

COSINUS low-background experimental facility at LNGS

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COSINUS EXPERIMENT

- Cryogenic Observatory for Signals seen in Next Underground Searches (**COSINUS**) is a direct dark matter search
- Operates sodium iodide (NaI) crystals as cryogenic calorimeters and reads out the phonon and light signal with Transition Edge Sensors (TES)
- The dual channel readout technique enables particle identification on an event-by-event basis
- Primary objective of the experiment is to provide a model-independent cross-check of the DAMA/LIBRA dark matter claim

EXPERIMENTAL FACILITY

- Located at the underground Laboratori Nazionali del Gran Sasso (LNGS), the facility includes:
 - The utility area, control room and service level host the infrastructure for operating the experiment
 - The clean room provides access to the dry dilution refrigerator and a clean environment for detector mounting
 - The water tank surrounds the dry dilution refrigerator and is filled with 269 m³ of water → passive shielding against ambient neutrons

WATER CHERENKOV MUON VETO

- The water tank is instrumented with photomultiplier tubes (PMTs) → water Cherenkov muon veto
 - High veto efficiency of $99.63 \pm 0.16 \%$ for the muon events
 - Shower veto efficiency drops while increasing the photoelectron threshold
 - Cosmogenic neutron background:
 - **Without muon veto:**
 $3.5 \pm 0.7 \text{ cts kg}^{-1} \text{ year}^{-1}$
 - **With muon veto:**
 $0.11 \pm 0.08 \text{ cts kg}^{-1} \text{ year}^{-1}$
 - Less than one background event for an exposure of 1000 kg days

SUPERNOVA NEUTRINO DETECTOR

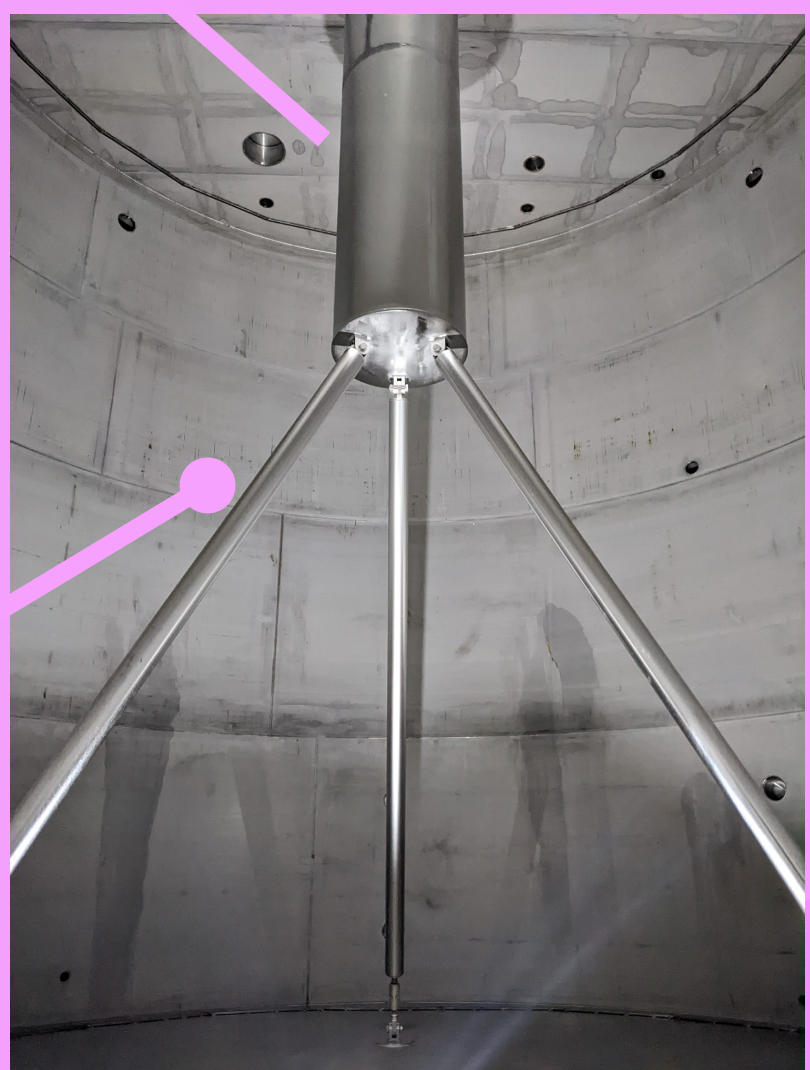
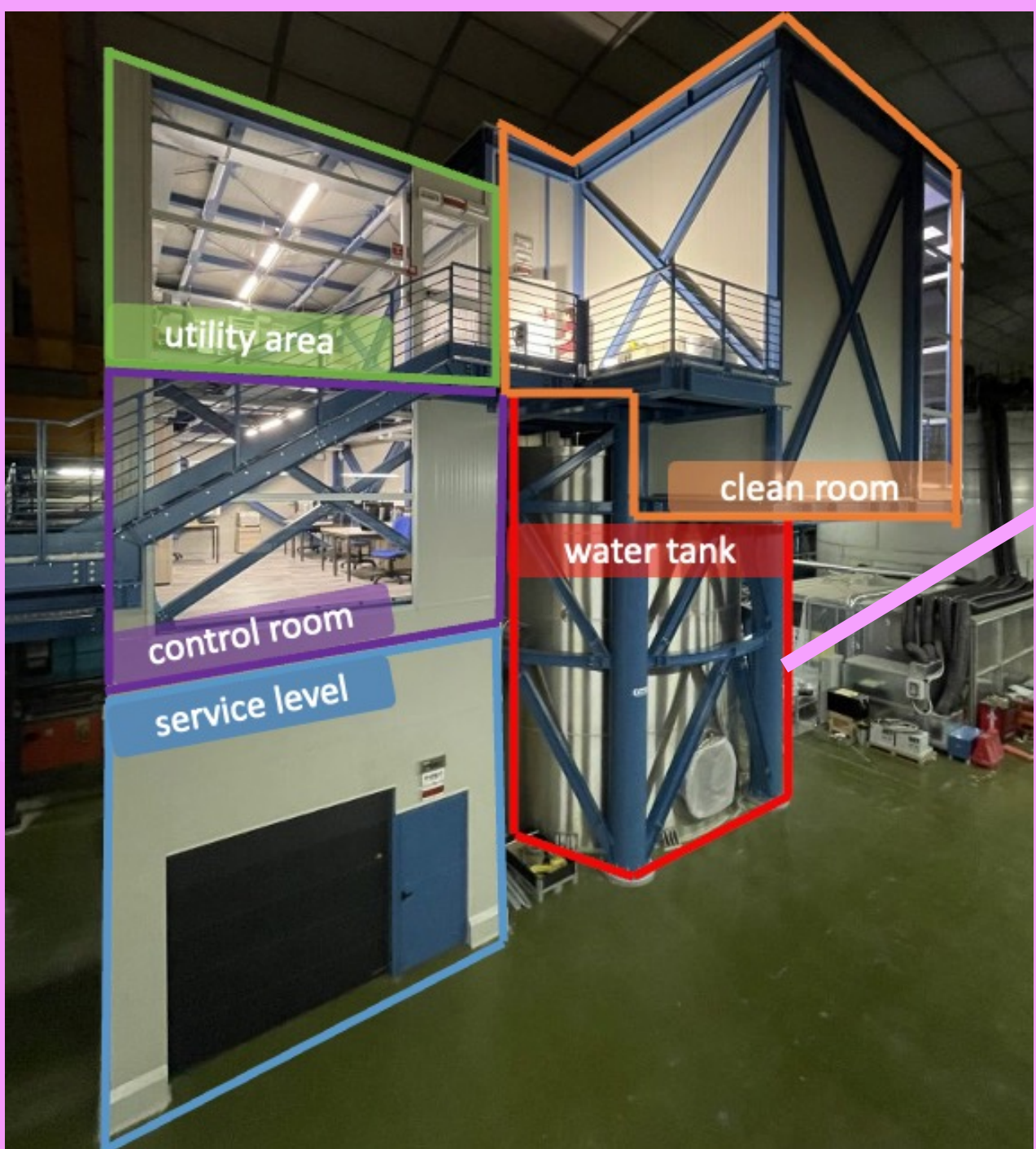
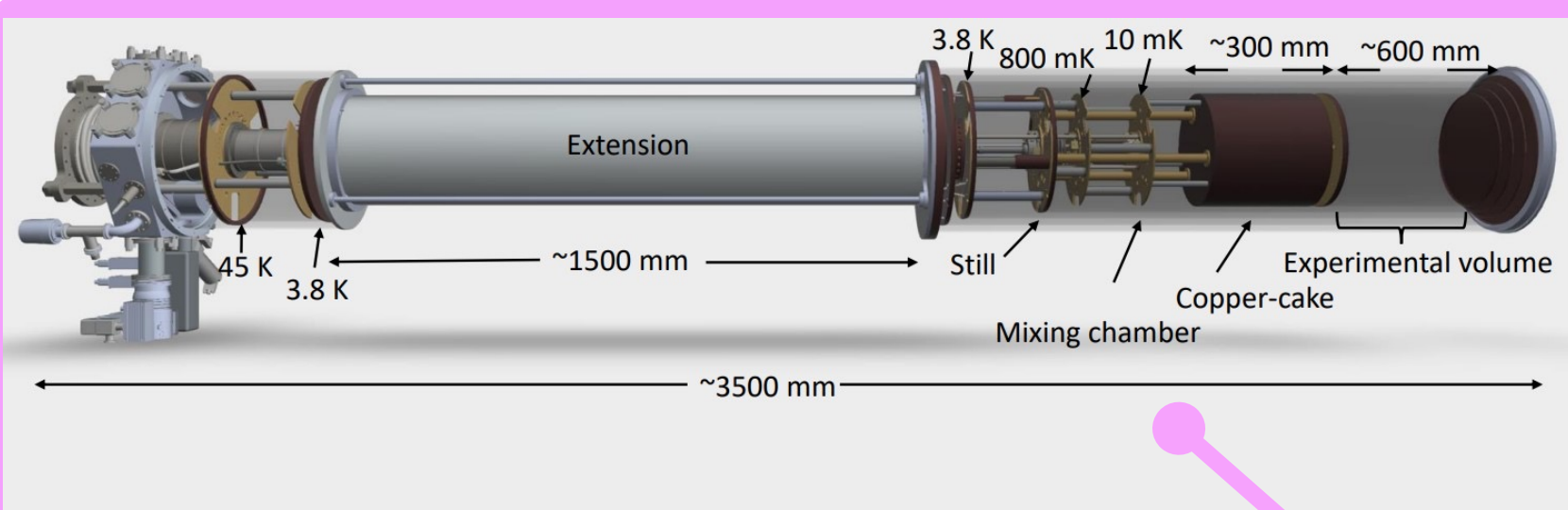
- The combination of the large water tank and the cryogenic NaI calorimeters allows COSINUS to be sensitive to numerous neutrino interaction channels
- The two main detection channels are:
 1. Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) is the primary detection channel in the NaI crystals
 2. Inverse Beta Decay (IBD) is the primary detection channel in the water tank
- Sensitive to all neutrino flavors in NaI up to 1 kpc
- Sensitivity in water tank up to 22 kpc

REFLECTOR FOIL

- To increase the light collection efficiency a reflector foil will be placed in the water tank
- The reflector foil for COSINUS comprises three layers:
 1. 1082D Tyvek
 2. Polyethylene
 3. 1082D Tyvek
- To reduce the ambient gamma trigger rate the foil will be placed at a distance of 30 cm from the wall and bottom of the tank and will be hung on springs
- Holes will be cut for the PMTs to look towards the interior of the tank
- Installation tests of the muon veto were performed at Max-Planck Institute for Physics
- The installation of the muon veto at LNGS is currently ongoing

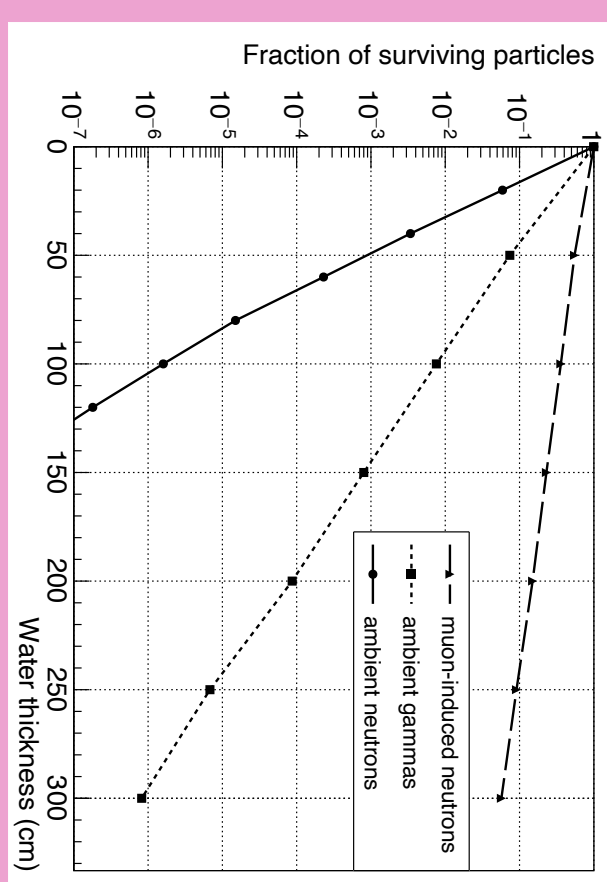
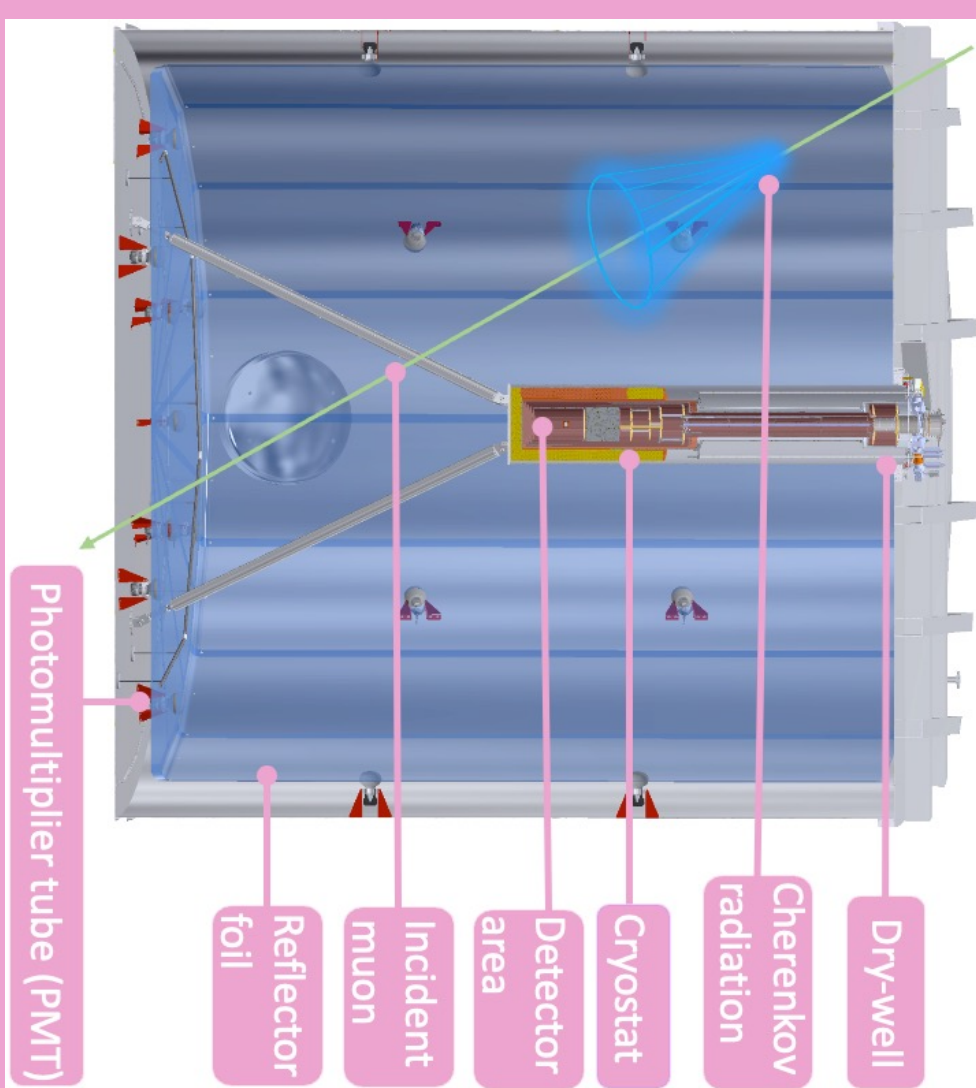
Have a look yourself during Friday's tour!

15th International Workshop on the Identification of Dark Matter 2024

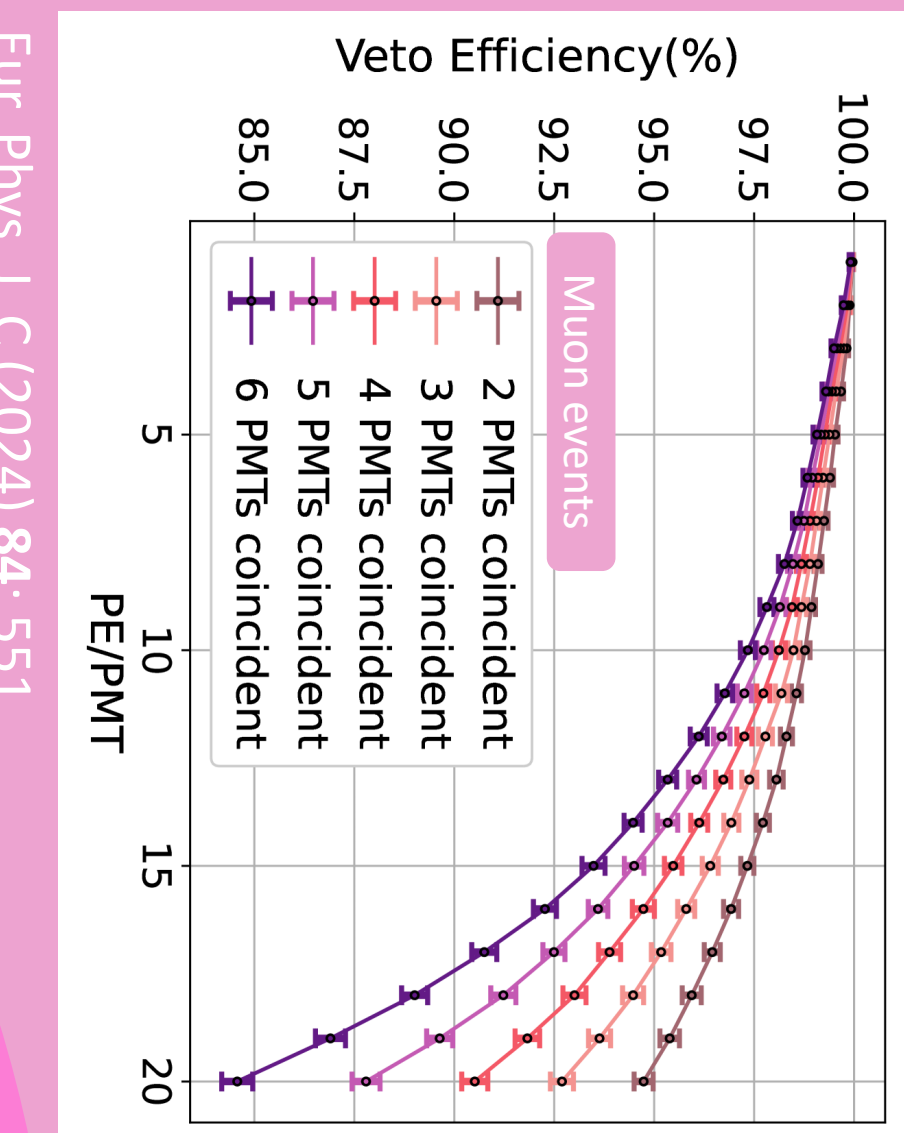


Dry-well

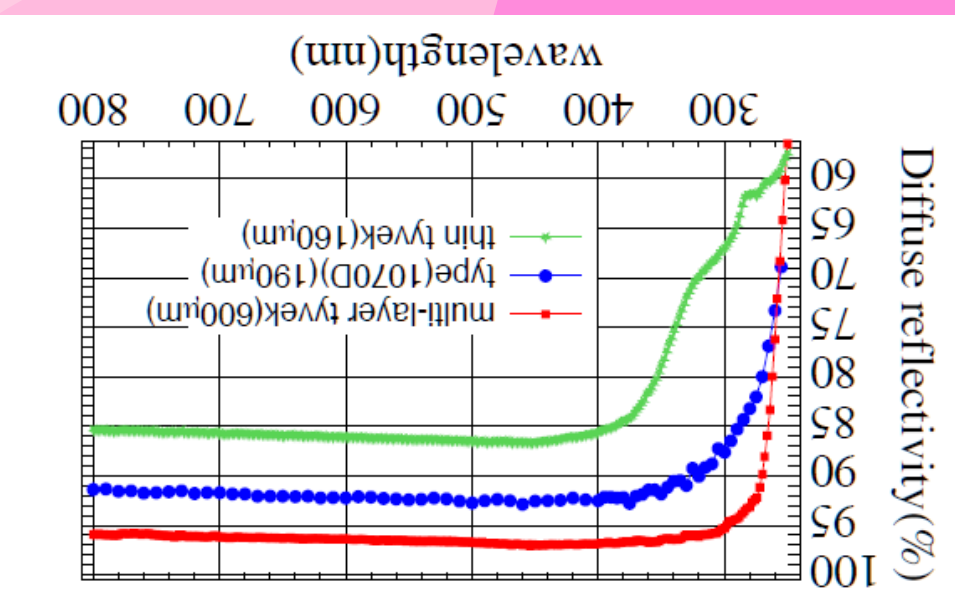
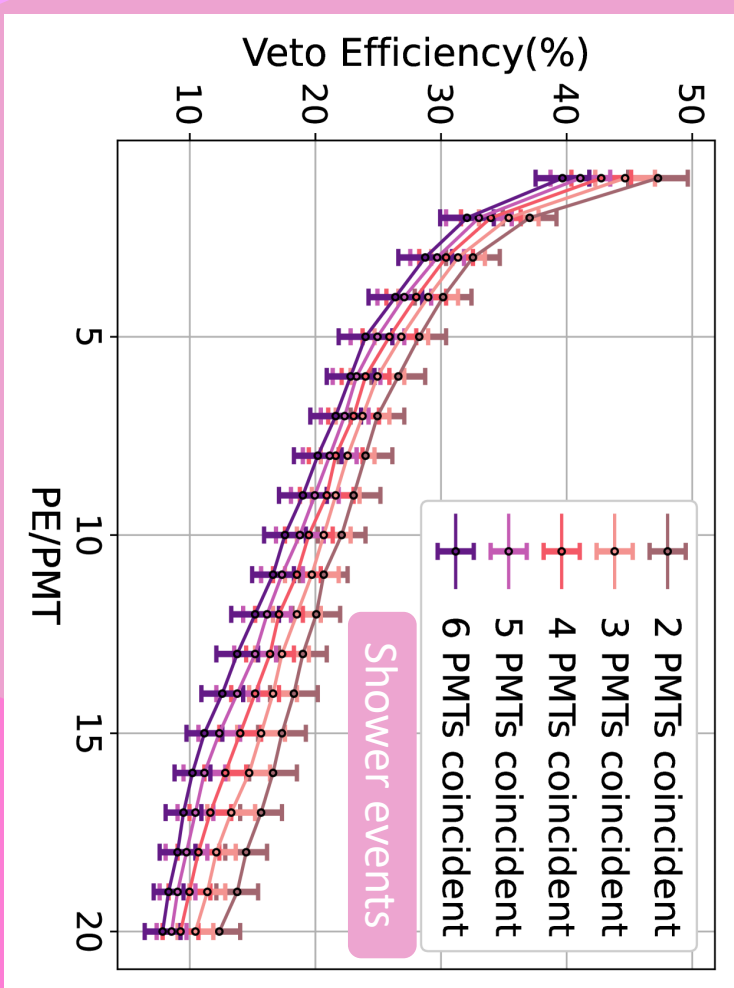
Hall B



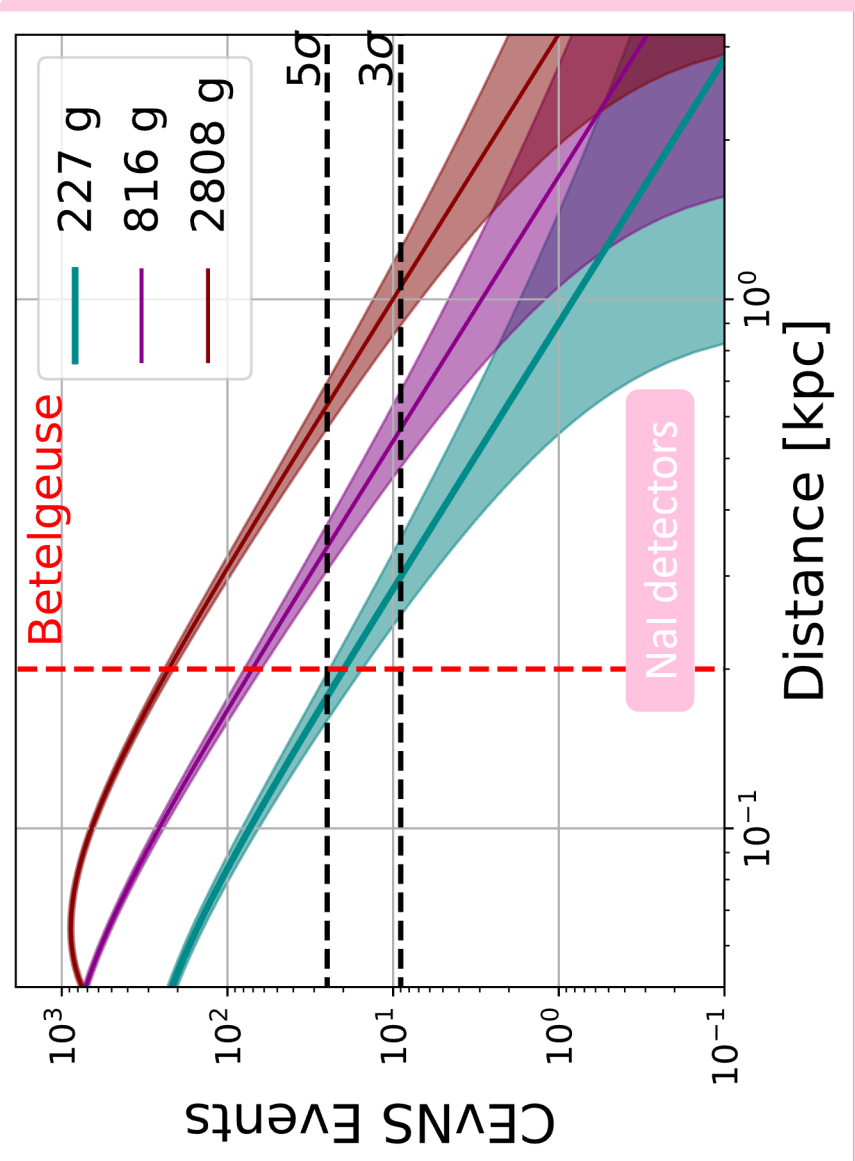
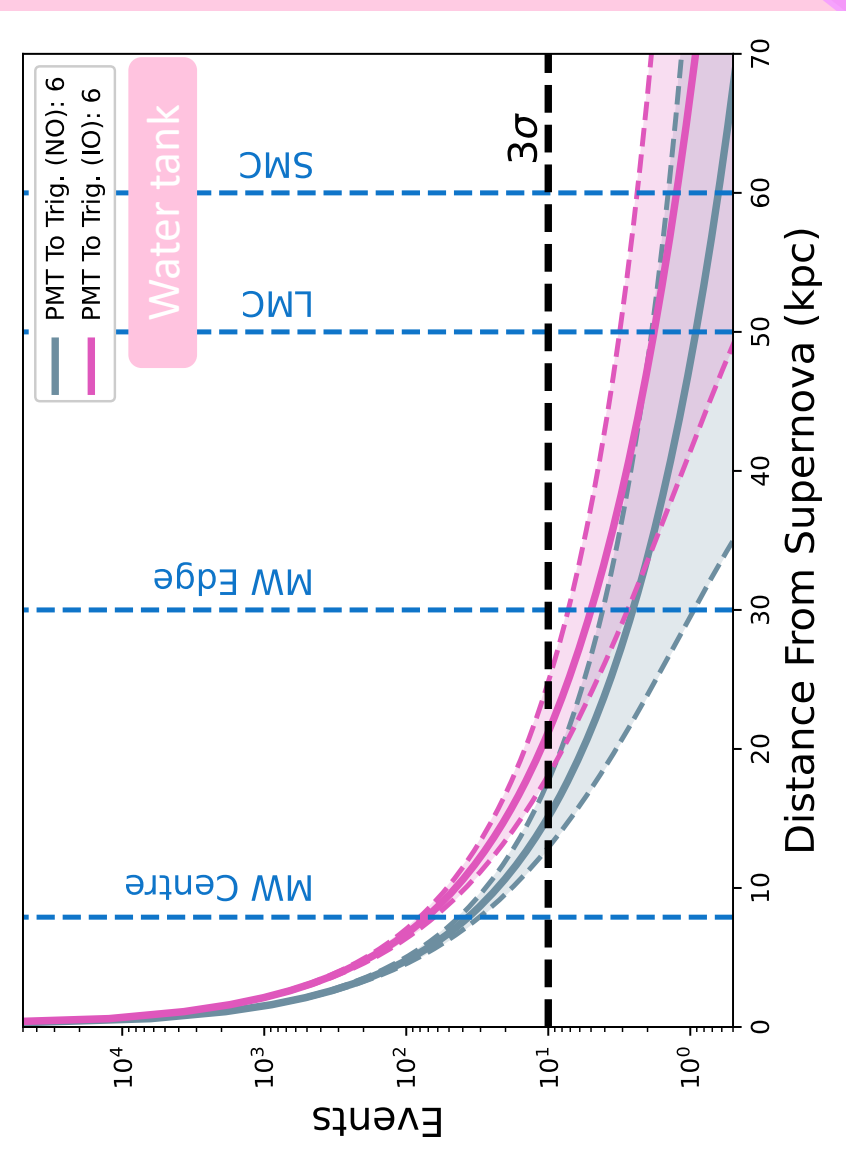
Eur. Phys. J. C (2022) 82: 248



Eur. Phys. J. C (2024) 84: 551



arXiv:1508.07166



Paper to be published!

