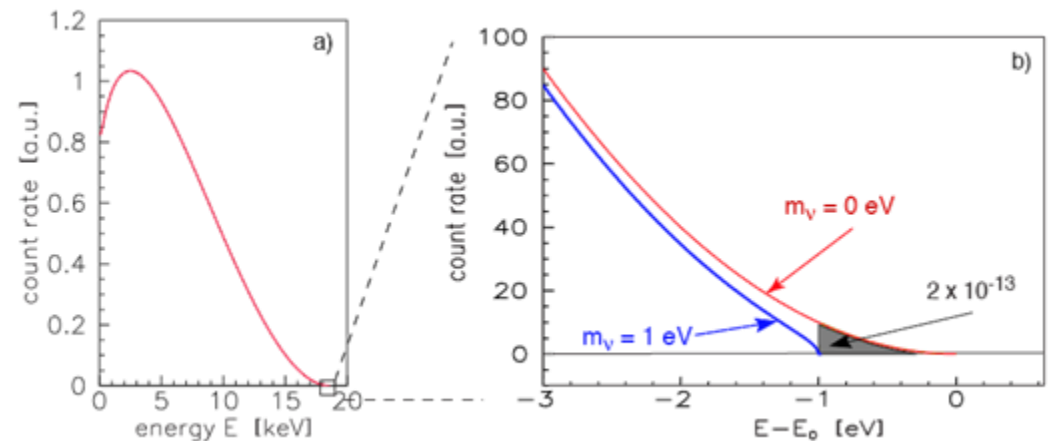
Two Pitches for the price of one

Nicolo de Groot RU/Nikhef

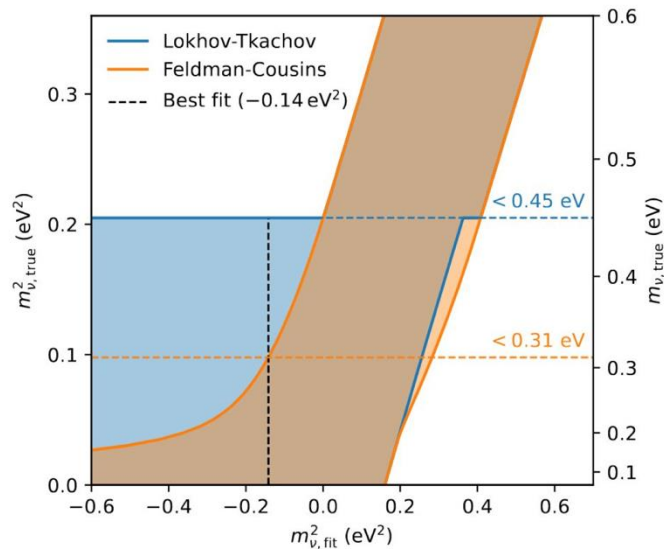
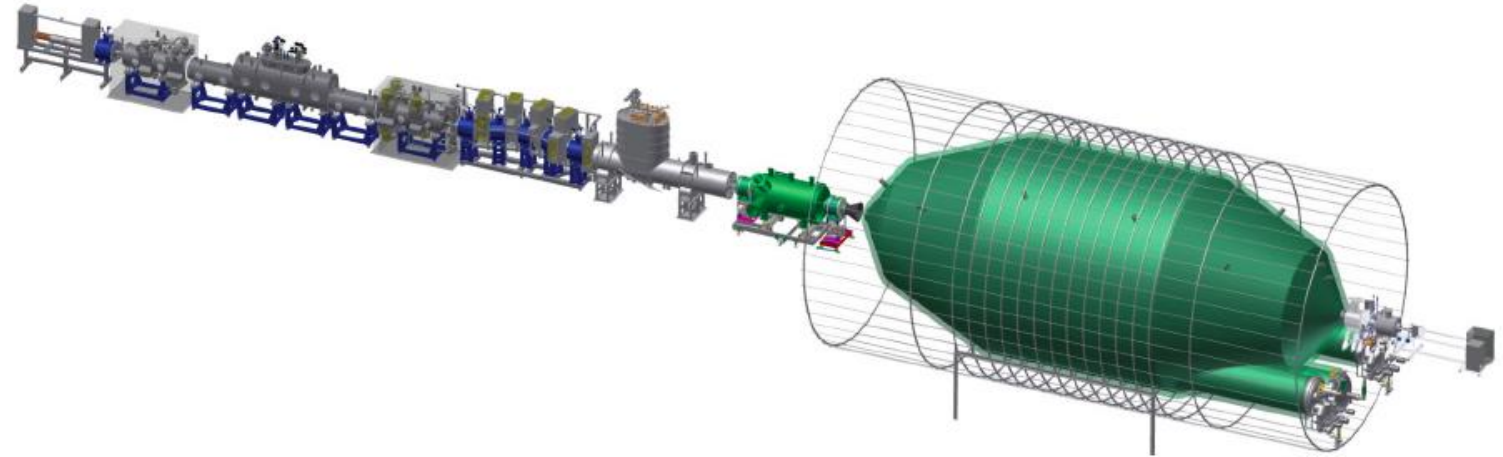
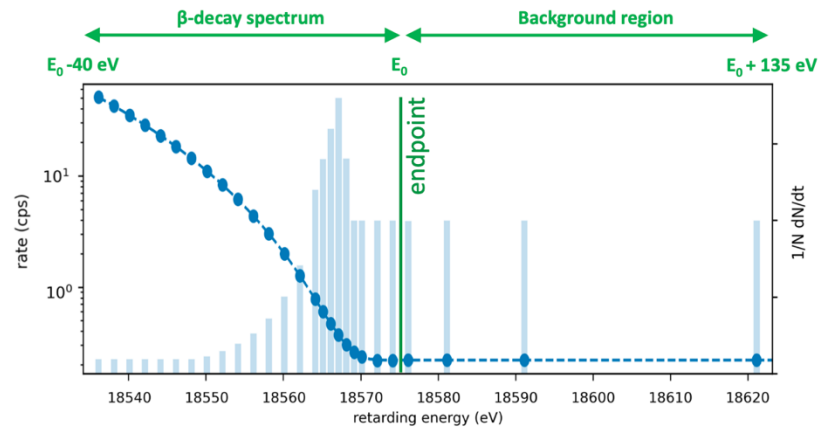


# Ptolemy

- Original plan to detect relic neutrinos
  - Requires 100g tritium and extreme precision ( $\sim 50\text{meV}$ )
- First phase: measure neutrino mass
  - Lower precision (0.2-0.5eV)
  - Small amount of atomic Tritium ( $100\mu\text{g}$ )
- Current participation: APC and NdG + not Nikhef participation (NWA funded)



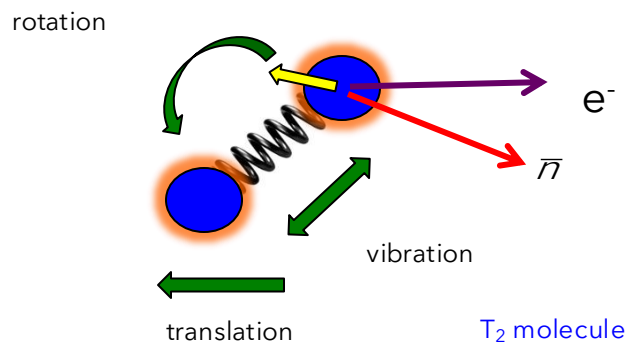
# Neutrino mass State of the Art: Katrin



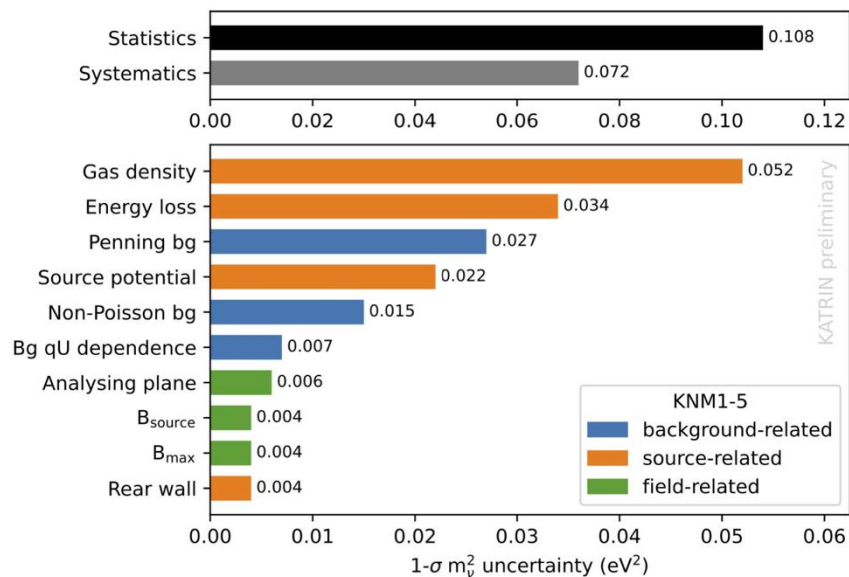
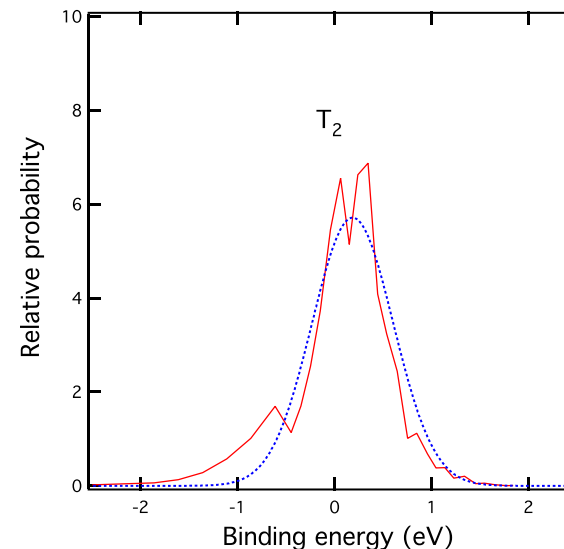
- Best fit:  $m_{\nu}^2 = -0.14_{-0.15}^{+0.13} \text{ eV}^2$
- Upper limit:  $m_{\nu} < 0.45 \text{ eV}$  (90% CL)

M. Aker *et al.* 2024  
<https://arxiv.org/abs/2406.13516>

# Katrin final reach



The g.s. has rms width of 0.436 eV (FWHM 1.02 eV), which **limits the neutrino mass reach of any molecular experiment**

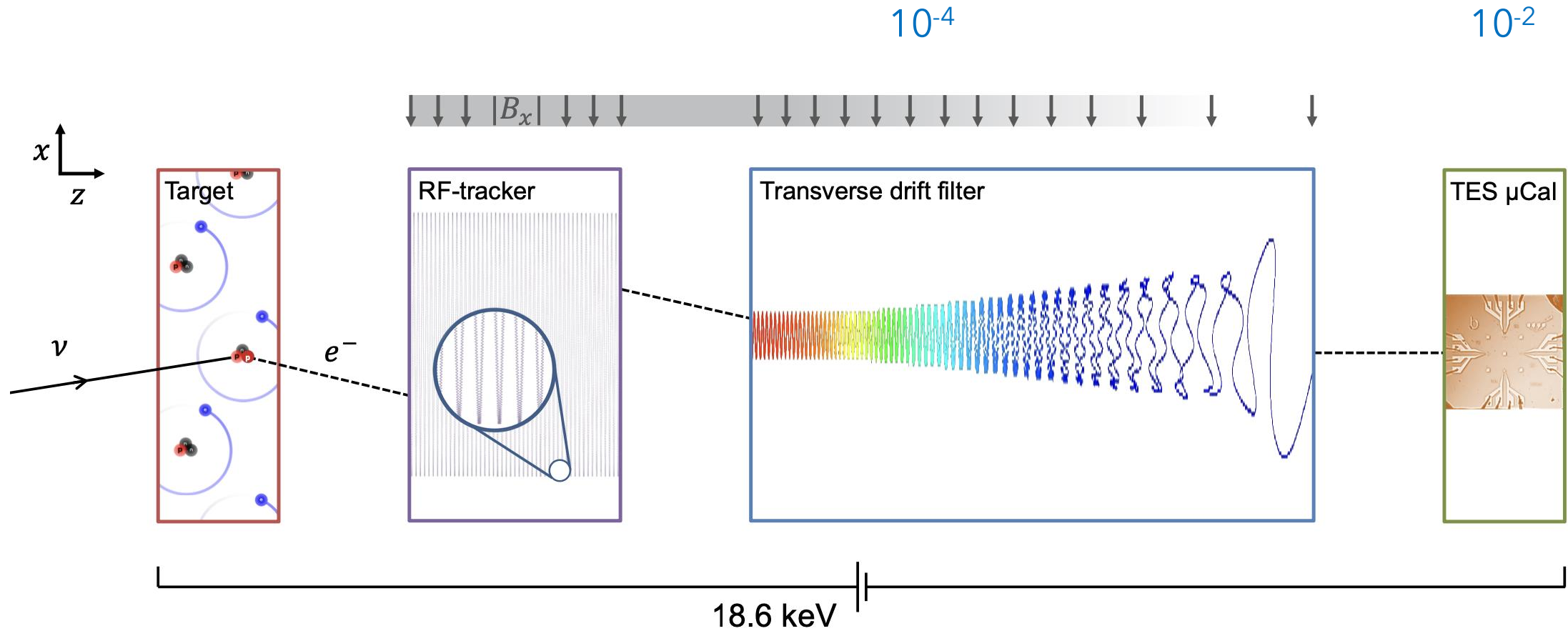


Final goal: 0.2-0.3 eV limit

From cosmology:  $\Sigma m_\nu < 140 \text{ meV}$

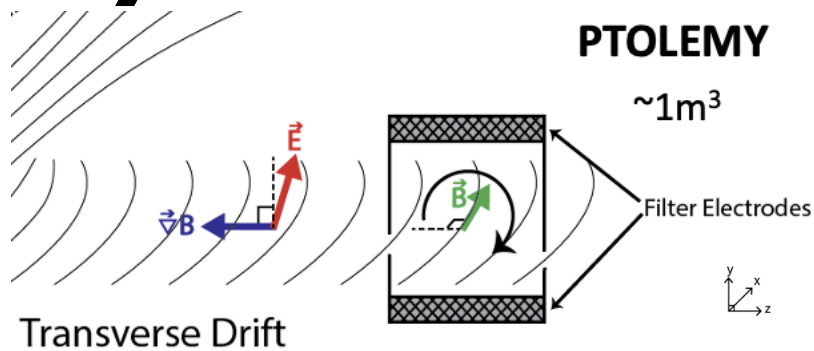
From mixing: 1 flavour with  $m_\nu > 50 \text{ meV}$

# PTOLEMY Basic concept

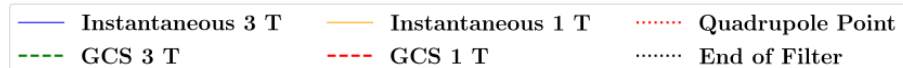
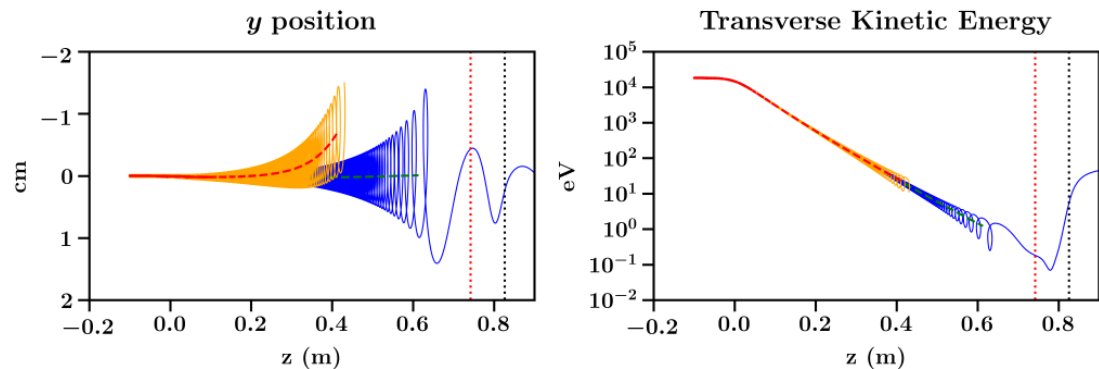
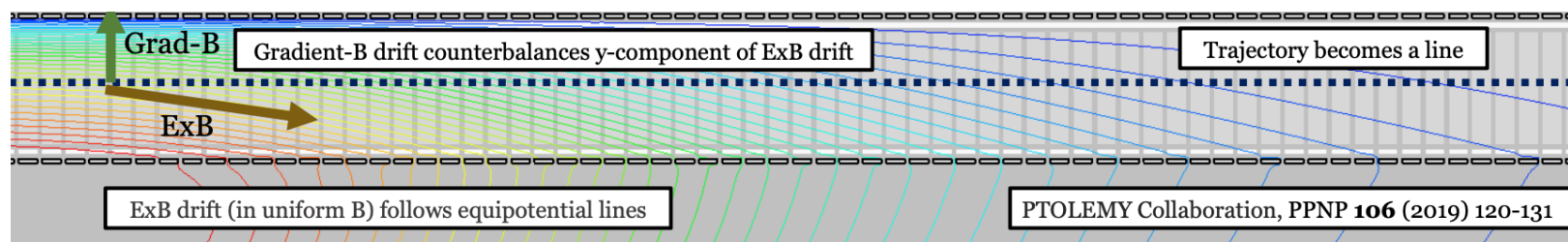


$$E_{total} = q(V_{TES} - V_{target}) + E_{RF} + E_{cal}$$

# Ptolemy filter

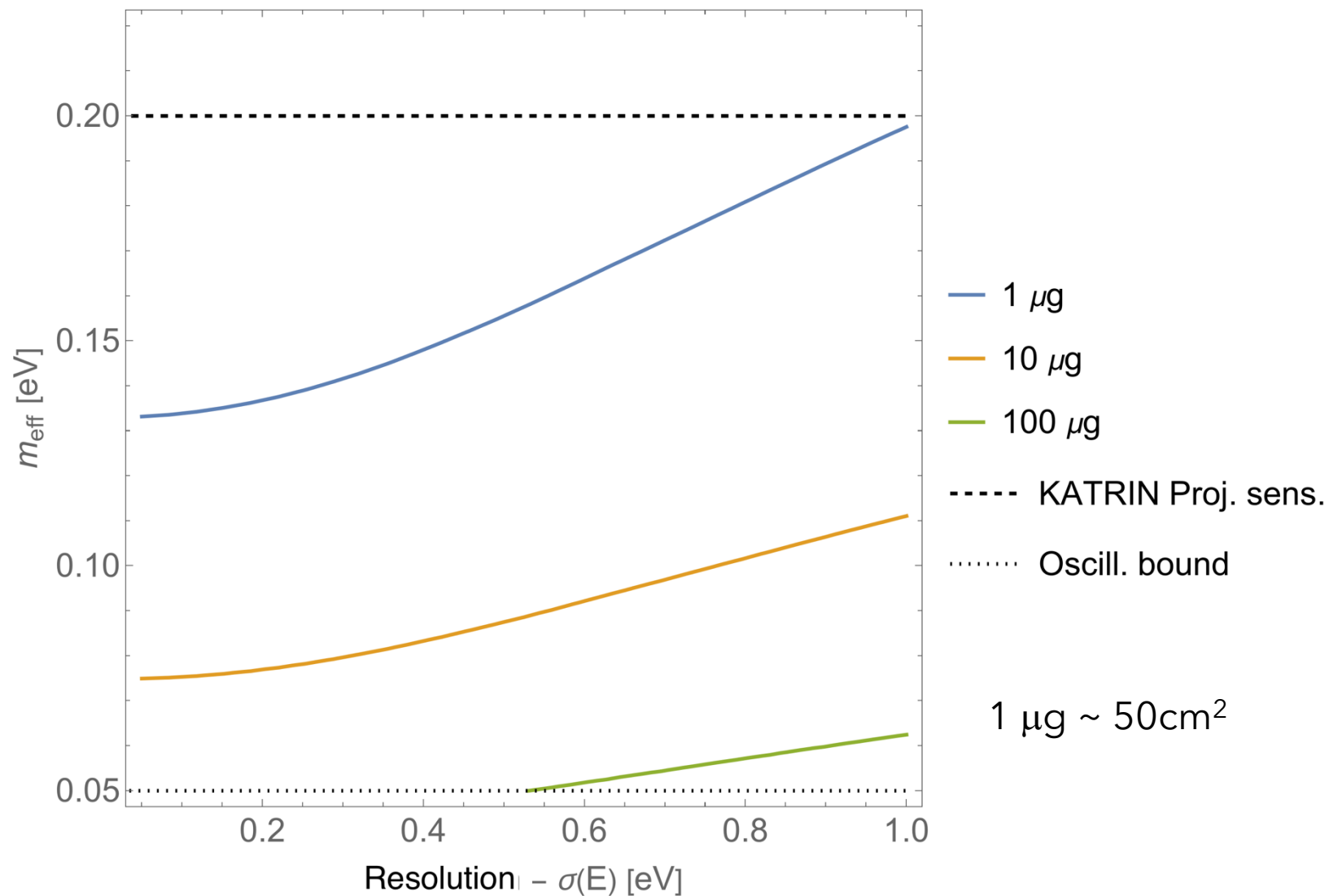


Simulations with KASSIOPEIA code (KATRIN) and Lorentz4 (N. Rossi, M. Messina, LNGS)  
<https://github.com/gkrossi/lorentz4>



# Mass Reach

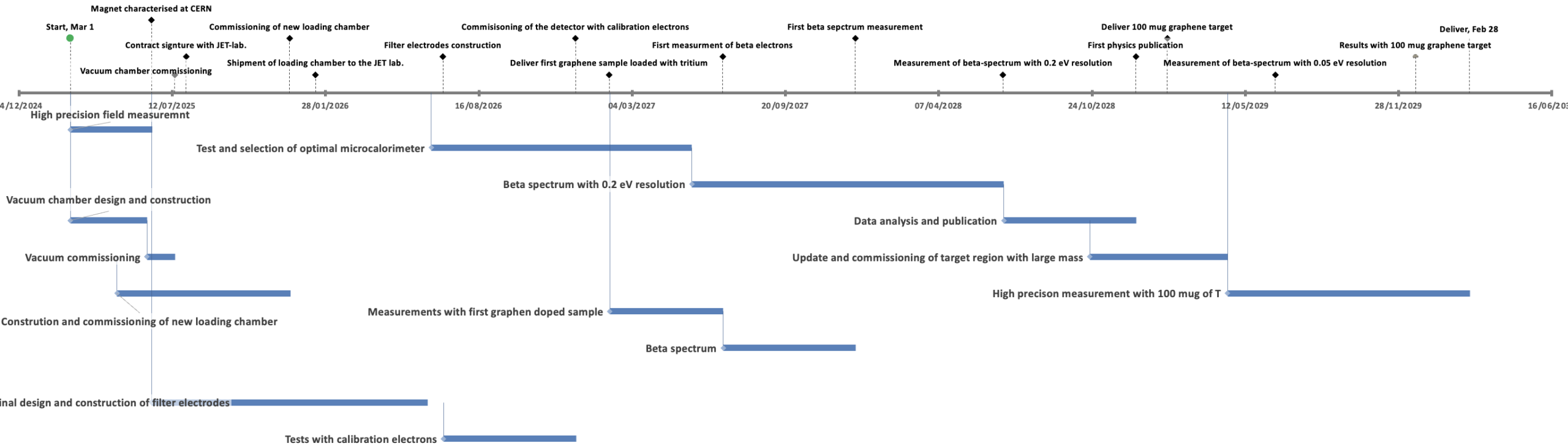
PTOLEMY Sensitivity (3 years)



# Ptolemy Timeline

## PACE Project

Chart Area





# Ptolemy Conclusions

- Ptolemy is a small experiment with a potentially large impact
- Perhaps the only realistic change to measure neutrino mass in the next decade, should be in the ESPP
- Small Nikhef group (APC, NdG)
- 2025 crucial year: demonstration of filter technique
- Could be part of neutrino platform and neutrino XL proposal
- Proposed text: *Ptolemy offers a unique opportunity to directly measure the neutrino mass and should be pursued*



# Nuclear Physics News

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## Contents

### Editorial

EURASIS European Rare Stable Isotope Supply for Research: Searching for a Way Out from Supply Shortage

*by Dieter Ackermann*..... 3

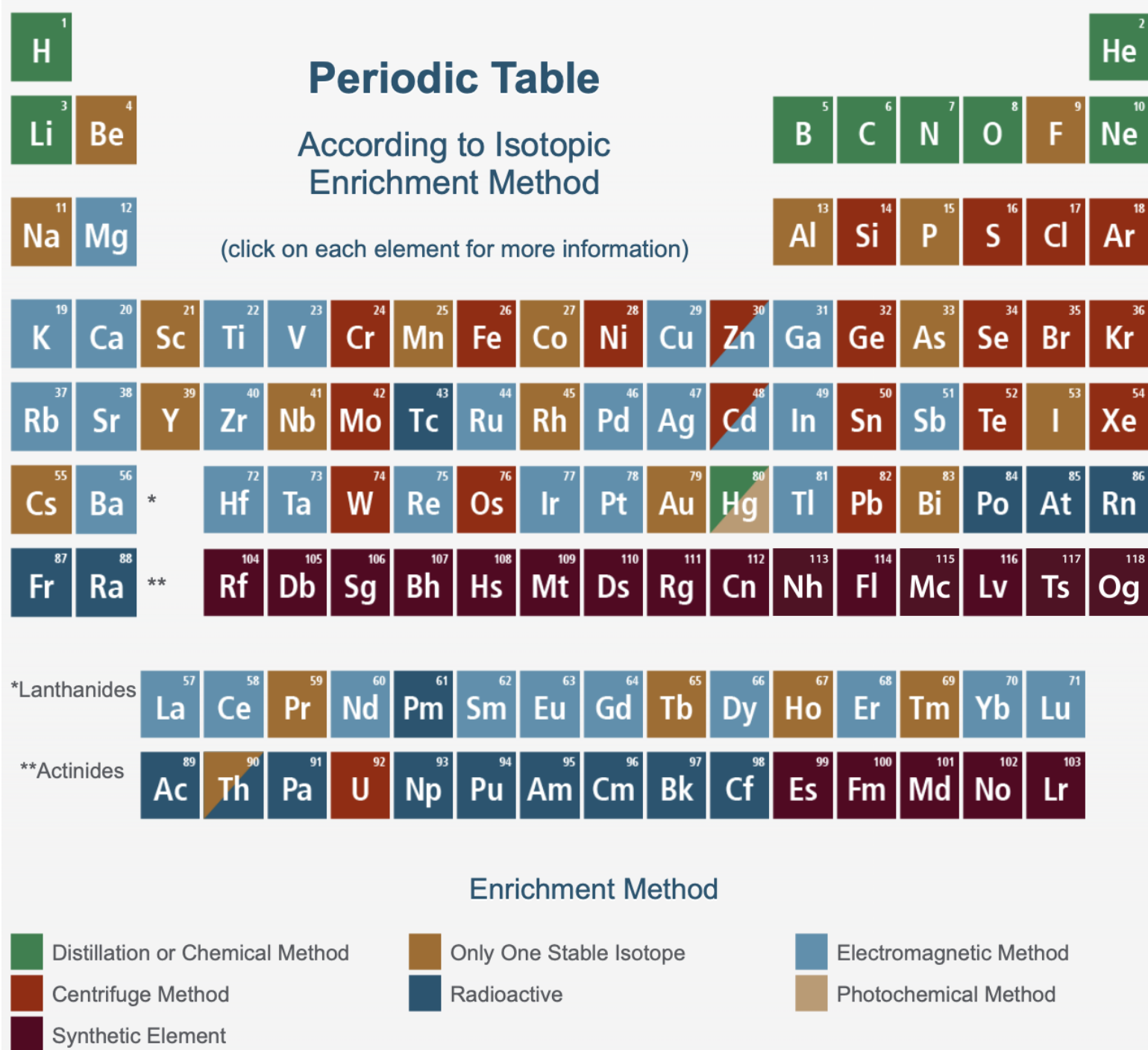
# Stable Isotope Production

## Isotope crisis in Europe:

- EM produced isotopes (calutron)
- War in Ukraine, Sverdlovsk unavailable
- USA protectionism (ORNL limited)
- Increased demand for  $^{177}\text{Lu}$

## Problem for

- Medical isotopes
  - Therapy
  - Diagnostics (PET, SPECT)
- Superheavies (needs  $^{48}\text{Ca}$ )
- $0\nu 2\beta$  ( $^{48}\text{Ca}$ ,  $^{150}\text{Nd}$ )
- (NWO demonstrator for  $^{48}\text{Ca}$ , J. Even, NdG)



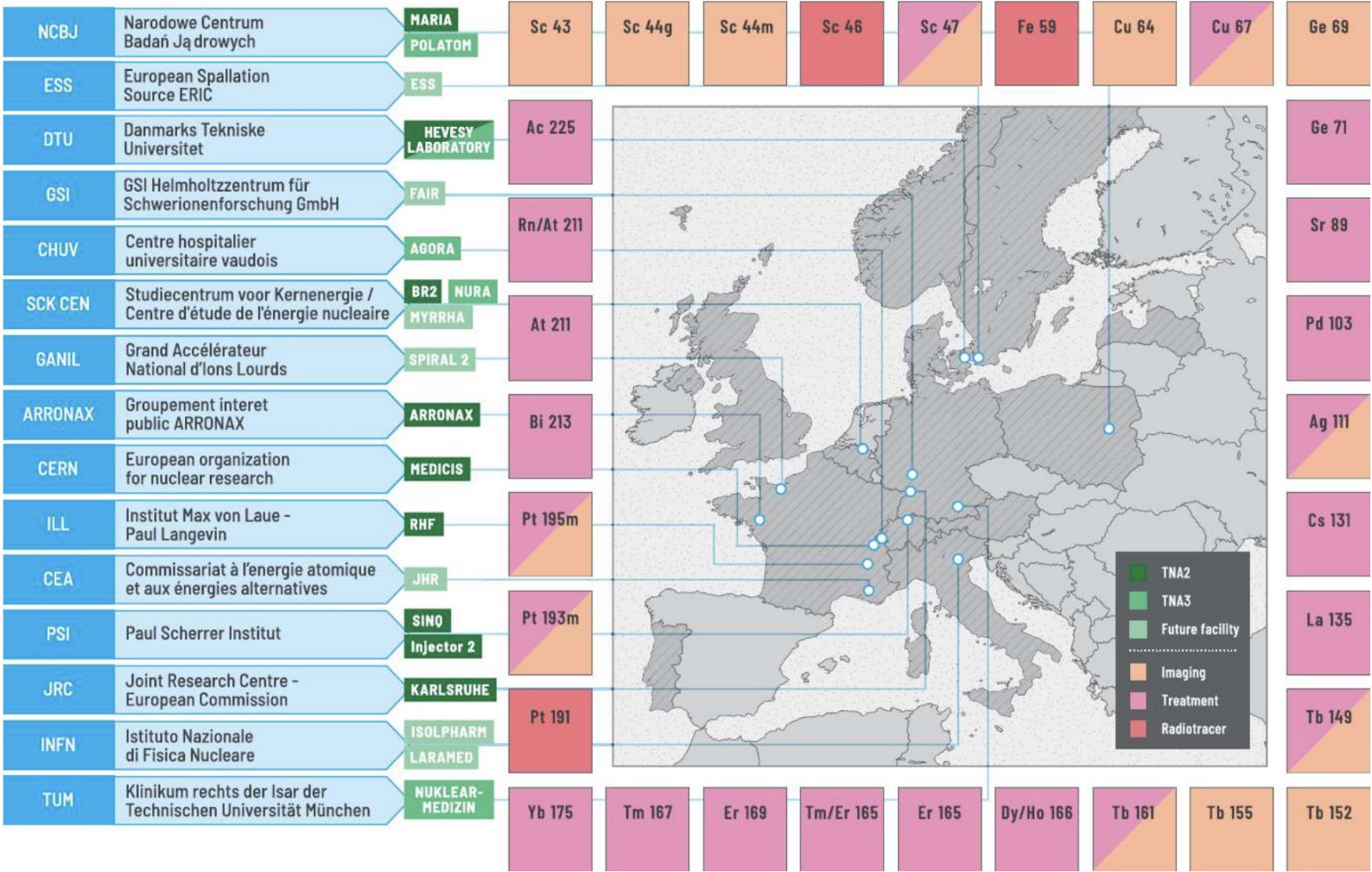
# PRISMAP: European Network for medical Radionuclides

**PRISMAP:**

Focus on irradiation, not separation of stable isotopes as source material.

For this need centrifuge or calutron

CERN is partner in PRISMAP through Medicis, using ISOLDE



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008571 (PRISMAP).

# Conclusions Stable Isotope Production

- There is a crisis in Europe
- We need a large calutron facility
- CERN would be the perfect place to host it
  - Connection with Isolde/Medicis/Prismap
  - Legal and technical infrastructure
- Interest from Groningen (next to Agor) / Shine Pharma
- Encourage CERN to take the lead in ESPP document,  
proposed text: *Europe needs a large calutron facility, CERN is an excellent place to host it*