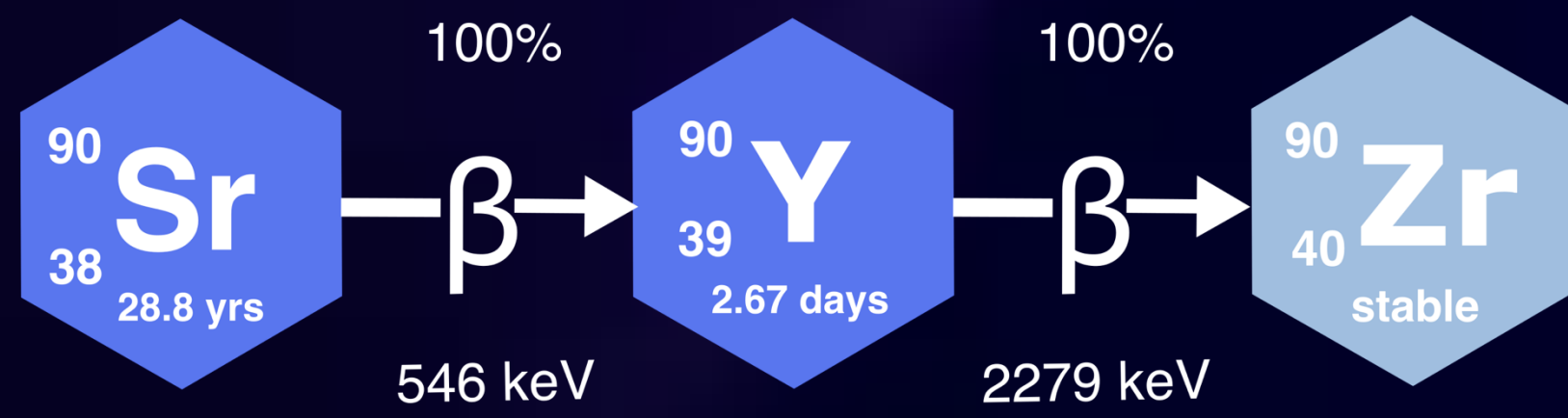


Strontium-90

Goal: study external crosstalk (ExCT) in LoLX



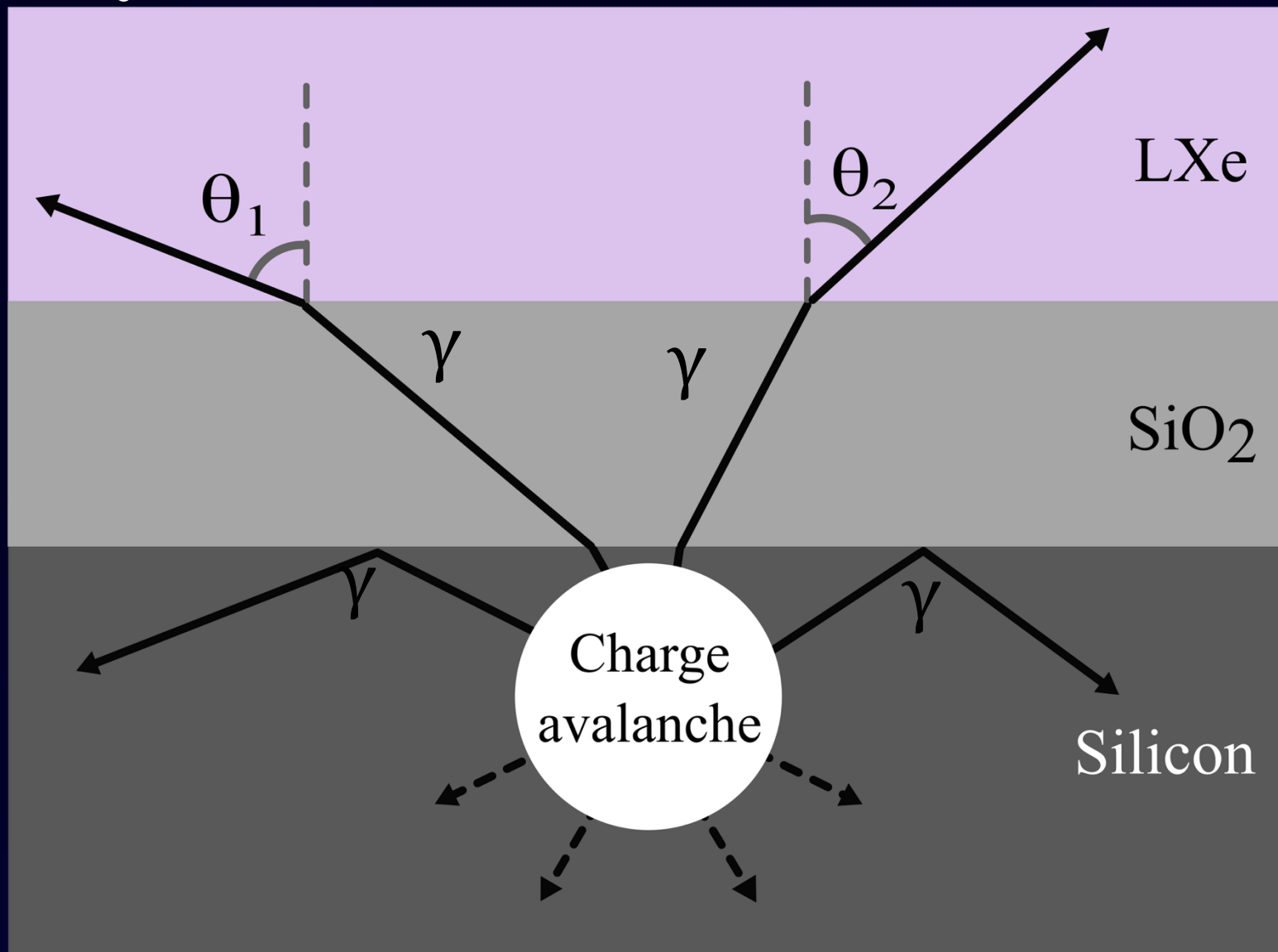
Characteristics

- Isotropic, point-like beta source
- High-energy beta → good Cherenkov light source

Challenges

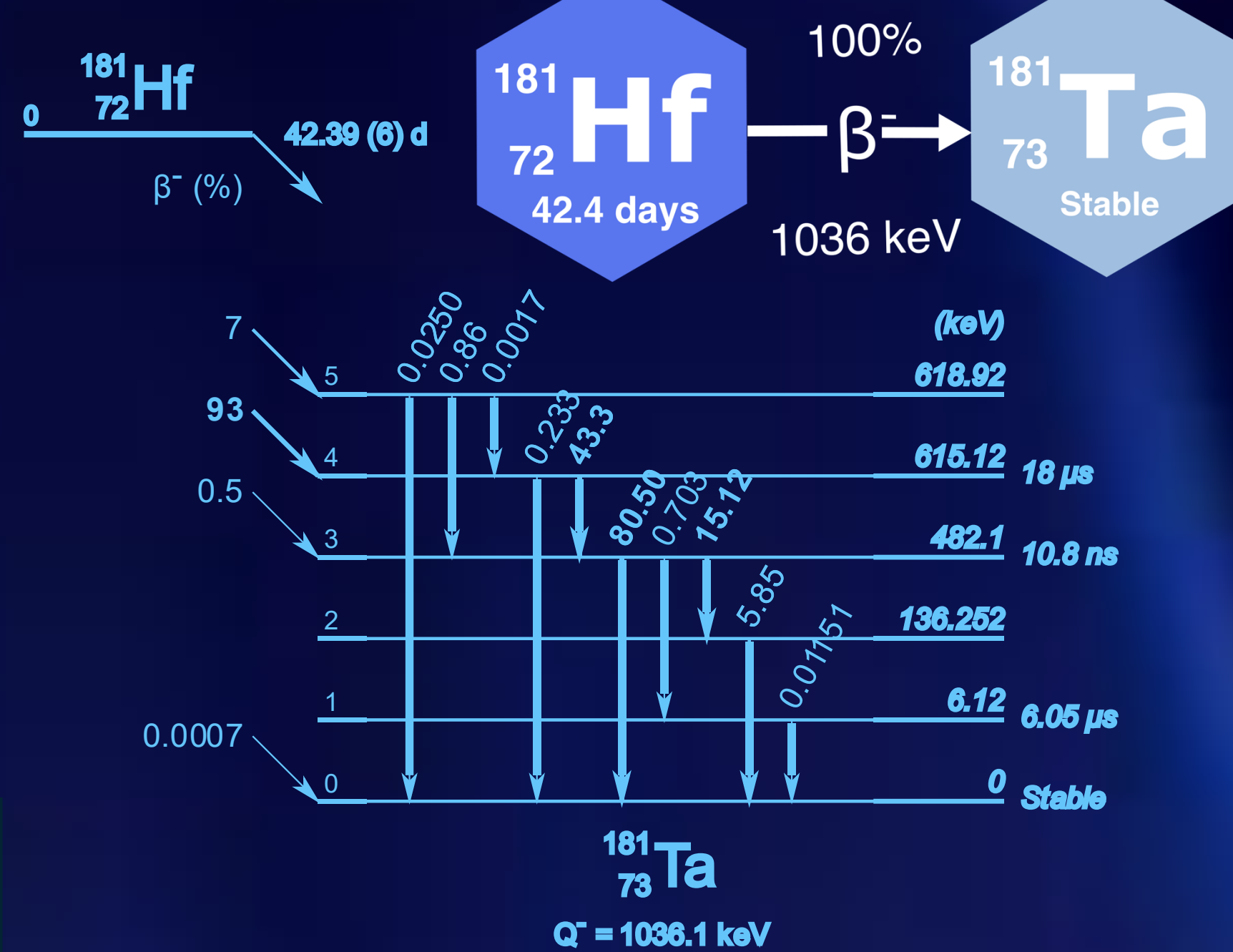
- Strontium needle coating flakes from repeated cryogenic runs
- Shadowing

Previously used in ExCT Studies [1]



Hafnium-181

Goal: light yield calibration with tantalum-181 gamma lines



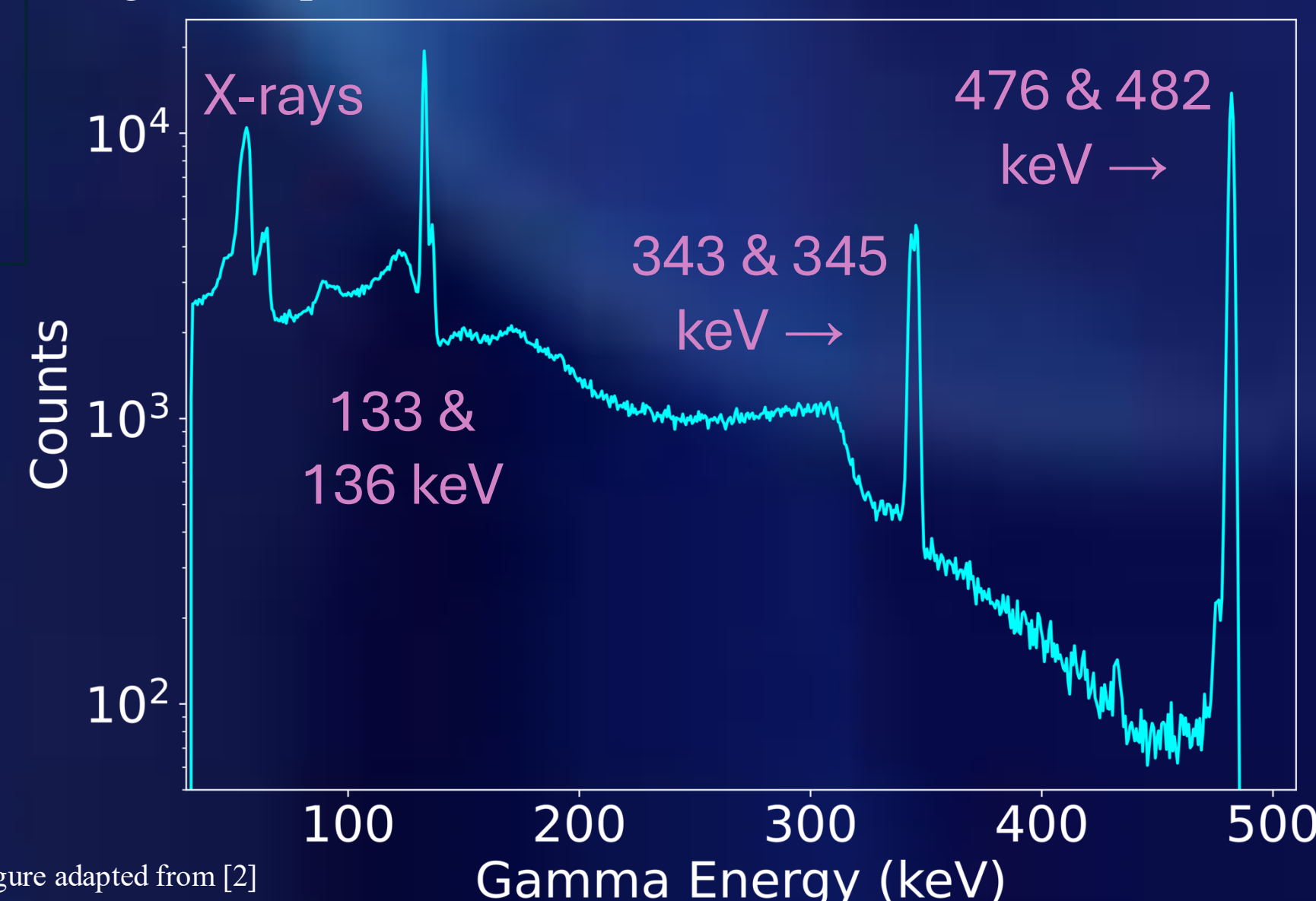
Characteristics

- Same geometry as strontium-90 (isotropic, point-like)

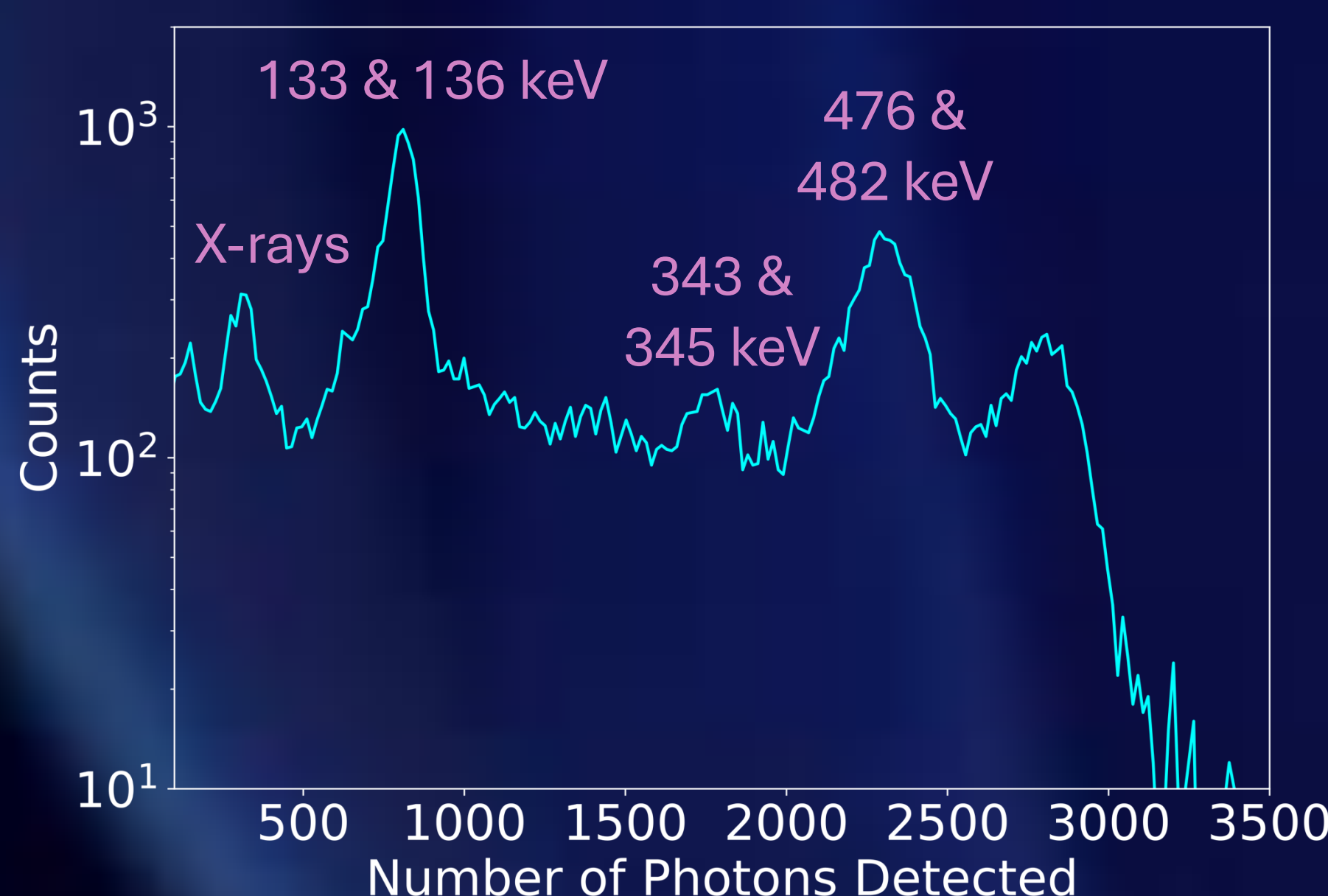
Challenges

- Small timing separation between gamma lines
- Conversion electrons

Hf-181 gamma spectrum with Ge detector Credit: Ethan Coulthard



Light yield simulations in LoLX 2 with GEANT4, NEST and Chroma

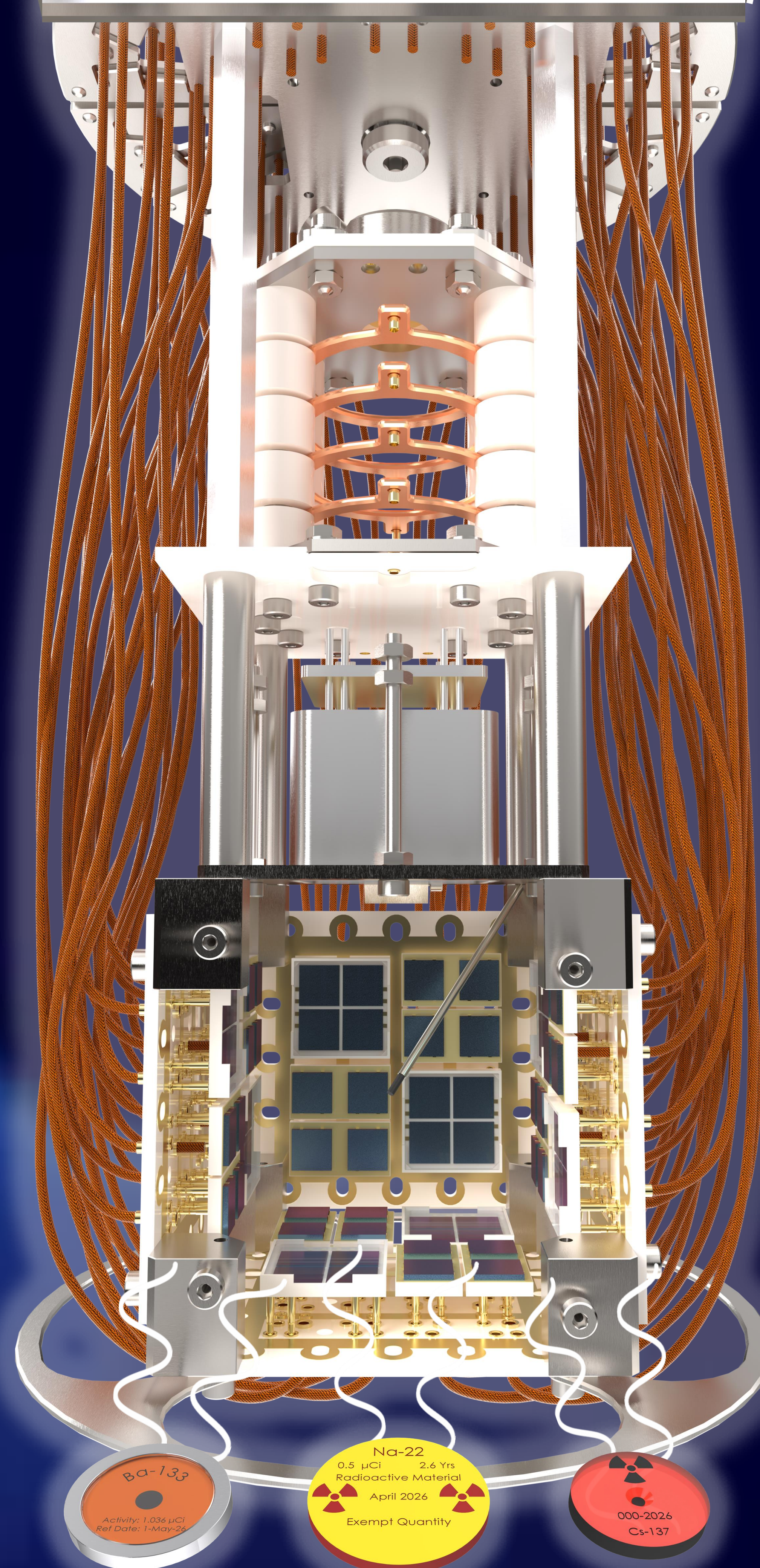


What is LoLX 2?

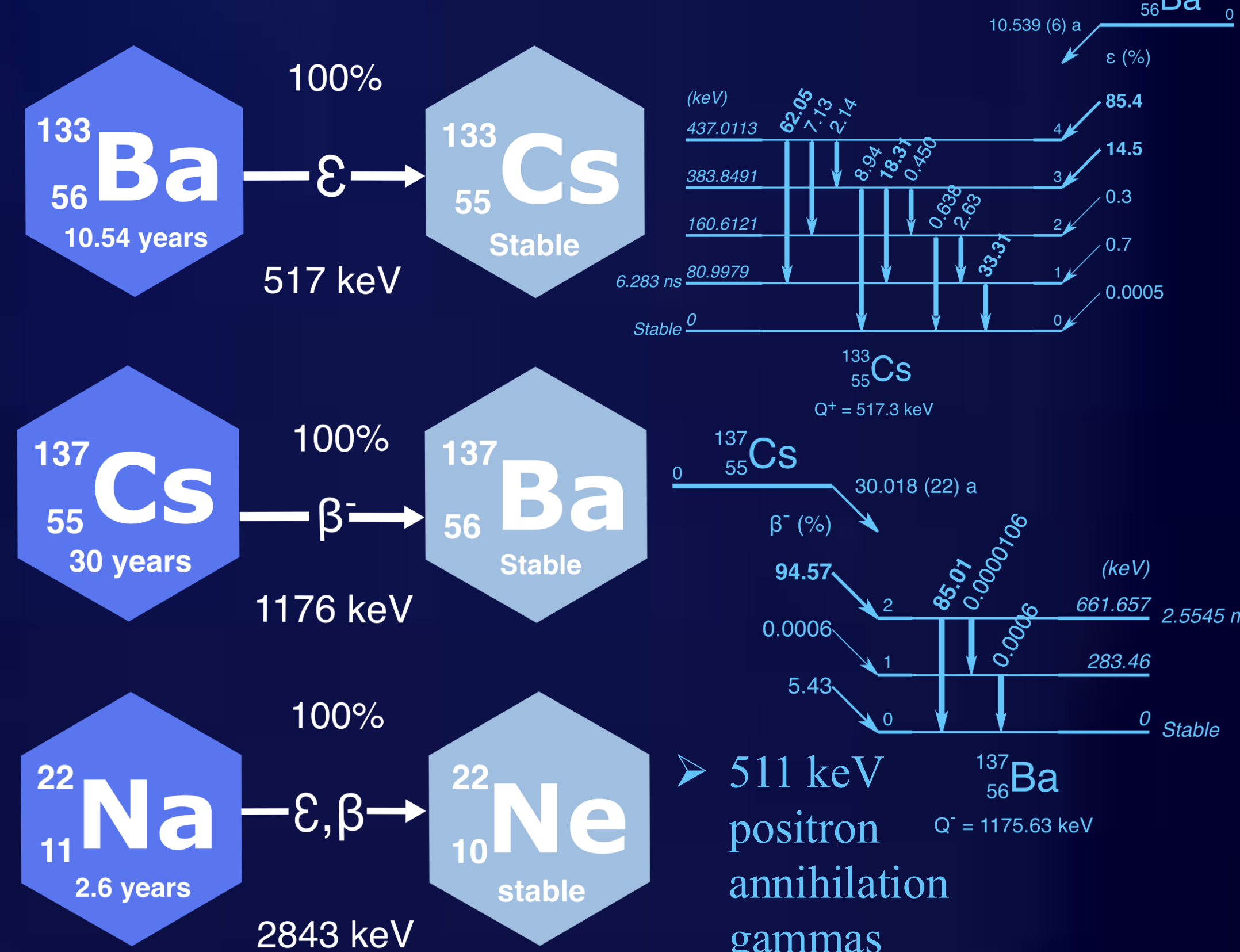
- Cubic configuration of silicon photomultipliers (SiPMs)
- Photomultiplier tube (PMT) at the top for PDE reference and light monitoring
- Submerged in liquid xenon

What is it used for?

- Comparative studies of Hamamatsu and Fondazione Bruno Kessler (FBK) SiPMs
- External crosstalk measurements
- Studies of Cherenkov and scintillation light production in liquid xenon
- Benchmarking of optical simulations



External Sources



Characteristics

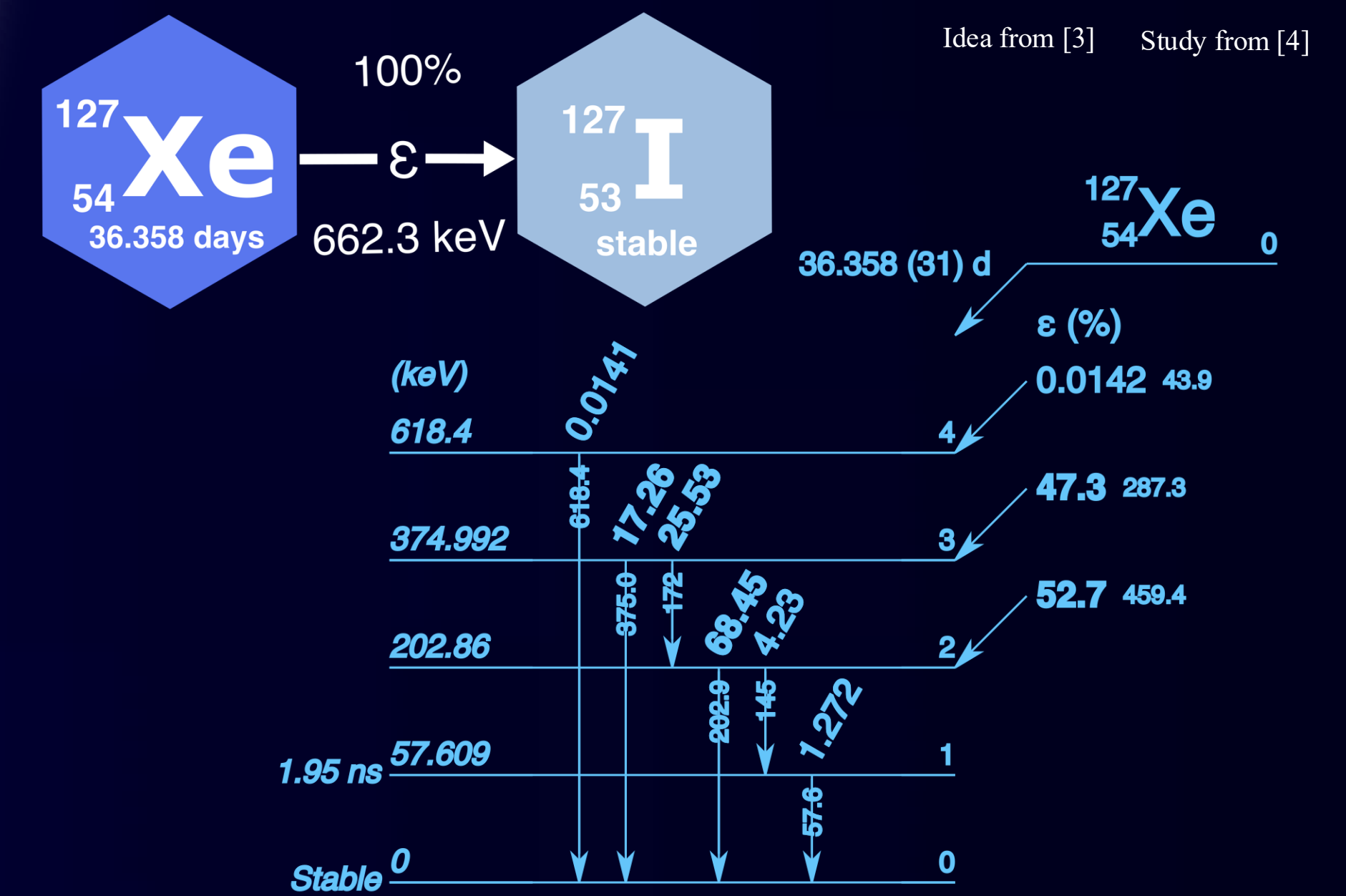
- Pure gamma sources
- Easier to locate outside of cryostat

Challenges

- Solid angle
- Position dependent energy depositions
- Scattering/attenuation in surrounding LXe

Xenon-127

Goal: Probe long-term SiPM stability and performance

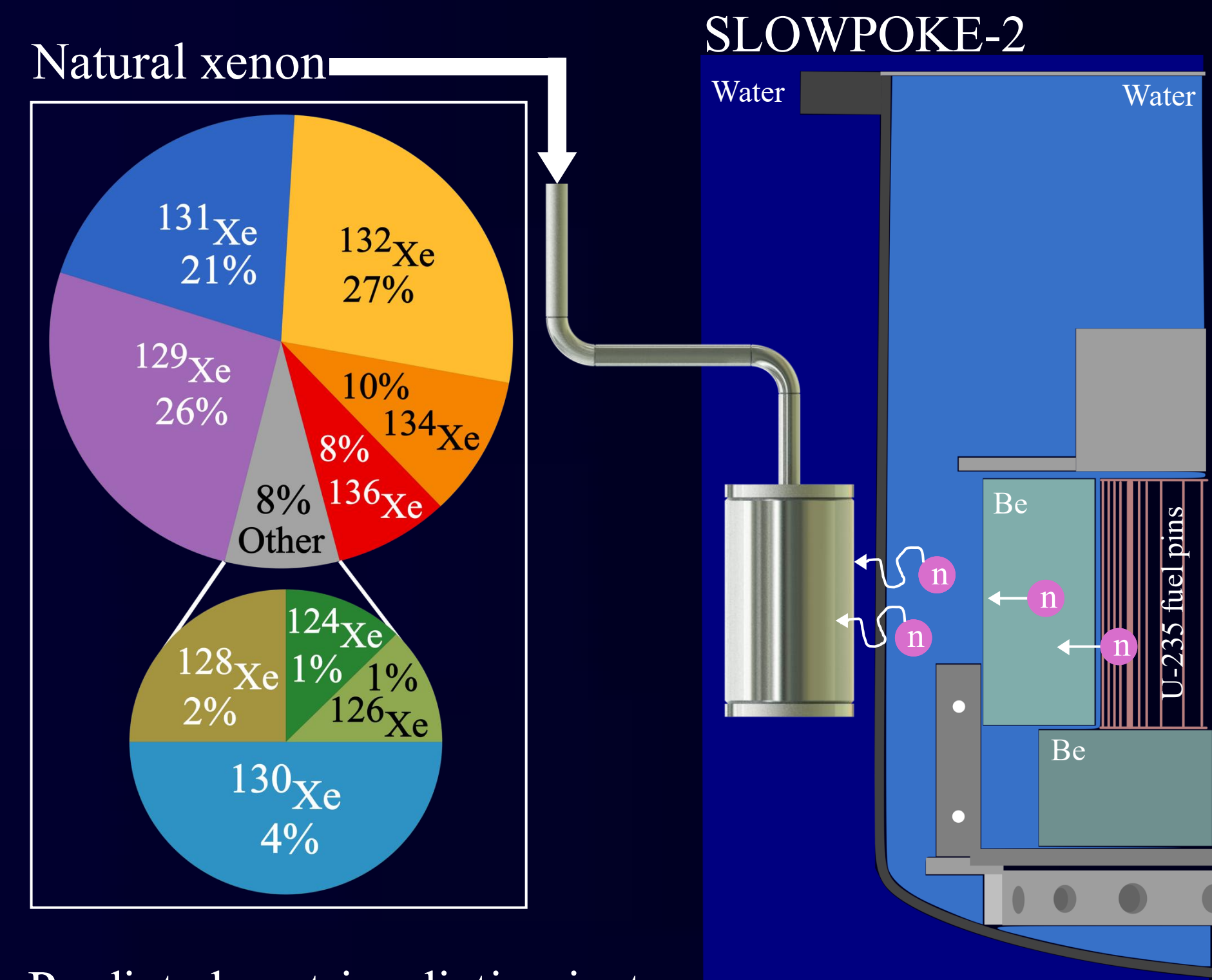


Characteristics

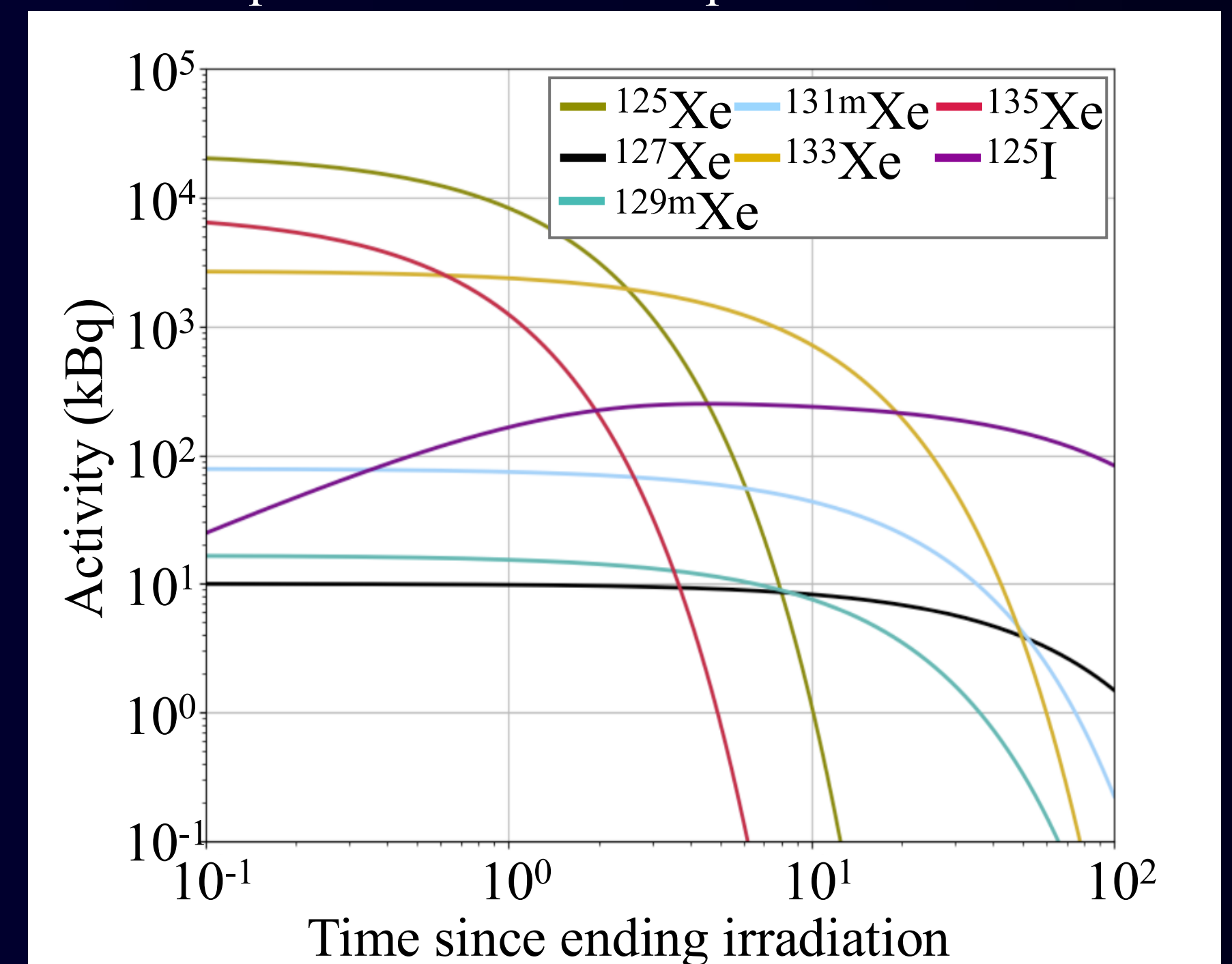
- Homogeneous gamma source
- Compatible with electric fields
- Relatively short half-life
- Lower energy gamma lines

Challenges

- Complicated gamma emission spectrum
- Complex source production process



Predicted post-irradiation isotopes

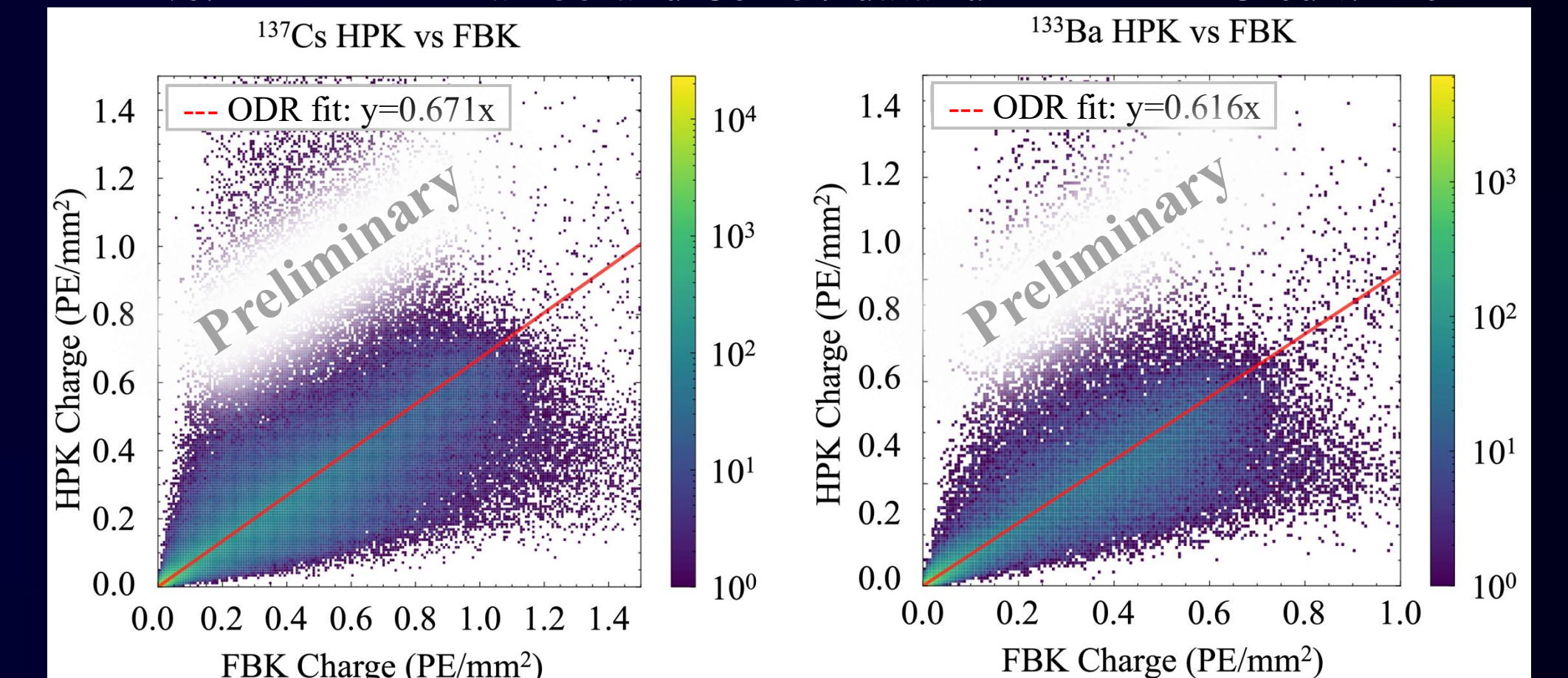


Credit: Lisa Rudolph

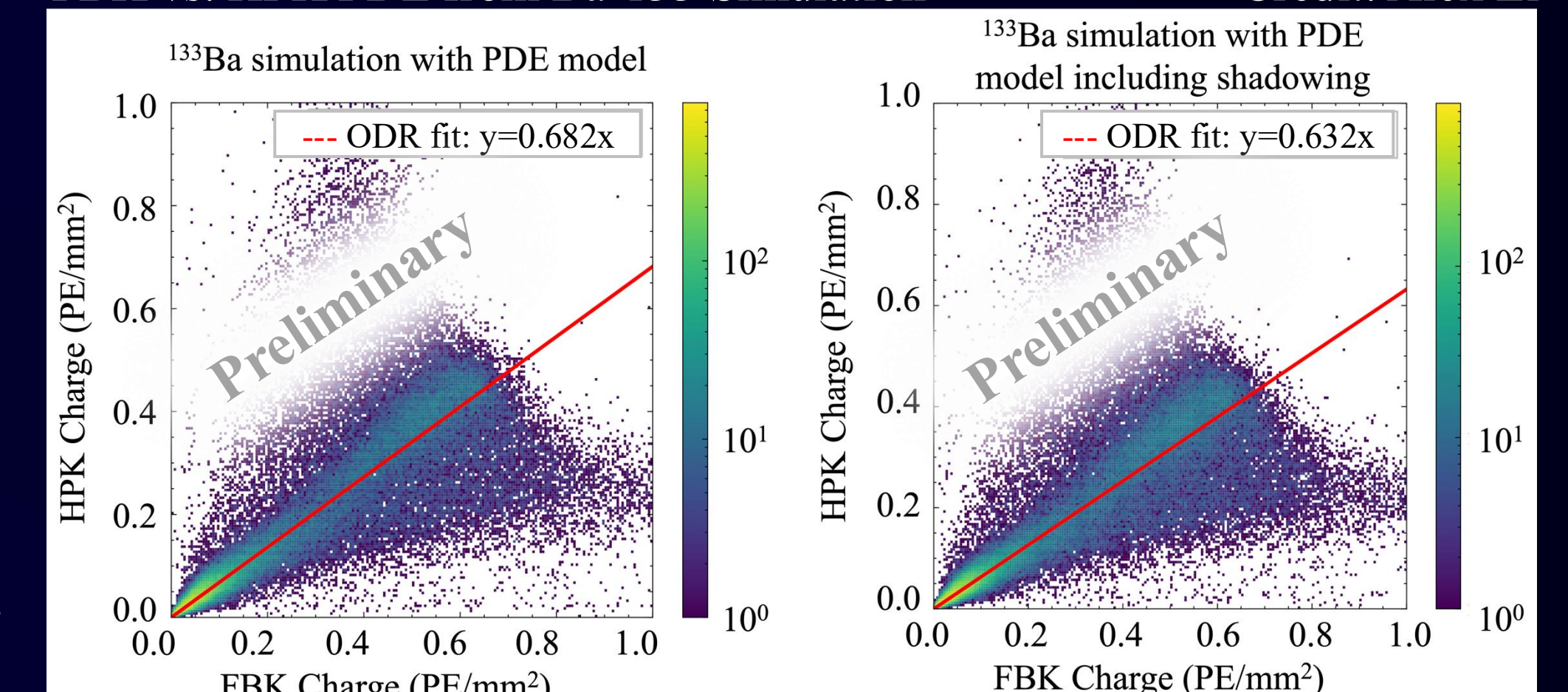
Figure adapted from [4]

External Sources (Continued)

FBK vs. HPK PDE Ba-133 and Cs-137 data run Credit: Alex Li



FBK vs. HPK PDE from Ba-133 Simulation Credit: Alex Li



Figures adapted from [5]

[1] D. Gallacher, A. de St. Croix et Al. Characterization of external cross-talk from silicon photomultipliers in a liquid xenon detector. The European Physical Journal C, 85(6), 2025.
[2] E. Coulthard. Spectral characterization of hafnium source for use in the LoLX experiment. Lecture notes/PowerPoint slides, 2025. Available: <https://indico.sno.ca/event/32/contributions/402/>.

[3] B.G. Lenardo et Al. Development of a ^{127}Xe calibration source for nEXO. Journal of Instrumentation, 17(07):P07028, 2022.
[4] L. Rudolph. A ^{127}Xe Calibration Source for the LoLX Detector. MSc thesis, McGill University, 2024

[5] X. Li, D. Gallacher et Al. In-situ performance of FBK VUV-HD3 and HPK VUV4 SiPMs in the LoLX liquid xenon detector, 2026.