

# Estimate background for QUP-Kamioka DM project

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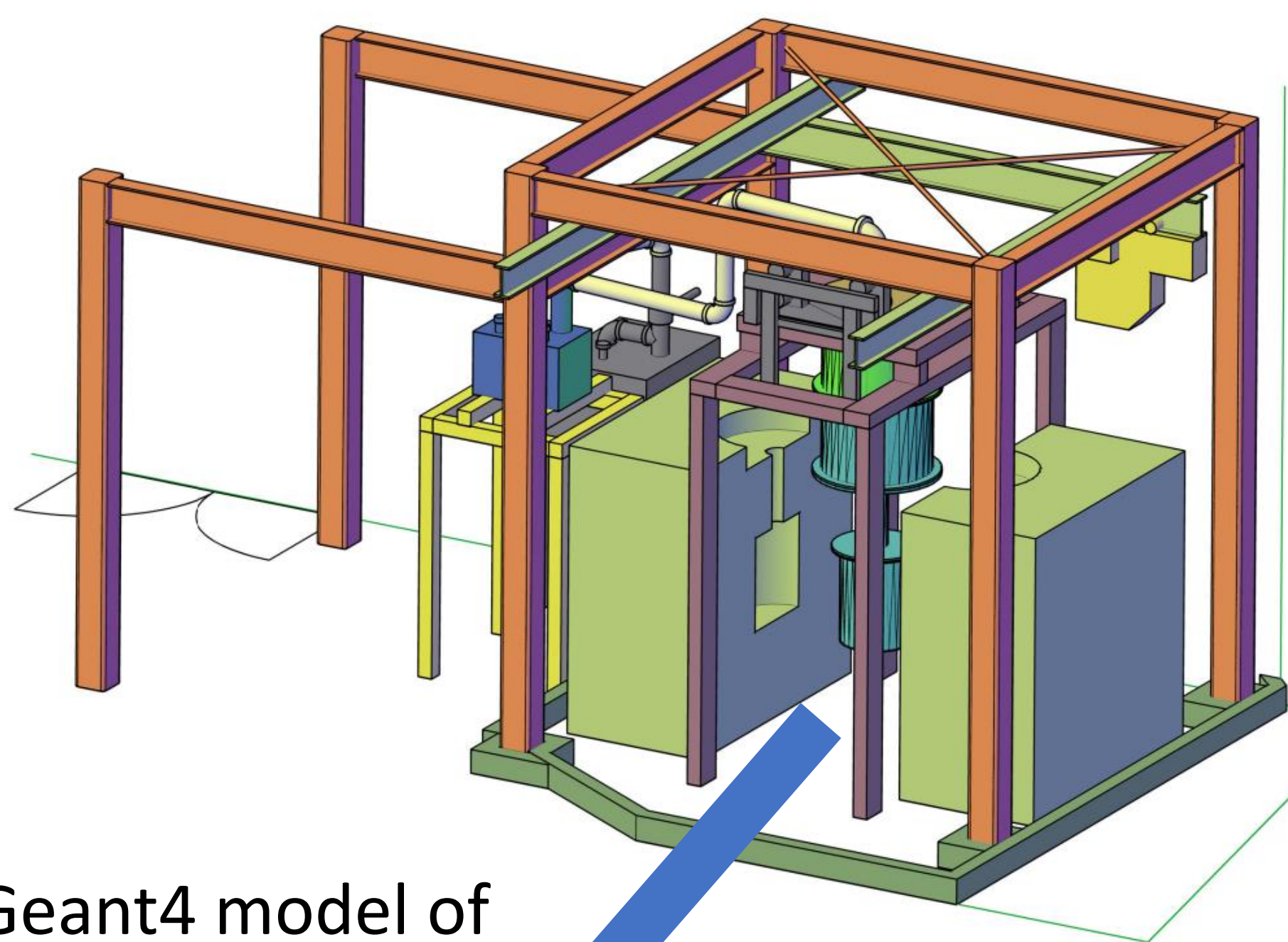
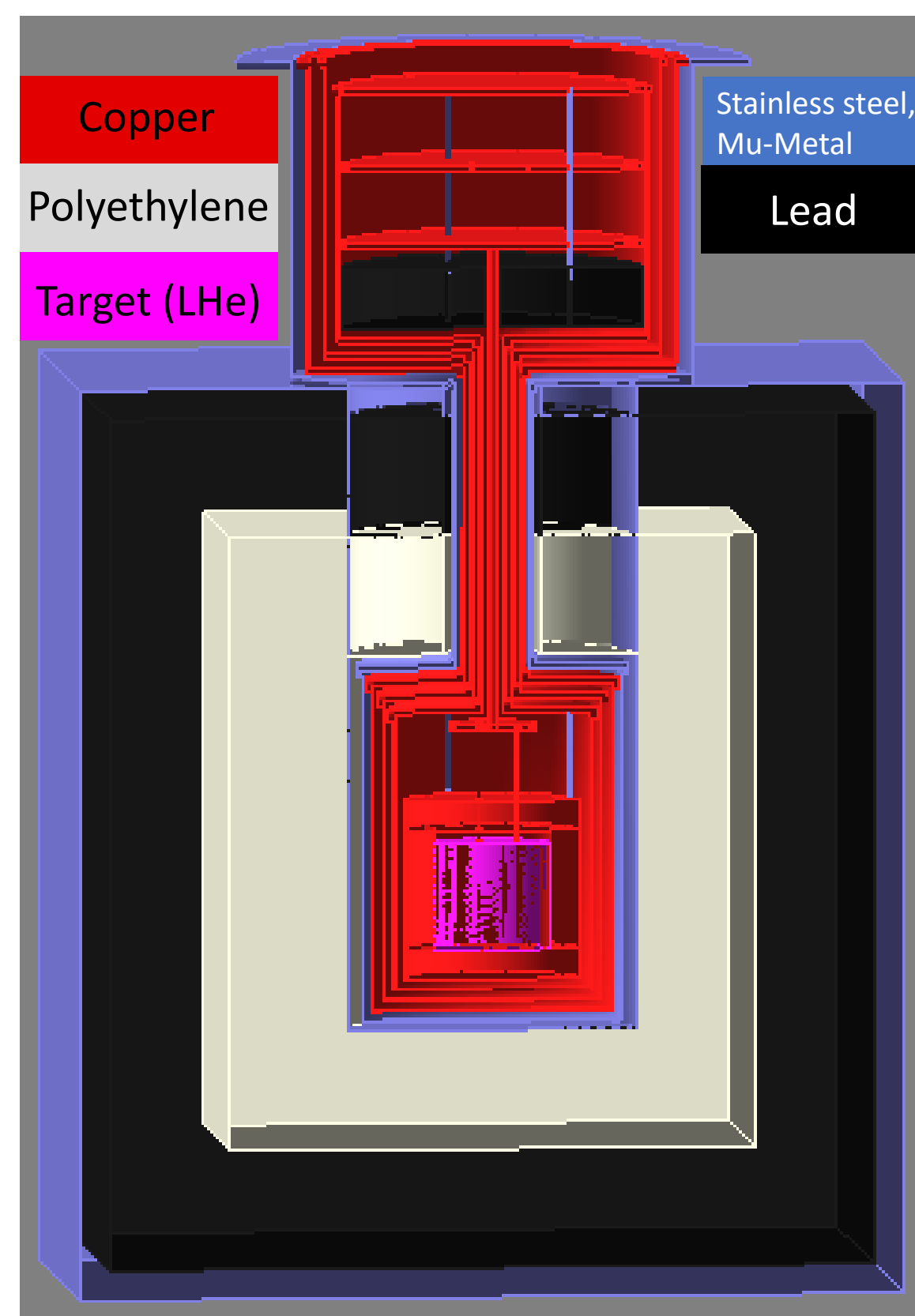
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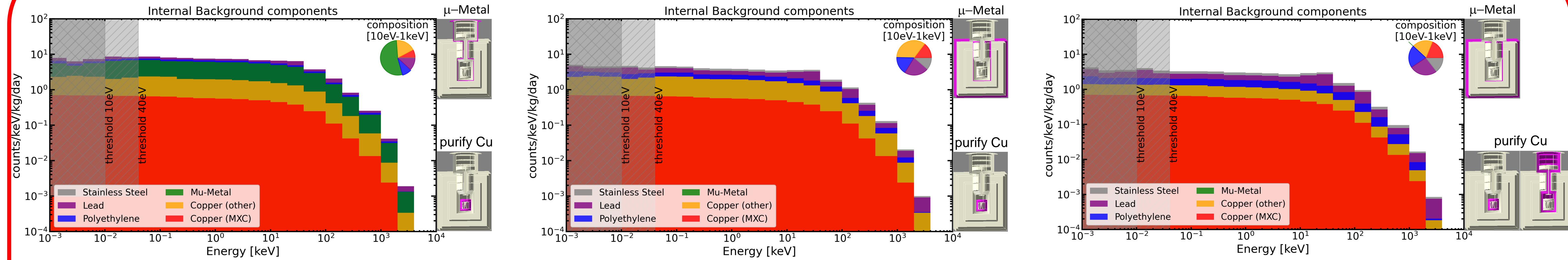


Geant4 model of XLD fridge @ KEK

## QUP-Kamioka DM project

- A new experiment using Transition Edge Sensor operated at milli Kelvin temperature will be set up to **search for Dark Matter (DM) in sub-GeV mass range**.
- Long term: **Optical TES** developed for DM **down to MeV scale**  
⇒ First step: **partner with TESSERACT** for LHe run, we want to achieve the  $10^{-29}$  cm<sup>2</sup> cross section at **100 MeV**.
- Combination of sensitive detector & low background environment
- Aim to achieve background level <10 counts/keV/kg/day (d.r.u)

## INTERNAL BACKGROUND FROM DETECTOR SHIELDING MATERIALS

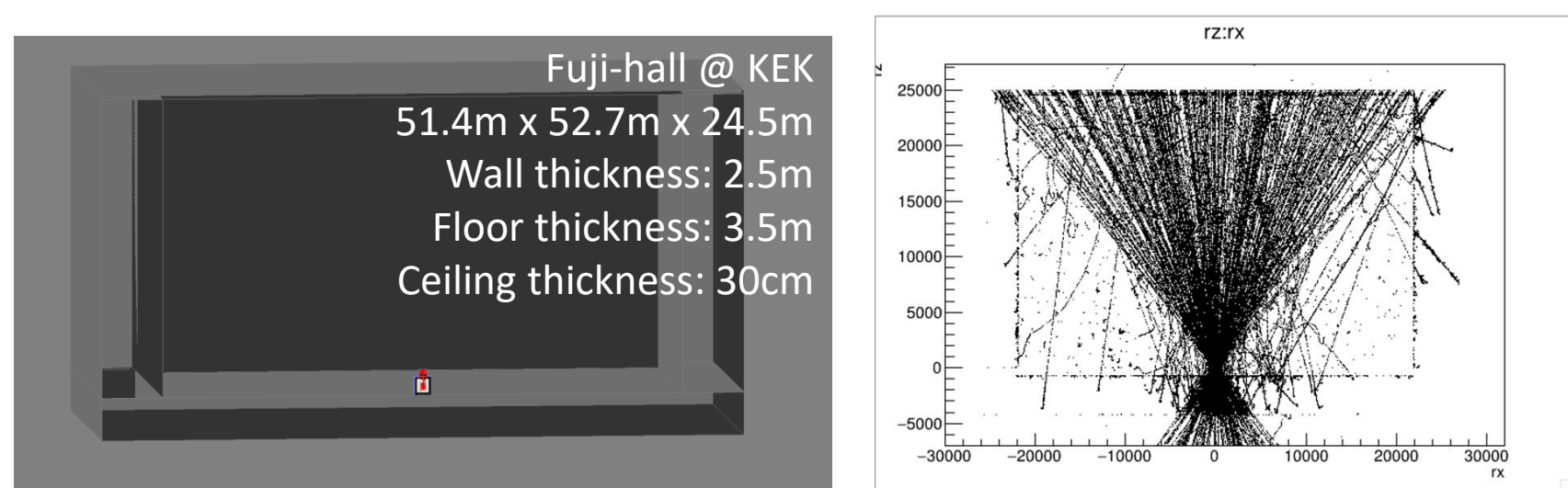


- Estimate the background from detector materials by simulation
- Assuming the material radioactivity from XENON, XMASS, Borexino

[1] XENON collaboration, *Astroparticle Physics*, vol. 35, p. 43-49 (2011)  
 [2] Borexino Collaboration, *Astroparticle Physics*, vol. 18, p. 1-25 (2002)  
 [3] N. Oka, *Master thesis about XMASS at University of Tokyo* (2014)

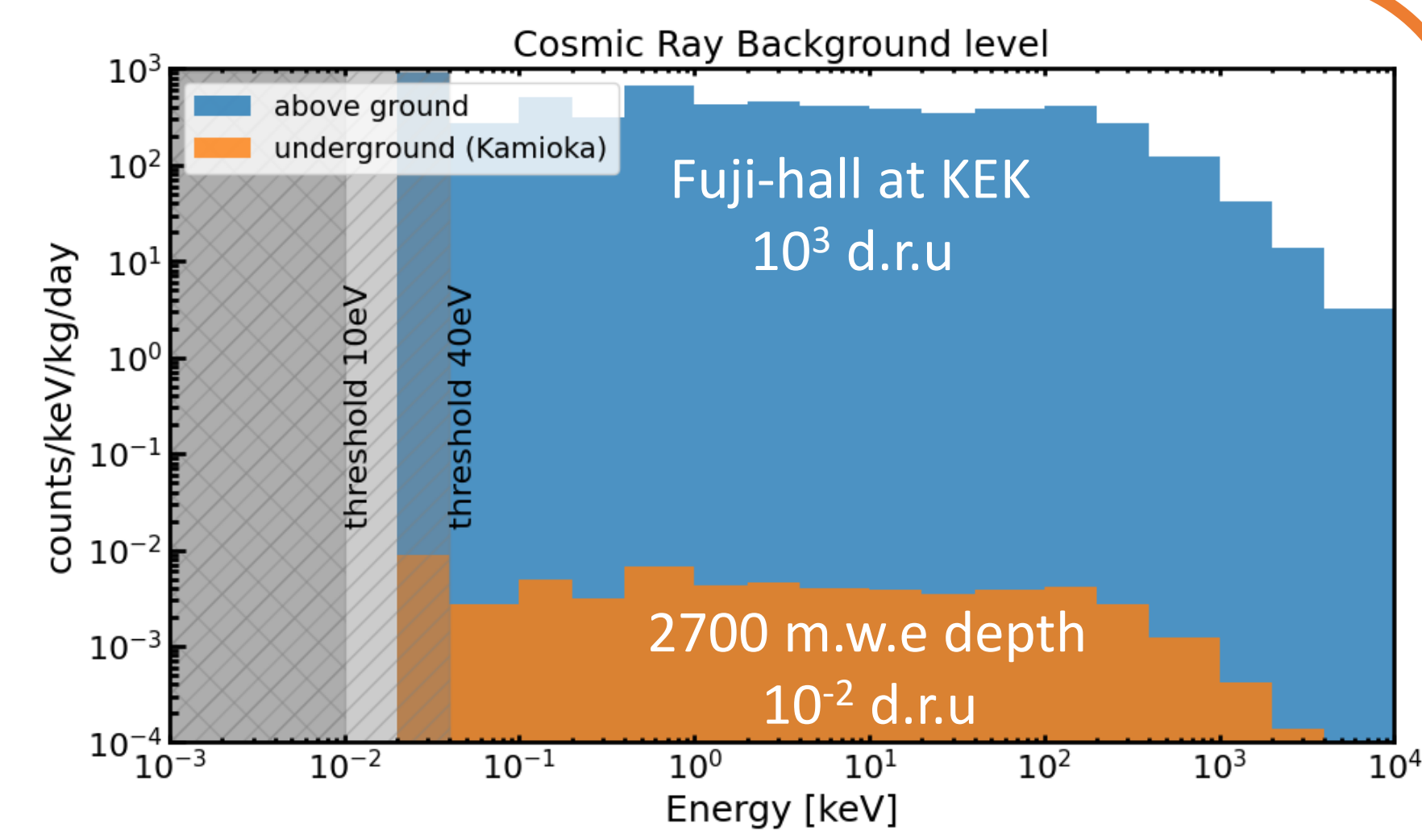
Different configurations are tested to figure out the most feasible detector setup

configuration	Change in mass	BKG level
MuMetal: Cryo300K	MuMetal: ~140kg	8 d.r.u
Pure Cu: innermost Cu	Pure Cu: ~135kg	
MuMetal: housing	MuMetal: ~4.5 ton	5 d.r.u ←
Pure Cu: all of Cu	Pure Cu: ~375 kg	4 d.r.u



## ARE WE SAFE FROM COSMIC RAY?

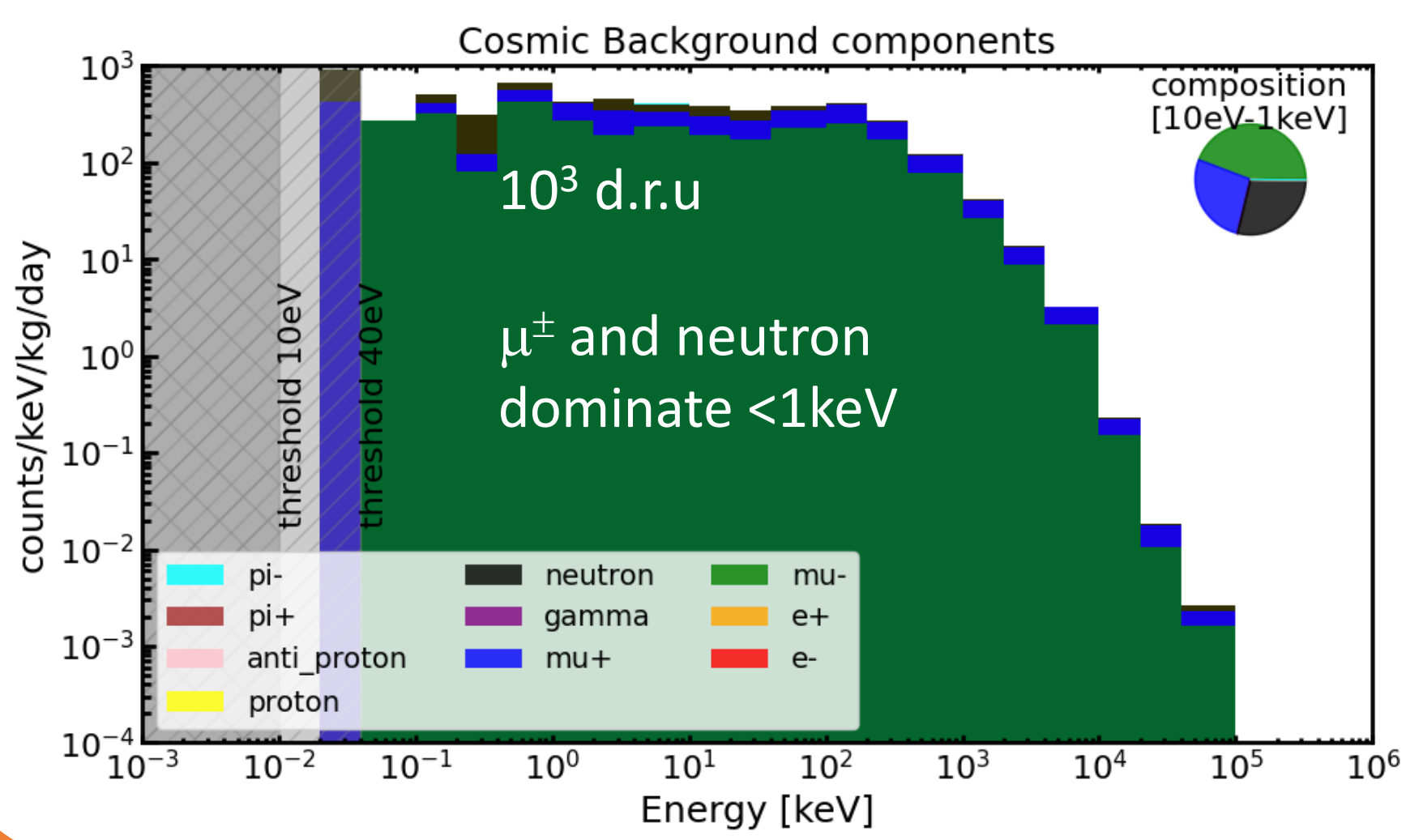
- Cosmogenic background is problematic for many tonne-scale experiments.
- We estimate the cosmogenic background at Fuji-hall (where we place our DR) using CRY (LLNL).
- Background observed in LHe is huge!  
⇒ Need underground (moving cost is high)
- Kamioka underground lab is a potential location  
2700 m.w.e depth



With 2700 m.w.e depth, the background can be reduced by 10<sup>5</sup> times<sup>[4]</sup>

⇒ rate 10<sup>3</sup> d.r.u to 10<sup>-2</sup> d.r.u

[4] *Phys. Rev. D* 74, 053007 (2006)



## Break down the background components

- Environmental gamma/neutron background depends on the site location and the shielding configuration.  
⇒ with 20 cm Pb, gamma background (at Kamioka or other sites) is almost removed.
- Currently, background level is < 10 d.r.u
- Estimate neutron background: in processing

