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Title: PAIN Schubert Review: Experiment

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PAIN Schubert Review: Experiment

These slides detail the experimental section of the PAIN Schubert Review.

The PAIN project is investigating the utility of portable neutron radiography for emergency response.

Further sections give an overview of the PAIN project and detail the simulation performed.

Experimental Review Agenda

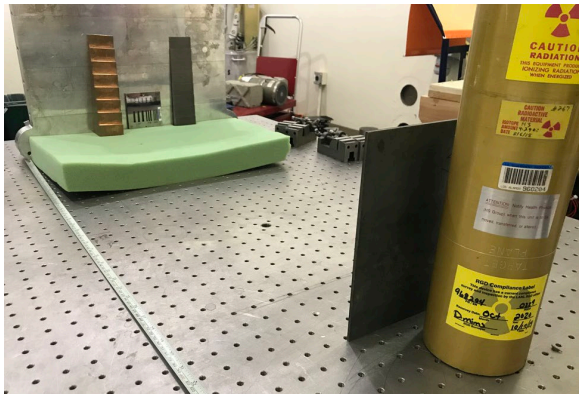
Experiment

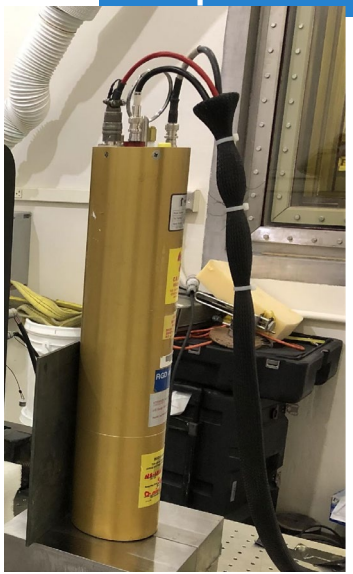
- Introduction
- Detector Characterizations
- Neutron Generator Characterizations
- Scatter Characterization
- Betatron vs DT generator

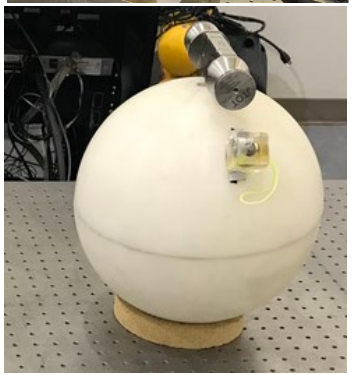
Experimental goals

Experiment

- Test current state of the art performance
  - Characterize detectors
    - Flat panel
    - Storage phosphor
  - Characterize generators
    - Flux
    - Spot size
- Inform simulations
  - Scatter
  - Building system models
  - Predict the future

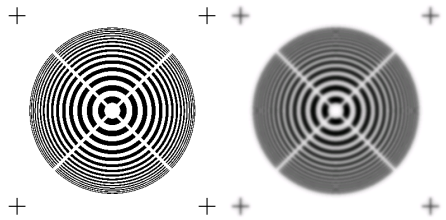




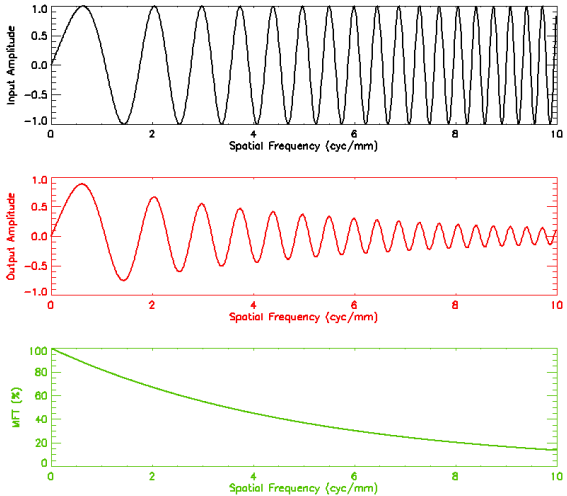


Overview of NPS, MTF, DQE

Modulation Transfer Function

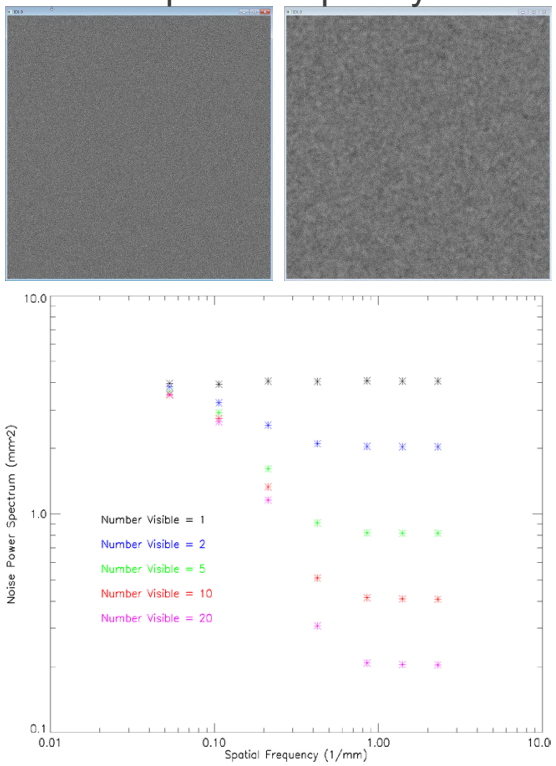


$$MTF(f) = \frac{Output\_Modulation}{Input\_Modulation}$$



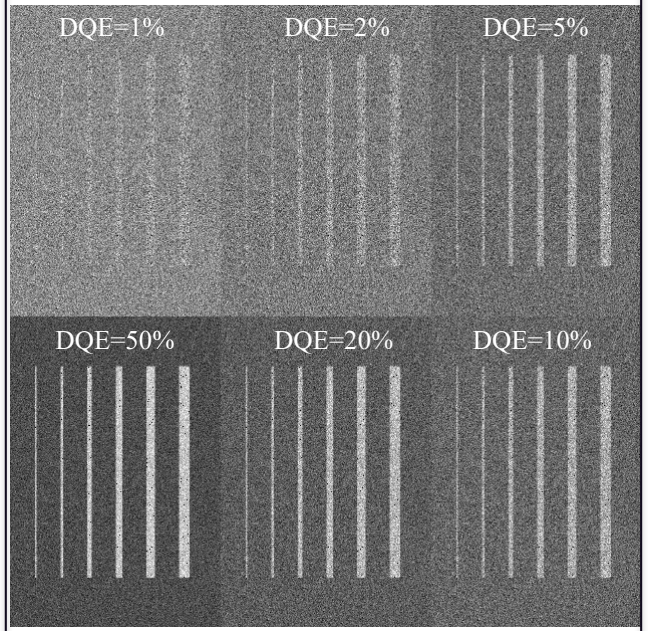
Noise Power Spectrum

How noise power is distributed in spatial frequency.



Detective Quantum Efficiency

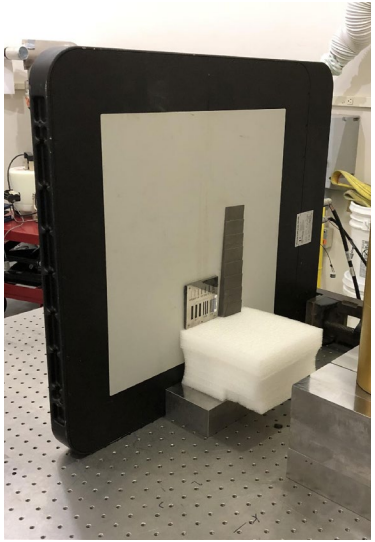
$$DQE(f) = \frac{MTF^2(f)}{NPS(f)N_{eq}}$$



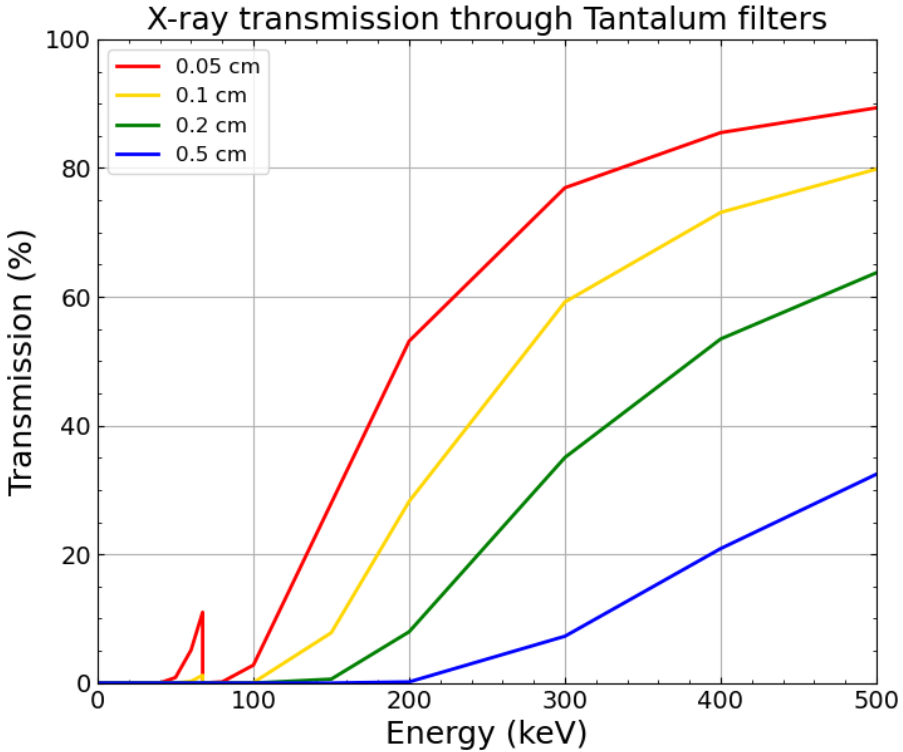
Detector Characterization

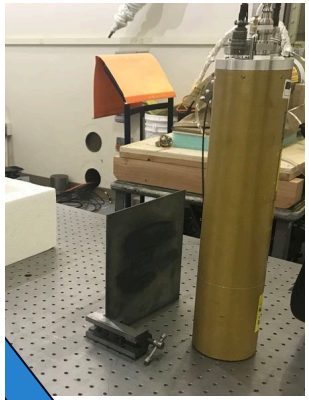
Experiment

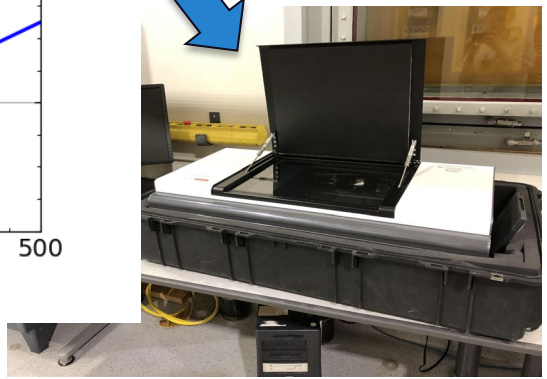
Flat Panel Sys



- Perkin Elmer 162
- 2.4 mm thick ZnS scintillator
- 200 micron pixel pitch



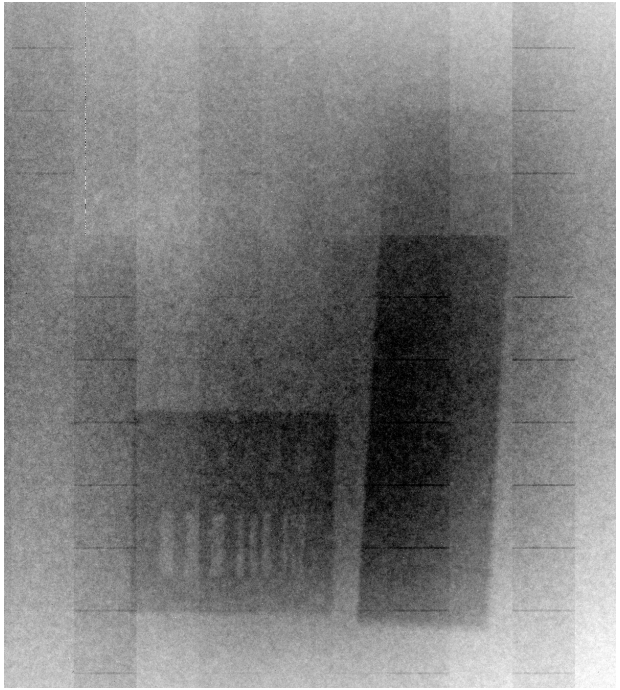




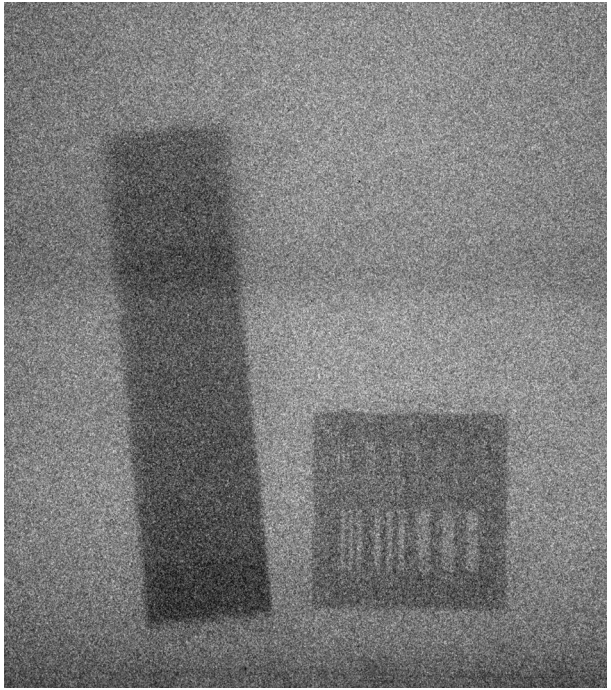
Flat Panel vs Storage Phosphor

Experiment

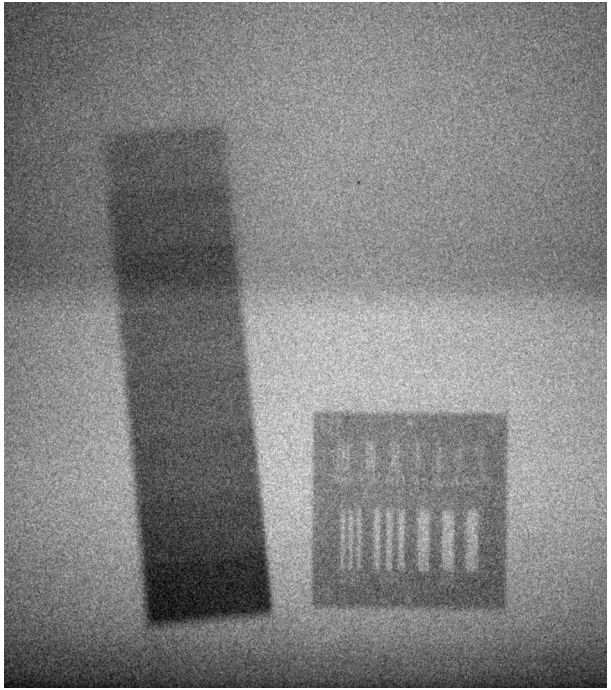
Flat Panel



Storage phosphor (single)



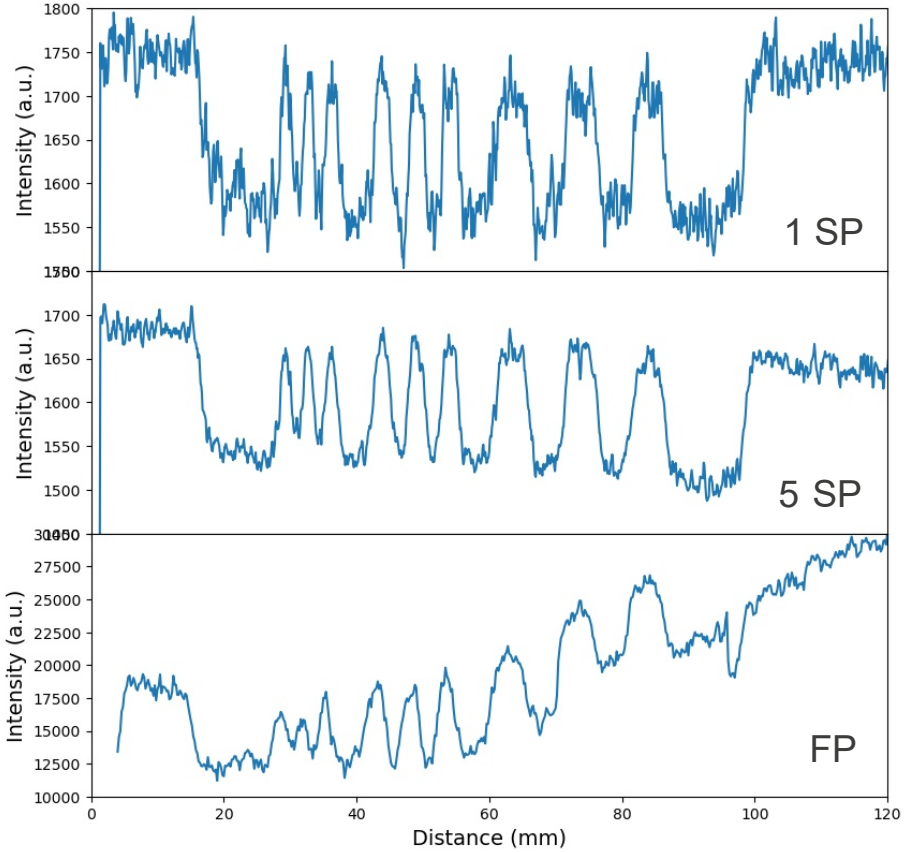
Storage phosphor (stack)



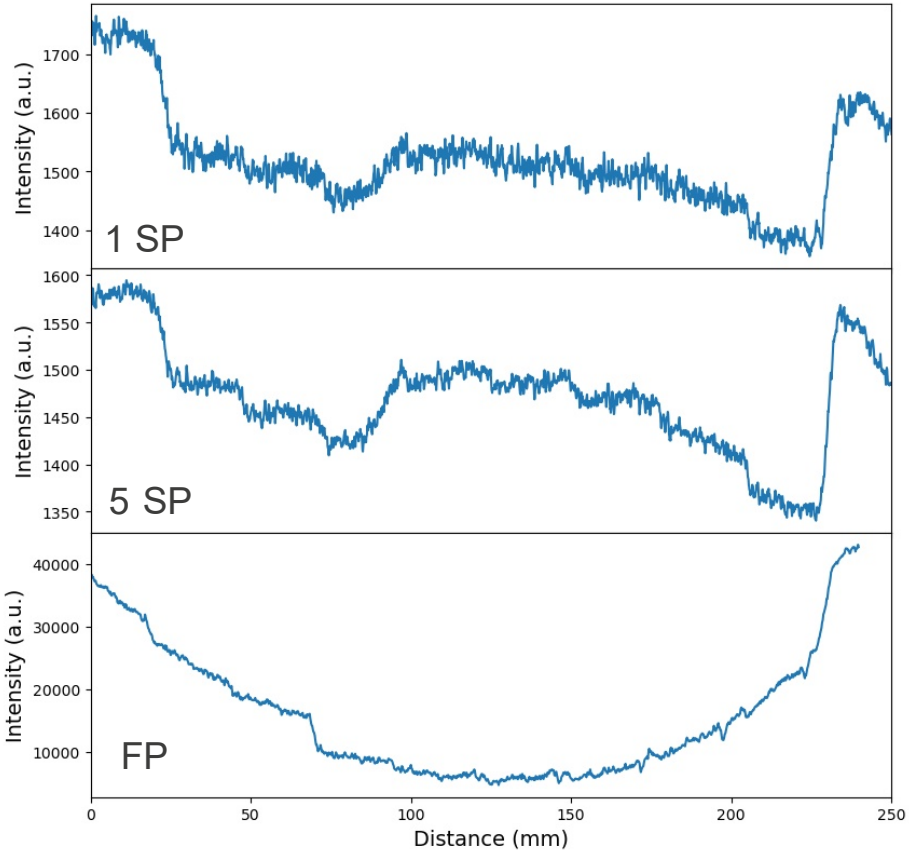
Flat Panel vs Storage Phosphor

Experiment

Grid Line Outs

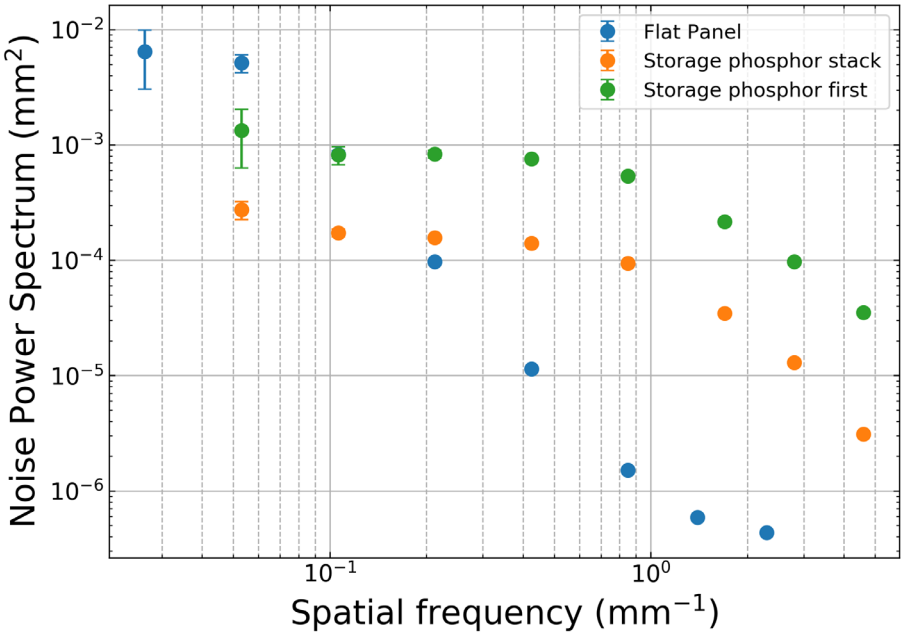


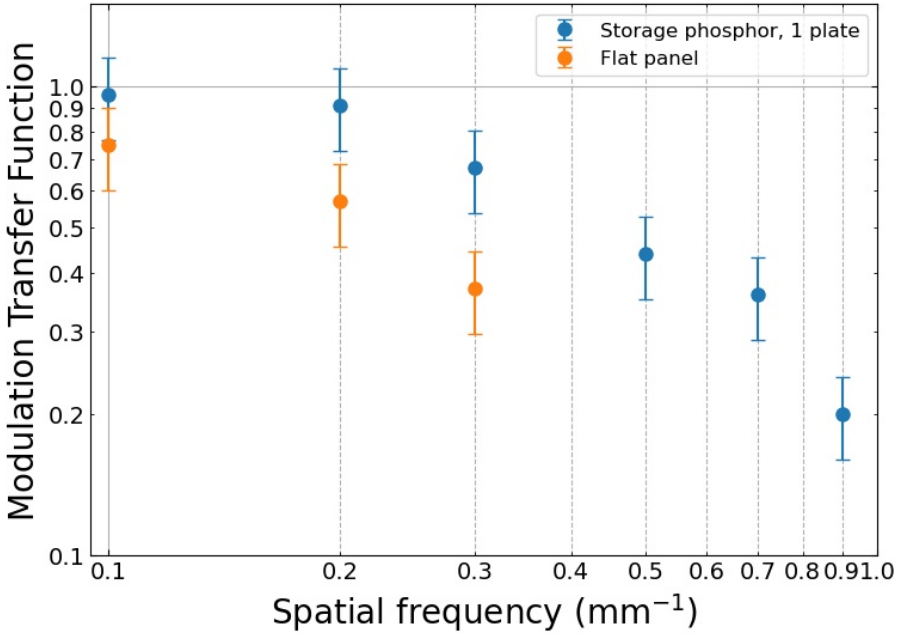
Step Wedge Line Outs



Flat Panel vs Storage Phosphor

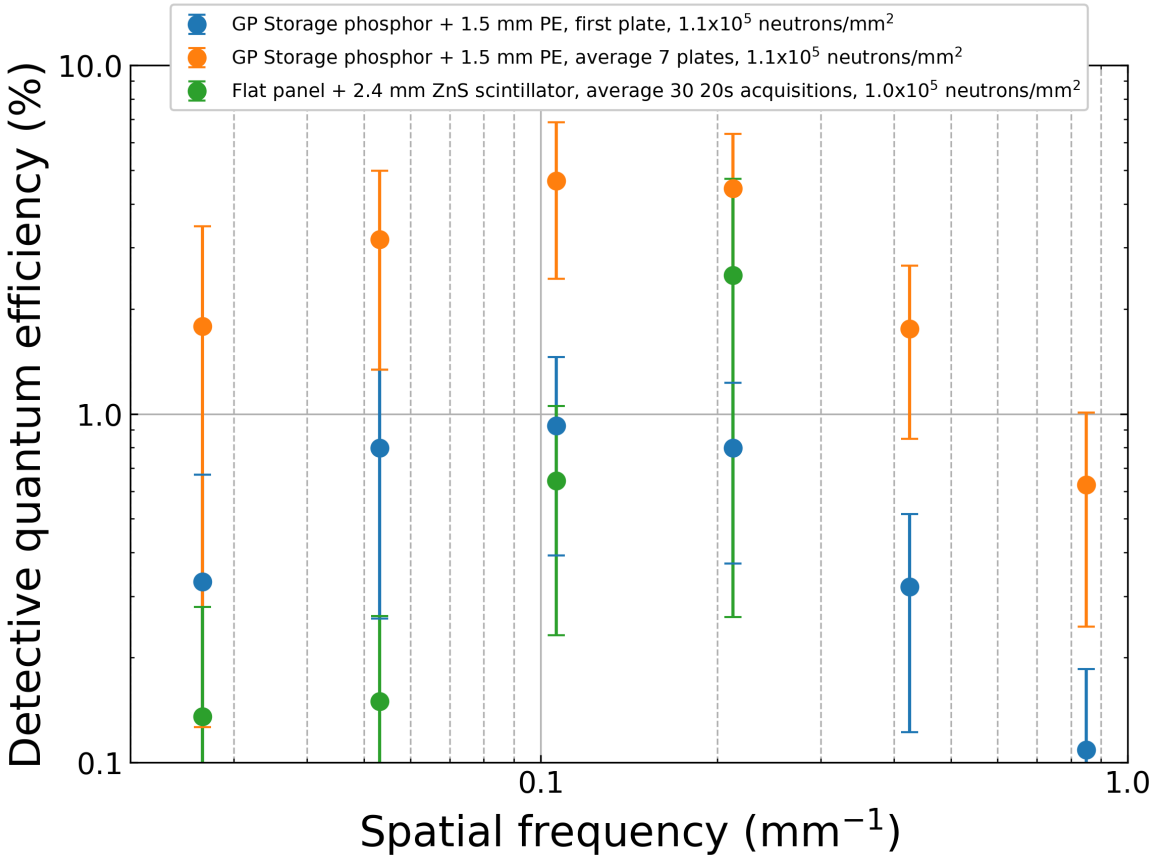
Experiment





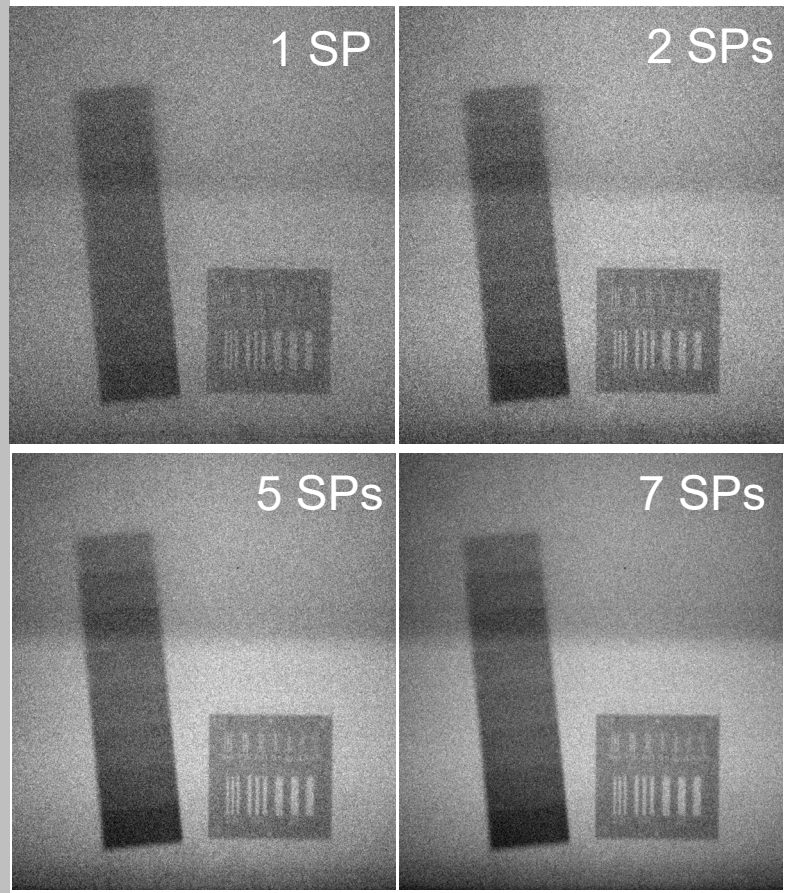
Flat Panel vs Storage Phosphor

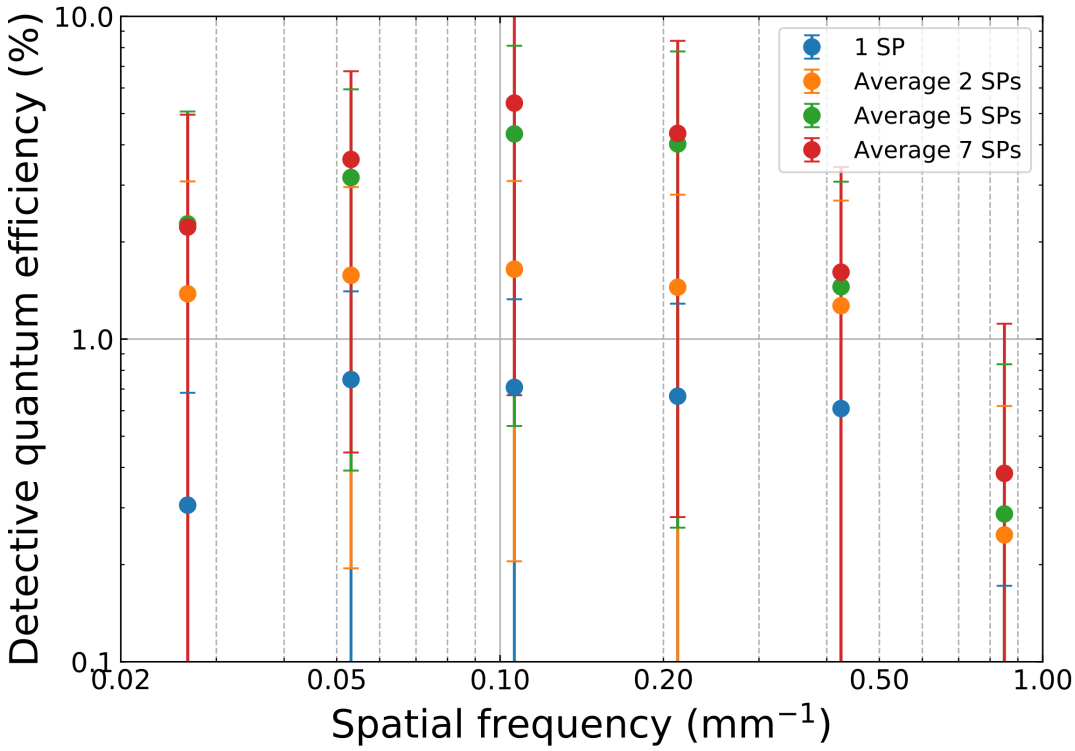
Experiment



Stacking storage phosphors

Experiment

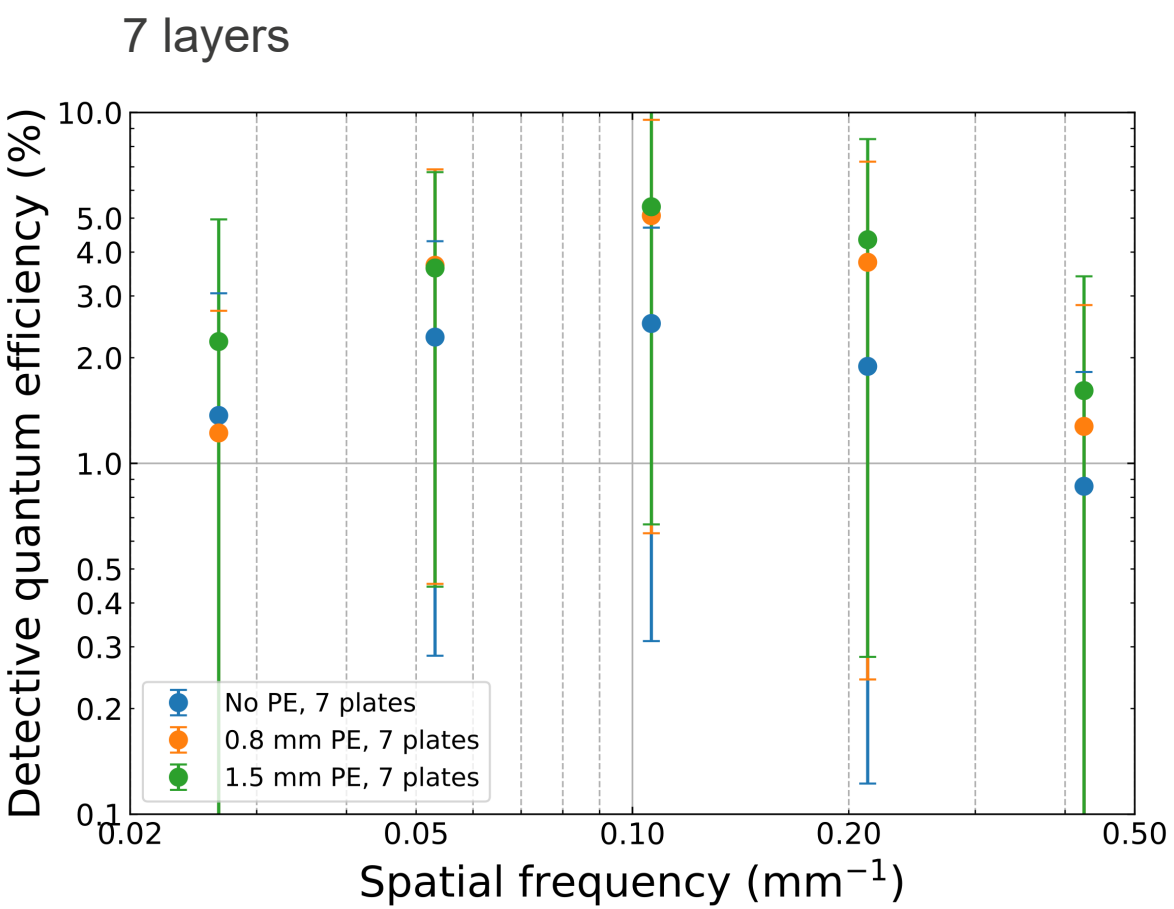


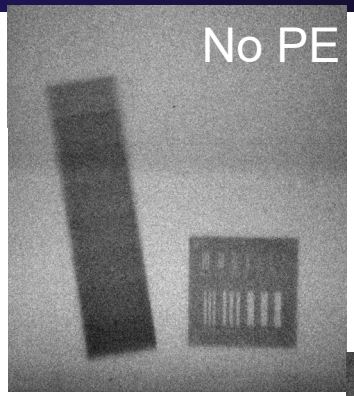


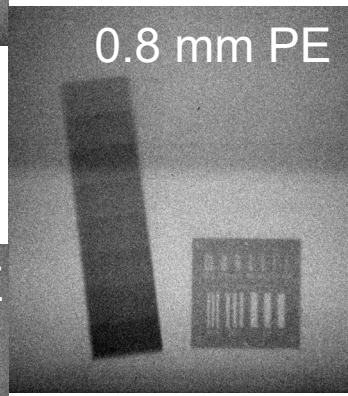
1.5 mm thick PE

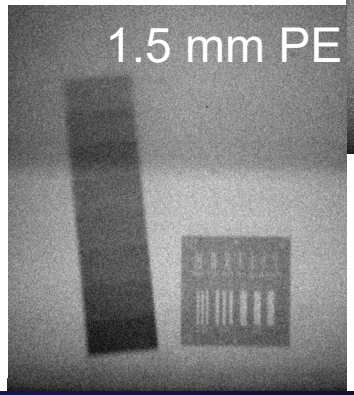
Thickness of converter material

Experiment





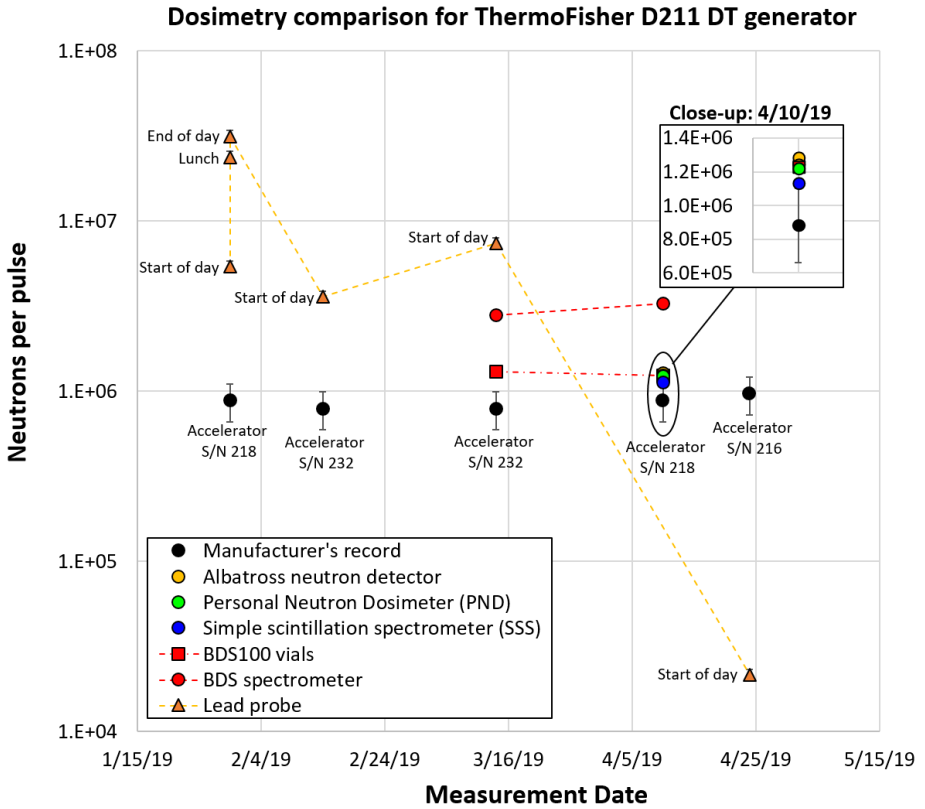




Thermo Fisher Flux Measurements

Experiment

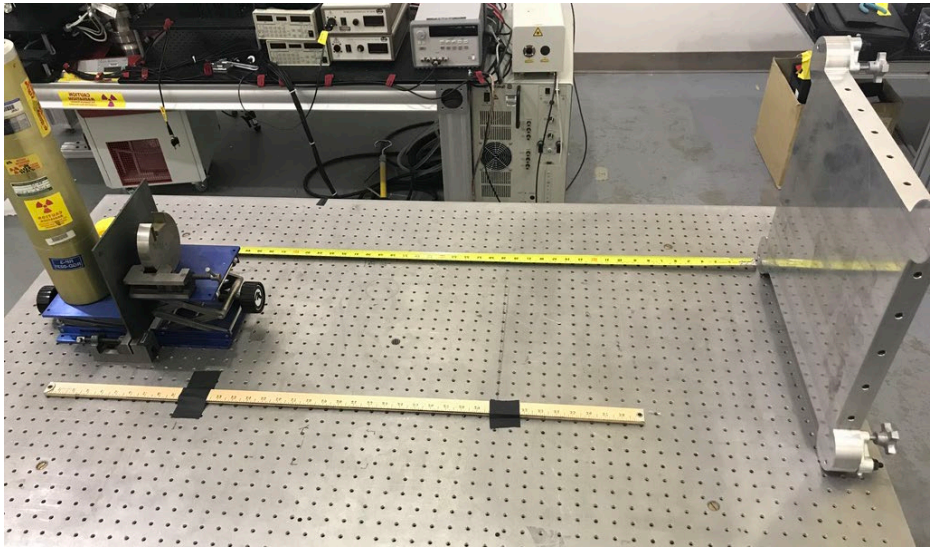
- Radiation Effects and Reliabilities Team
  - ISR Division
- Measured flux from Thermo Fisher neutron generators with multiple detectors
- Identified Albatross neutron detector as best measurement tool
  - Gamma insensitive
  - No dose limit
  - Agreed within reason to manufacturer's specifications

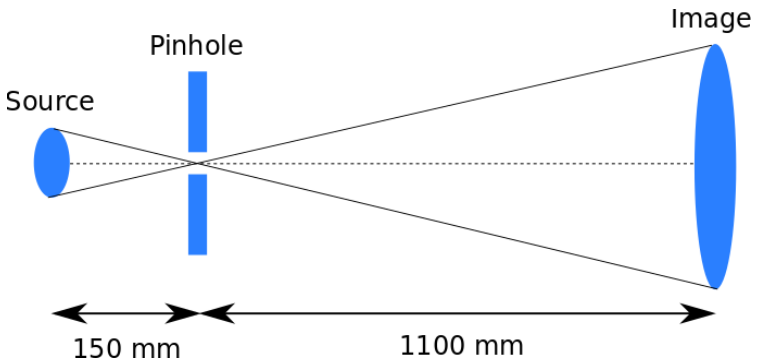


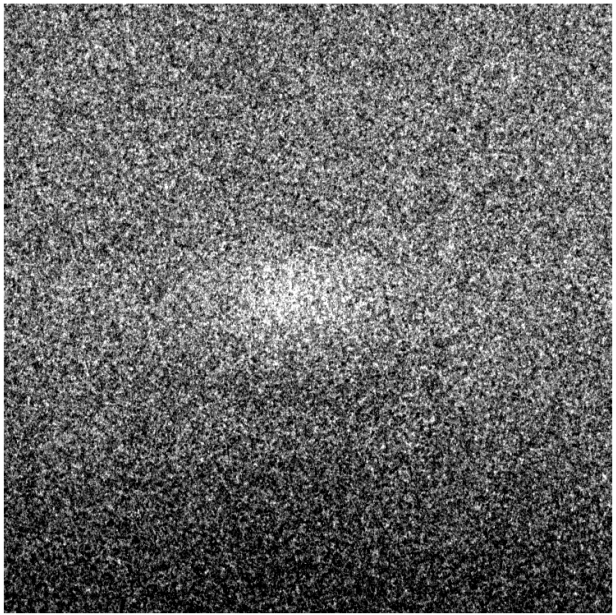
Measured ~1.3E6 n/pulse ~1.9E8 n/s/4π

Thermo Fisher Spot Size

Experiment



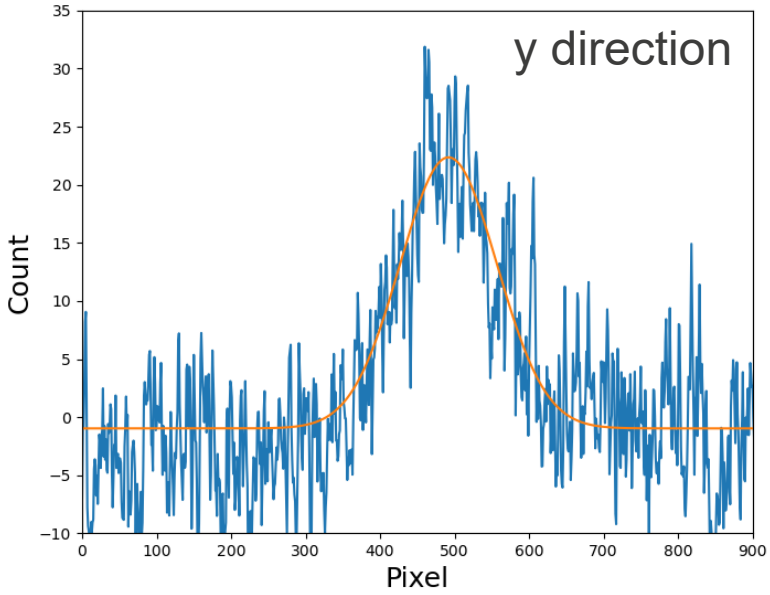


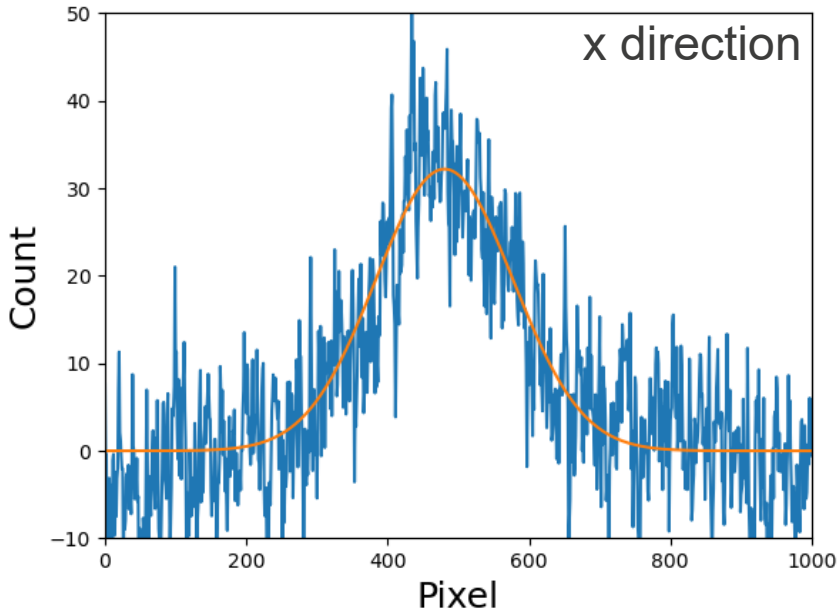


Magnification = 8

Thermo Fisher Spot Size

Experiment



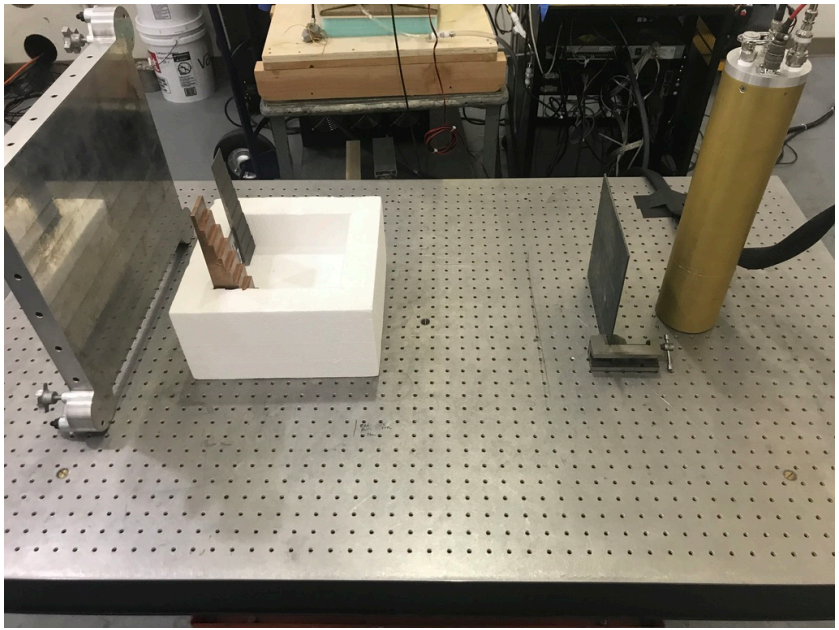


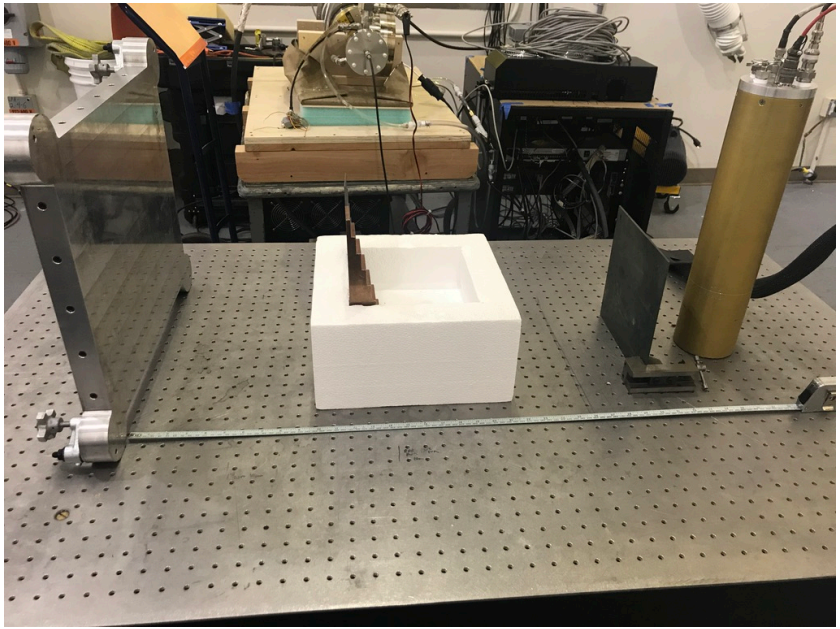
Direction	d_{FWHM} (mm)	d_{LANL} (mm)
X	3 +/- 2	5 +/- 3
Y	2 +/- 1	3 +/- 3

Scatter characterization

Experiment

- Varying the object to detector position
  - At detector, 6” from detector, 12” from detector
- Fixed source to object distance of 36”
- On table and on the floor

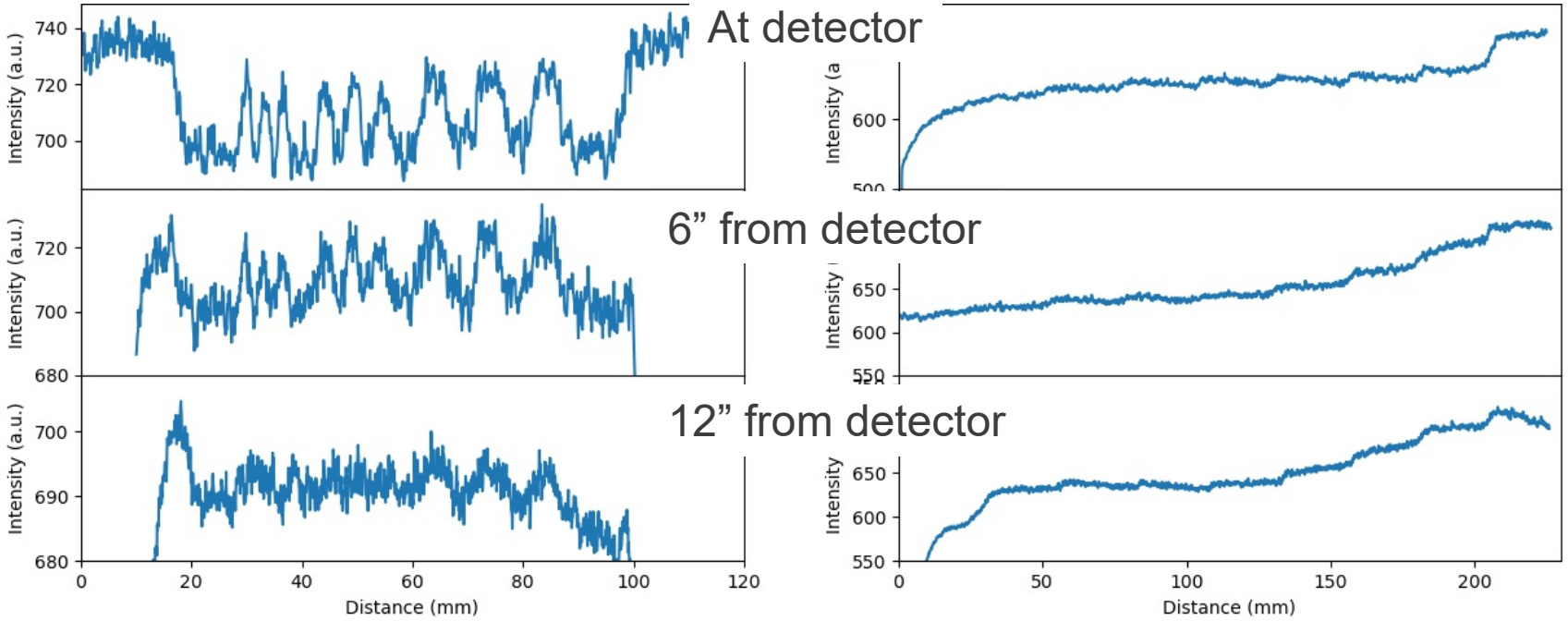




Scatter Characterization

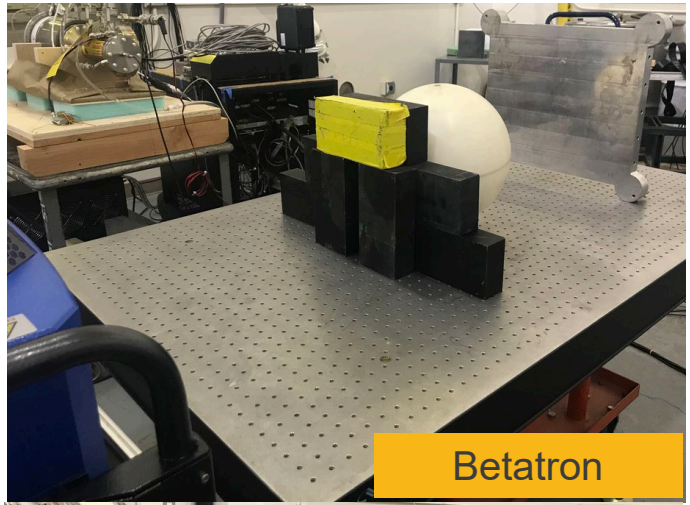
Experiment

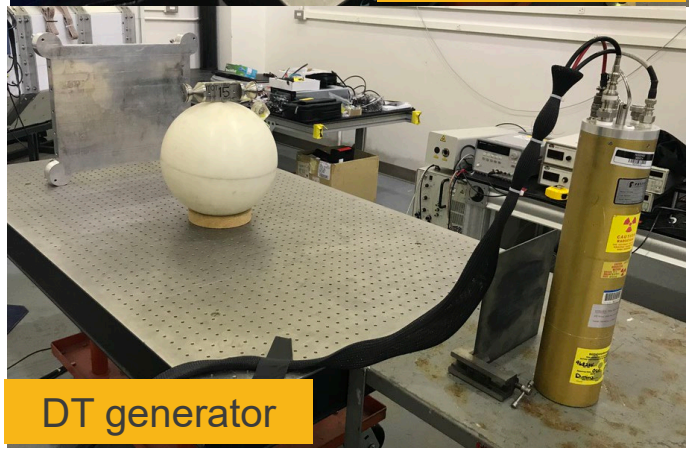
Preliminary analysis will look at line outs of step wedge and resolution grid



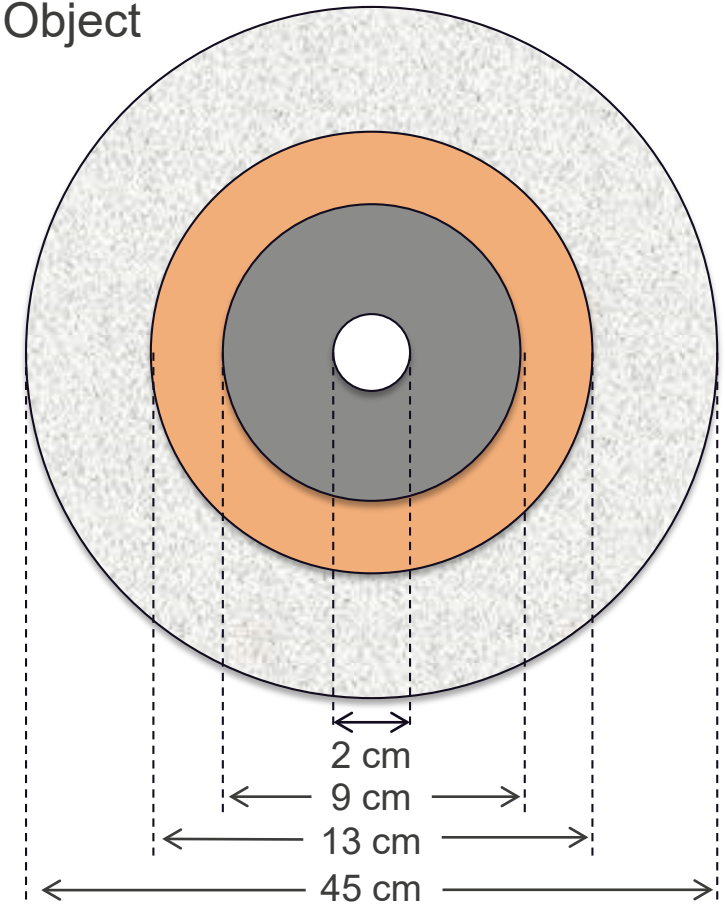
Betatron vs DT generator

Experiment





French Test Object



Betatron vs DT generator

Experiment