

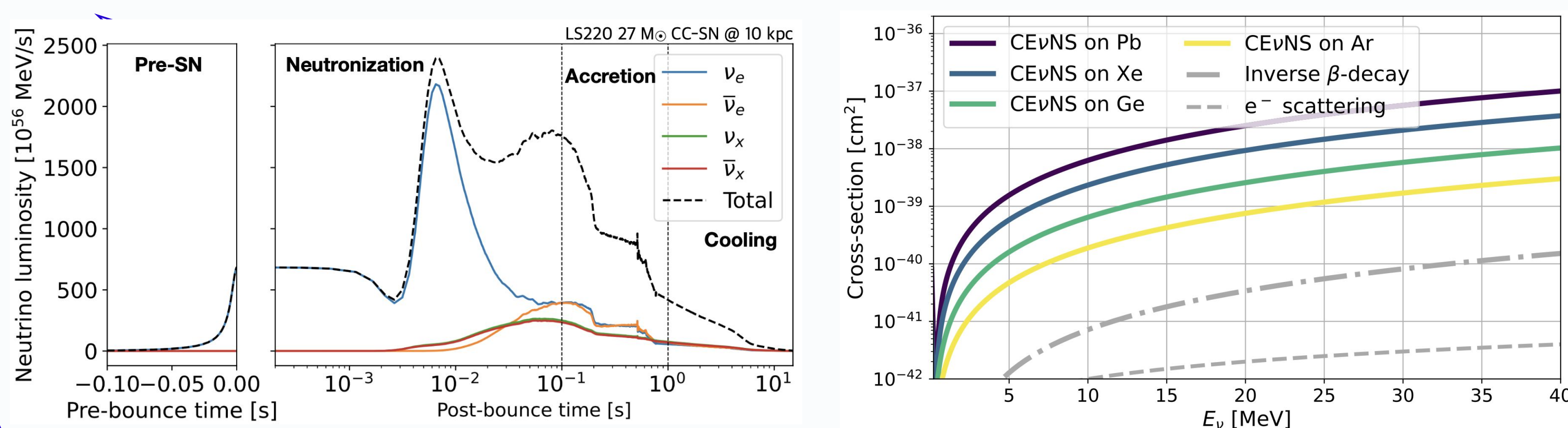
Cosmogenic activation of archaeological Pb-based crystals at ChiPr neutron-beam facility for the RES-NOVA experiment

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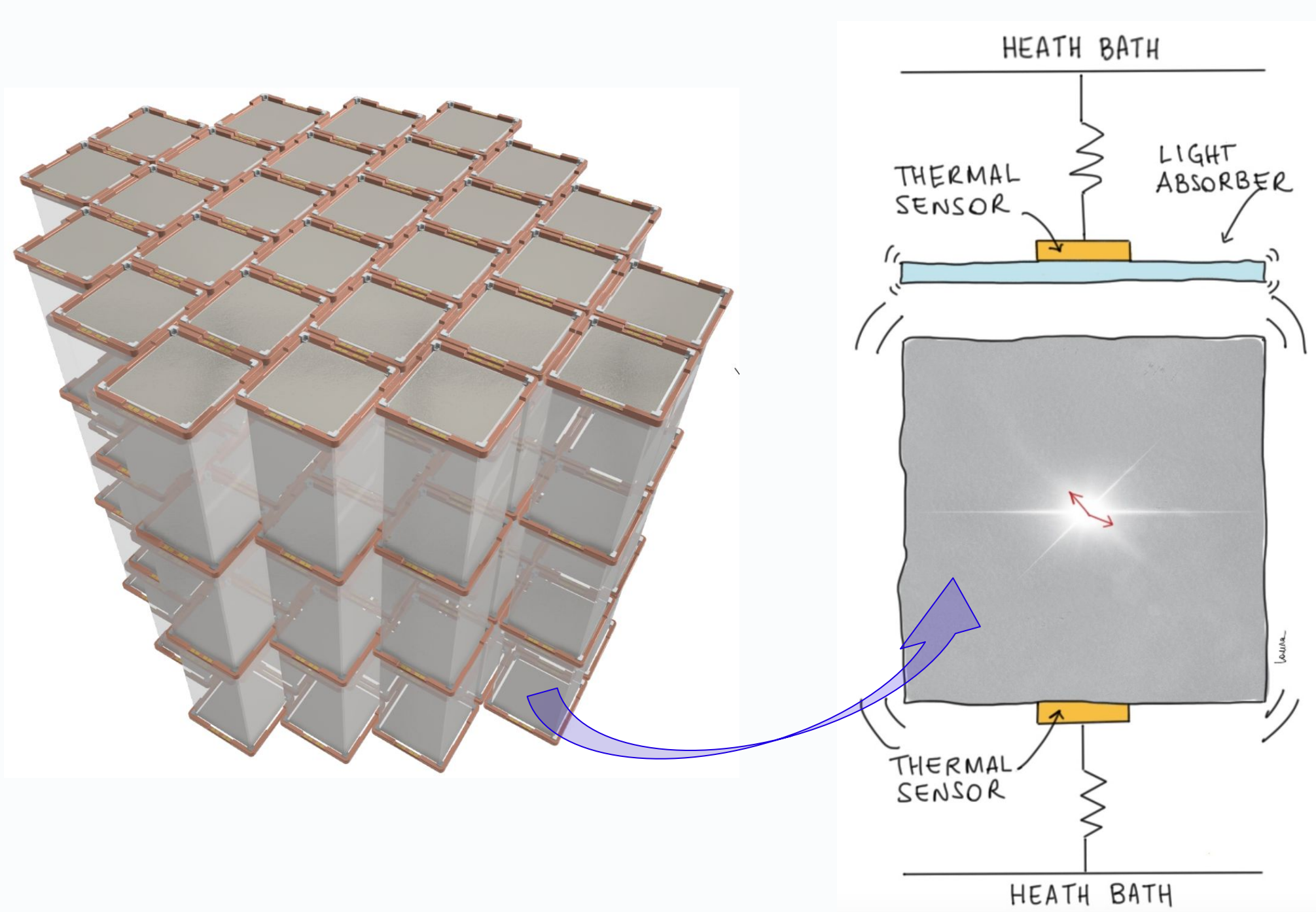
1. Detection of supernova neutrinos

- Supernova (SN) neutrino burst:
 - $\sim 10^{58}$ ν over ~ 10 s, equipartition among all flavours;
 - $\sim 99\%$ of gravitational energy.
- Coherent Elastic Neutrino-Nucleus Scattering:
 - **equally sensitive to all ν flavours;**
 - $\sigma_{\text{CEvNS}} \propto (N_{\text{neutrons}})^2 \rightarrow$ max. on Pb target.



2. RES-NOVA experiment

- RES-NOVA demonstrator at LNGS:
 - scintillating archPbWO_4 @ ~ 10 mK
 - $\rightarrow \alpha$ vs β/γ particle ID;
 - TES thermal sensors $\rightarrow \sim 1$ keV threshold;
 - compact detector $\rightarrow (30 \text{ cm})^3 - 170 \text{ kg}$.

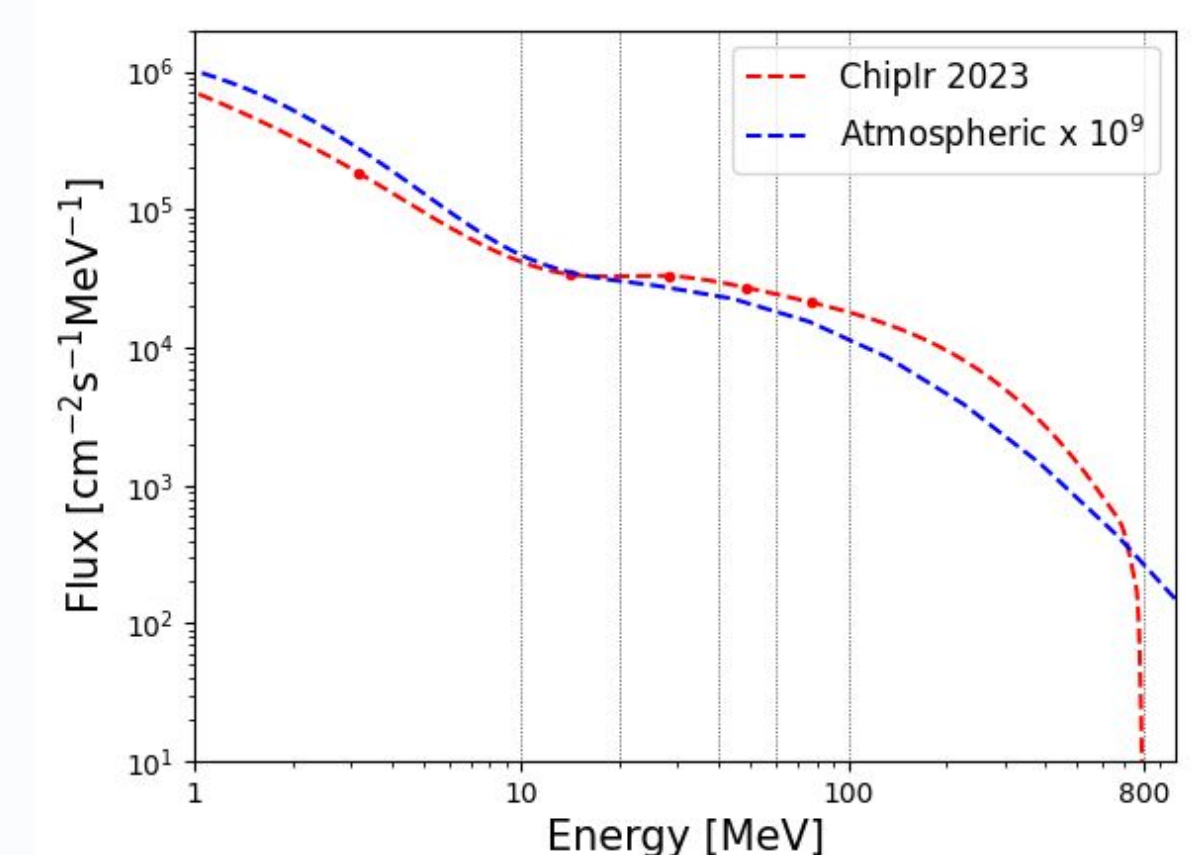


- Suppressed ^{210}Pb contamination in archPb :
 - $\rightarrow$ target bkg. index @ $[1,30] \text{ keV}$: $\sim 10^{-3}$ counts/(keV·ton·s)
 - $\rightarrow$ **$>5\sigma$ signal significance to galactic SN candidates.**

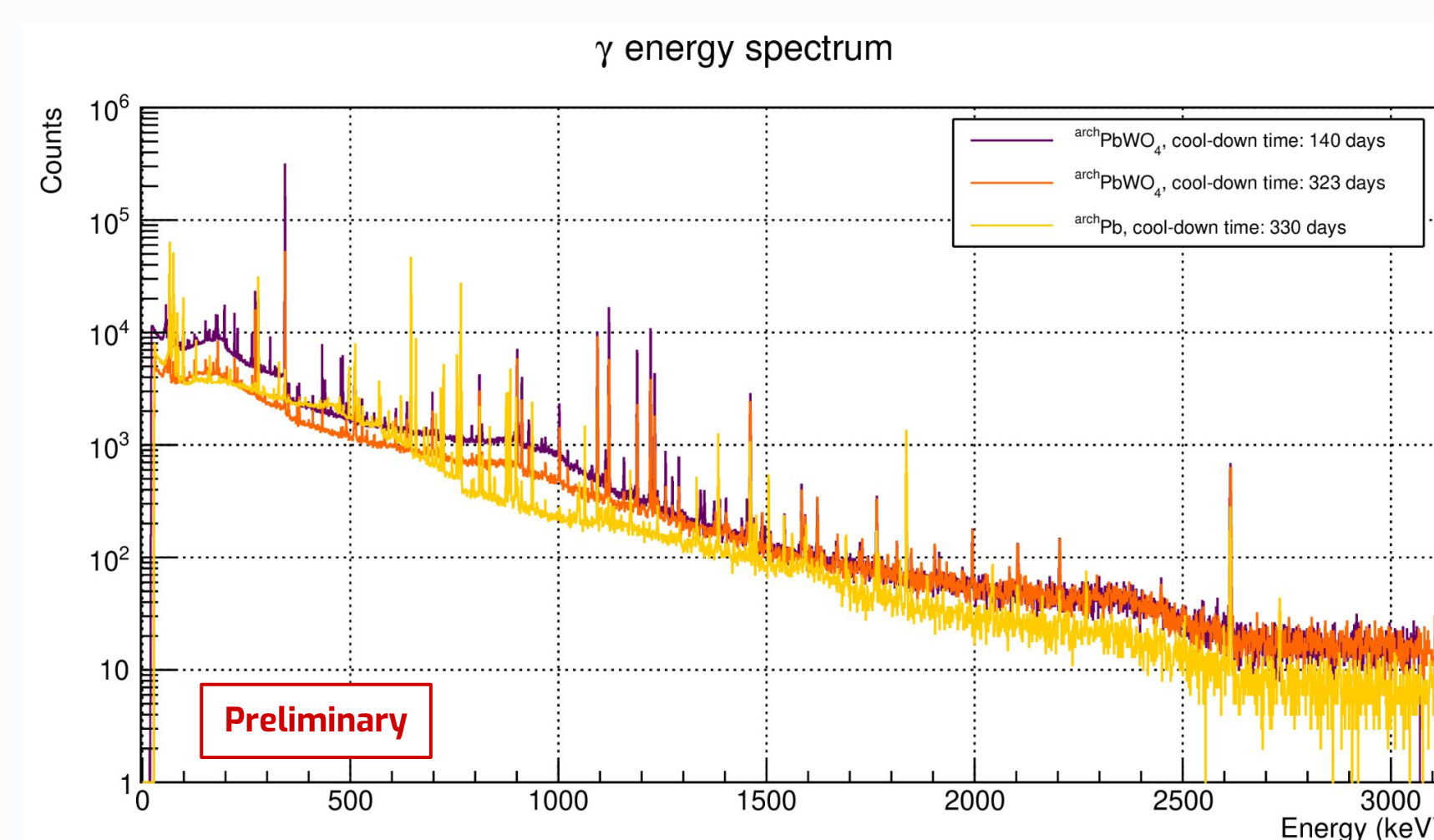
3. Cosmogenic activation of archPbWO_4

- PbWO_4 crystal growth in China $\rightarrow$ shipment to Italy $\rightarrow$ cosmogenic activation.
- Mimic cosmogenic activation through neutron irradiation of archPbWO_4 / archPb @ ChiPr (ISIS, UK) (Nov. 2024):
 - atm.-like neutron spectrum;
 - ChiPr neutron flux:

$$\Phi_n(E_n > 10 \text{ MeV}) \sim 10^9 \cdot \Phi_n^{\text{atm}}$$

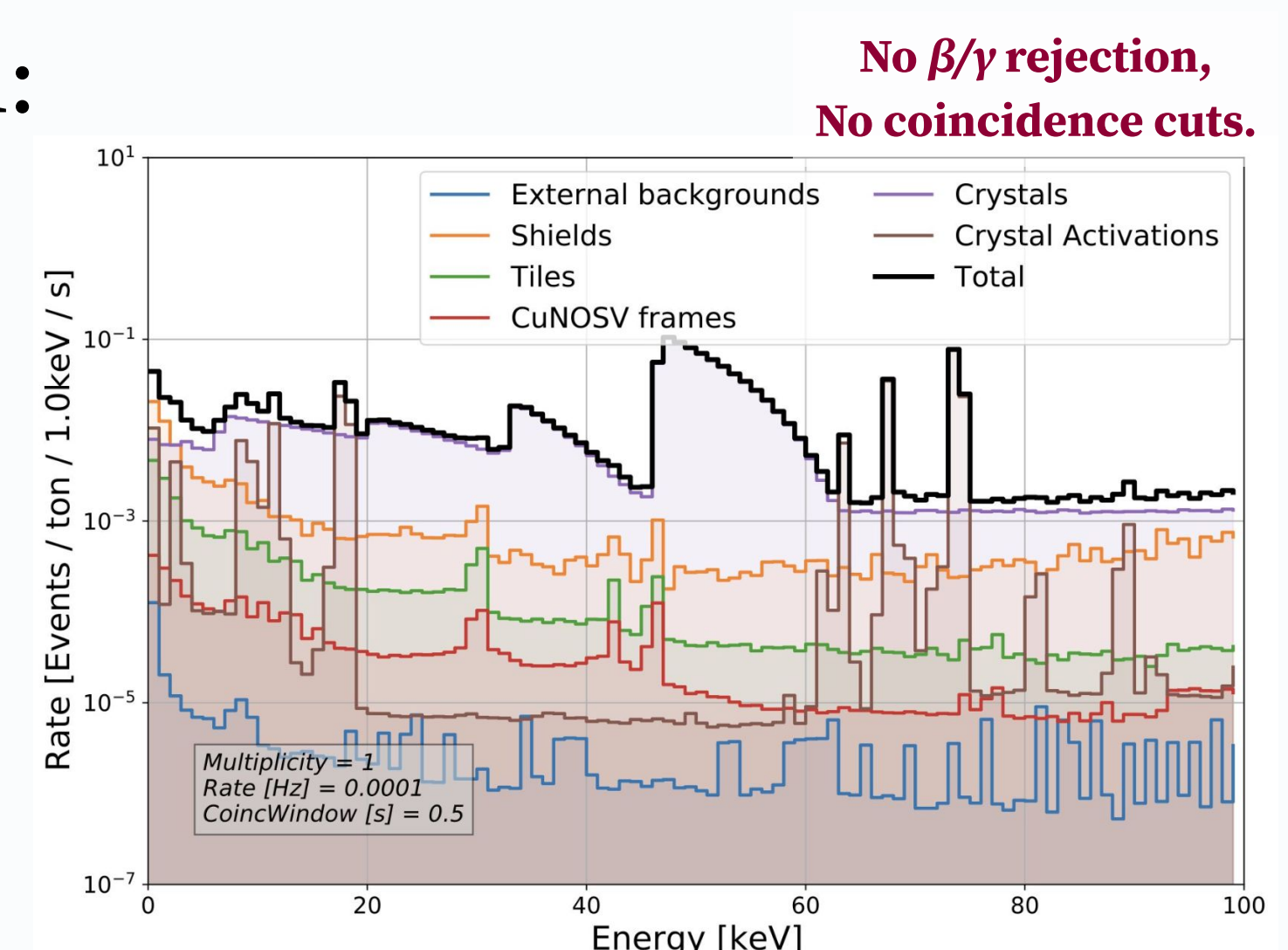


- Measure activation rate through HPGe detector @ UNIMIB (Italy) (2025-2026):



- RES-NOVA background model:

- environmental (n, μ , γ);
- cryostat shields;
- crystals contamination;
- crystals activation.



- Cosmogenic activation bkg. is under control: the bkg in the ROI is dominated by crystal contaminations.

4. Ongoing and future activities

- Complementary purification/screening activities: Pb atomization, ICP-MS, liquid scintillation screening.
- Crystal radiopurity assessment at cryogenic temperatures.



[Eur. Phys. J. A 55:127 \(2019\)](#)
[Phys. Rev. D 102:063001 \(2020\)](#)
[ICAP 10:064 \(2021\)](#)
[Eur. Phys. J. C 82:692 \(2022\)](#)
[Phys. Rev. D 111:103050 \(2025\)](#)
[EPIC 86:698 \(2026\)](#)