Neutron Tomography and Simulation of Compton Imaging

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Projects

• Implement Neutron Tomography system
  • Software controls
  • Automated data collection

• Continue design work on Compton Imaging Detector
  • Geant4 Simulations
What is neutron tomography?
Task: Integrate hardware and software into one system

CCD Camera from Oxford Instruments

Rotary Stage from Thorlabs

XYZ translational stages from physik instrumente (PI)
Solution: LabVIEW
PI LabVIEW Example
What to perform tomography on?

- $8 Disposable Vape
- 2nd most popular on market
Beam Tube 2 (BT2)

- Closer to reactor → more collimated beam
- Has top tier Neutron & Xray Tomography
- Special Thanks to Jacob LaManna
Neutron Guide D (NGD) Tomography Setup
Tomography Images

Our camera

BT2 Camera
3D Renders
Reconstruction Video
Projects

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Hope to find sources of some metals: Aluminum, Arsenic, Cadmium, Chromium, Copper, Iron, Manganese, Nickel, Lead, Antimony, Tin, Titanium, Uranium, Tungsten, Zinc
Compton Imaging

Fig. 1 Principle of Compton imaging with a two-stage pixelated detector. The Compton cones are generated based on the energy and location of the scattered gamma rays to determine the origin of the emission.

\[
\frac{1}{E'} - \frac{1}{E} = \frac{1 - \cos(\theta)}{m_e c^2}
\]
Geant4

• Particle Simulation software developed by CERN
• Expanding on work by Ben Riley (SURF 2017) and Nathaniel Kaneshige (SURF 2018)
Status of projects

- Automated Neutron Tomography Controls: Complete
- Gamma Ray Compton Imaging Geant4: Fixed and ready to simulate

To do:
- 3D Model Reconstruction Process for Neutron Tomography
- Optimize Geant4 Simulation Model for detector design
Bibliography


Acknowledgements

- Heather Chen-Mayer (MML)
- David Jacobson and Jacob LaManna (PML)
- Joe Dura, Julie Borchers, Brandi Toliver (NIST SURF)
- Ben Riley (SURF 2017), Nathaniel Kaneshige (SURF 2018)
- Center for High Resolution Neutron Scattering