3-D SNM Detection Using CdZnTe Detectors

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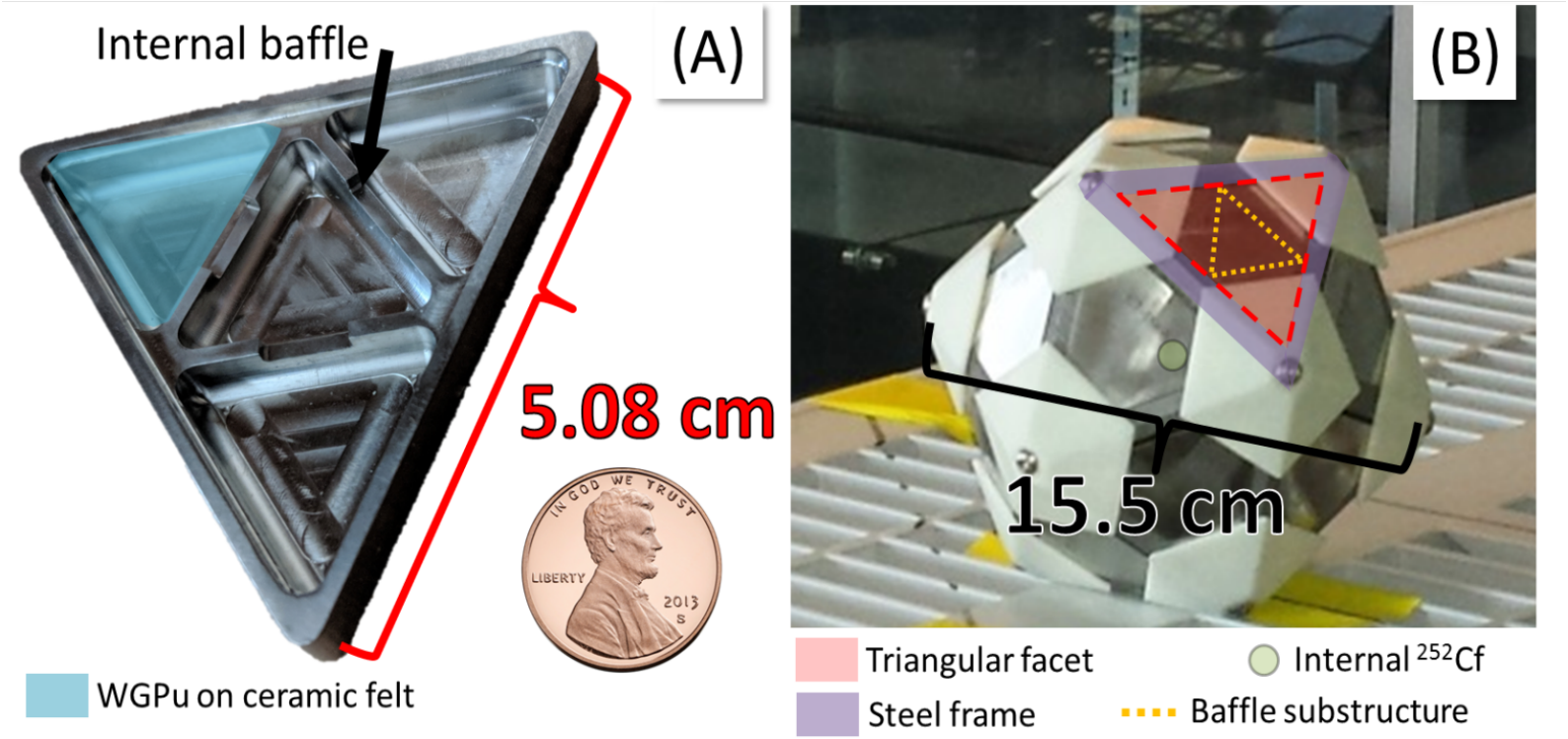
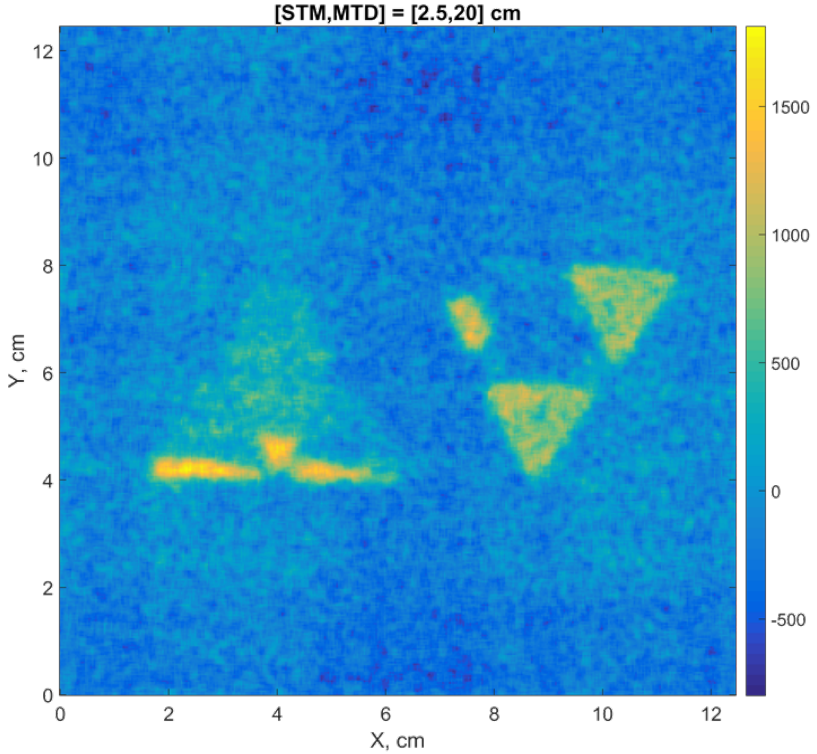
Introduction & Motivation – 3-D Gamma-Ray Imaging

- Gamma-ray imaging with high spectroscopic resolution in 3-dimensional space will be important to detect, **locate** and **characterize** special nuclear materials (SNMs) in real world applications.
- 3-D position sensitive CdZnTe detectors offer unique capabilities, including very **compact** form factor (handheld), high gamma-ray spectroscopic **resolution**, real-time gamma-ray **imaging** and **neutron detection**. Gamma-ray imaging in 3-dimensional space, especially at higher gamma-ray energies, require substantial development to be widely deployed in the field – **faster**, **higher signal-to-noise ratio** (less artifacts), **simpler** for handheld devices & **environmental awareness**.

High Resolution Time Encoded Imaging (TEI)

- Portable TEI for hand-held devices, make use of 3-D position sensing (~**300 μm**) in CdZnTe, add correction on source-to-detector distance.

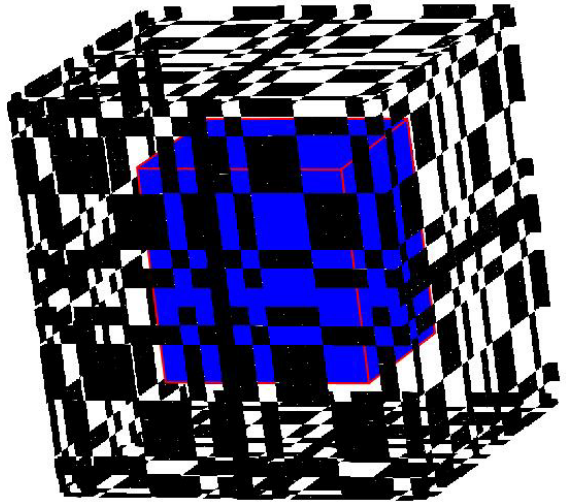




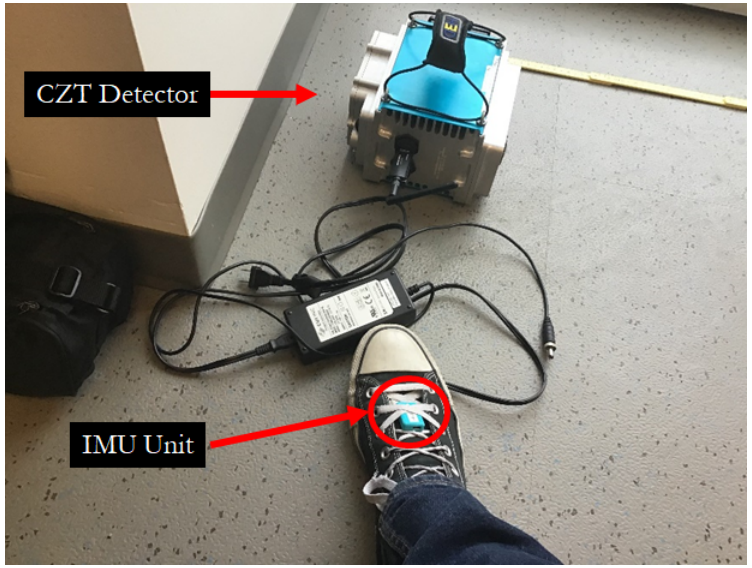
3-D Gamma-Ray Imaging

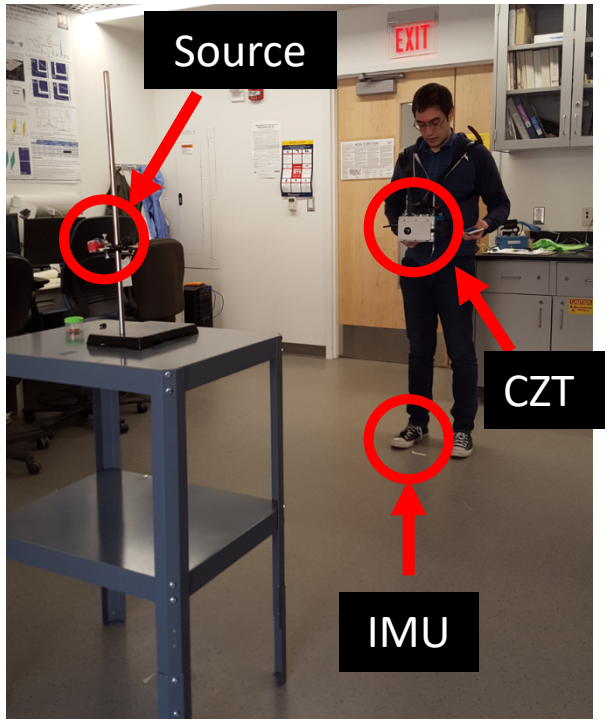
- *Motivations: GPS denied areas (**indoor** and **outdoor**), commercially availability and minimum computing for hand-held RIID's like devices.*

Sonal Joshi's cubic coded aperture

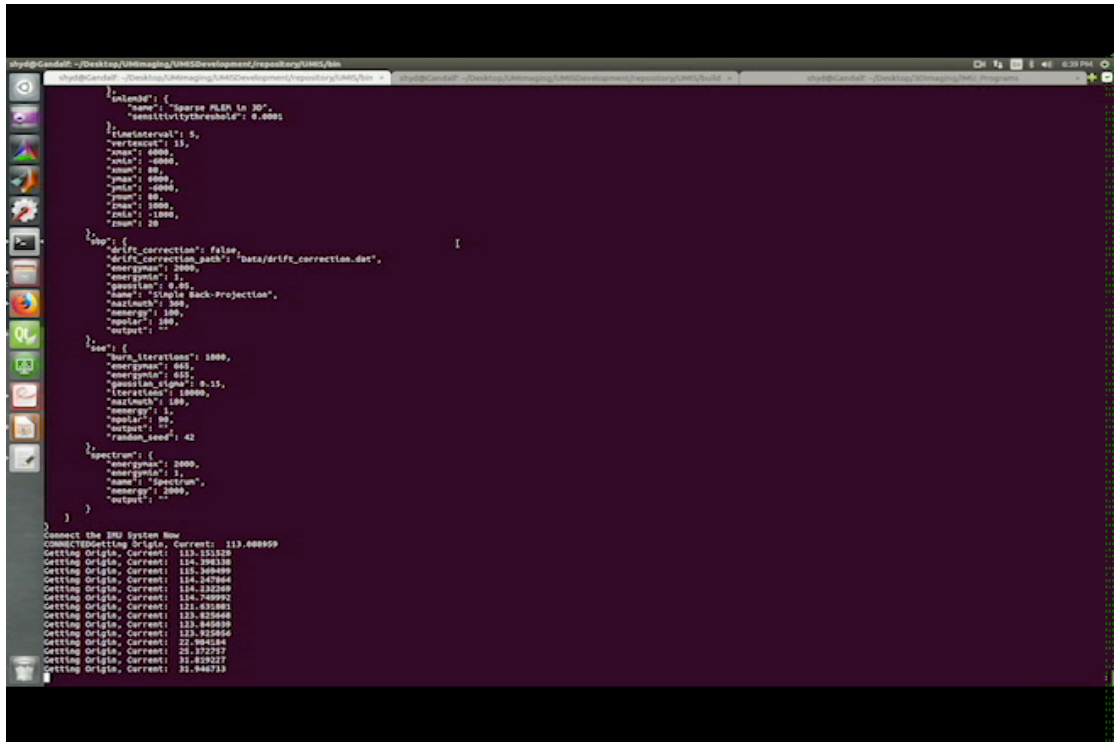


Daniel Shy's approach using Inertial Measurement Units (IMUs)



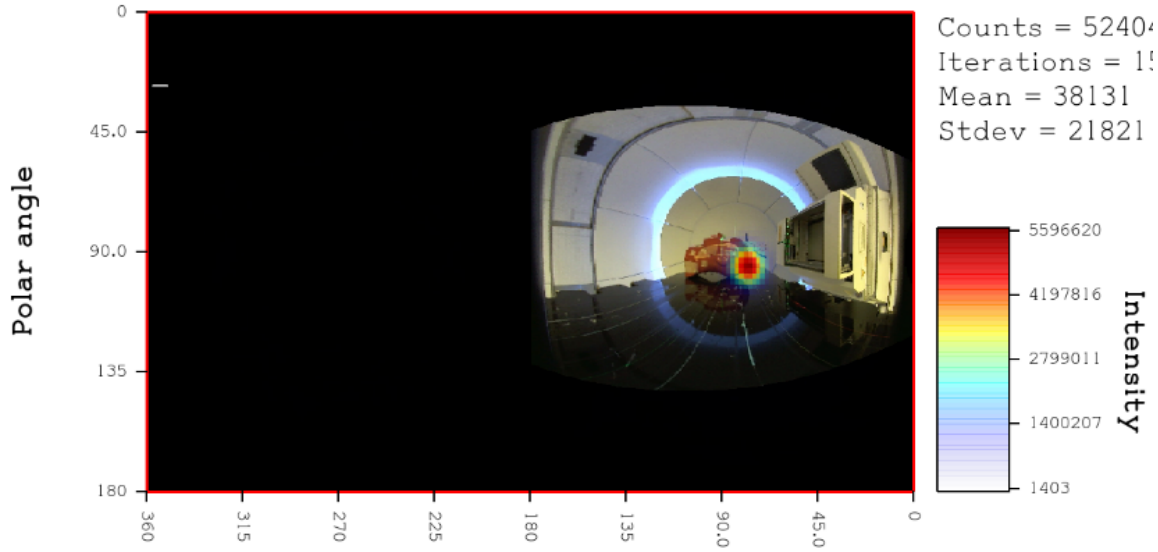


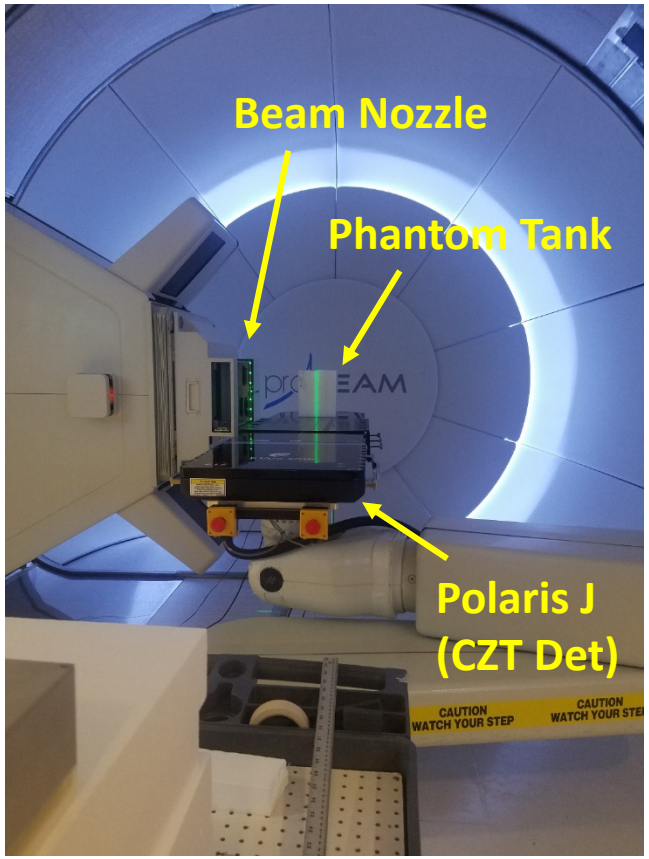
3-D Gamma-Ray Imaging



Higher-energy & higher-flux gamma-ray imaging

- **Neutron activation** analysis with added **gamma-ray imaging** capability
- **Proton cancer therapy range verification**
- NIST: **imaging hydrogen** in metal
- NASA: **planetary science** missions





MTV Impact

- Training Ph.D students to work in radiation detection field
  - Opportunities: Internships, MTV workshops, networking, connections
- Personnel transitions: Collaborations with national labs – **INL, PNNL**
- Technology transitions
  - **Who is interested**? Radiation Detection Companies
  - **Interested Companies**: H3D Inc., RMD, PHDs

Conclusion

- MTV will support our research on **3-D gamma-ray imaging for SNM detection, location and characterization**. These are important technical development very relevant to NNSA missions

Acknowledgements

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