



Annual Users' Conference

**ADVANCING RADIATION SAFETY.
EMPOWERING PROGRESS.**

M Resort, Henderson, NV | June 15 – June 18



MIRION
TECHNOLOGIES

*Advancing Radiation Safety.
Empowering Progress.*

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Neural Radiance Fields for Drums (NeRD)

Cameron Cianci

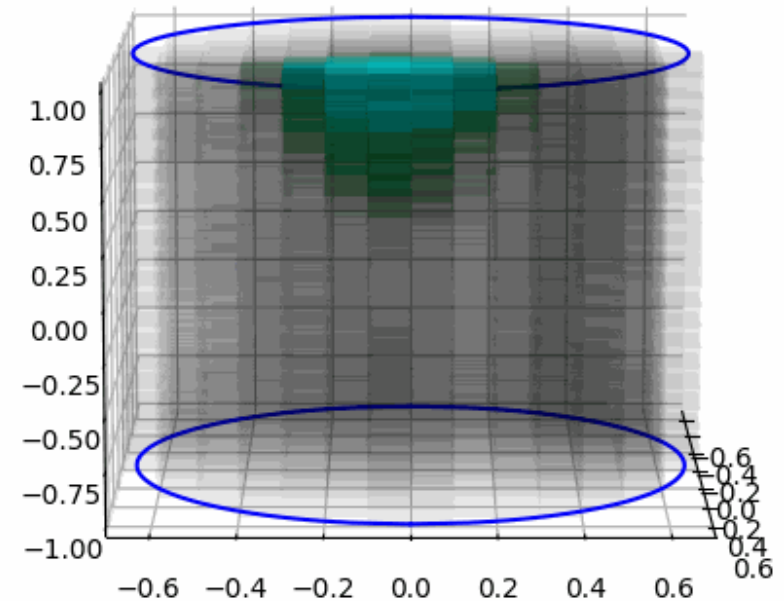
Sr. Applied Machine Learning Engineer

Mirion Connect | Annual Users' Conference 2026

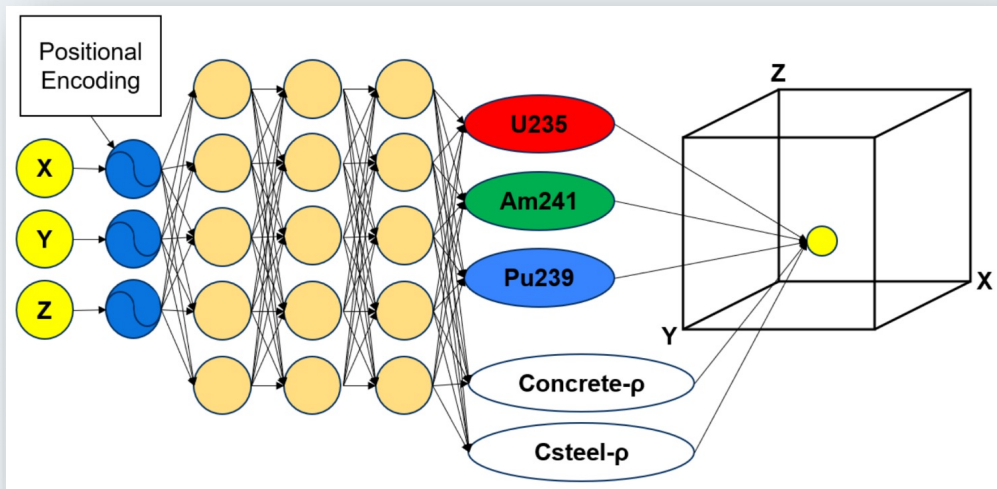
Henderson, NV

Neural Radiance Fields for Drums (NeRD)

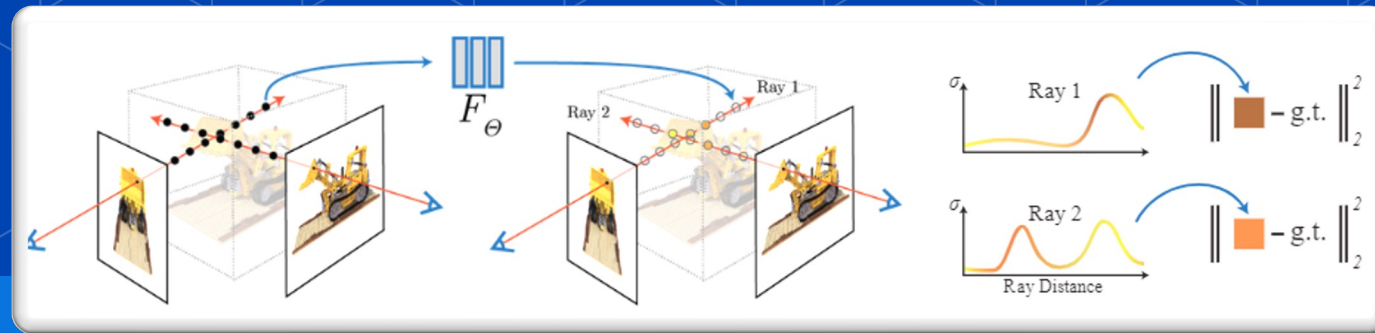
*Cameron Cianci, Xavier Ducoux,
Taylor Kurtz, Patrick Chard, Marcel
Villani*



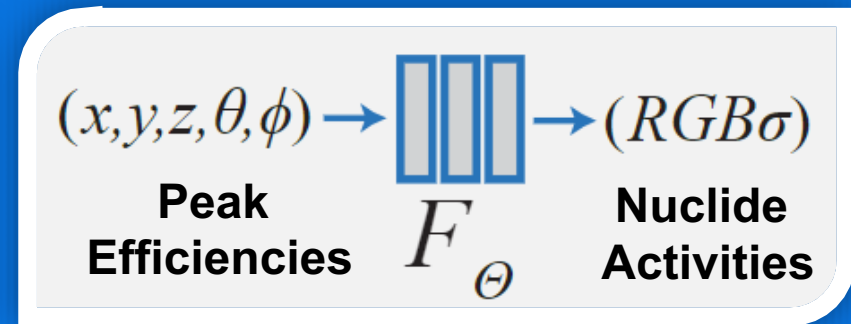
Neural Radiance Fields (NeRF)



Cianci, Cameron, et al. "Using Neural Radiance Fields to Map Fissile Material in Corrugated Metal Pipes" Waste Management Symposia, 9 Mar. 2026, Pheonix, AZ.

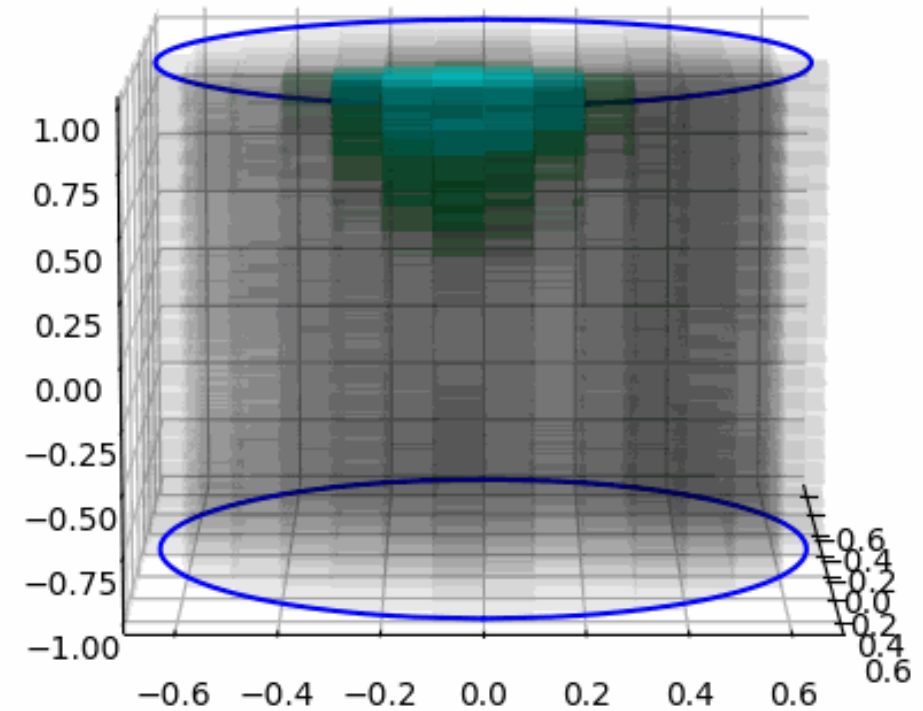
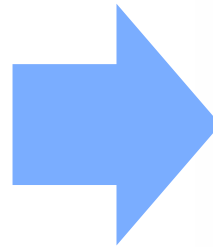


Mildenhall, Ben, et al. "Nerf: Representing scenes as neural radiance fields for view synthesis." *Communications of the ACM* 65.1 (2021): 99-106.



- Encode a 3D representation inside a neural network
- "Training" the neural network refines the 3D reconstruction

From NeRF to NeRD



Mildenhall, Ben, et al. "Nerf: Representing scenes as neural radiance fields for view synthesis." *Communications of the ACM* 65.1 (2021): 99-106.

Multi-System Compatibility

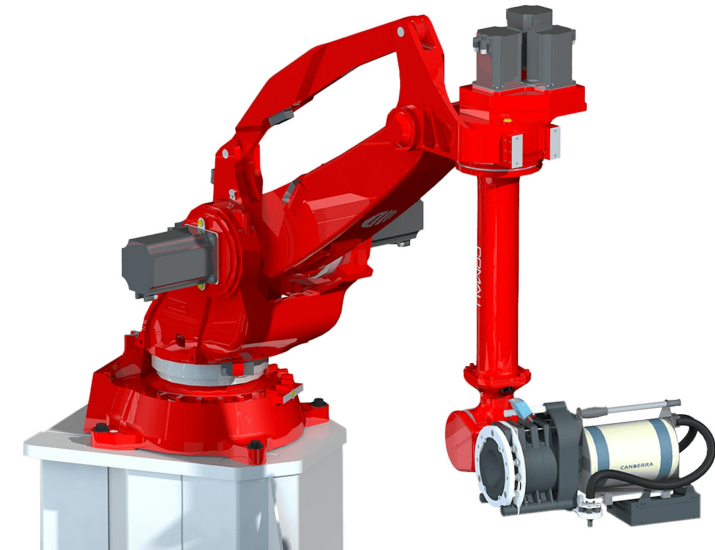
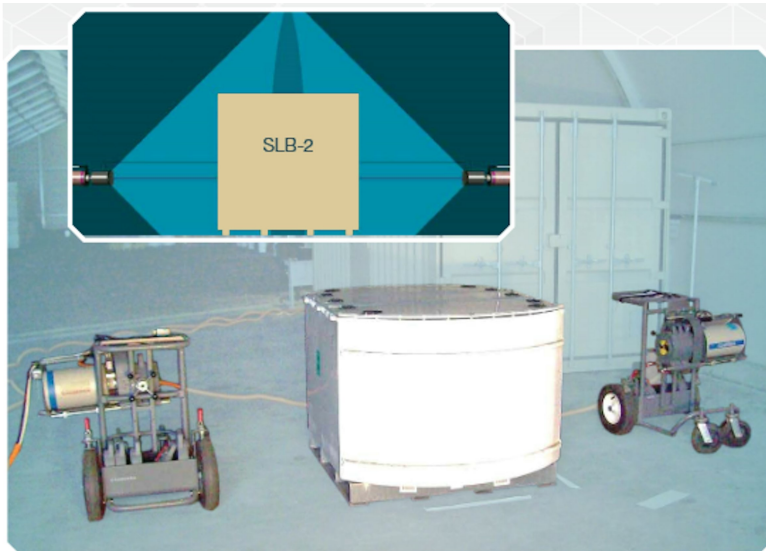
**Tomographic
Gamma
Scanner
(TGS)**



Segmented Gamma Scanner (SGS)



**Mobile ISOCS
Large Container
Counter
(MILCC)**

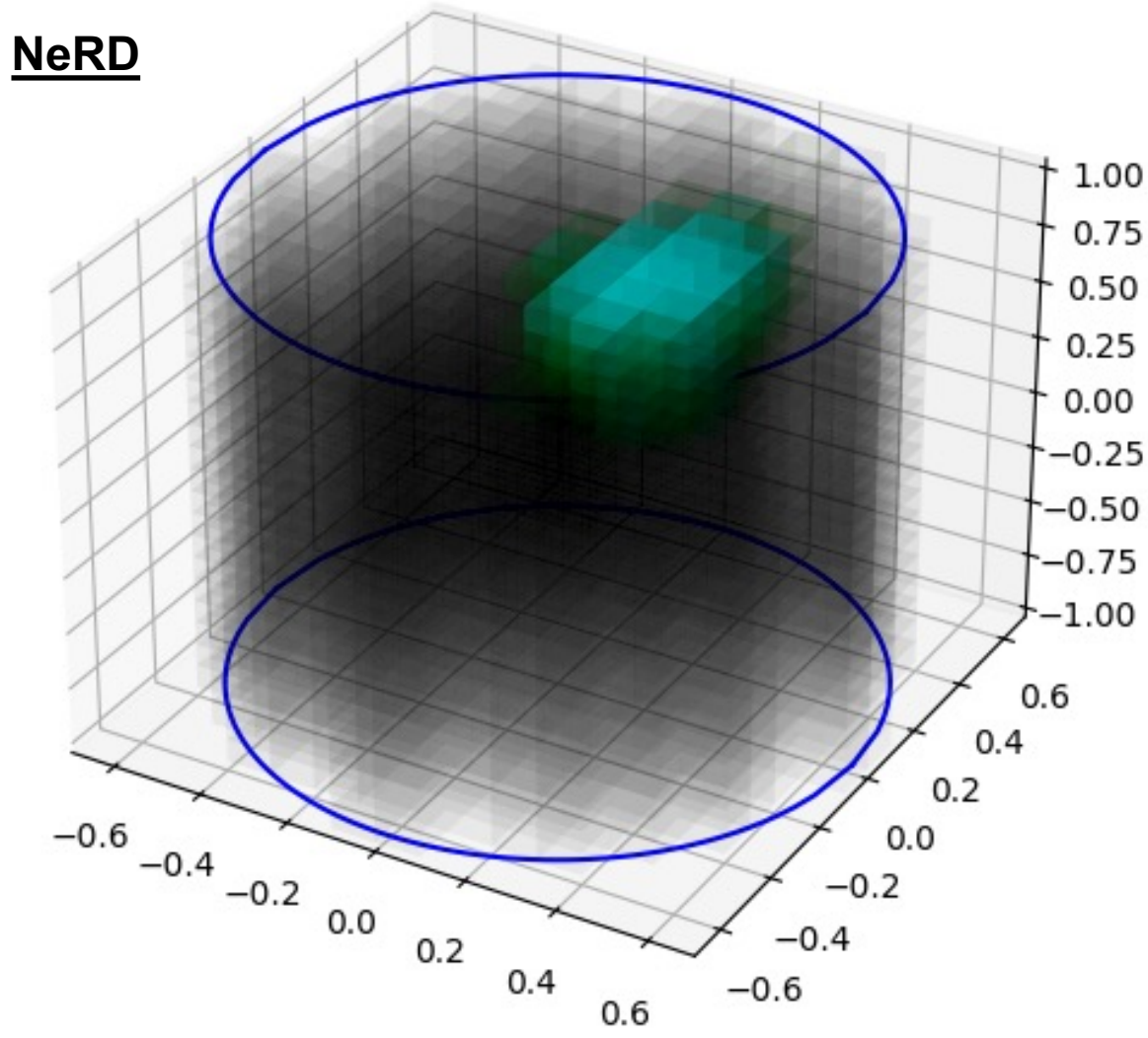
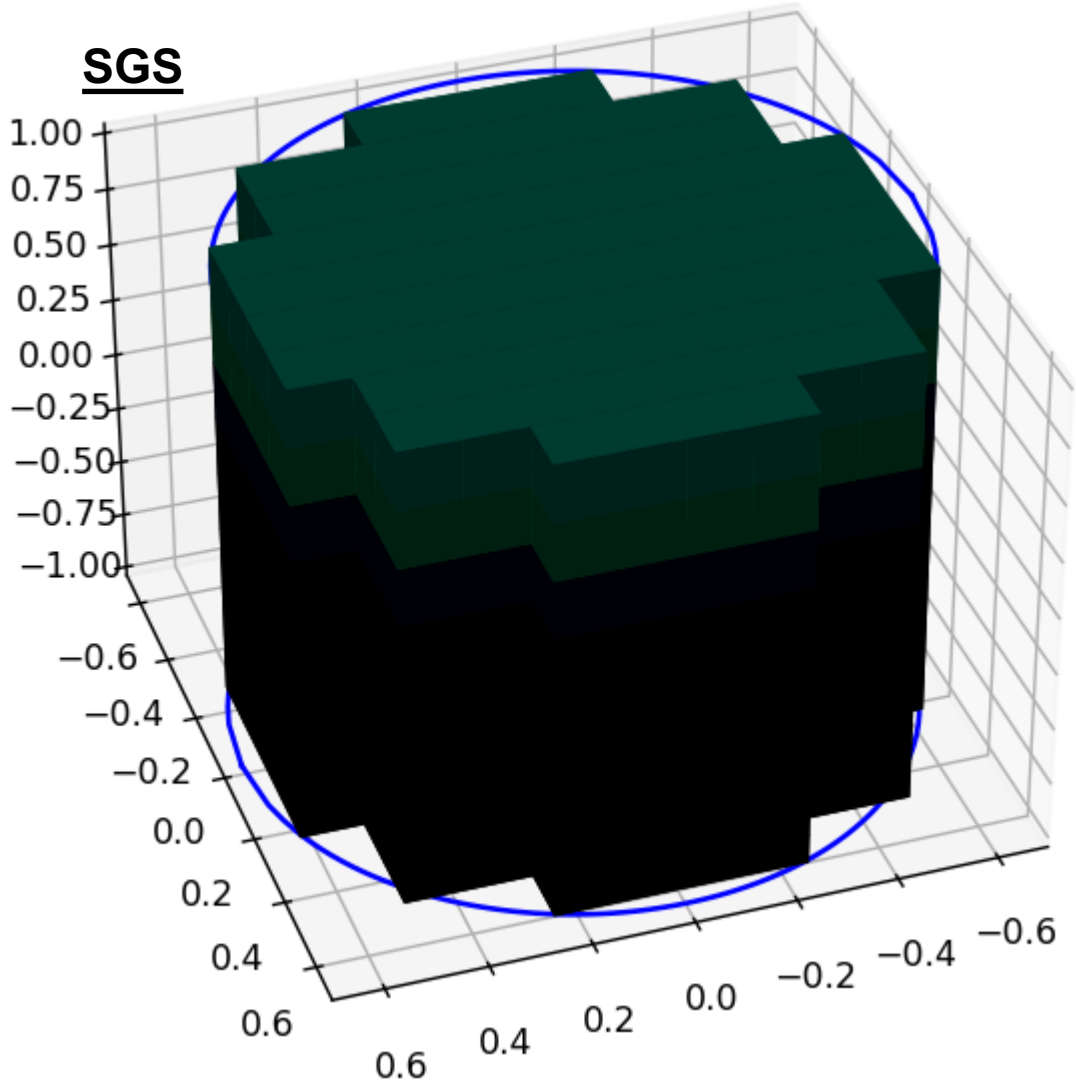


RoboCount

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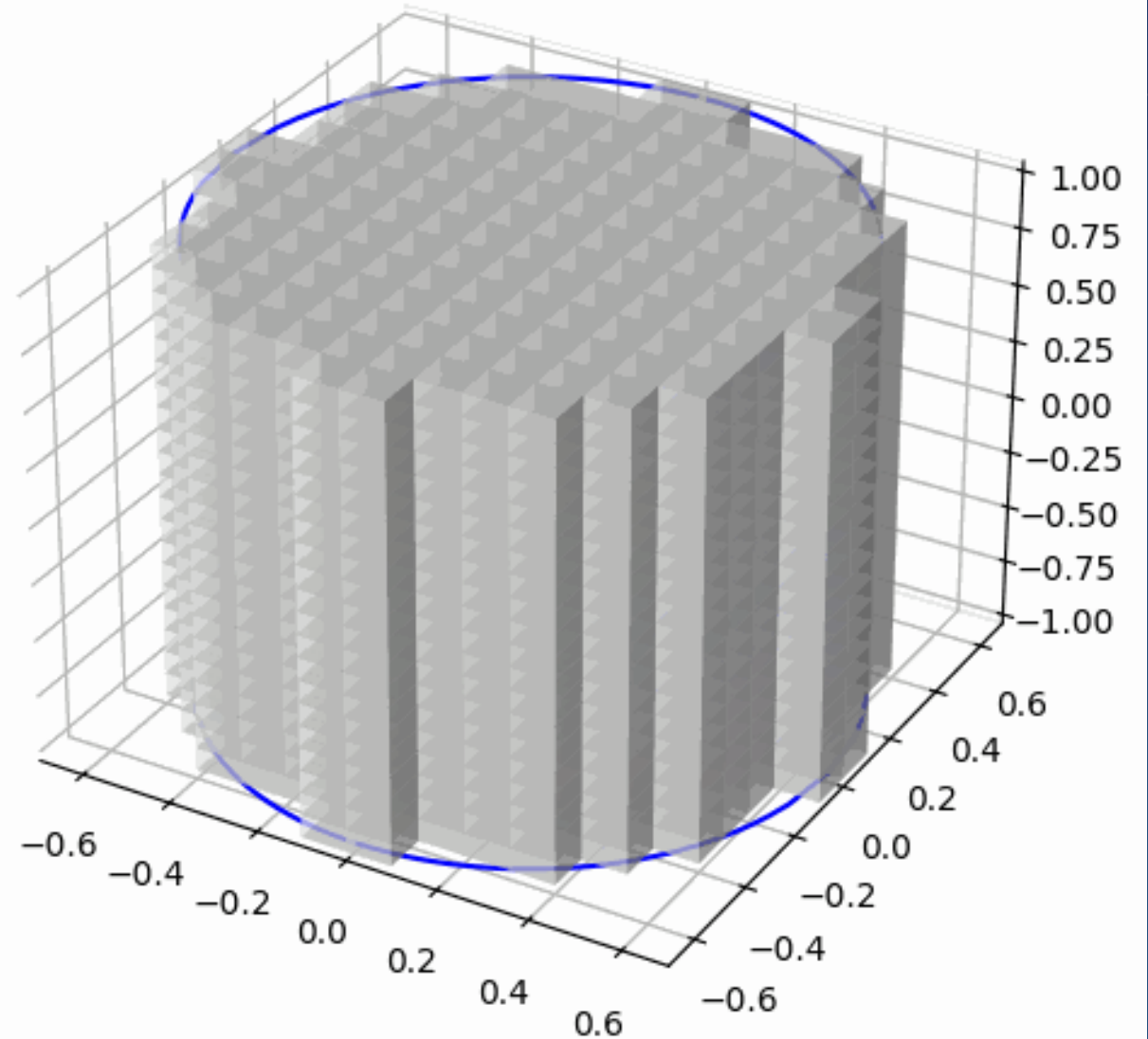
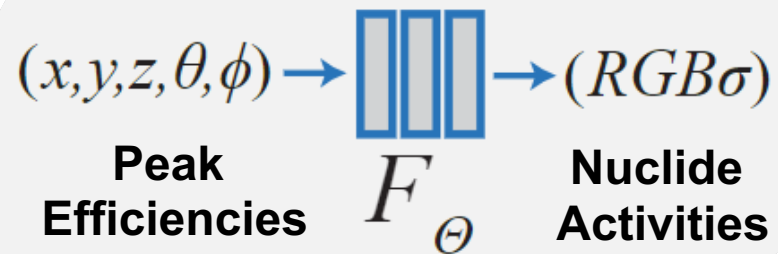
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Enhanced-SGS Data

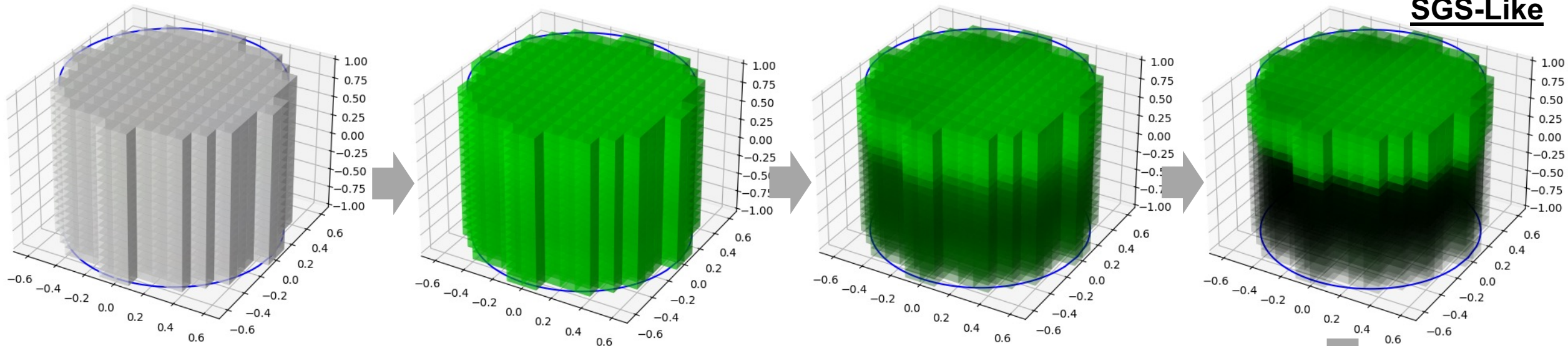


NeRD Training

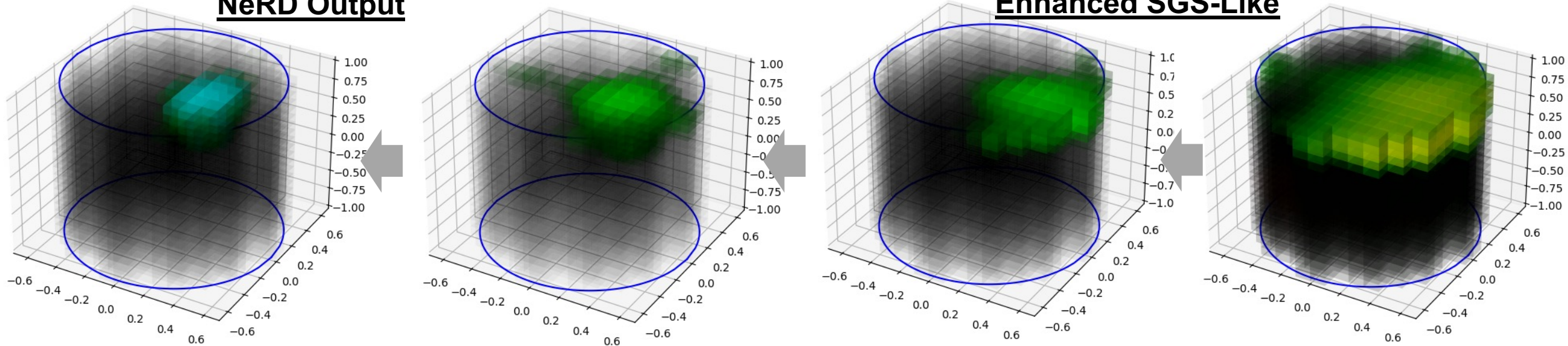
- *NeRD iteratively refines its tomographic reconstruction*
- *Localizes sources*
- *Compares measured peak efficiencies to expected*
- *Performs gradient descent to improve reconstruction*



NeRD Reconstruction

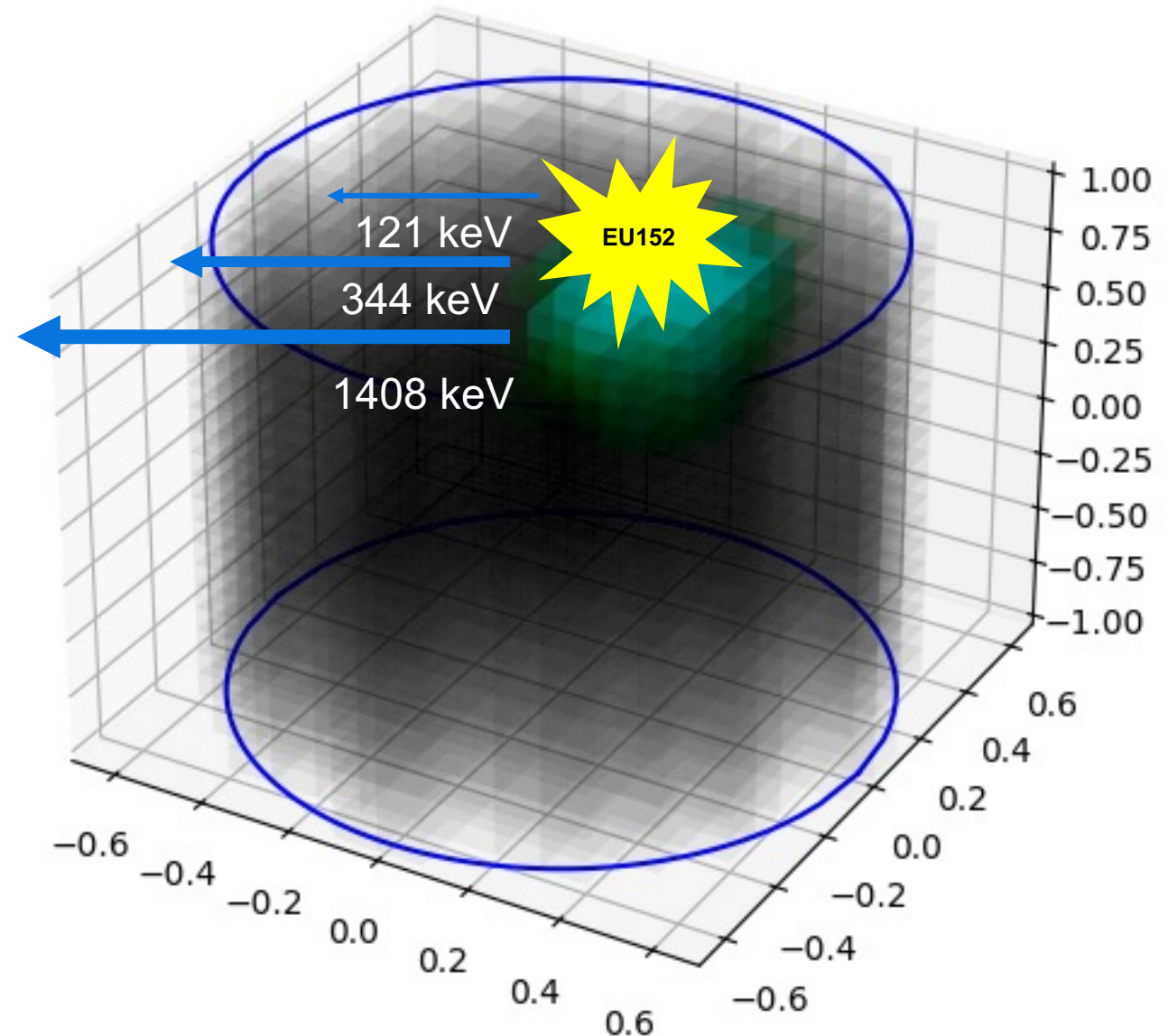


NeRD Output



Differential Peak Analysis

- *Take advantage of multiple lines in one nuclide*
 - *Better performance on heterogeneous matrices*
- *Difference between high and low energies*
 - *Identify position with higher accuracy*



Multi-System Compatibility

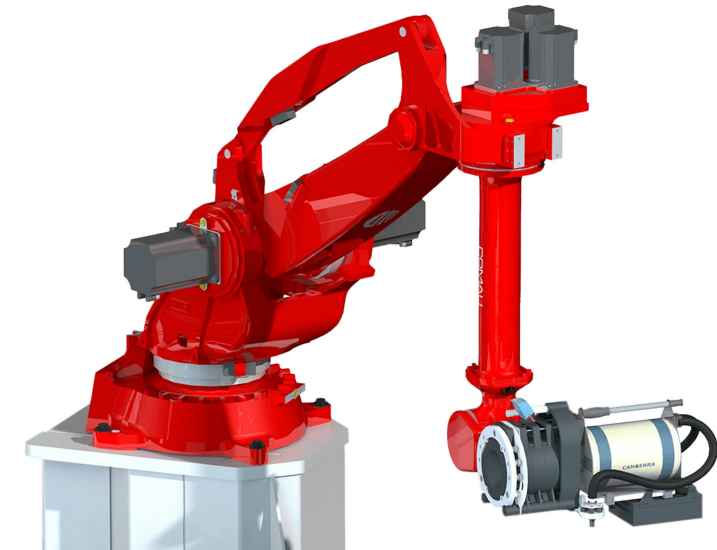
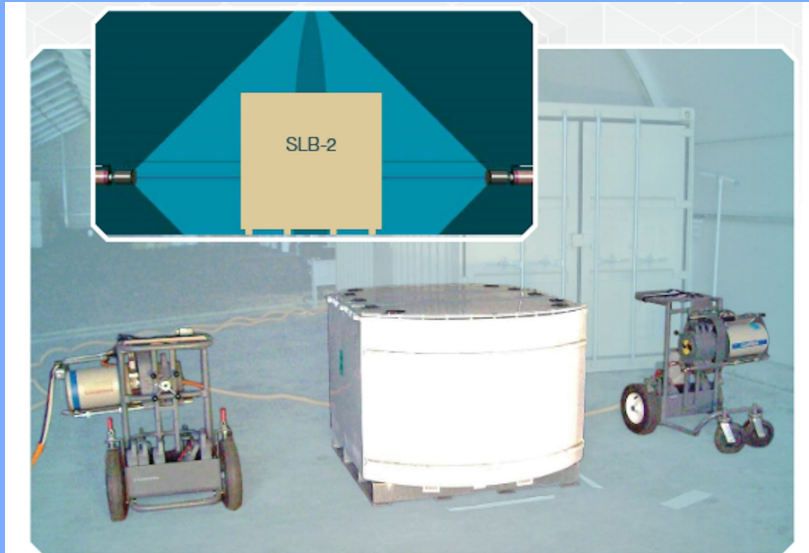
**Tomographic
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Segmented Gamma Scanner (SGS)



**Mobile ISOCS
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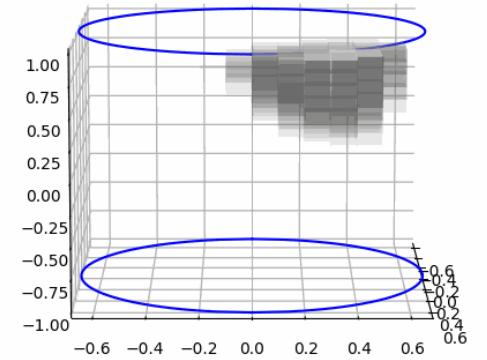
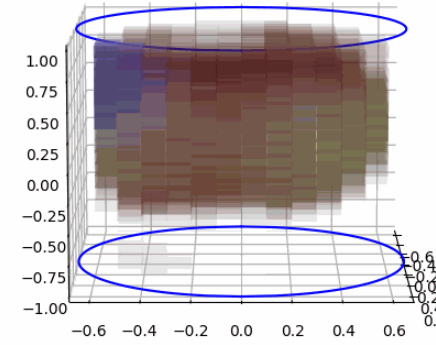
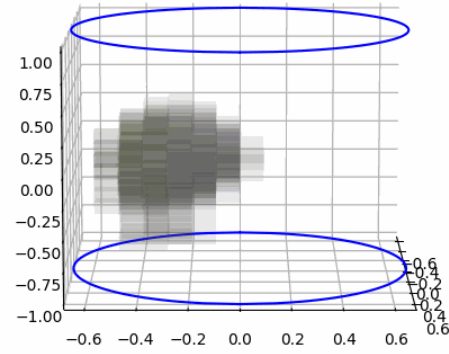
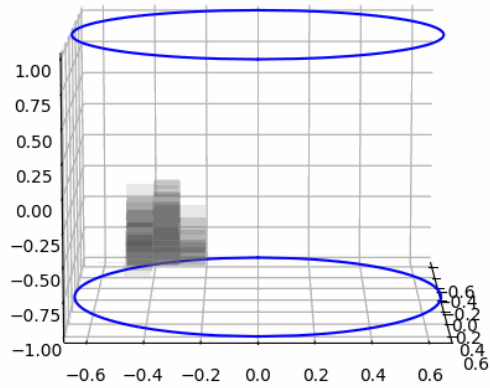


RoboCount

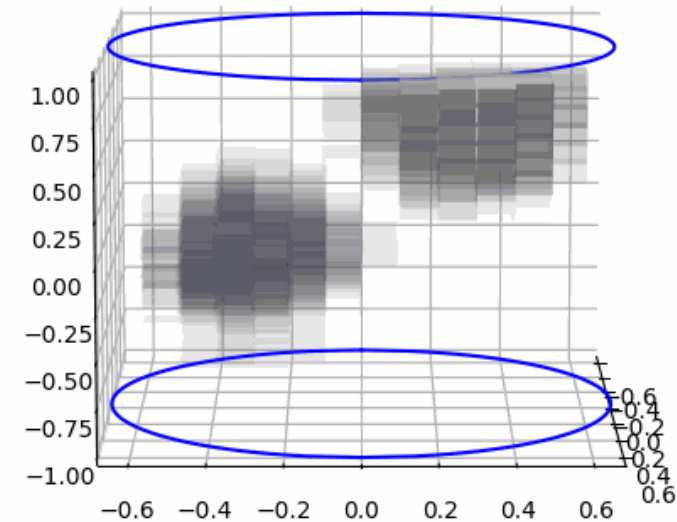
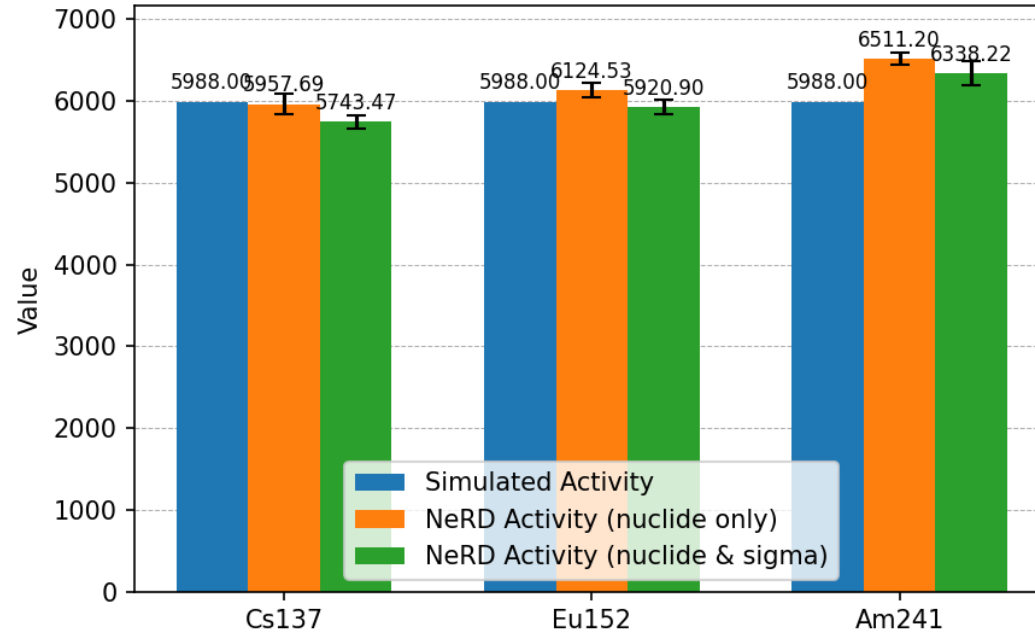
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Simulated MILCC Voxel



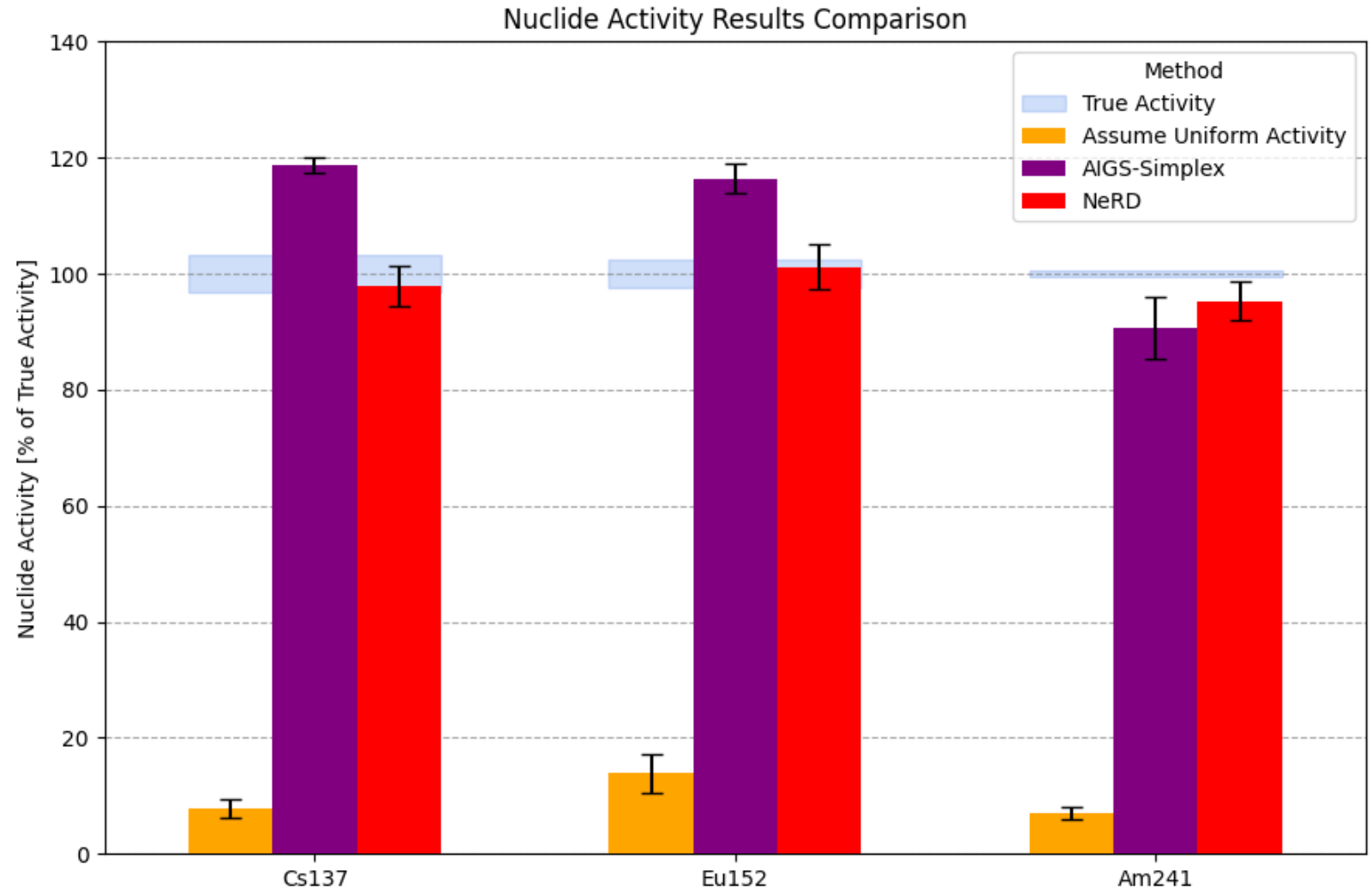
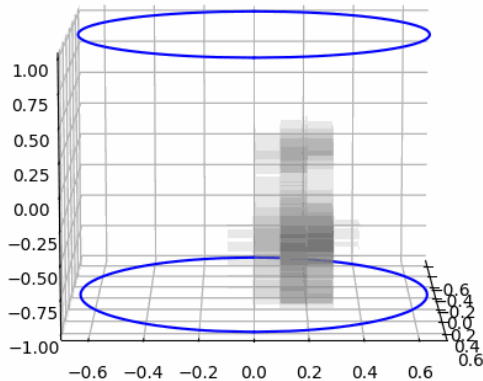
Comparison for 1_1_1_3_3_3



Activity Quantification (In Laboratory)

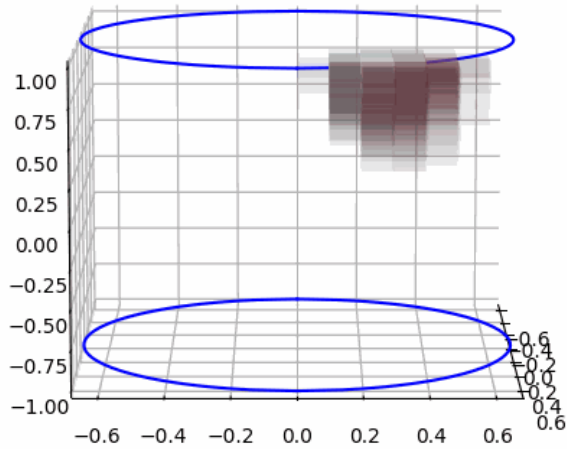
- Now NeRD can not only **localize** a source.
- NeRD can also **quantify** nuclide activity

Nuclide	AIGS err	NeRD err
Cs-137	18%	5%
Eu-152	16%	1%
Am-241	10%	3%

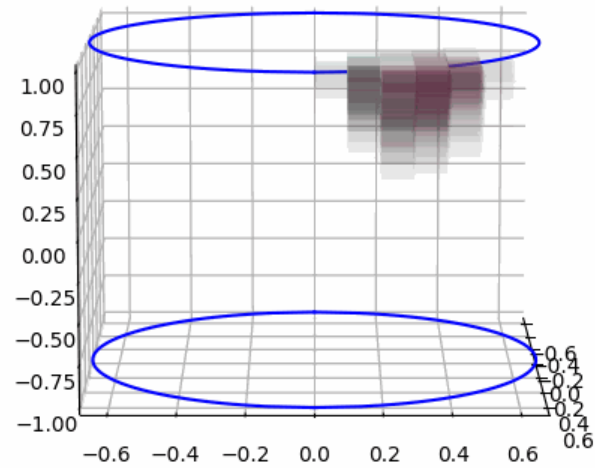


Minimal Number of Views

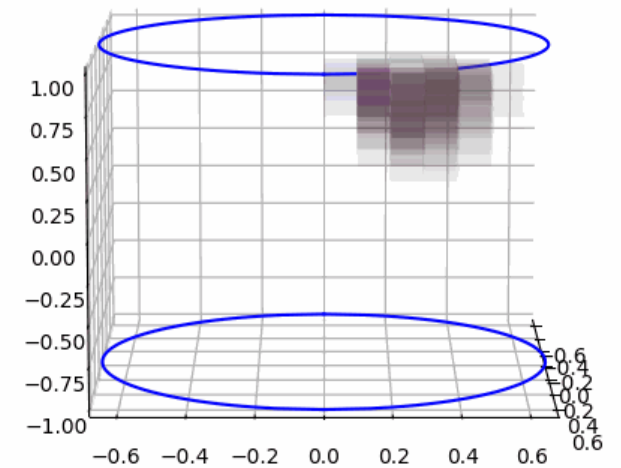
24 views



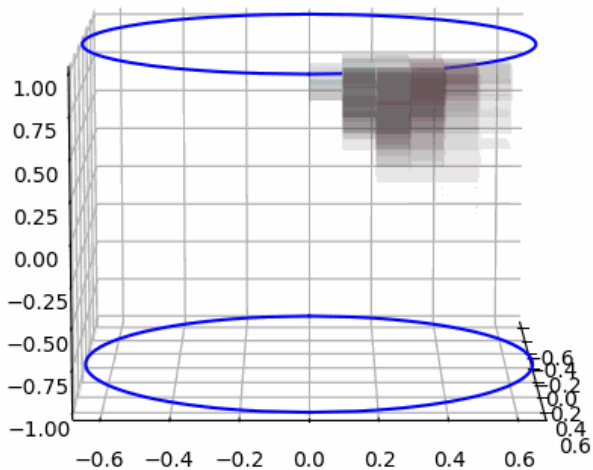
12 views



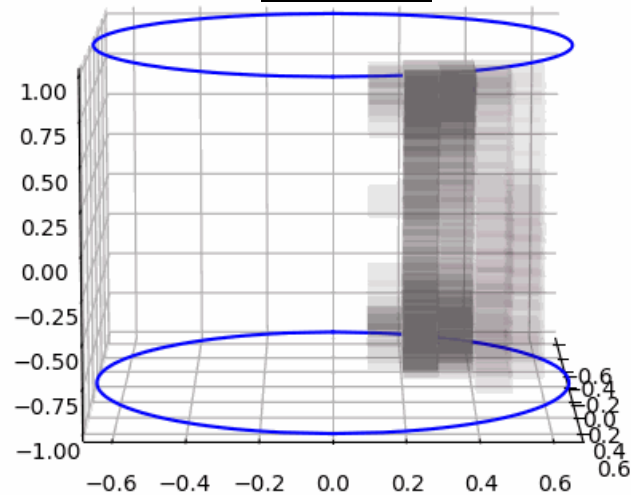
8 views



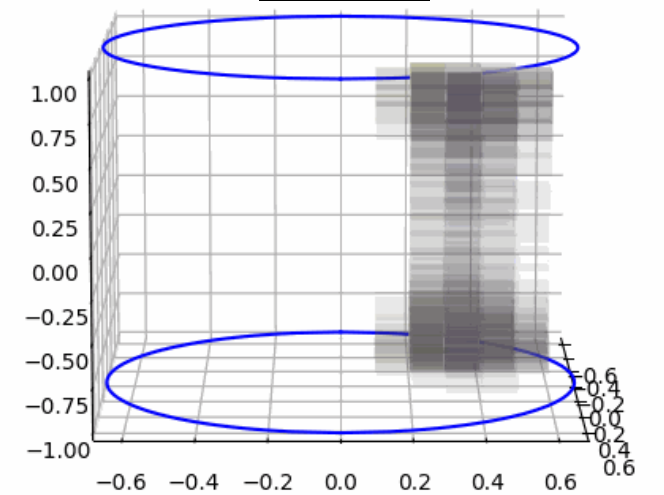
5 views



4 views



3 views

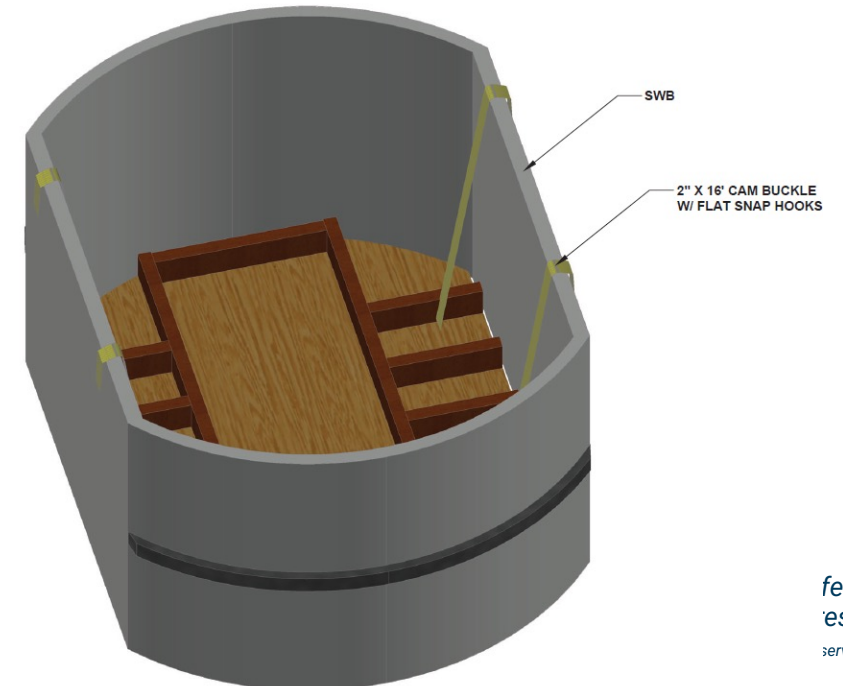
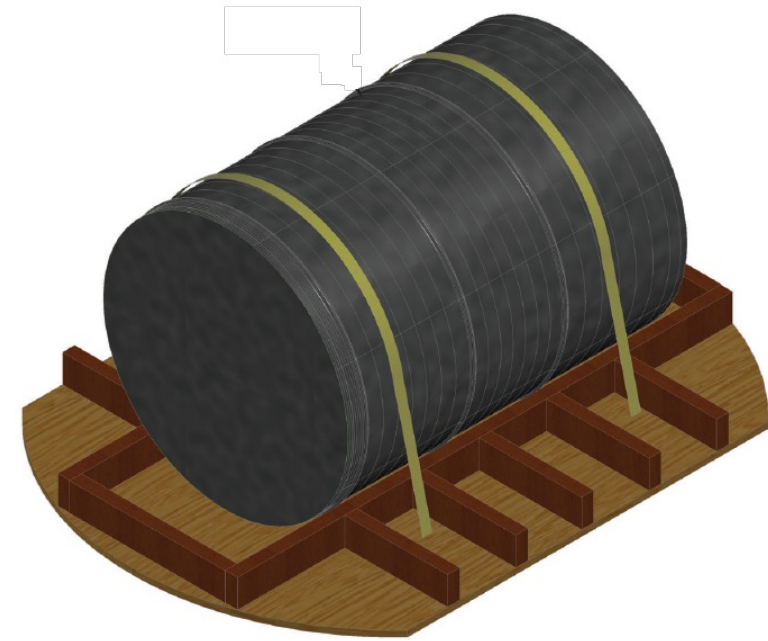
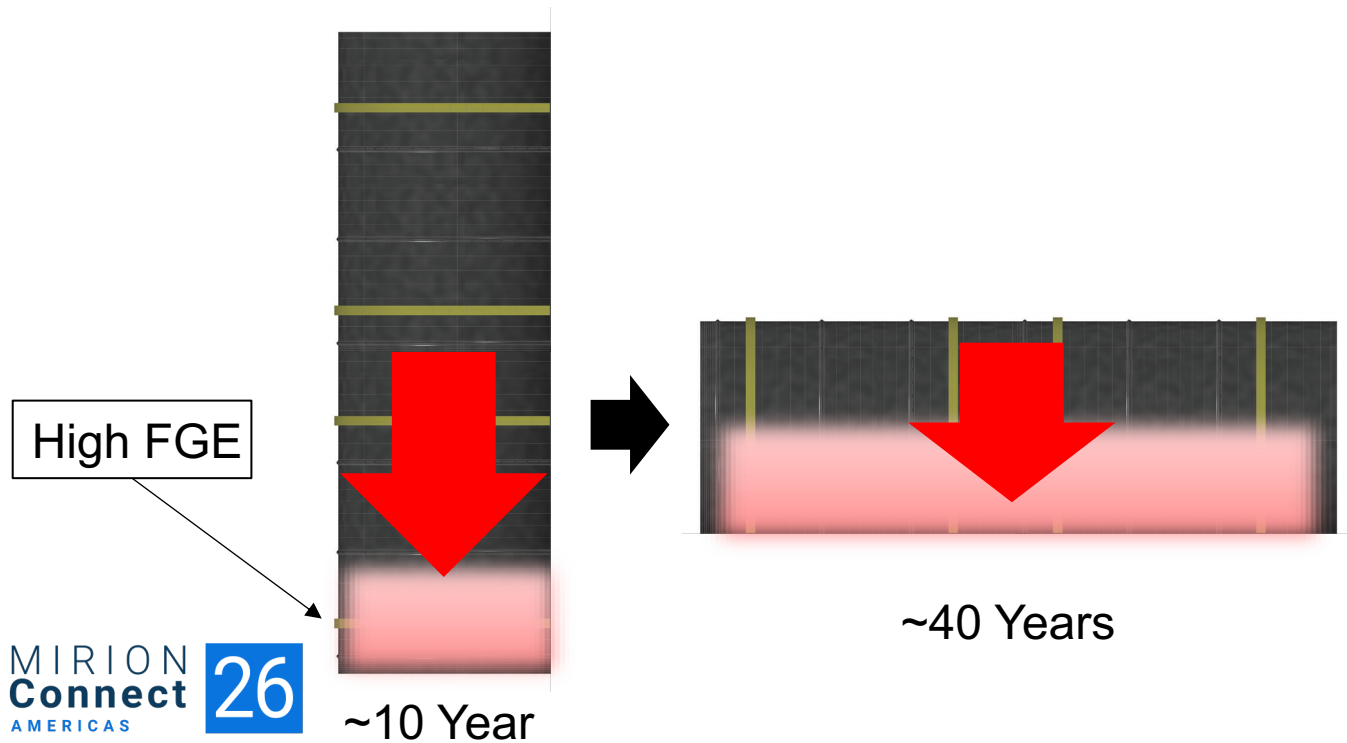


Corrugated Metal Pipes



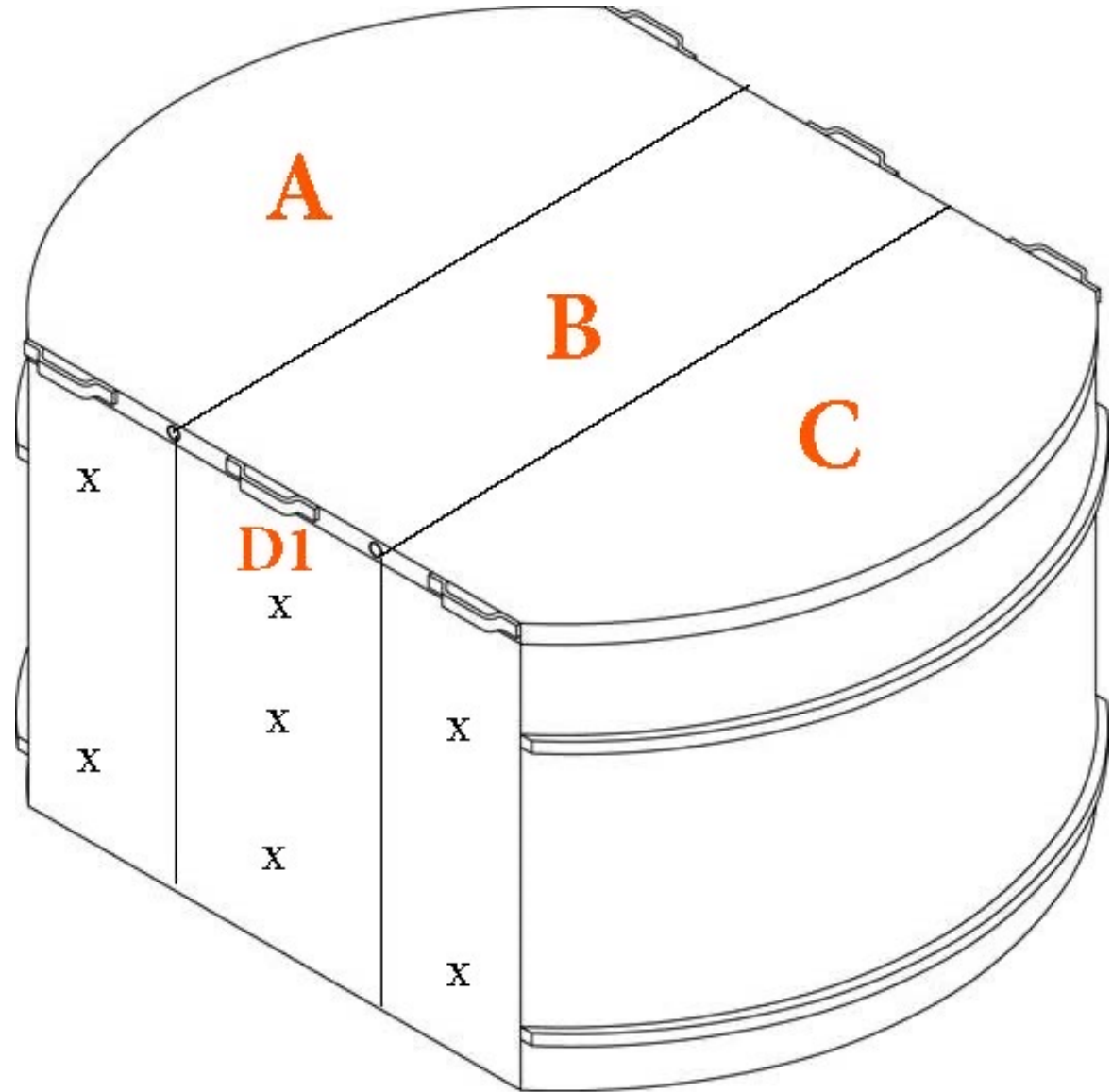
CMP NeRD

- *Measuring Corrugated Metal Pipes (CMPs)*
- *Some CMPs turned out to not have Homogeneous source distribution*
- *Some CMP slices are above FGE limits*

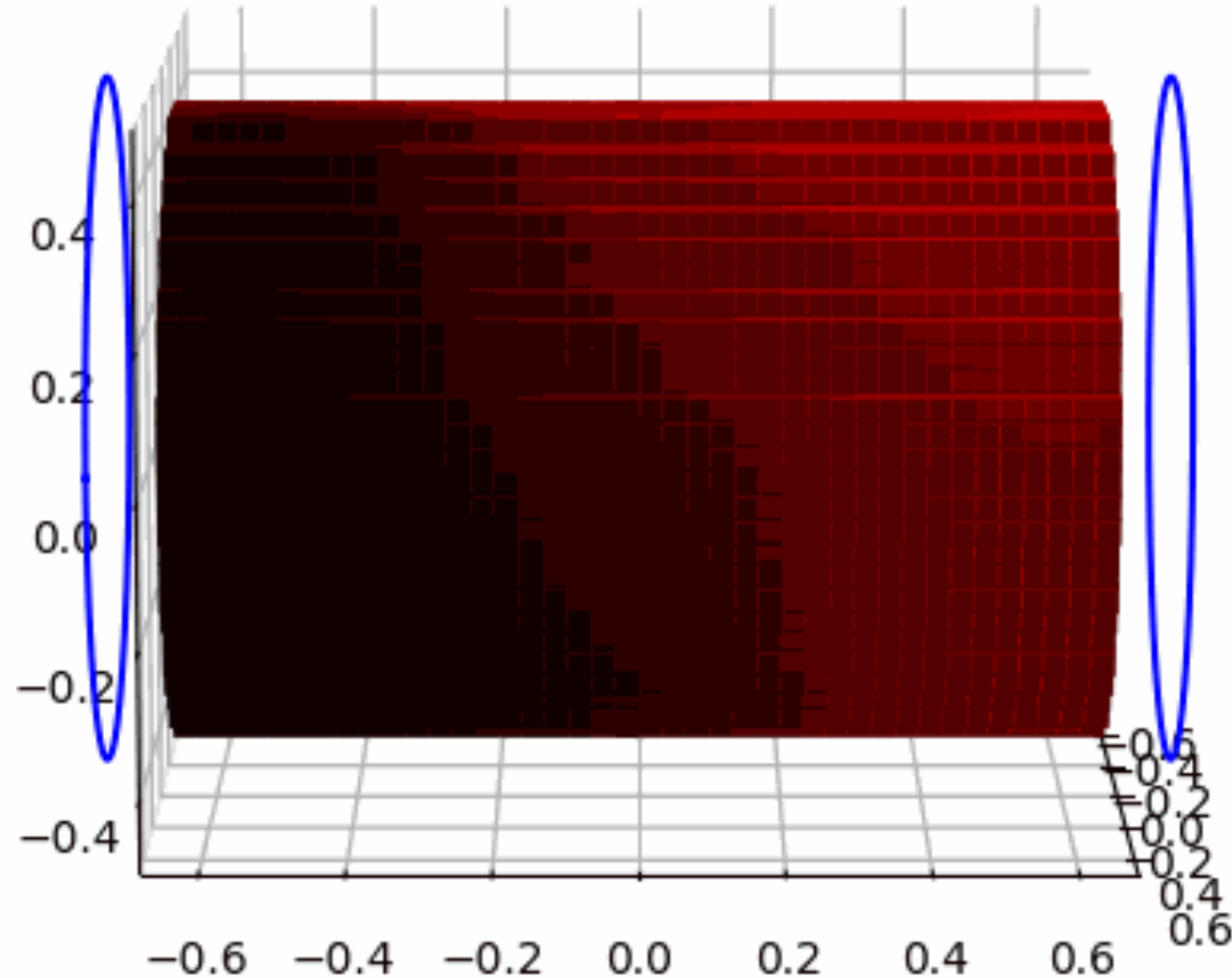


High FGE Container

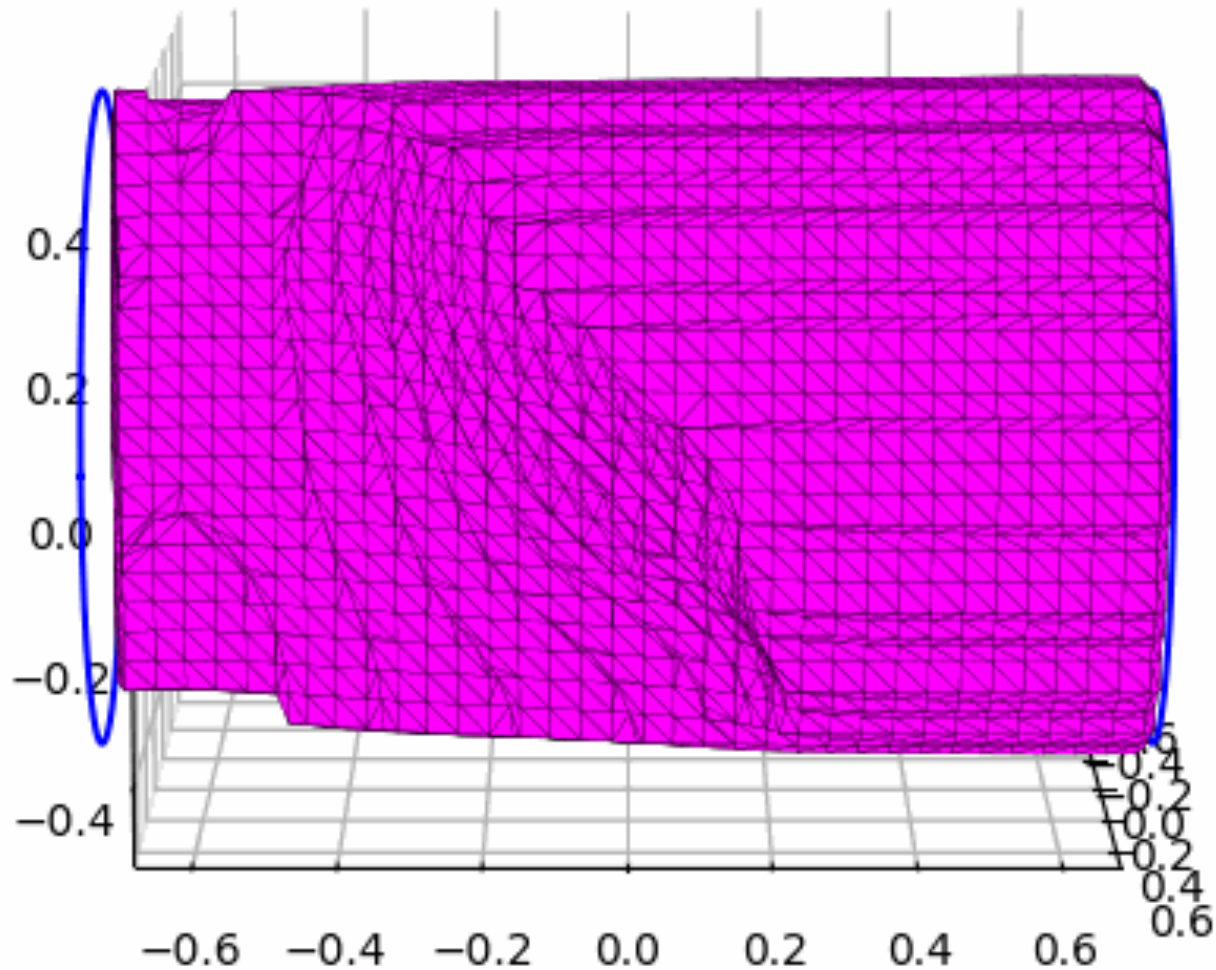
- We took 14 measurements
 - 7 views per side
- Allowed NeRD to achieve accurate source location

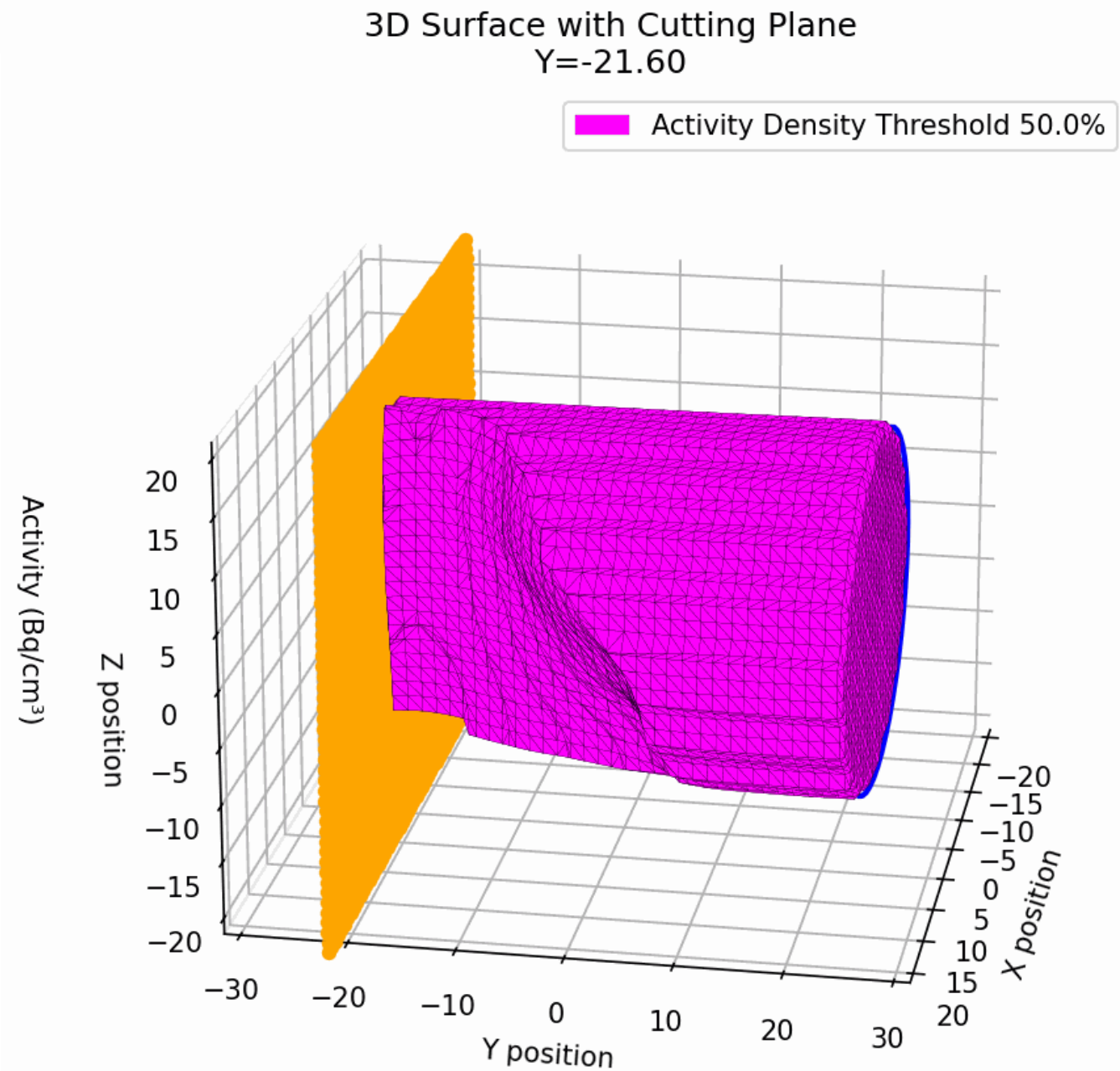
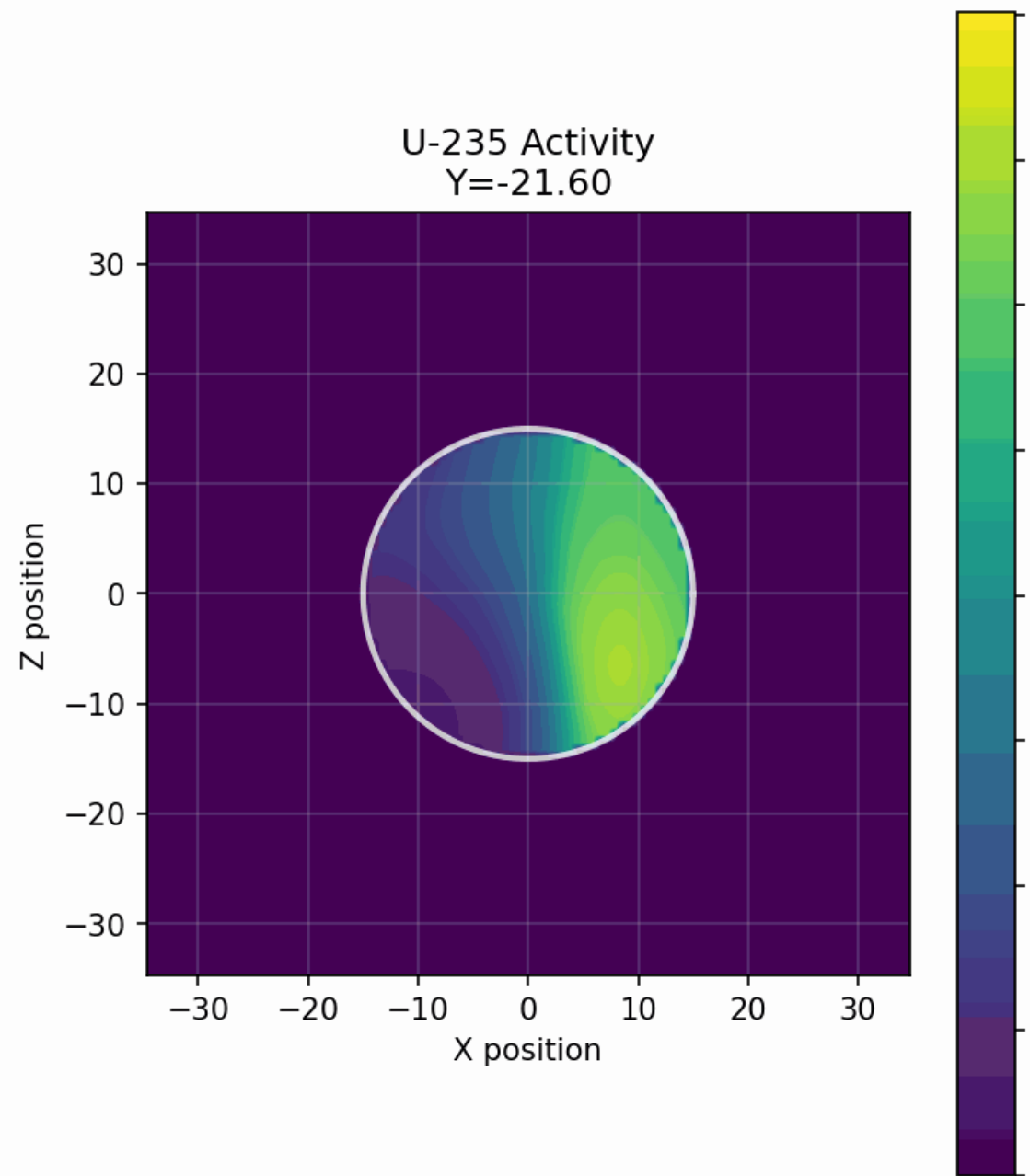


High FGE CMP NeRD Result



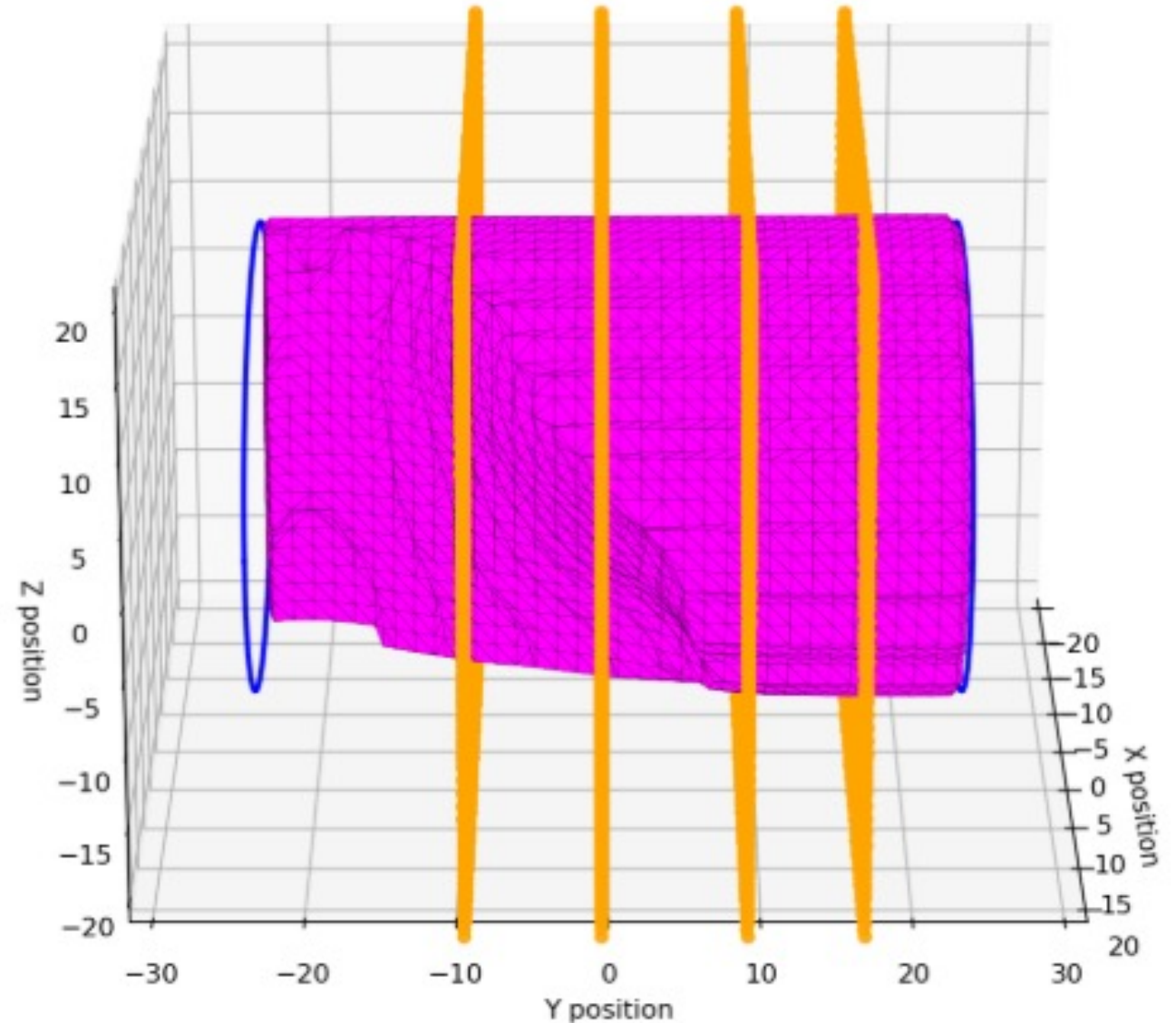
High FGE CMP NeRD Result





Secondary Cutting

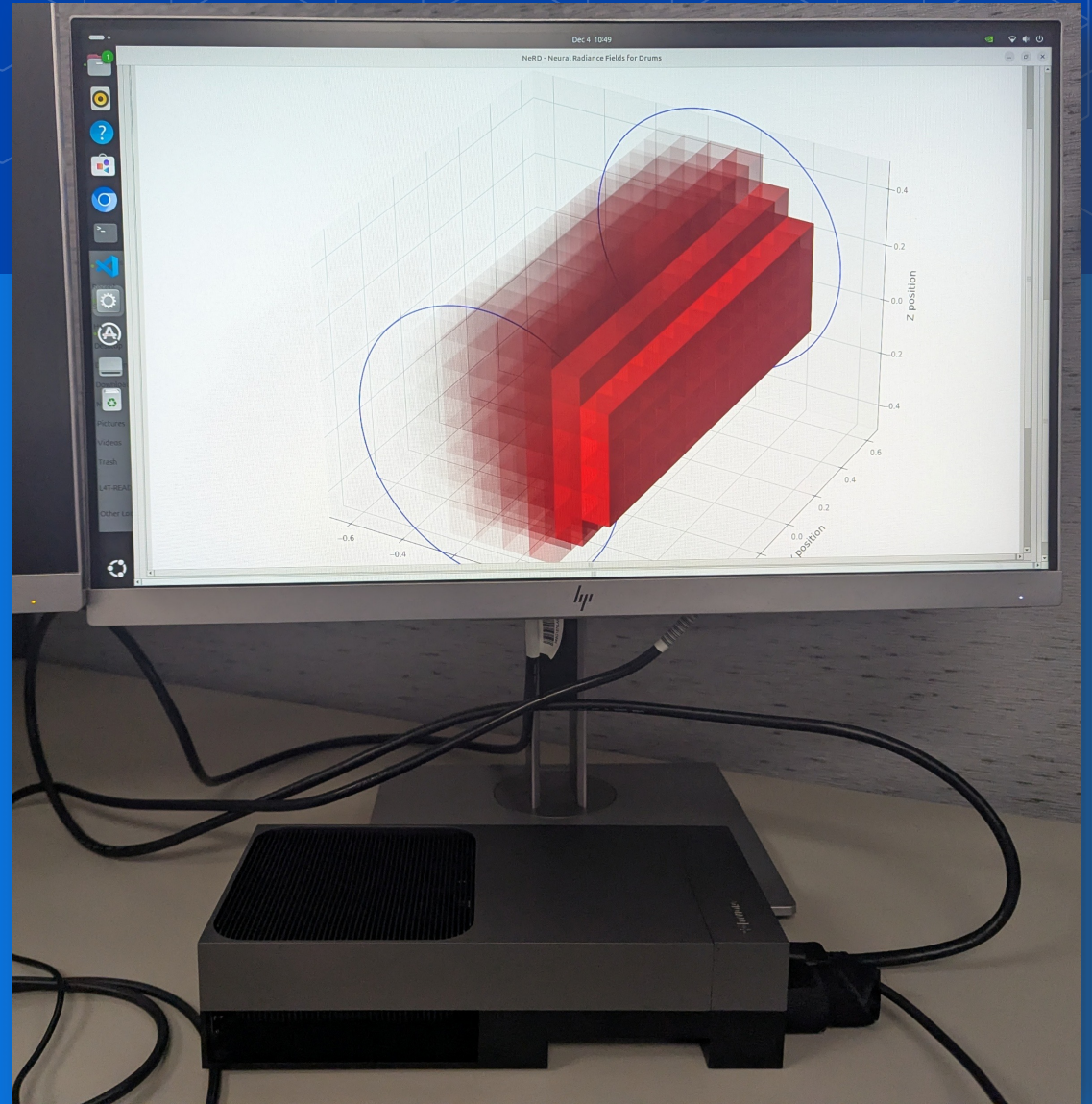
- *NeRD reconstructs U-235 activity profile*
- *Enables better understanding of waste*
- *New cutting sections below FGE limits*
- *Creates a pathway for waste that was once unshippable*





NeRD Processor Prototype

- GPU analysis < 15 min
- Will be compatible with NDA2000



Thank you



Survey for:

Research & Technology Forum



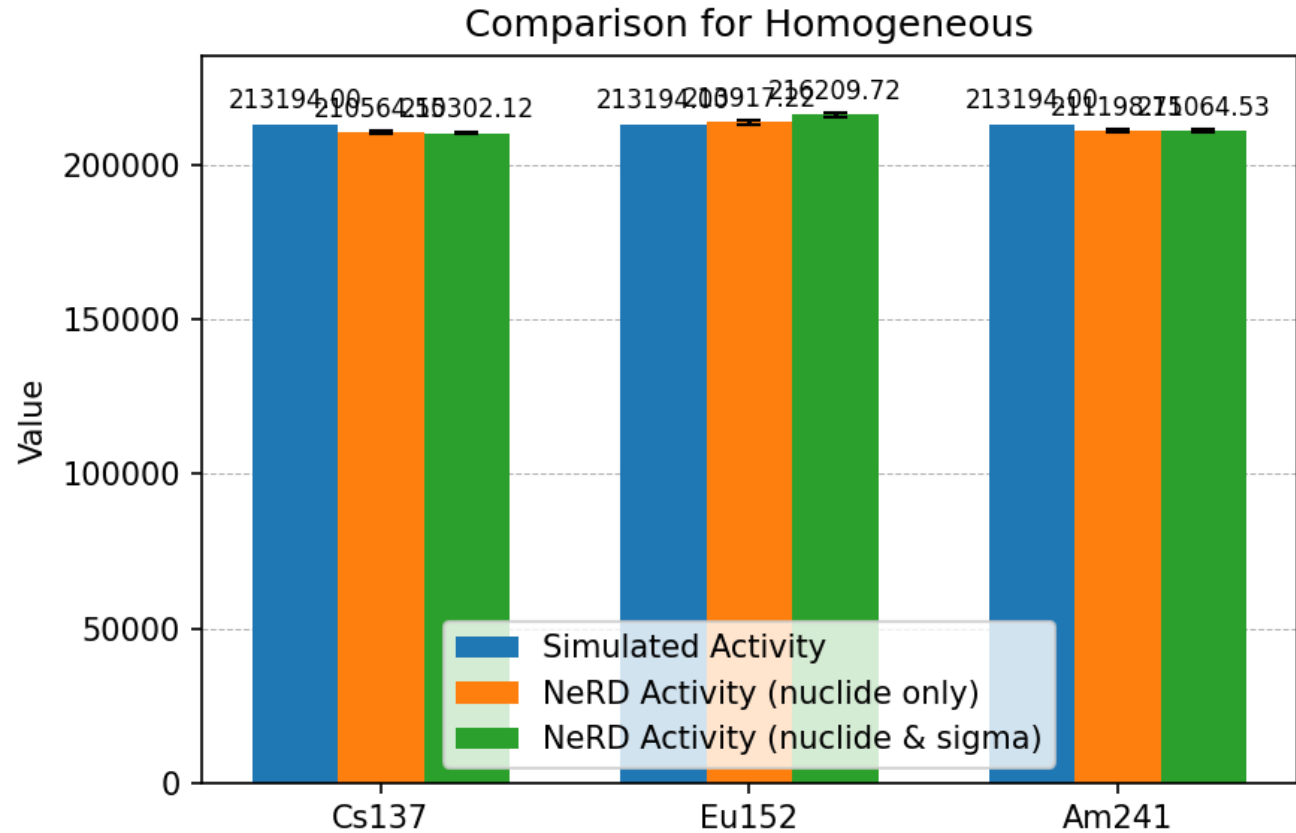
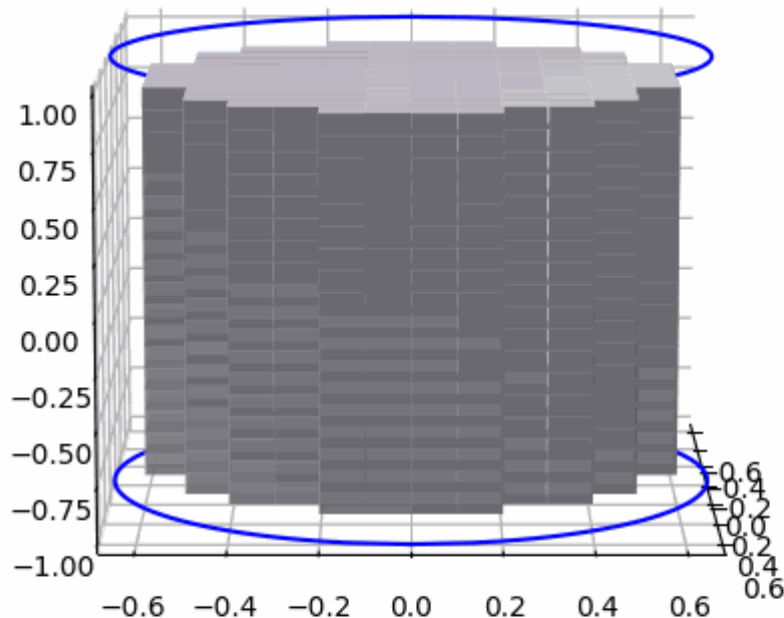
*Please take a moment
to fill out a short survey
on this session.*

Extra Slides

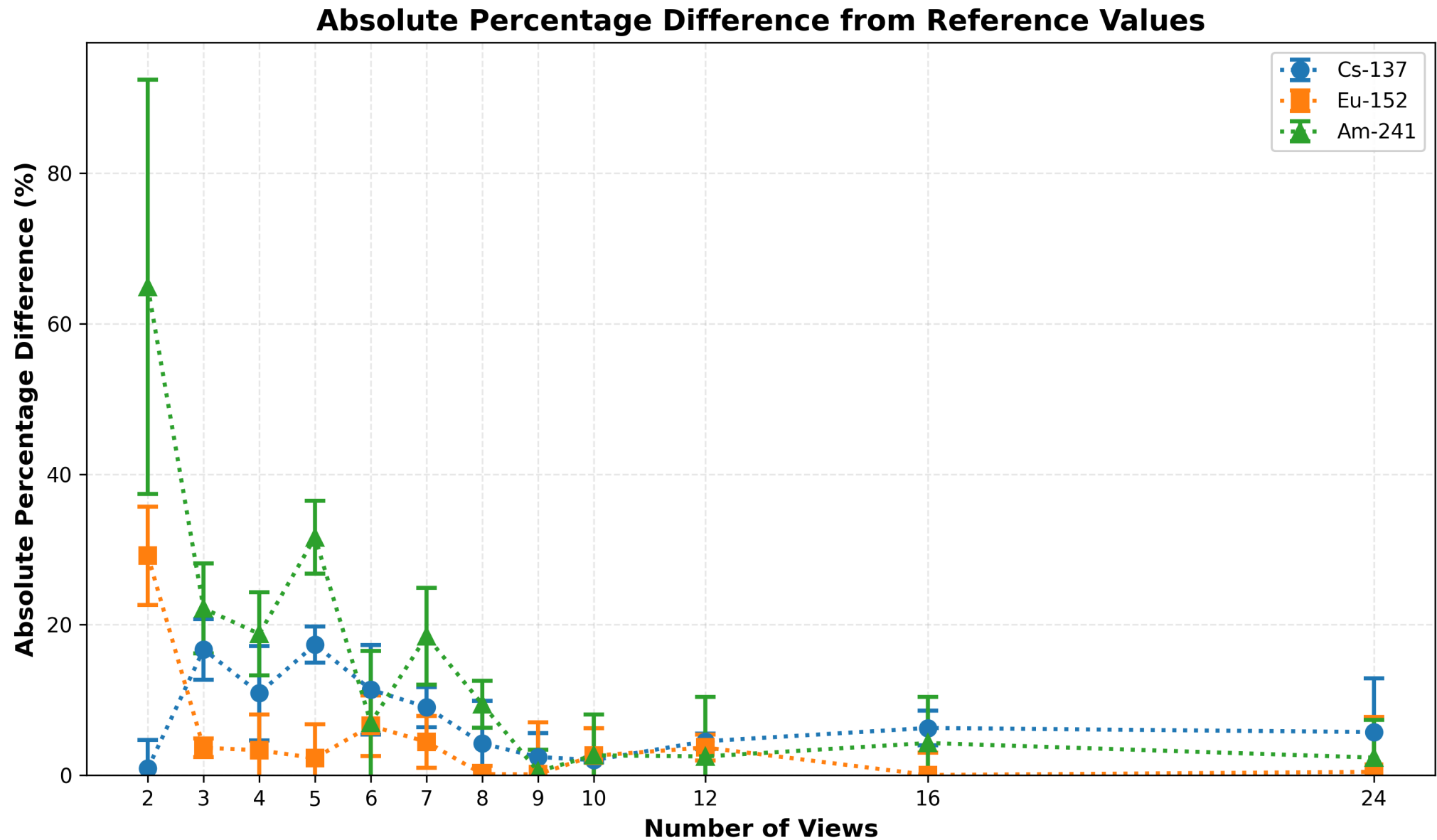


Simulated MILCC Homogeneous

- *Simulated homogeneous activity/density*
- *NeRD can determine activity only, or activity and density*
- *Error is < 2% for all tested nuclides*

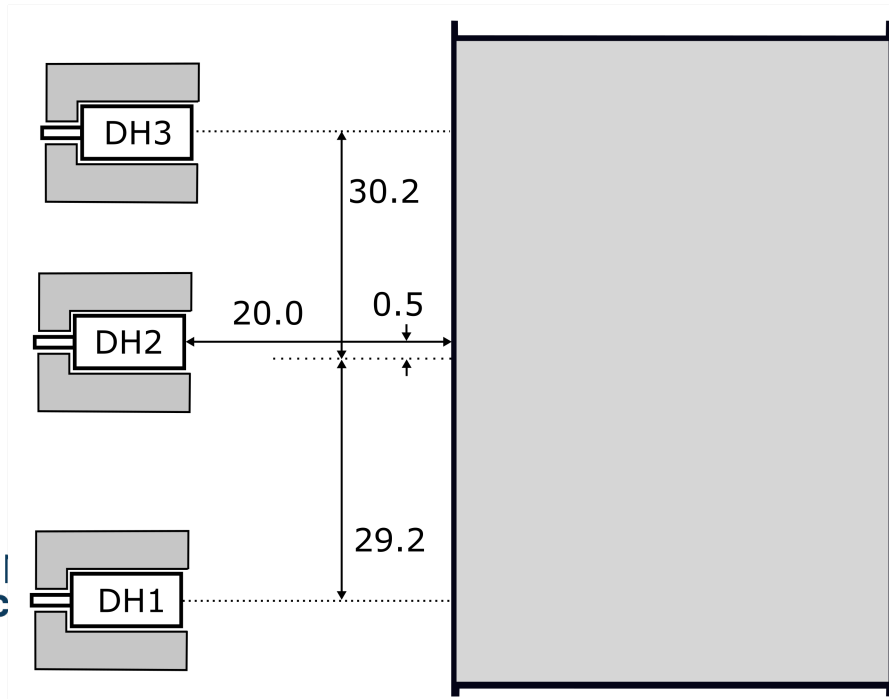


Minimum Number of Views



NPL Proficiency Test Drum

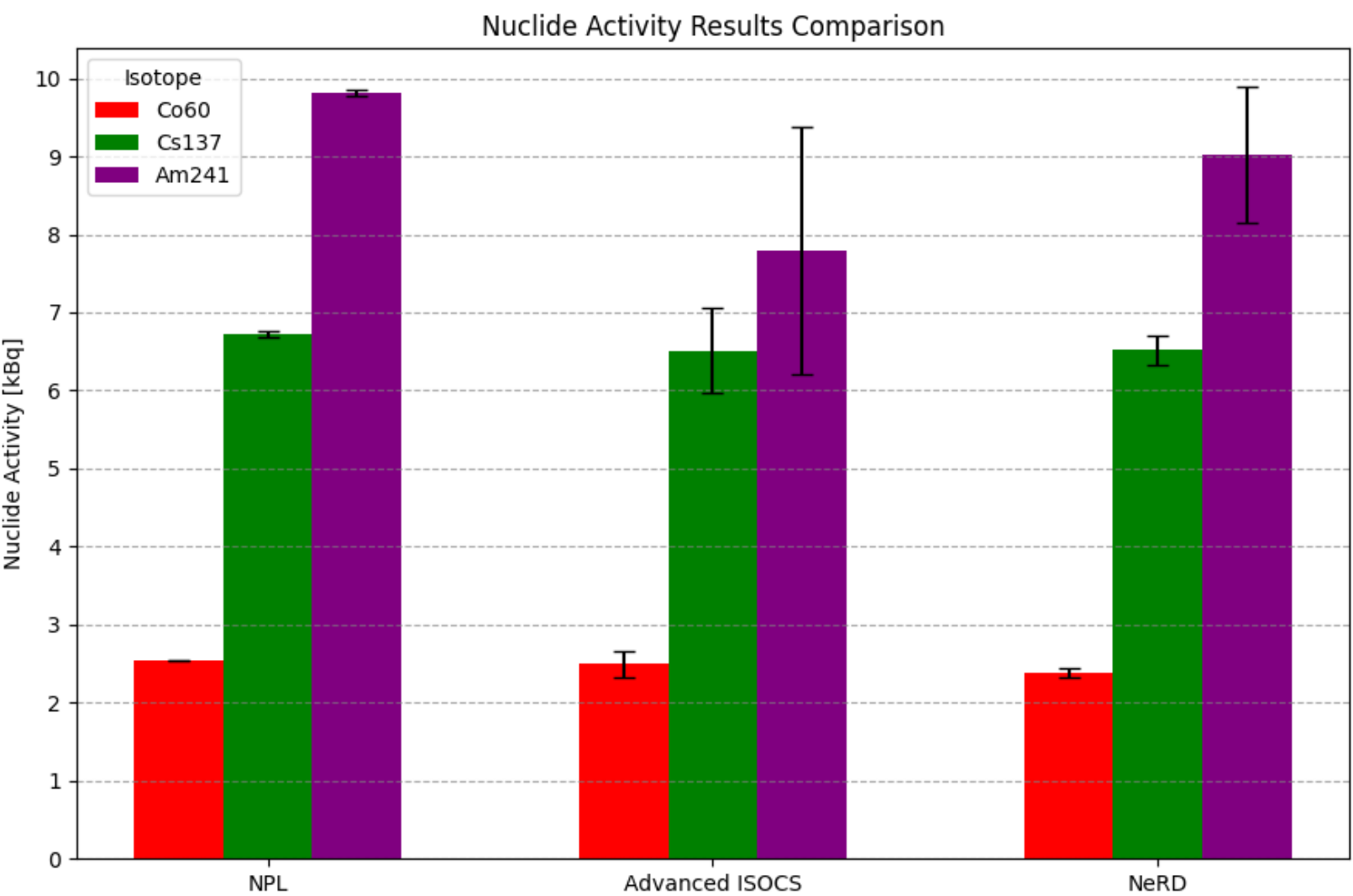
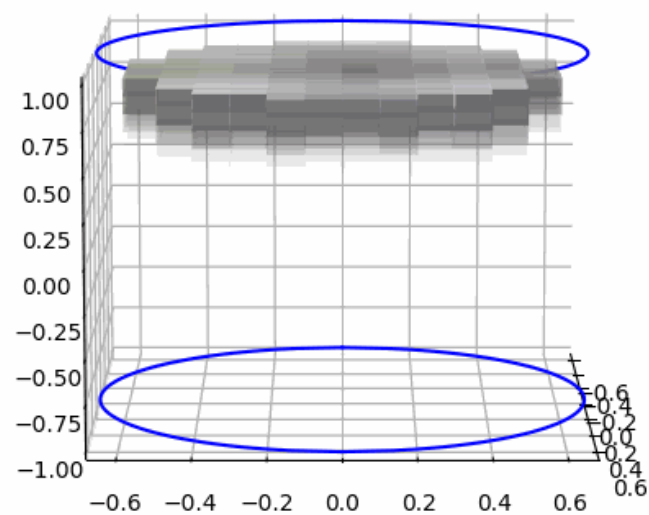
- Round Robin waste drums sent to labs by NPL
 - Unknown source geometry
 - NPL announces source locations and activities after results are announced.
- Excellent validation of NeRD



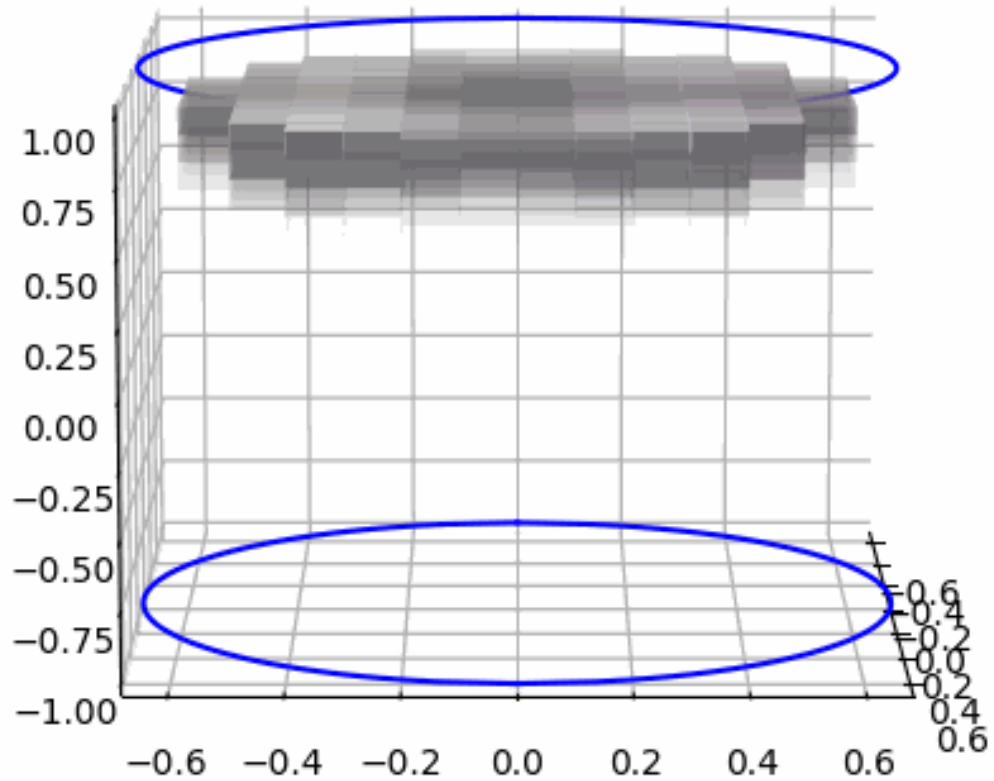
NPL 2019 Results

- Sources were in special Ion Resin containers
 - NeRD instead assumed homogeneous density

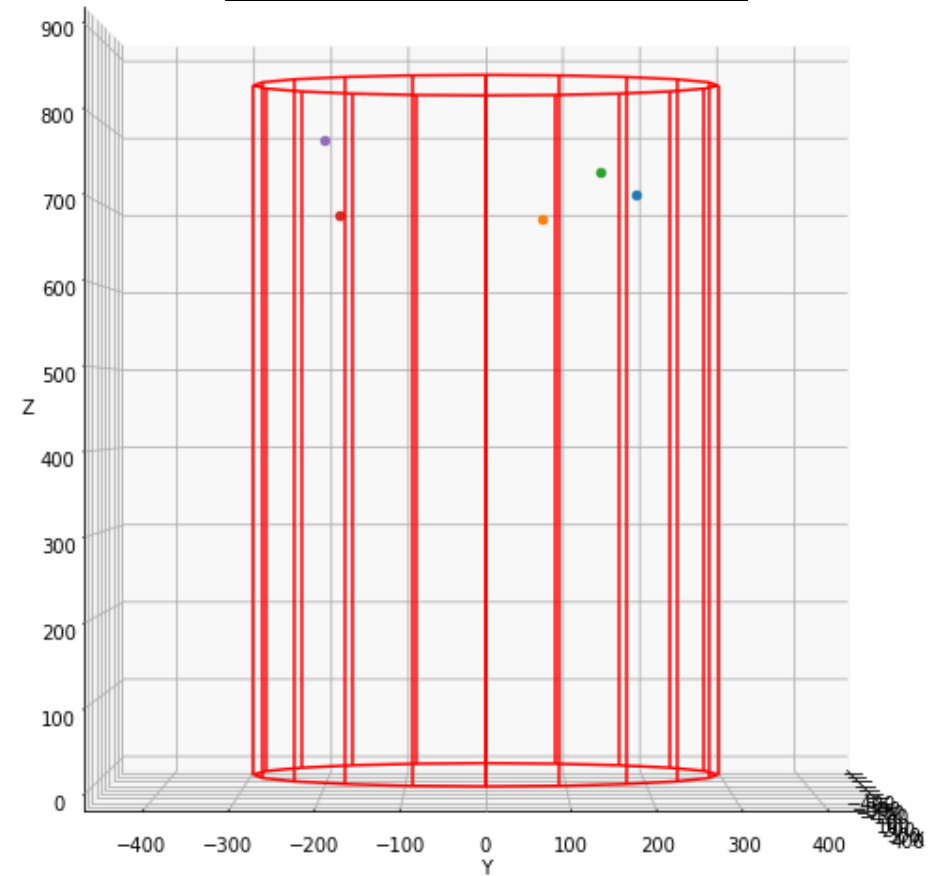
Nuclide	AI SOCS err	NeRD err
Co-60	5%	5%
Cs-137	3%	3%
Am-241	20%	8%



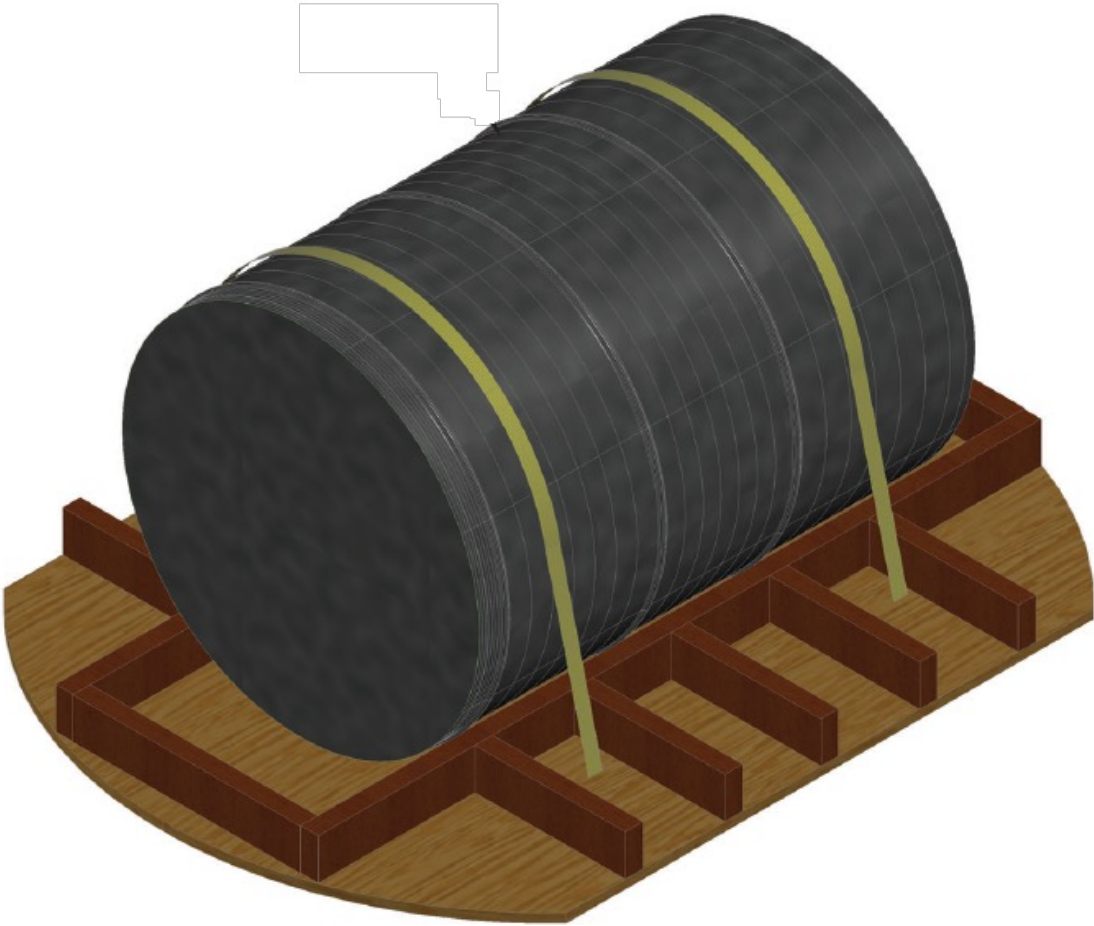
NeRD Reconstruction



AIUE Hotspots



Historical CMPs With NeRD



From only 2 spectra!!!

