

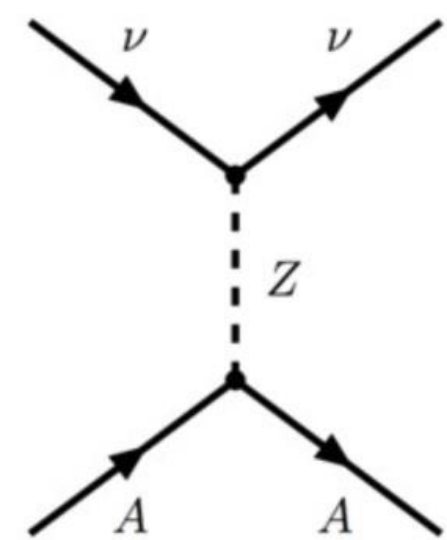
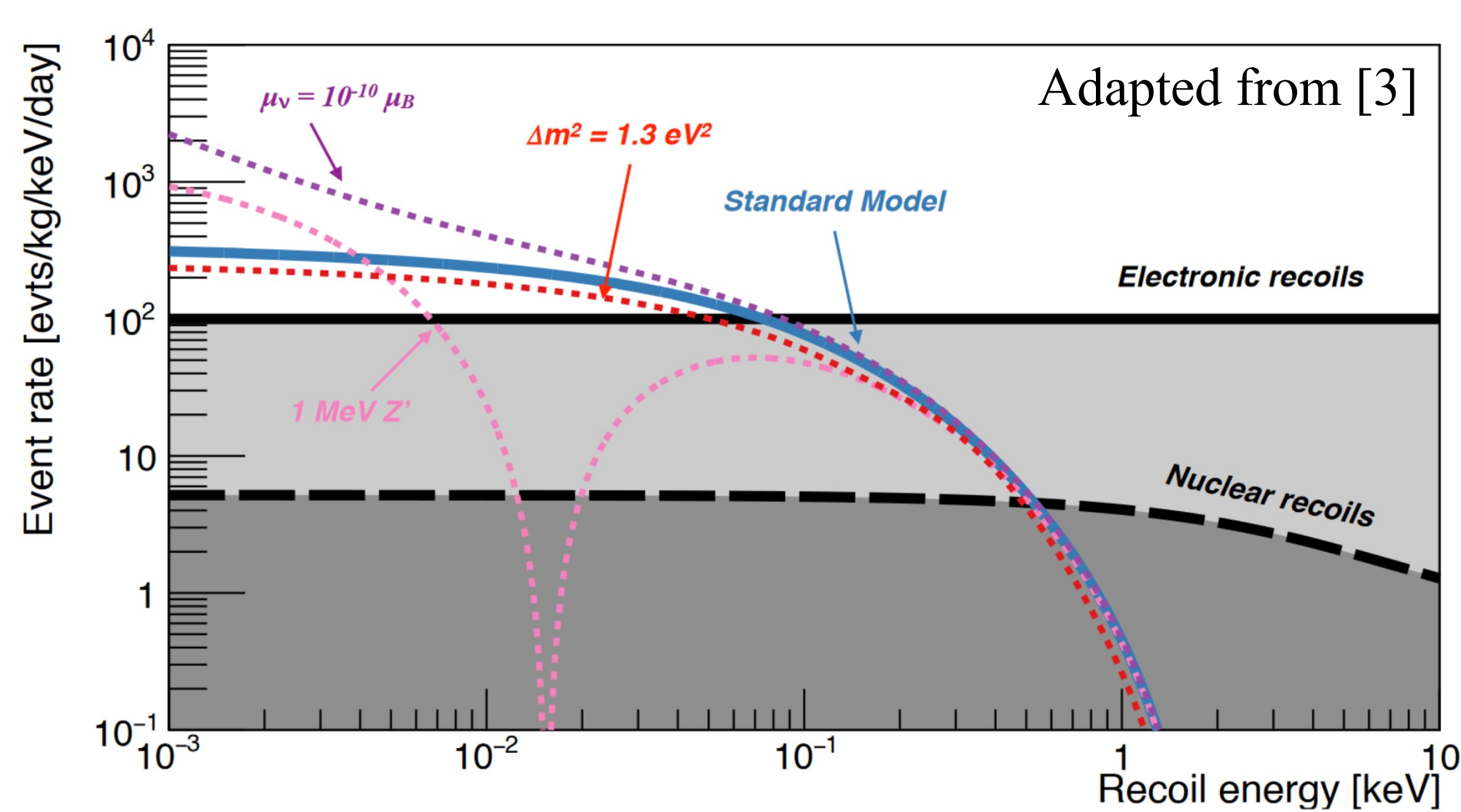
In-situ Measurement of the Nuclear Recoil Background Rate in RICOCHET

Valentina Novati, on behalf of the RICOCHET collaboration
valentina.novati@lpse.in2p3.fr



Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)

The CEvNS process was predicted in 1974 by Freedman [1] and first observed in 2017 with O(10 MeV) neutrinos at the Spallation Neutron Source [2].



CEvNS is a probe for new physics beyond the Standard Model [3]:

- Sterile neutrinos
- Neutrino magnetic moment
- Neutrino couplings to new mediators
- Non-standard interactions of neutrinos and quarks

The RICOCHET experiment

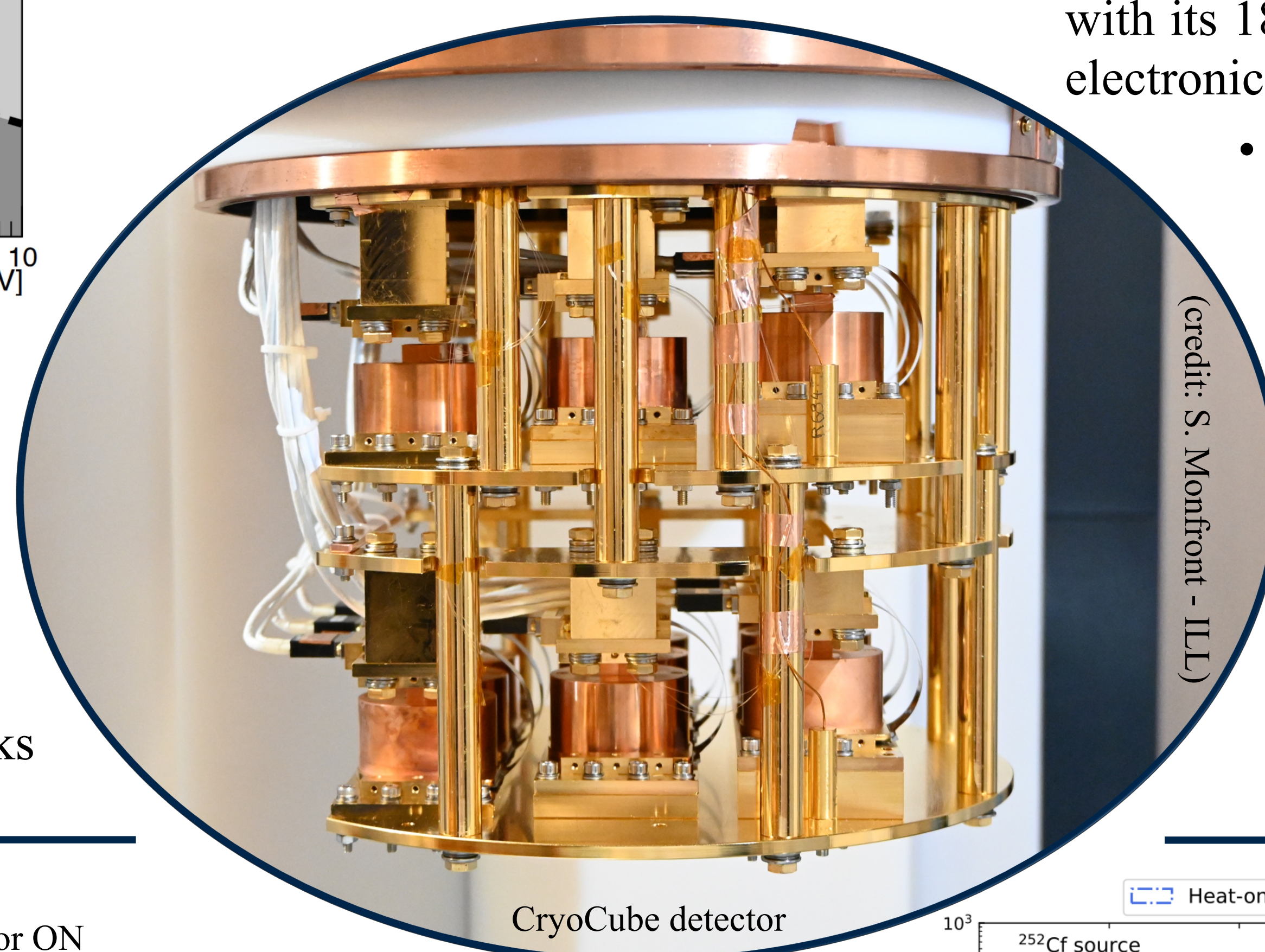
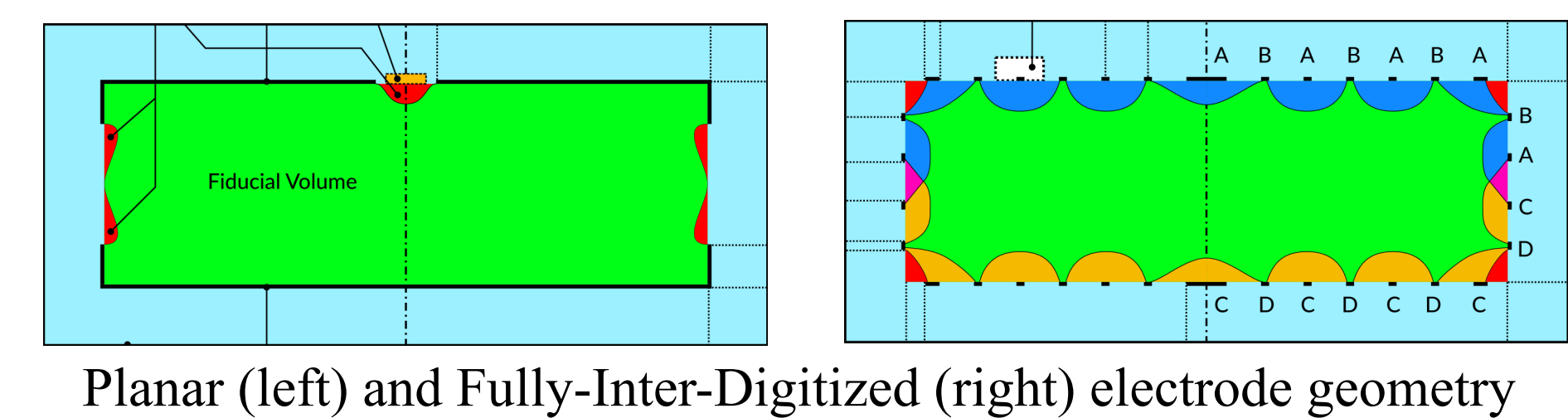
The RICOCHET experiment [4] searches for the CEvNS at a research reactor hosted at the Institut Laue Langevin (ILL) in Grenoble, FR.

- The RICOCHET detector is installed at the ILL-H7 site, at a distance of 8.8 m from the reactor core with a power of 58 MW, leading to an expected flux of $1.2 \cdot 10^{12}$ neutrinos / (s·cm²) at the RICOCHET payload.

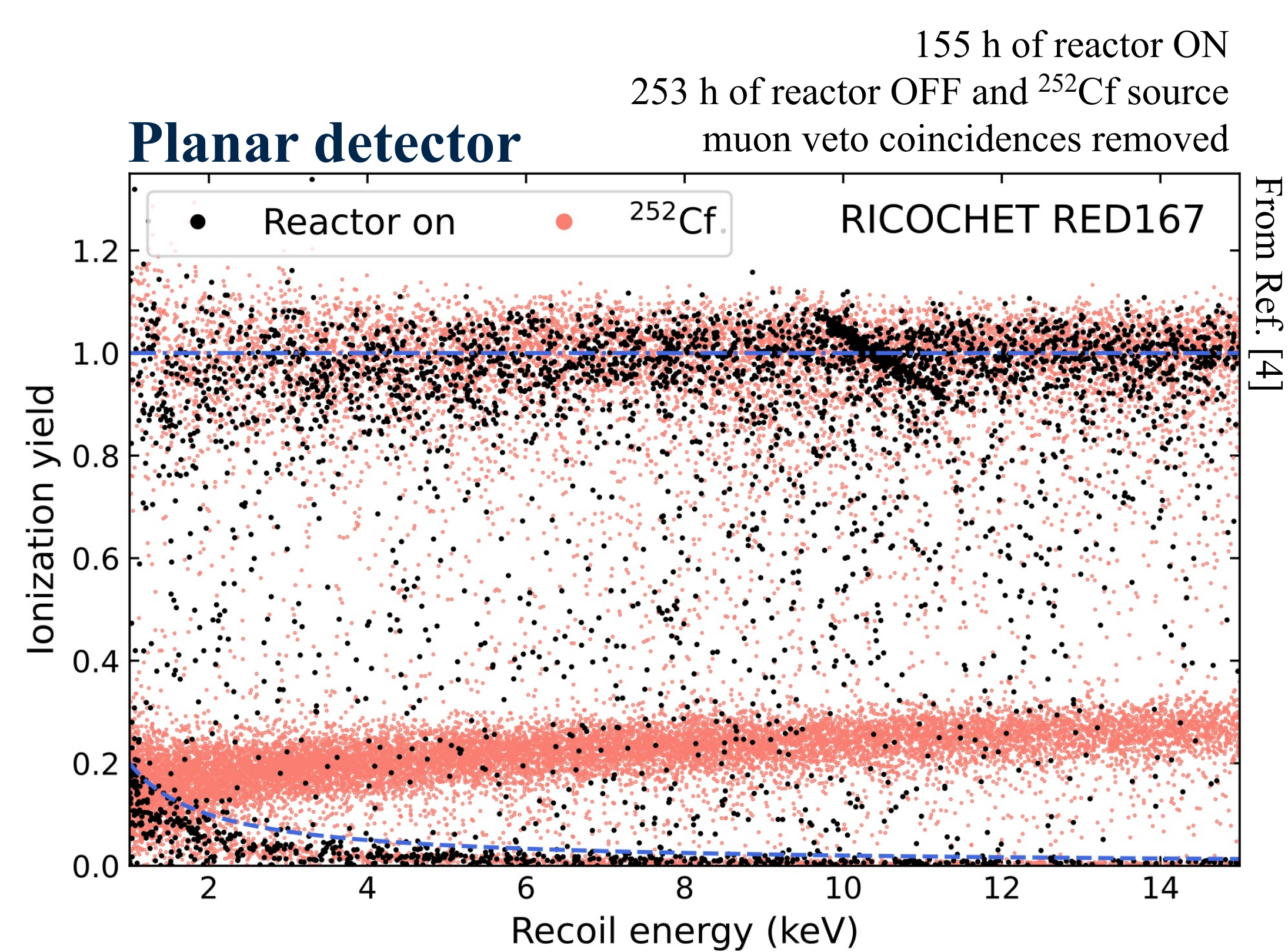
- RICOCHET has entered its first science phase in July 2025 with the full deployment of the CryoCube [5] detector payload with its 18 germanium cryogenic detectors, dedicated readout electronics and DAQ, and all of its subsystems.

- RICOCHET plans to search for the CEvNS process at ILL with a total of seven reactor cycles in its first science phase

- Two detector geometries are installed: seven planar detectors and eleven Fully-Inter-Digitized (FID) detectors

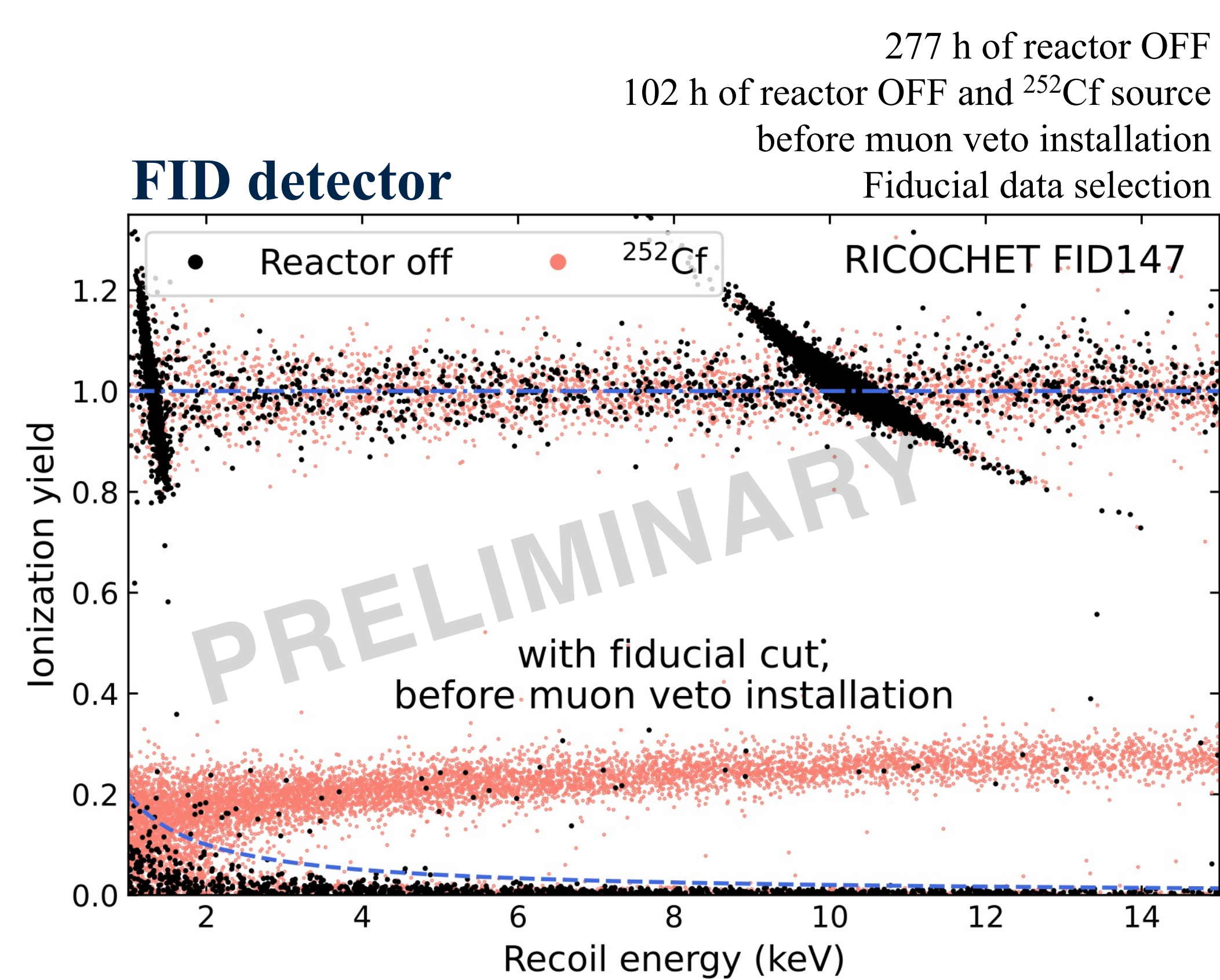


CryoCube detector



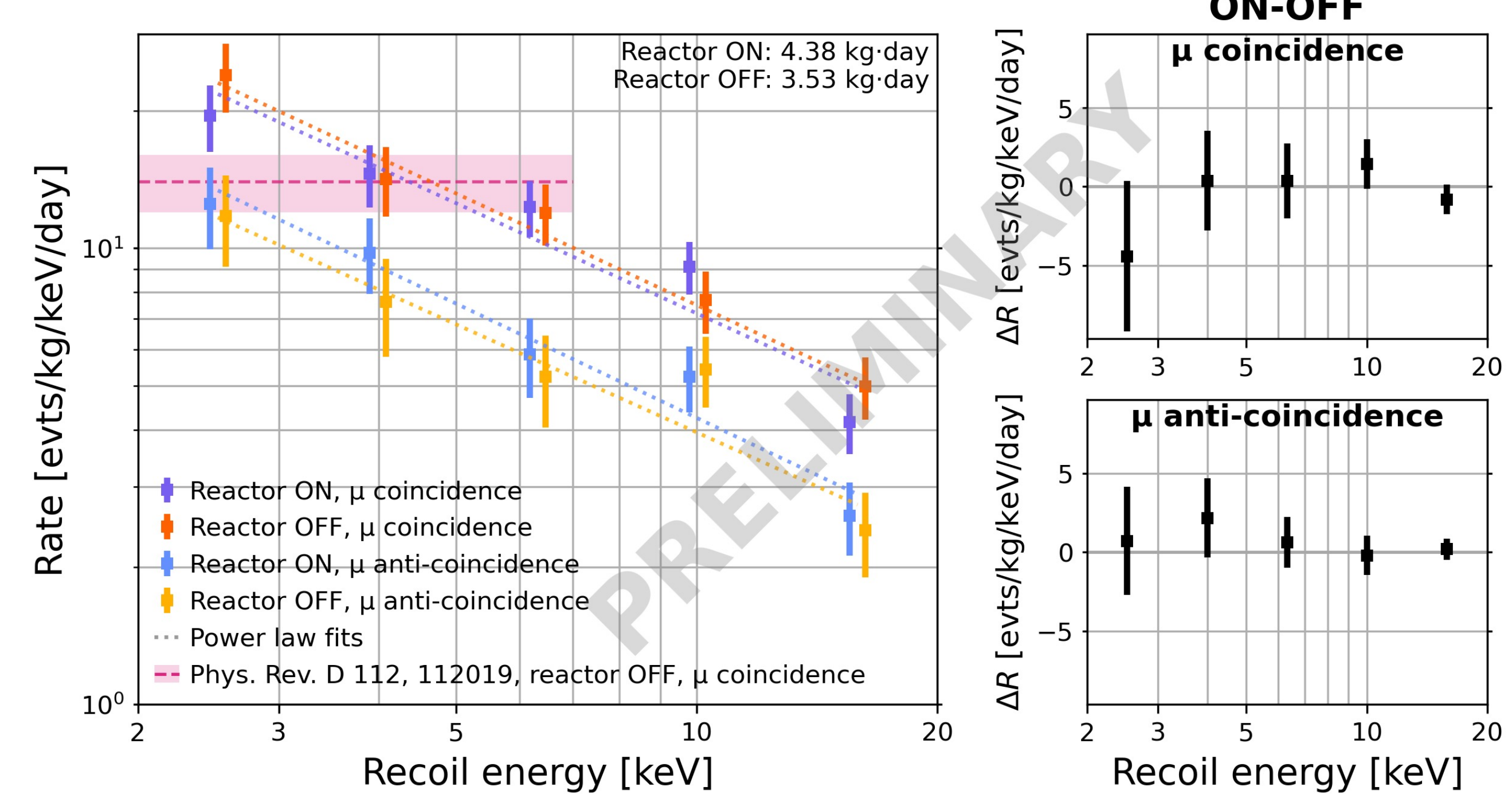
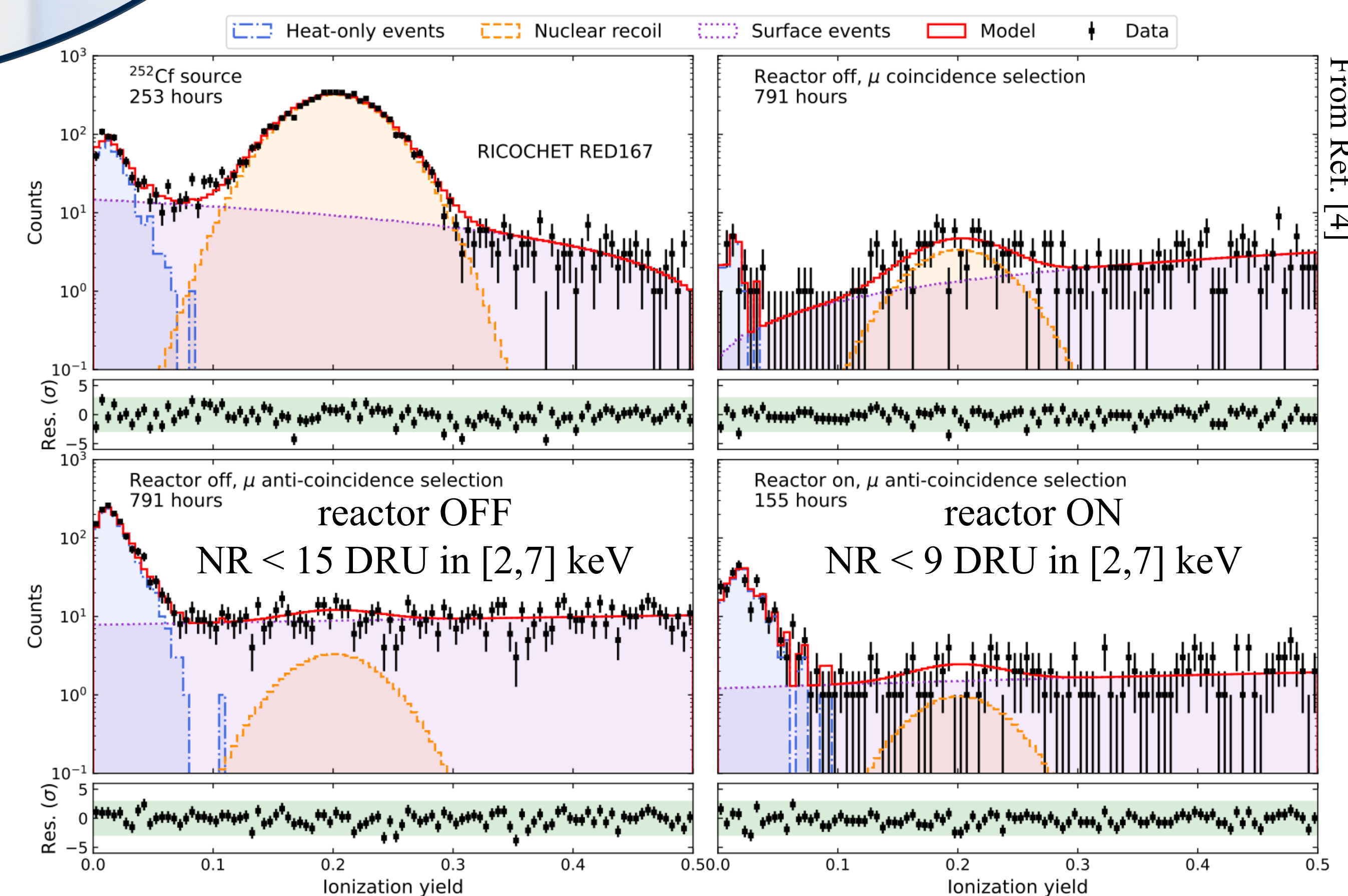
Thanks to the discrimination between electron recoils (ER) and nuclear recoils (NR) from the double readout of phonon and charge, only NR events are a background in the CEvNS region of interest.

During the commissioning run with **planar** detectors [4], surface ER events leaked in the NR band.



In the following run, the introduction of **FID detectors** allowed us to reject surface events and measure the NR background:

- NR rates are compatible between detectors
- No excess of NR events in reactor-ON vs. reactor-OFF data
- NR rates with reactor ON and OFF data are compatible with results from Ref. [4] (using only planar detectors)



Outlook

- RICOCHET has a median detection threshold of about 250–300 eV_{nr} leading to an expected CEvNS event rate of 1.8–1.4 event/day in the CryoCube array
- The first science phase of RICOCHET is expected to lead to a possible first CEvNS hint with a statistical significance in the 2 sigma range based on current detector performance and background measurements
- A second science phase including silicon target detectors, improved ionization energy resolution down to 20 eV_{ee}, and a germanium-based cryogenic vetoing detector array was approved for operations until 2030–2031 and to lead to a combined germanium and silicon CEvNS detection significance between 4 and 7 sigma

References

- [1] D. Z. Freedman, PRD 9, 1389, (1974) [3] J. Billard et al, JCAP 11,016, (2018) [5] C. Augier et al., EPJC 84, 186, (2024)
[2] D. Akimov, Science 357, 1123 (2017) [4] A. Armatol et al., PRD 112, 112019, (2025)