

Light Dark Matter search with Superconducting Sensor in Kamioka

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Quantum sensing

Cryogenic system

- ~0.1 K with refrigerator

Superconducting device

- MKID, TES, ...
- Fabrications
- Chain tests

RF/readout electronics

- 5G/6G technologies
- Quantum limited amplifier

meets
X

Low background

Underground facility at the Kamioka mine

- Protecting system from cosmic-ray

Low environmental radiation

- Understanding impacts of radio activities
- Low radio activities in materials
- Shielding system from radio activities

Low systematic fluctuations

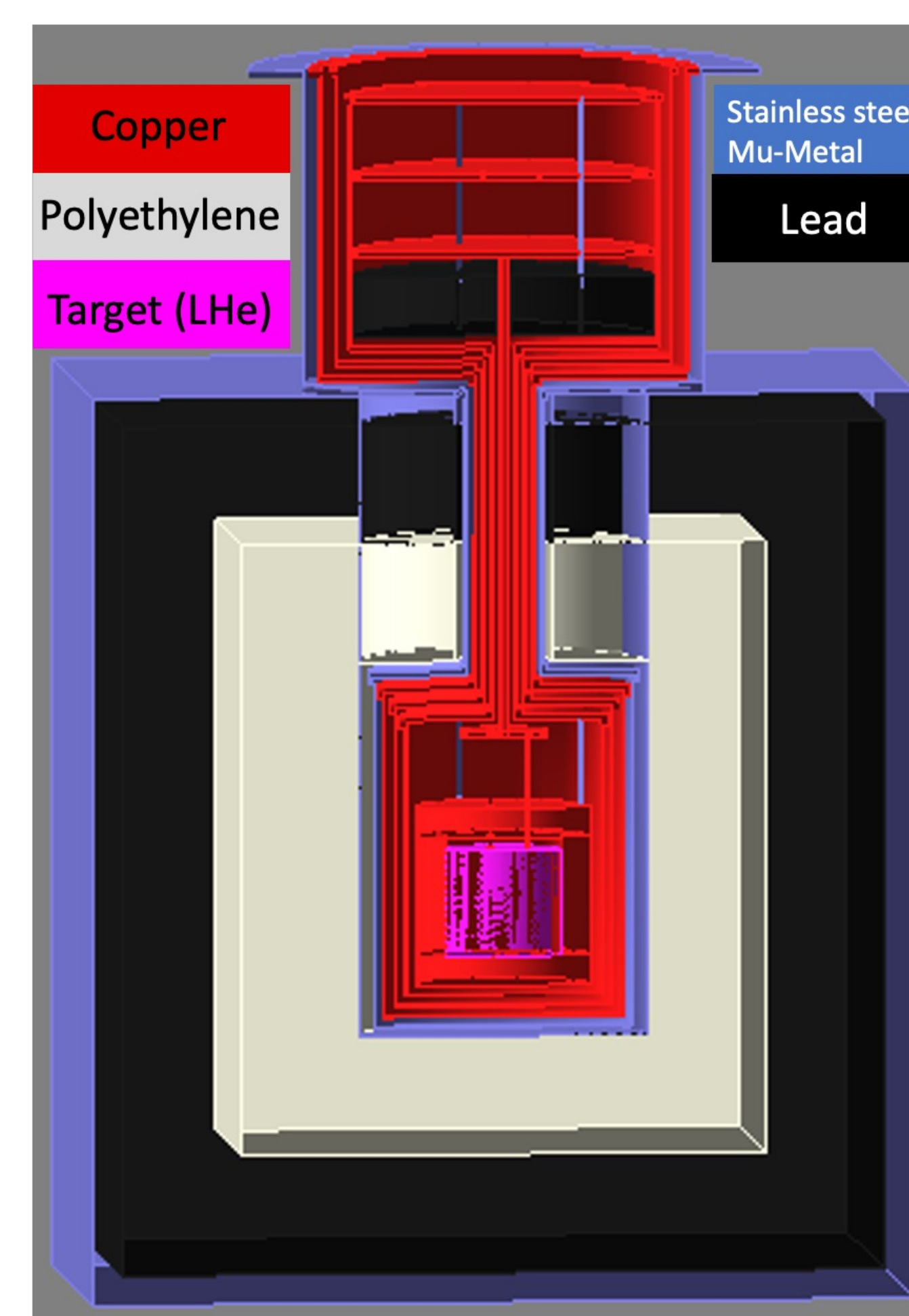
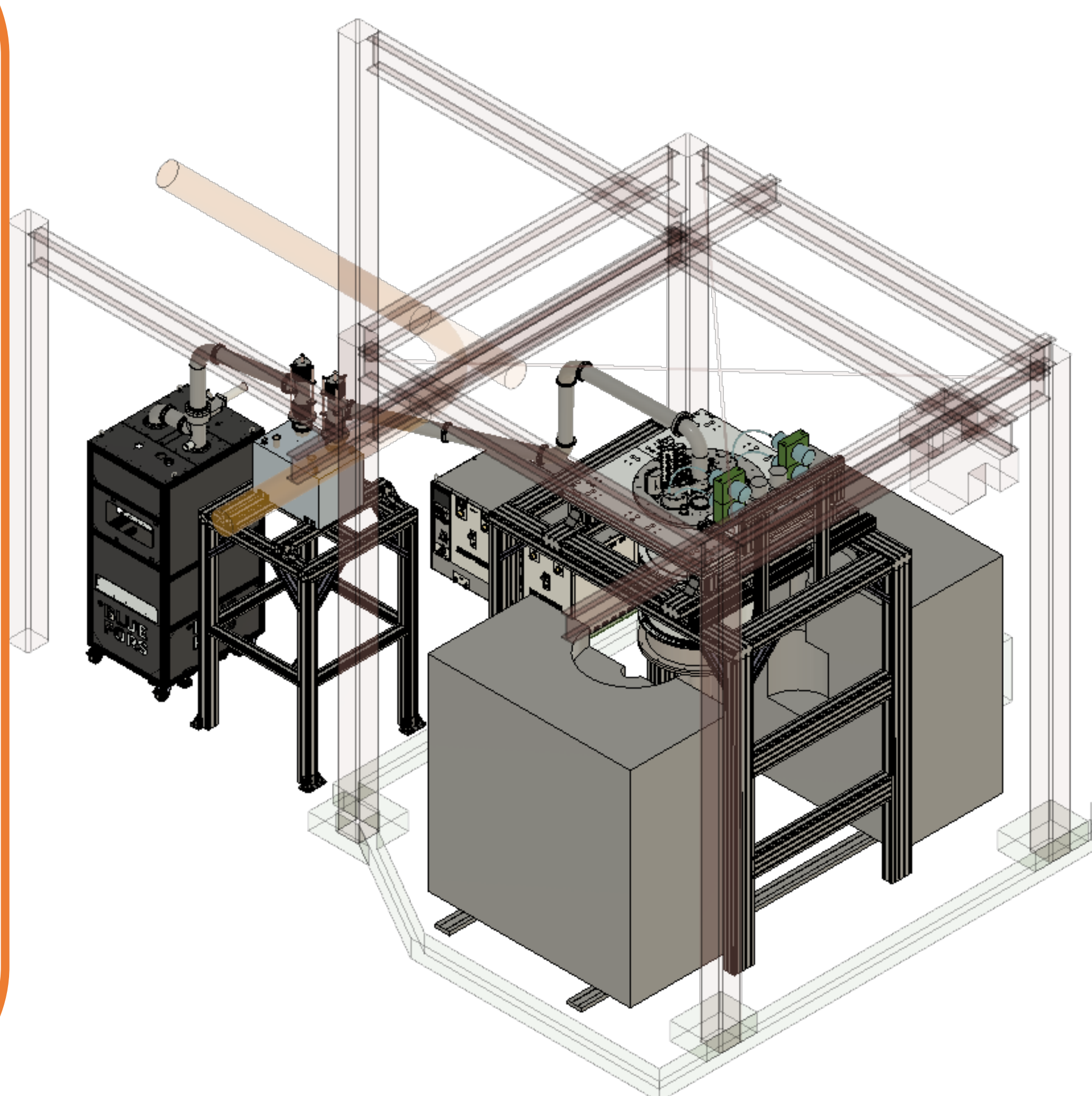
- Low thermal noise
- Low vibration

LIGHT DARK MATTER SEARCH

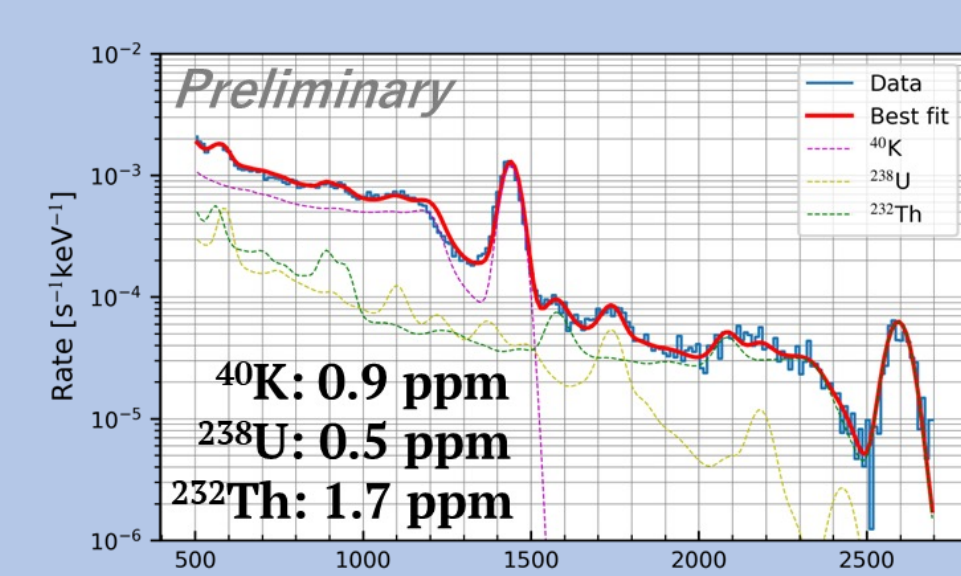
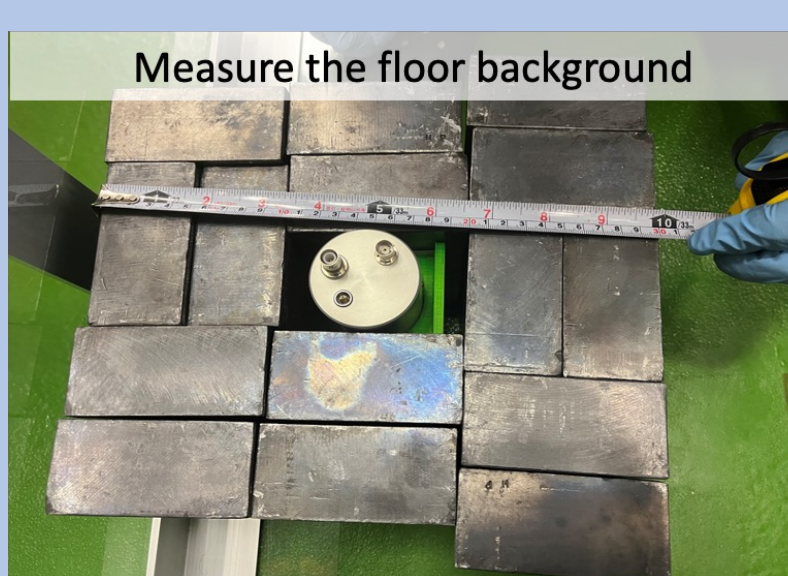
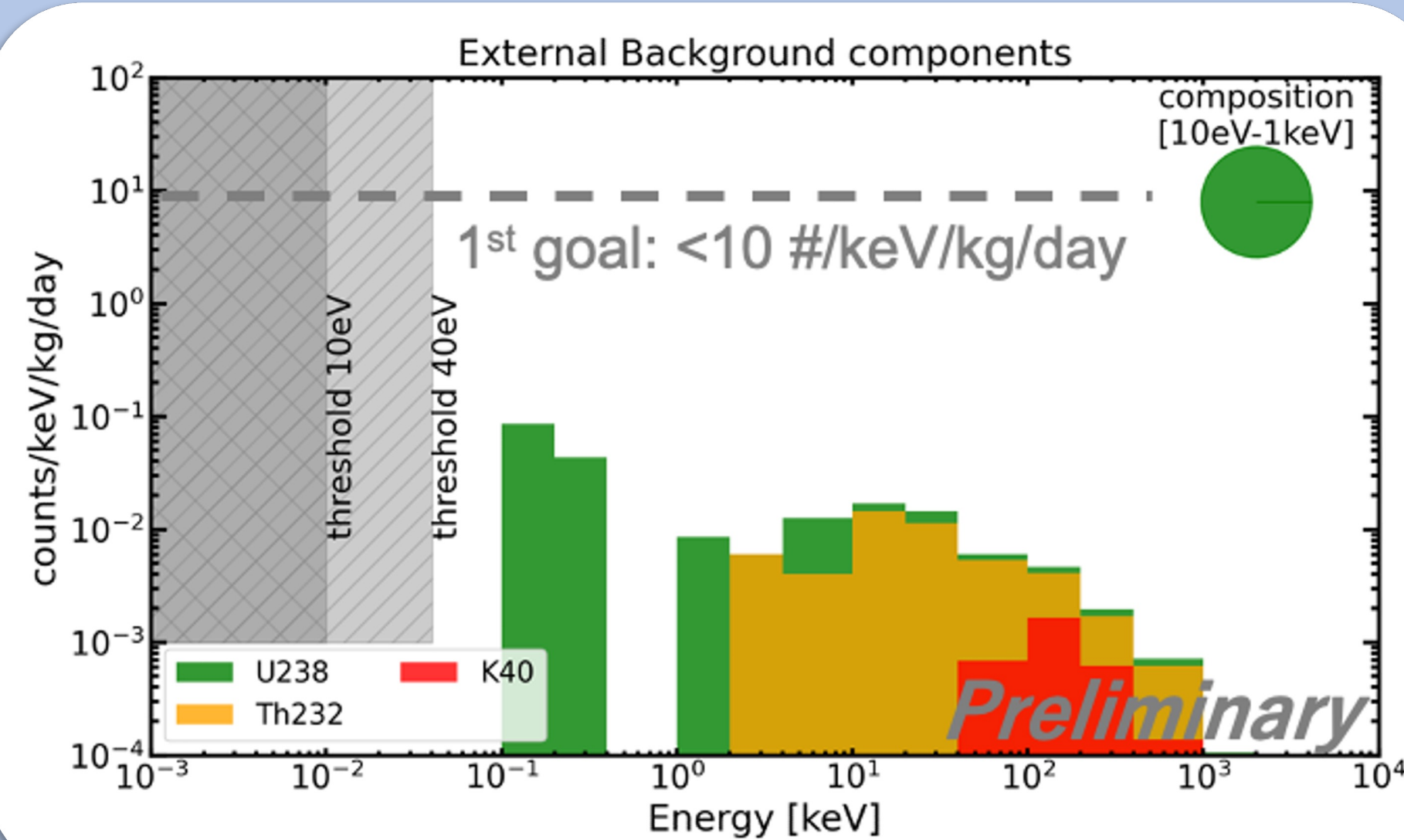
- Direct detection is a cornerstone of dark matter (DM) searches
- Conventional searches have focused on DM at the GeV mass-scale.
- A new experiment using Transition Edge Sensor technology operated at millikelvin is being planned to search for sub-GeV DM.
- Set up at Kamioka to reduce cosmic rays.

EXPERIMENTAL SETUP

- A Bluefors XLD dilution fridge was purchased and is being tested at QUP facility at KEK.
- The fridge will be moved to Kamioka in this FY.
- ⇒ Cooperate with Bluefors and Kamioka to finalize the floor plan and schedule
- Contact companies to fabricate low-radioactive detector (e.g. Cu, SS, Mu-Metal).
- Need to estimate background from: cosmic-ray, external gamma, external neutron, background from detector components.

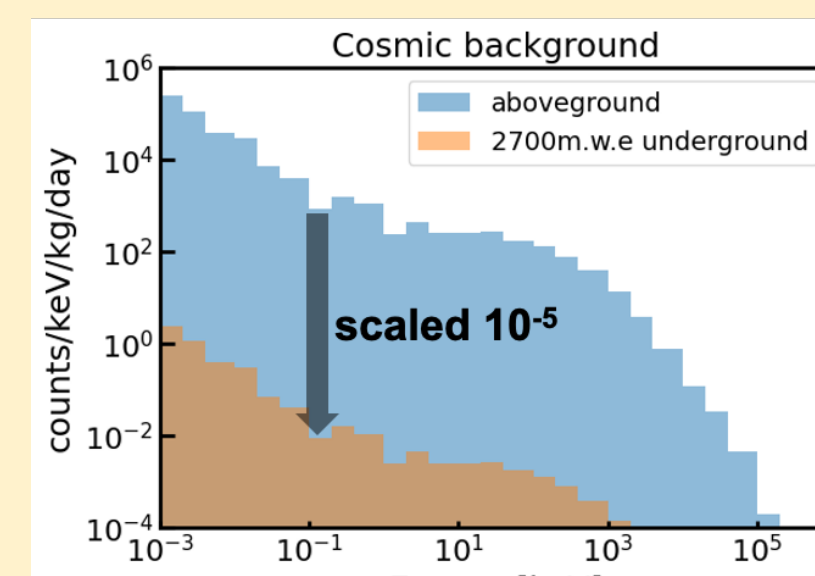
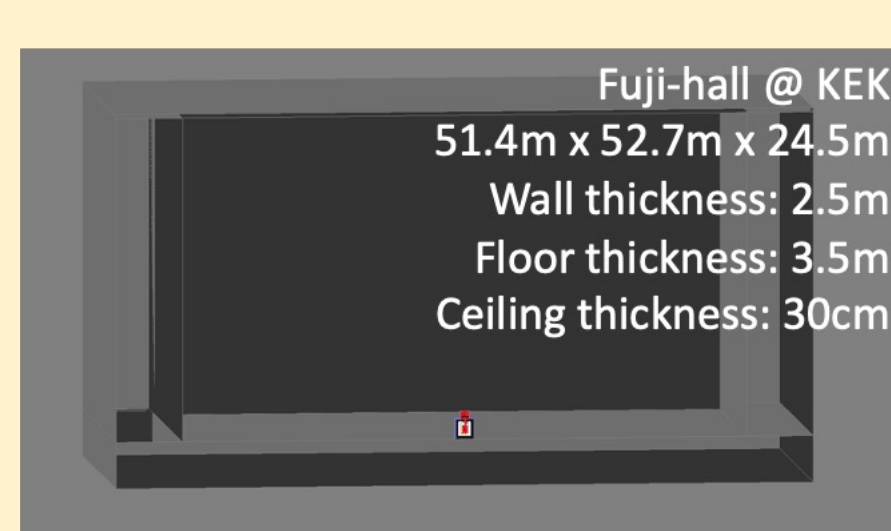
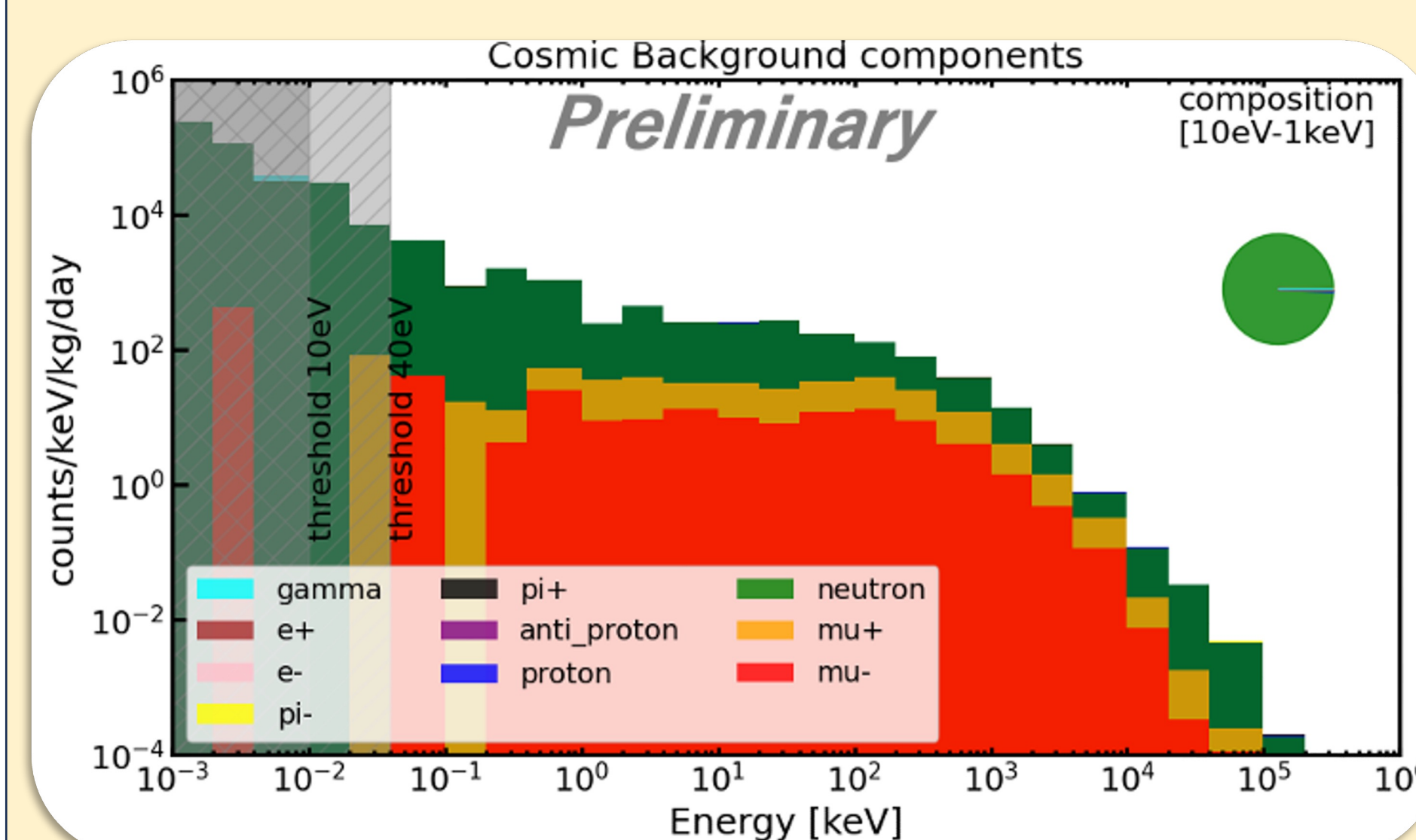


Rock gamma background



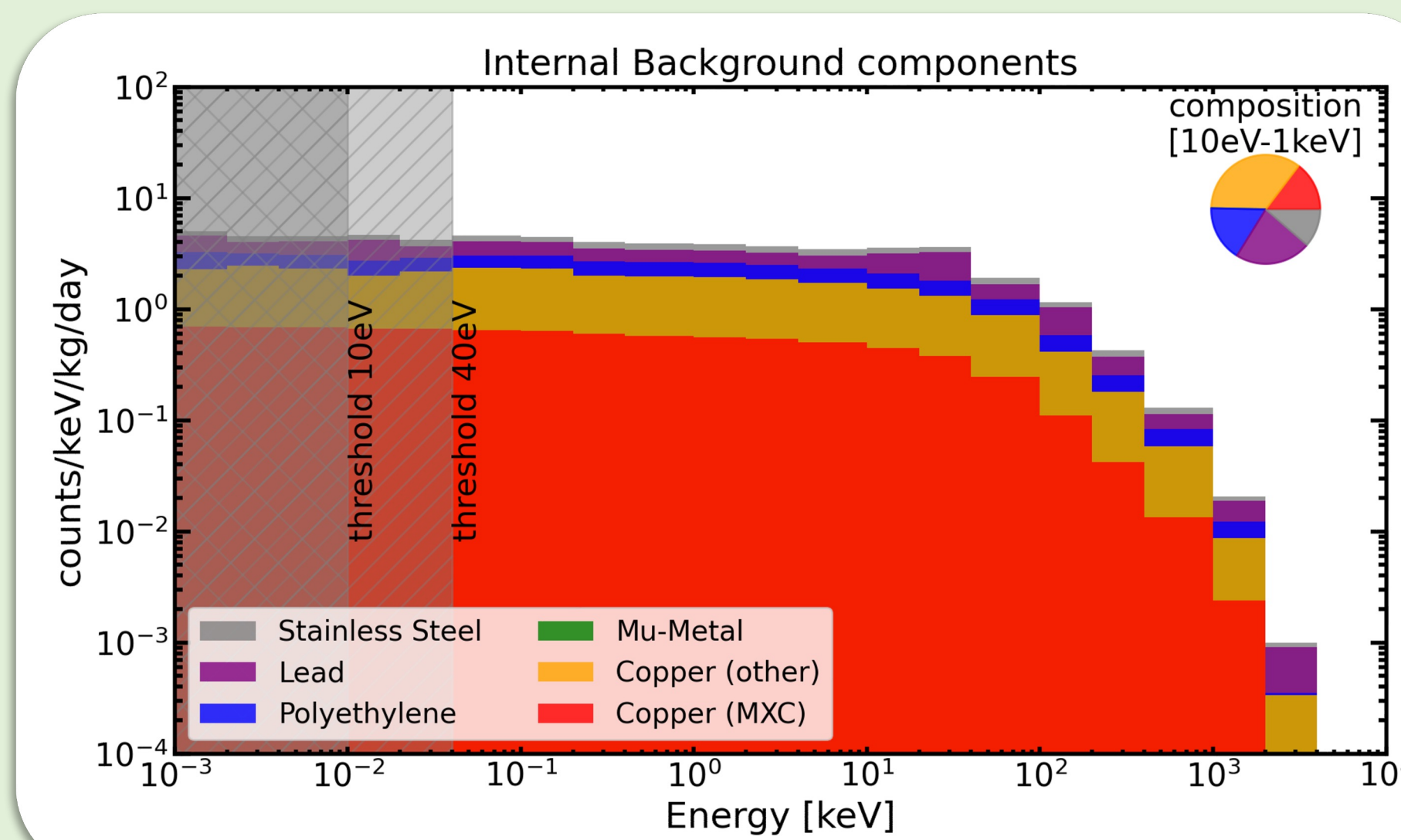
- Measure the gamma background from the Kamioka rock cavern with NaI(Tl).
- Estimate the contamination of gamma background from simulation and fitting
- Estimate background visible in LHe
- Measure neutron background: please check *KamiokaCryoLab*における環境放射線測定 [P21: 見上 万葉]

Cosmic-ray background



- Cosmogenic background is problematic for many tonne-scale experiments.
- We estimate the cosmogenic background at Fuji-hall at KEK (where we place our DR) using CRY (LLNL).
- Background observed in LHe is huge!
- ⇒ Need underground (moving cost is high)

Background from shield



- Assume radioactivity from previous experiments (XMASS, XENON, Borexino) to estimate background from detector
- Background level is expected <10 d.r.u, mainly background from detector components.

