Technology Development of 3-D CZT Detectors

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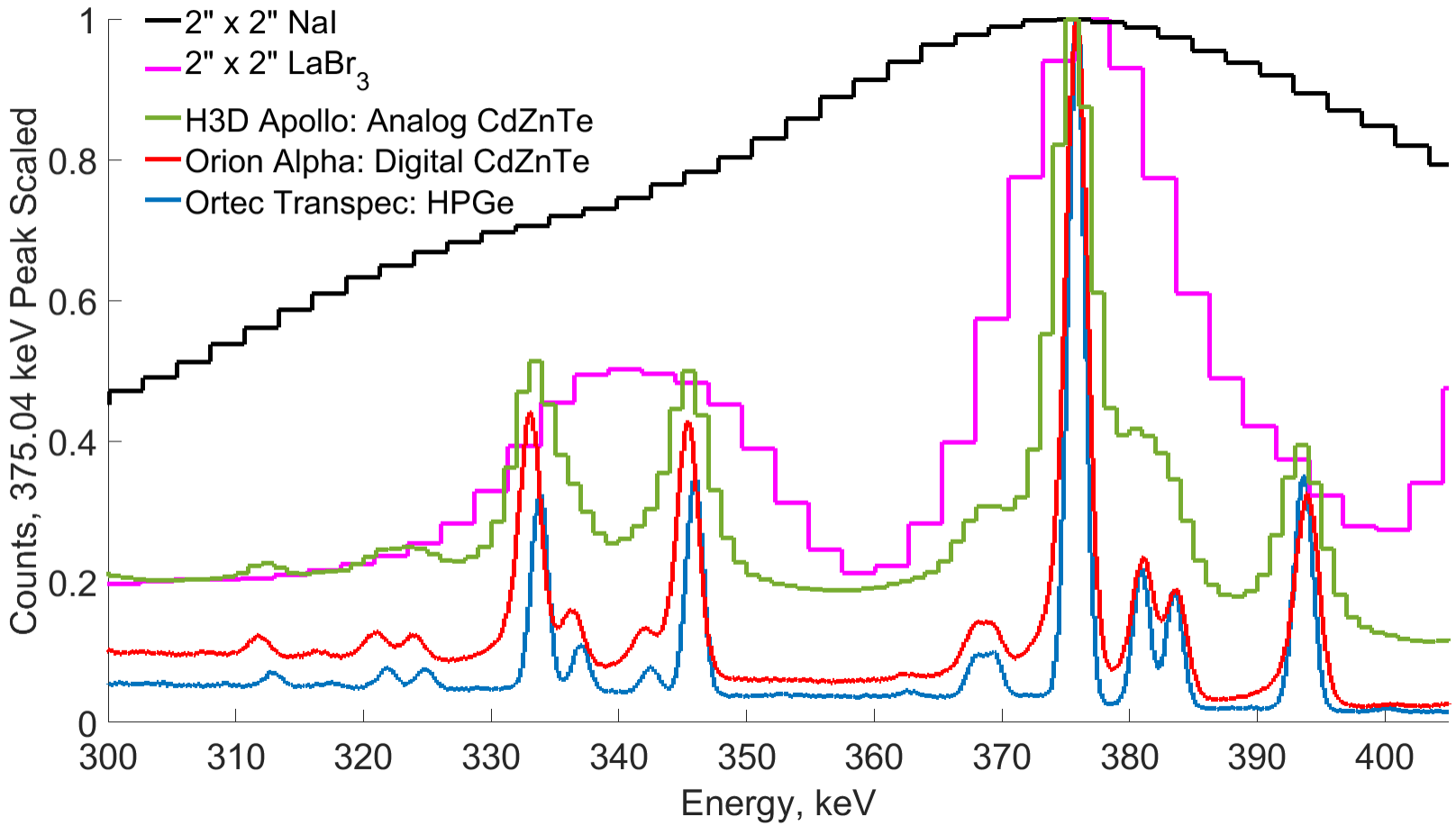
Introduction and Mission Relevance

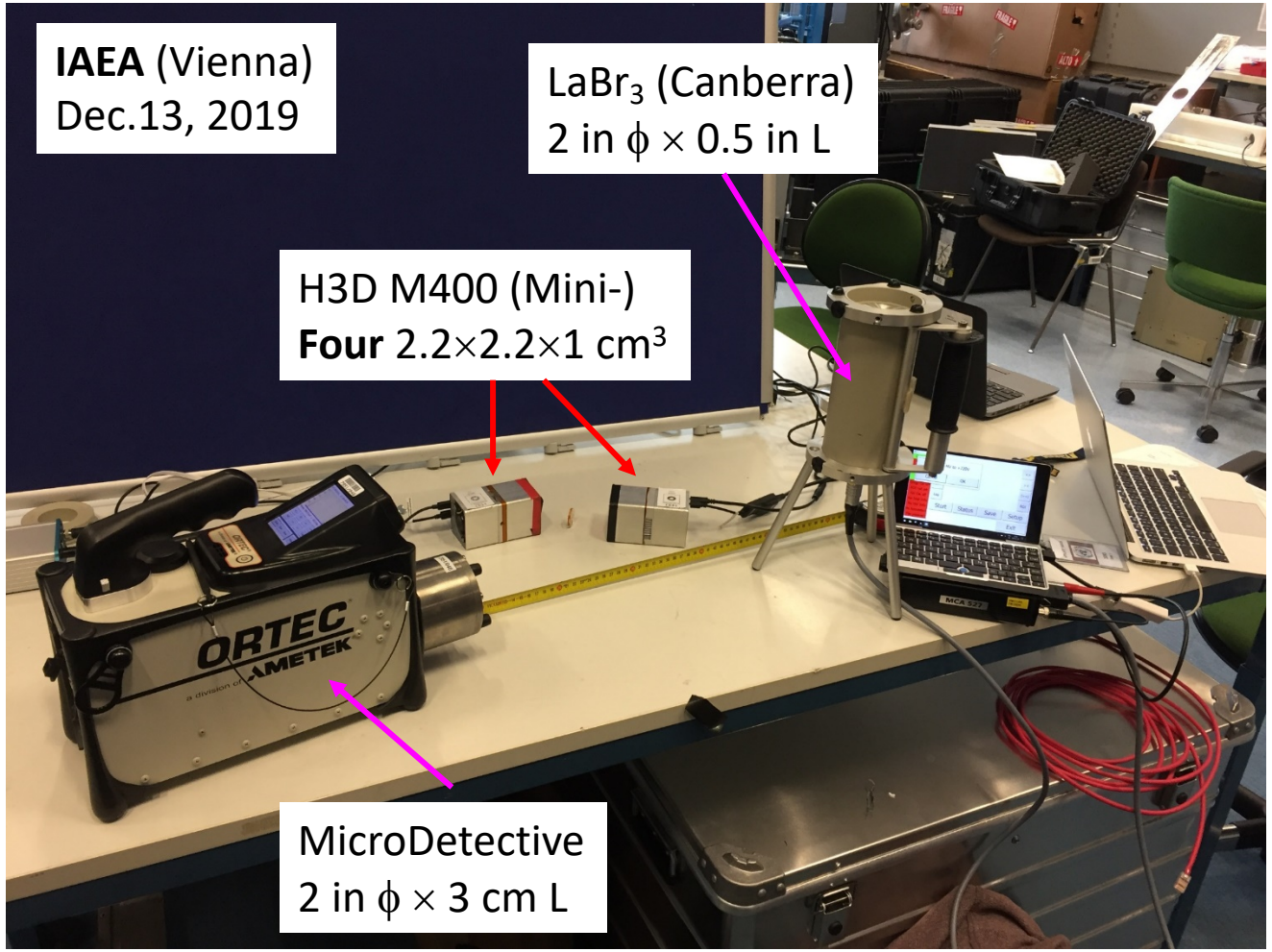
What are special about 3-D CdZnTe (CZT) gamma-ray detectors?

A: Close to HPGe Res. at Ambient Temp.

Comparison on measured plutonium spectra



B. Compact & Ruggedized



(1) **No cryogenic cooling** required by HPGe

(2) vs **Scintillators** (even with SiPM)

Much higher res.
→ Higher sensitivity or smaller volume

(3) **Ruggedization** (smaller volume helps)

Example: IAEA Safeguard Applications

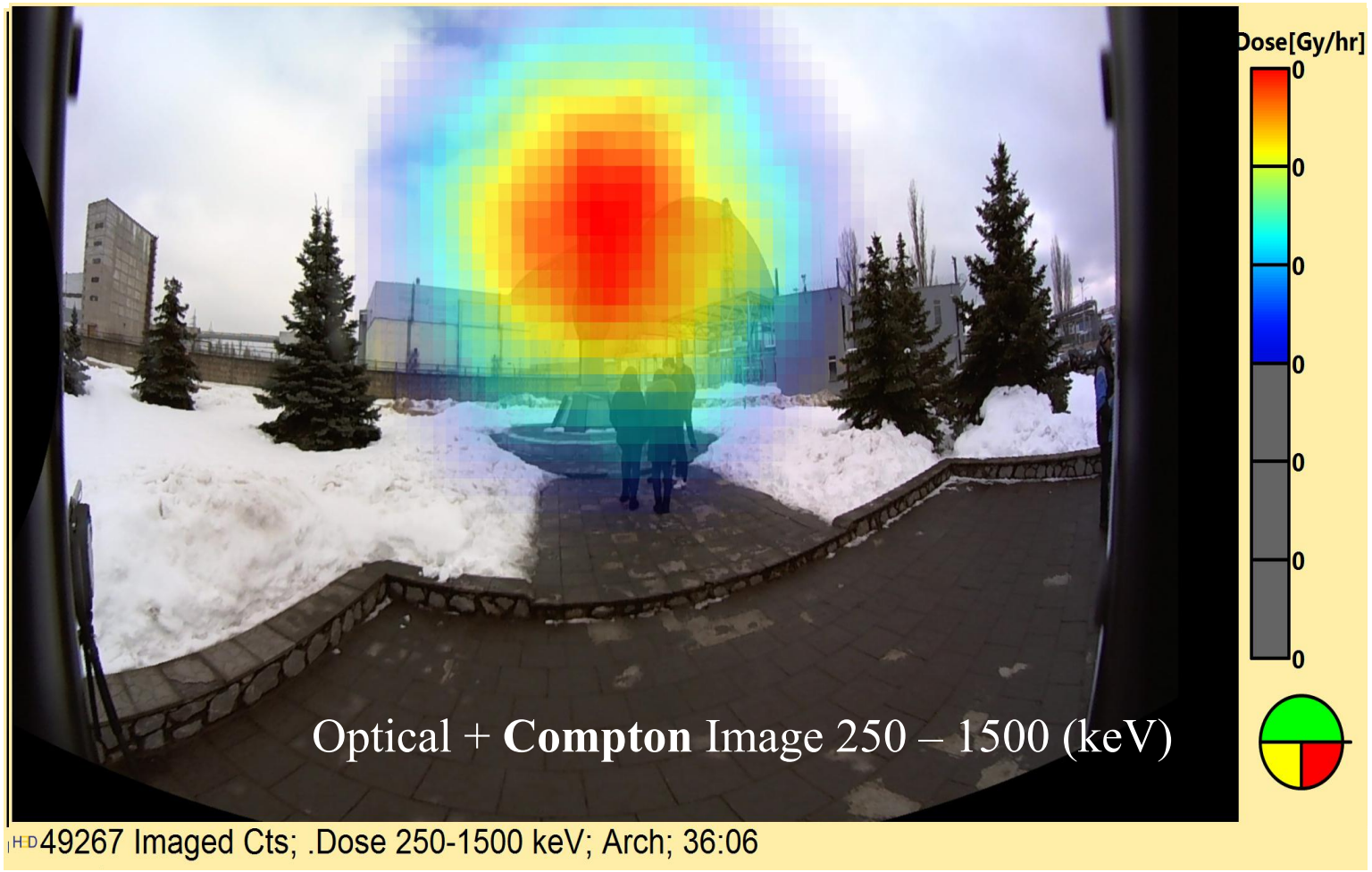
The three-years evaluation process has shown that CZT can offer combined capabilities of scintillation detectors and much of HPGe (except some situations requiring the best possible energy resolution and highest sensitivity)

C. Real-Time Gamma-Emitting Isotope Imaging

Optical & (^{60}Co) Gamma Image at Fermi, 2012

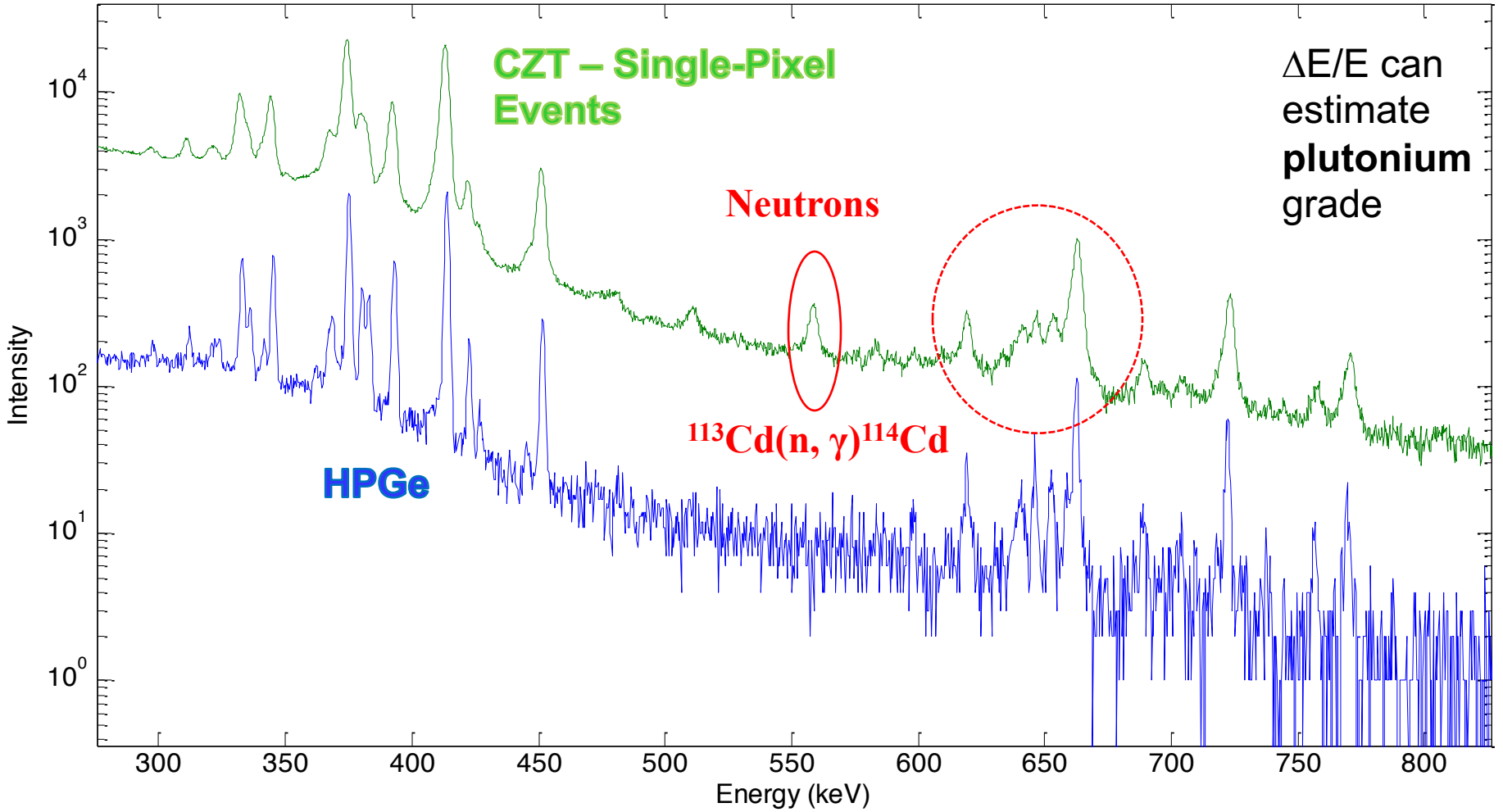
Chernobyl Arch

by Dr. Willy Kaye of H3D Inc. in 2019



Example: People in **FBI** envision that this technology will enable first responders to “**see**” and **characterize** the situation instantly.

D. Gamma & Neutron Detection on One Detector



Research Plan for MTV

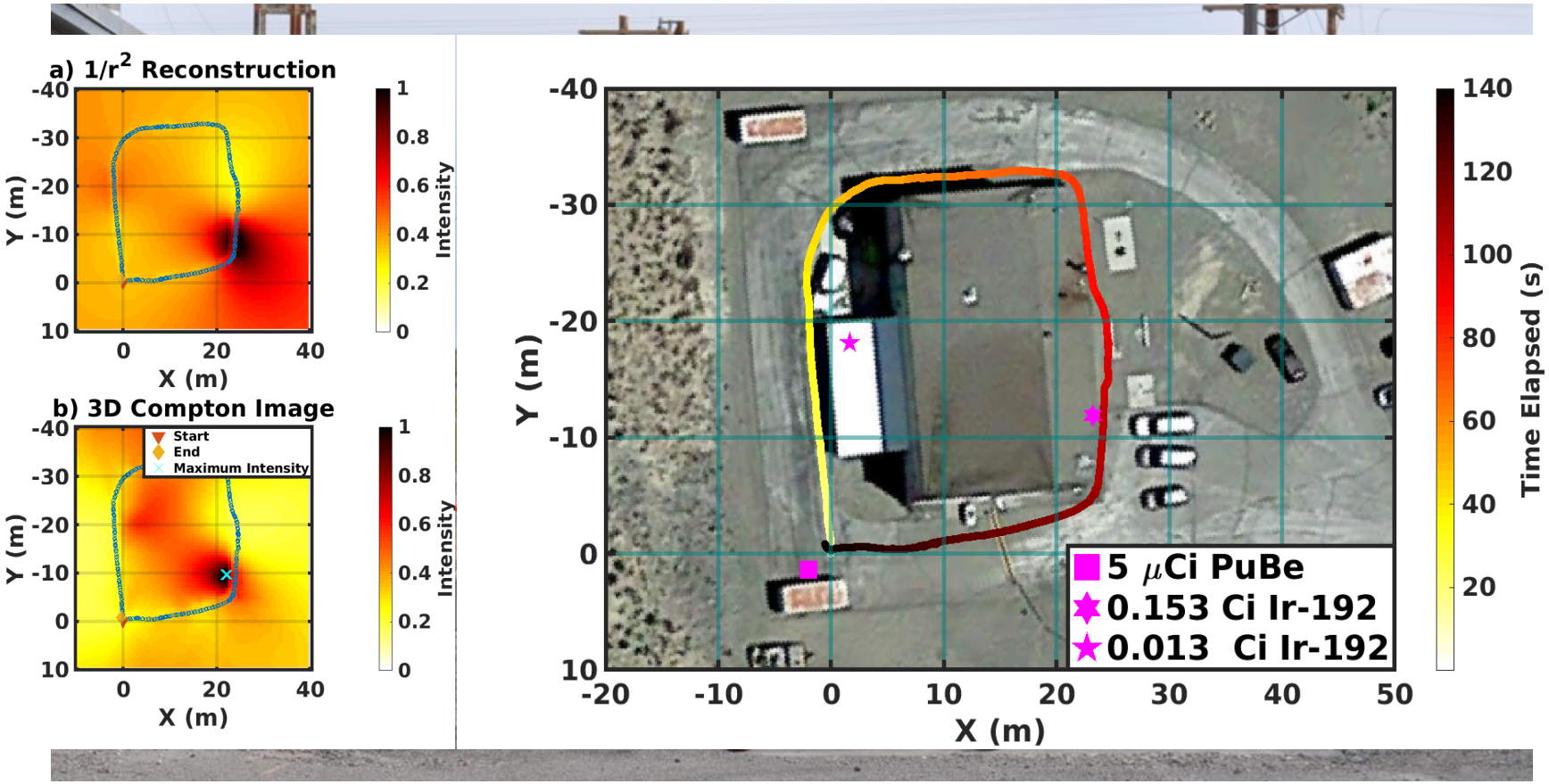
(1) Advancing faster 3-dimensional gamma-ray imaging algorithms for source detection & characterization

(2) Advancing Compton gamma-ray imaging at higher energies (> 2 MeV)

Three-Dimensional Gamma Imaging for Source Detection & Characterization

Poster by Daniel Shy

INL collaboration



Estimate U Holdup in Pipes (Y12 collaboration – Alexander Rice)

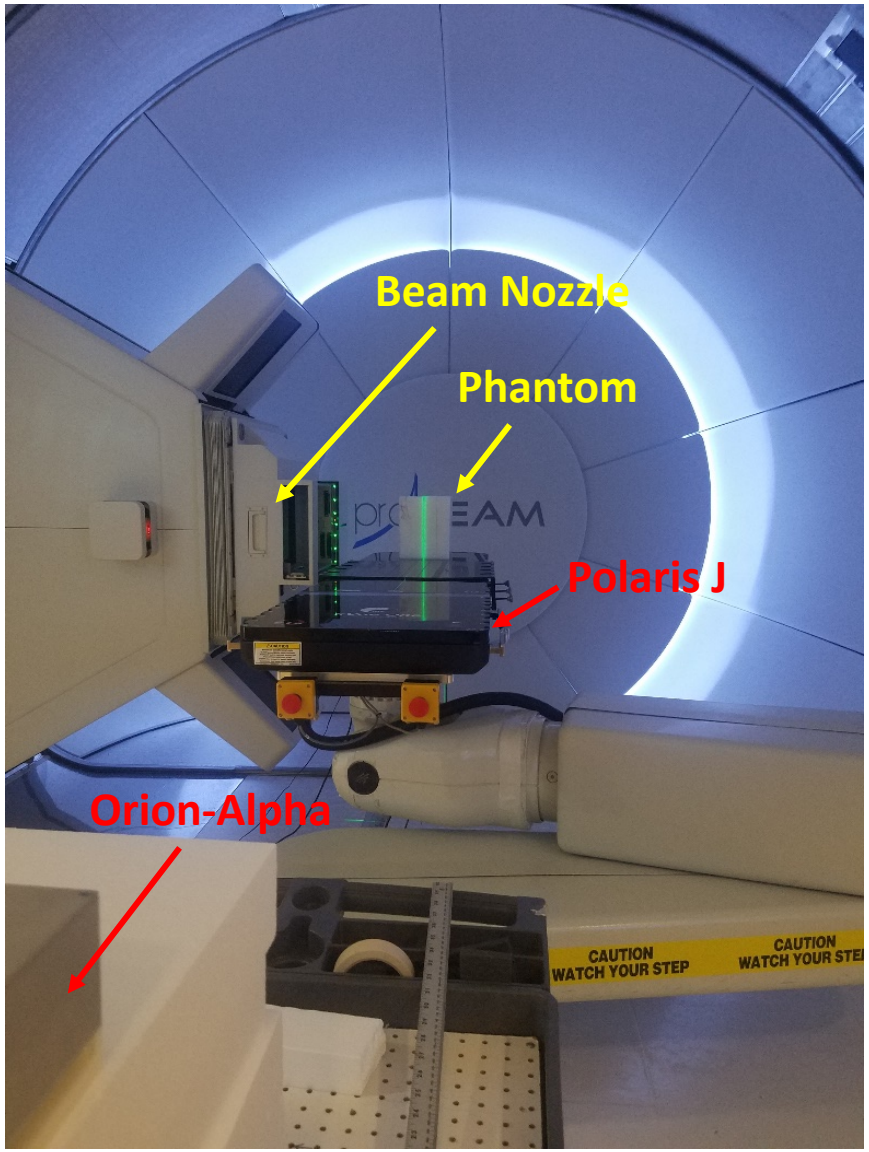
^{60}Co (1.3 MeV) γ Image → 186 keV (^{235}U) and 1 MeV (^{238}U)

+

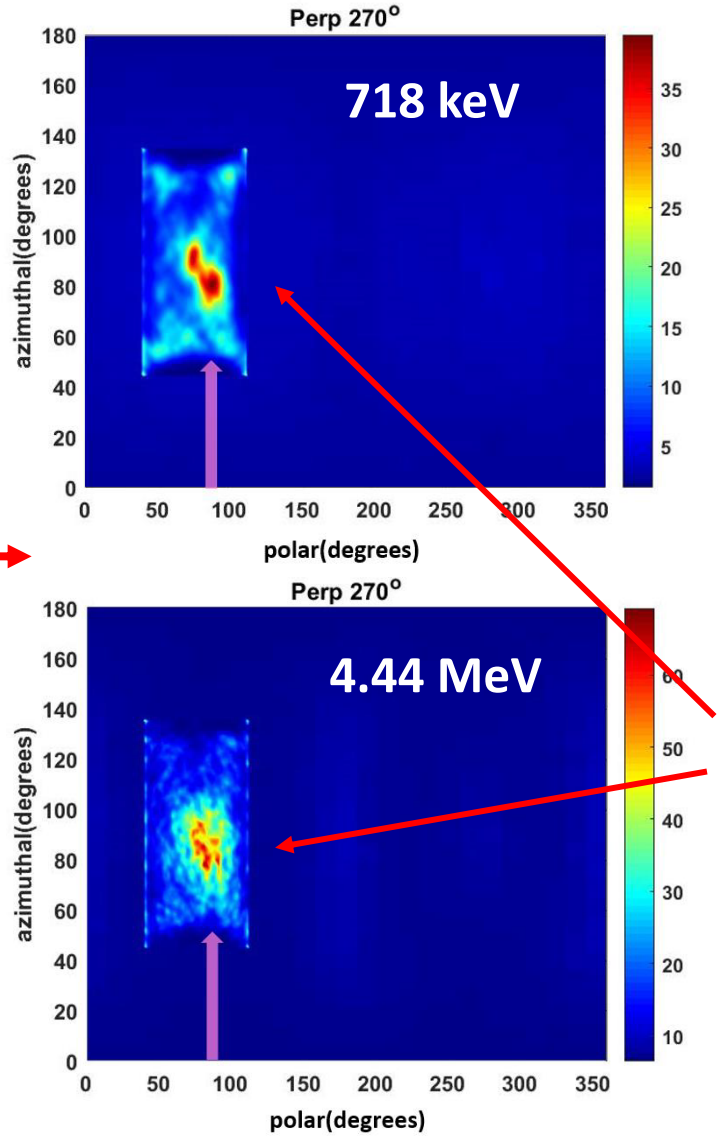
Quantitative estimate on mass

High-Energy Gamma Imaging

Poster by Valerie Nwadeyi



Truncated Field of View



For
Neutron activation imaging
or
Proton cancer therapy

70 MeV protons Interact with ^{12}C

Questions?