

# LA-UR-23-32260

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**Title:** Developments in the Microcalorimetry Program at Los Alamos National Lab

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# Developments in the Microcalorimetry Program at Los Alamos National Lab

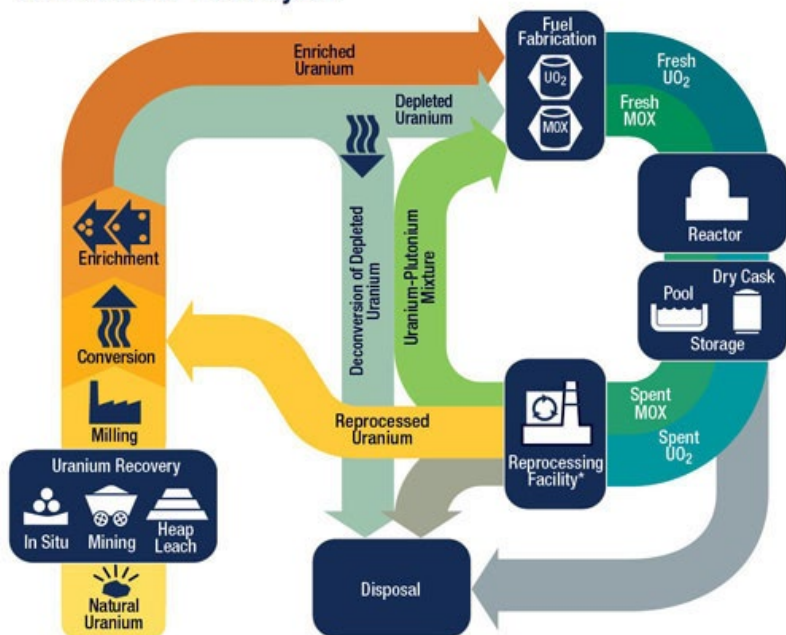
Jacob Ward  
*NEN-1, Safeguards Science and Technology*

November 3<sup>rd</sup>, 2023

LA-UR-23-XXXXX

# Nuclear Safeguards

The Nuclear Fuel Cycle



\* Reprocessing of spent nuclear fuel, including mixed-oxide (MOX) fuel, is not practiced in the United States.

Note: The NRC has no regulatory role in mining uranium.

As of January 2019



Inspectors collect  
environmental  
samples

Analysis at the  
environmental  
sample laboratories

Confirm  
completeness of  
State Declarations

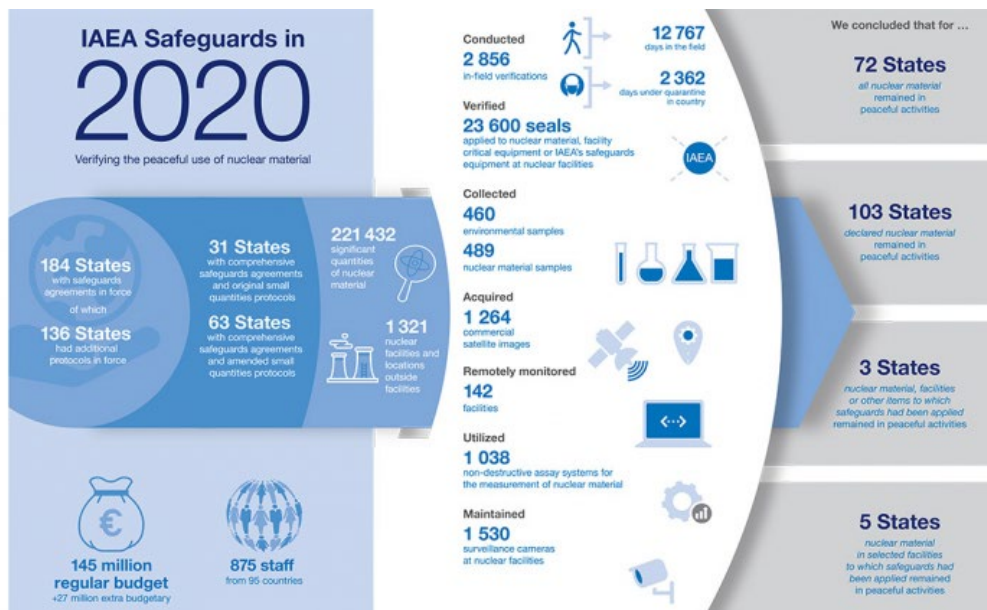
Inspectors collect  
nuclear material  
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nuclear material  
laboratories

Confirm  
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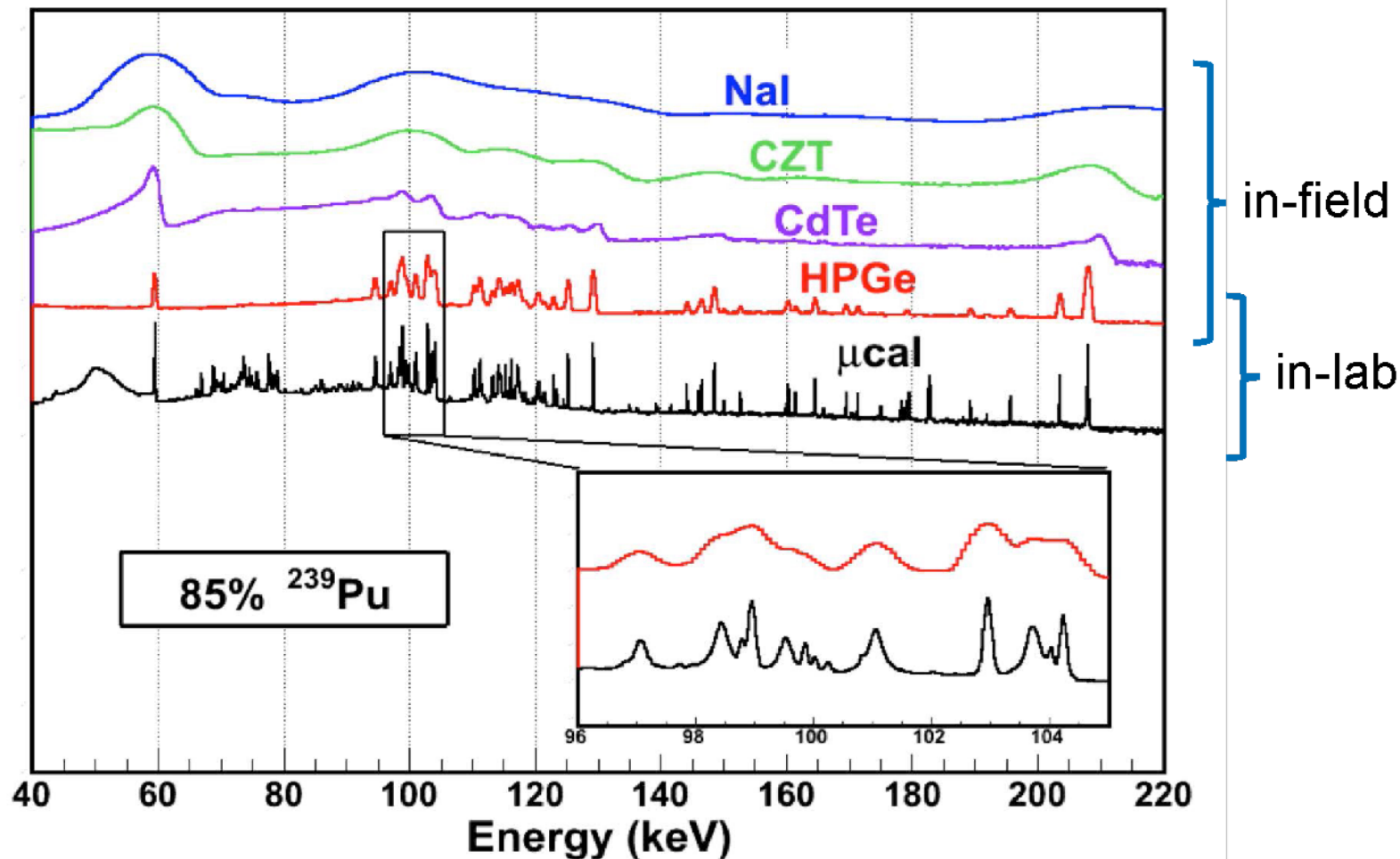
# Nuclear Safeguards



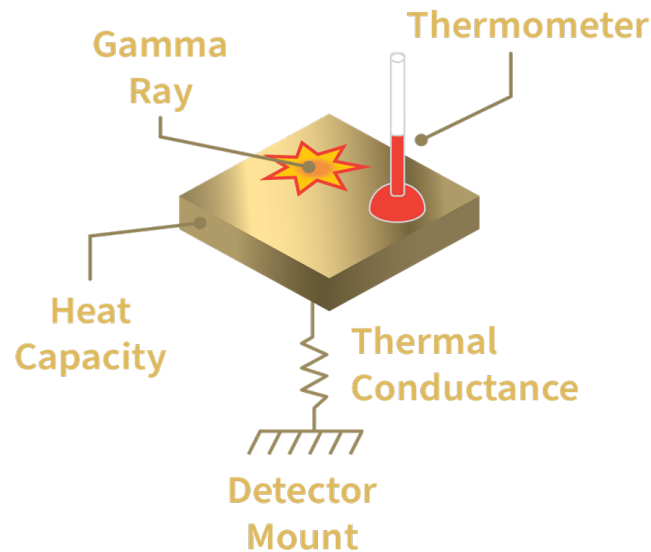
# Nuclear Safeguards Tools



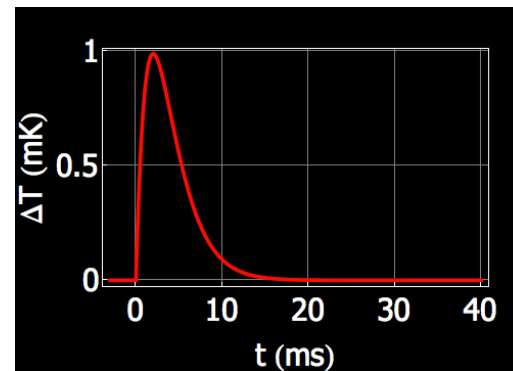
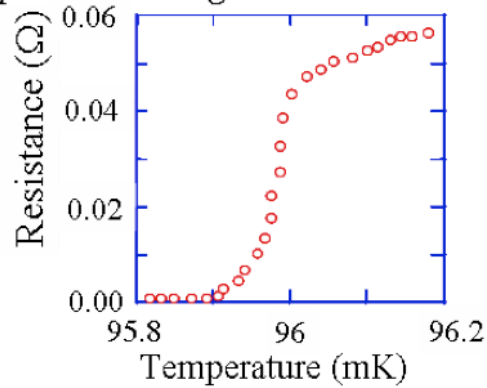
# Nuclear Safeguards R&D Developments: Low Temperature Detectors



# Transition Edge Sensors (TES)



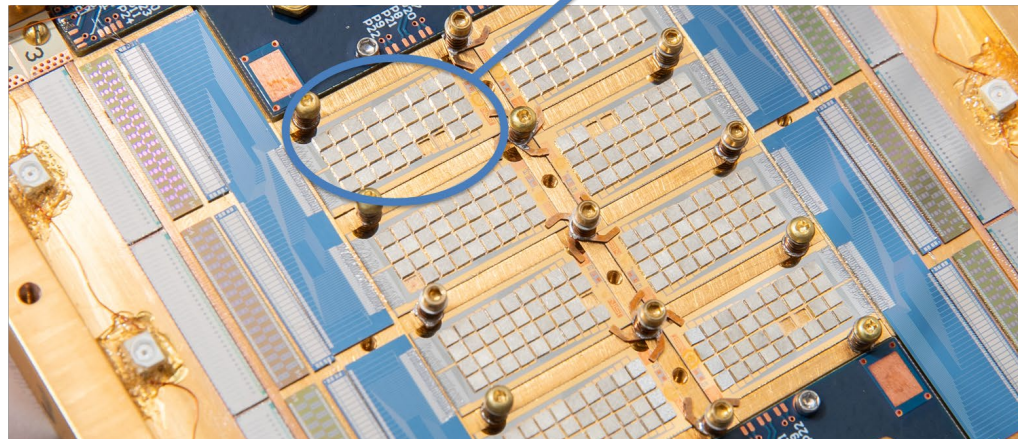
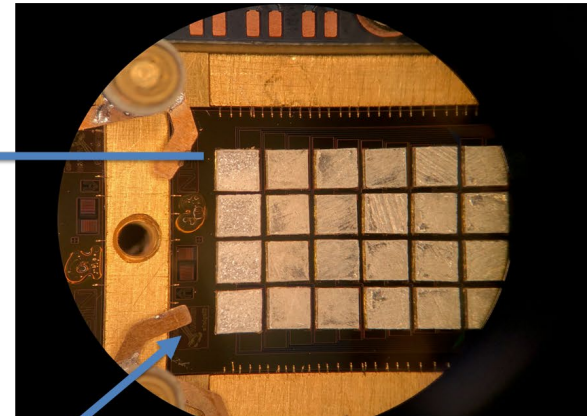
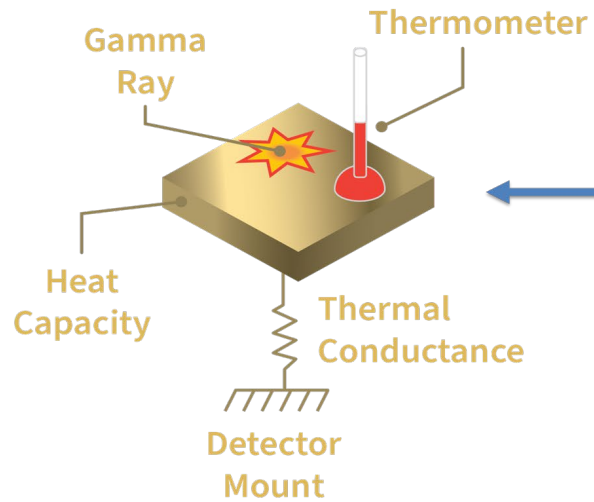
*Superconducting-Normal Transition*



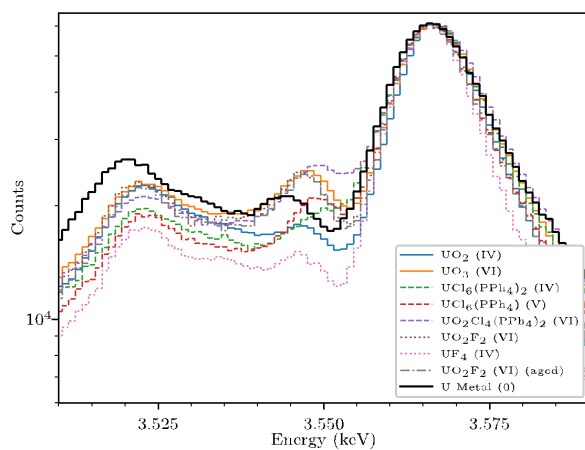
$$E = C \times \Delta T \quad \Delta E \approx \sqrt{4kT^2 C}$$



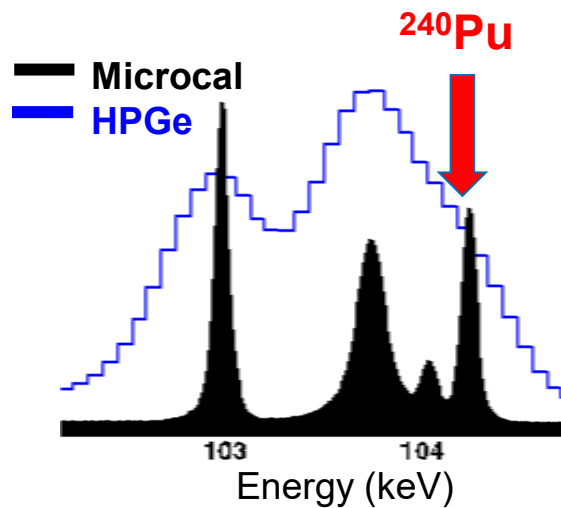
# Microcalorimeters



# Microcalorimeters

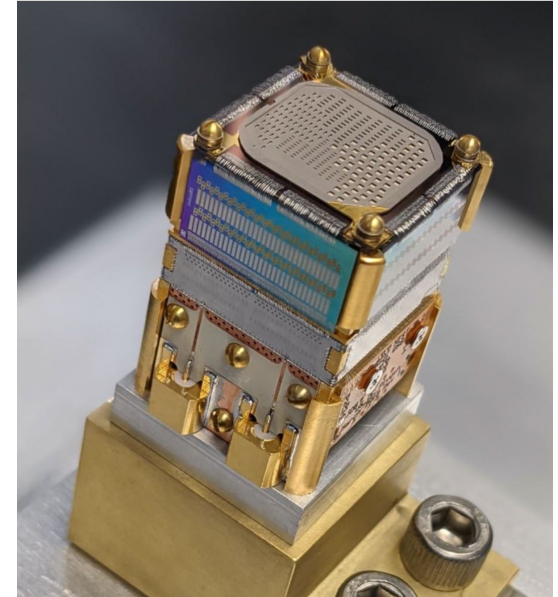
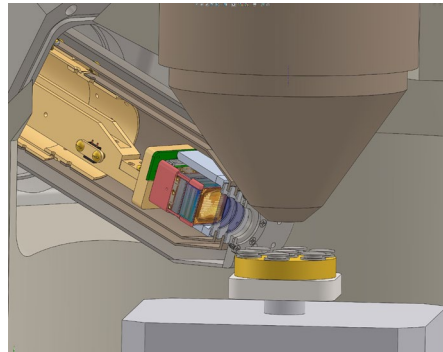
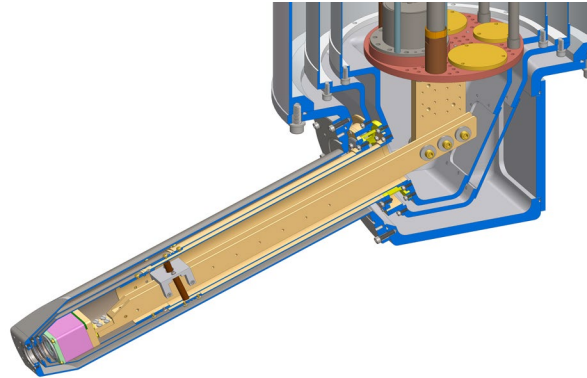


*X-ray spectroscopy*

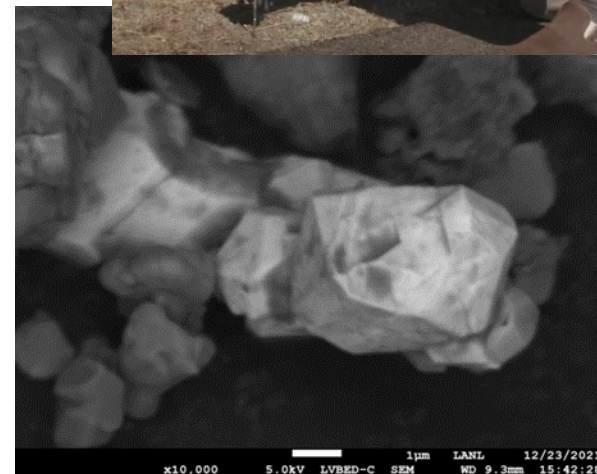
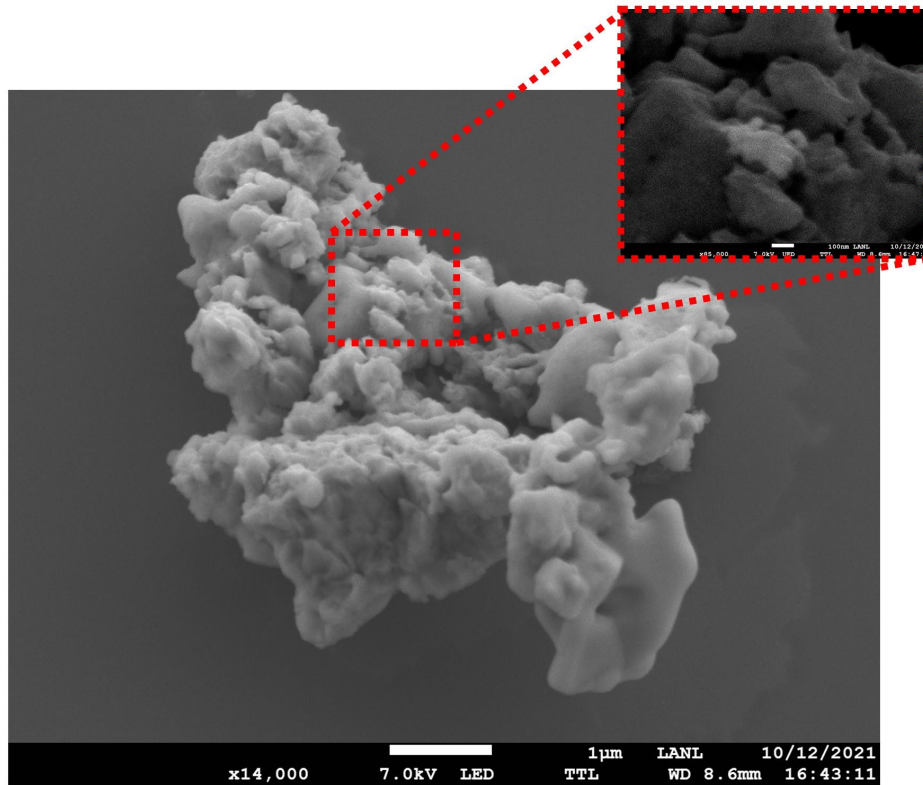


*Gamma-ray spectroscopy*

# Hyperspectral X-ray Imaging (HXI)

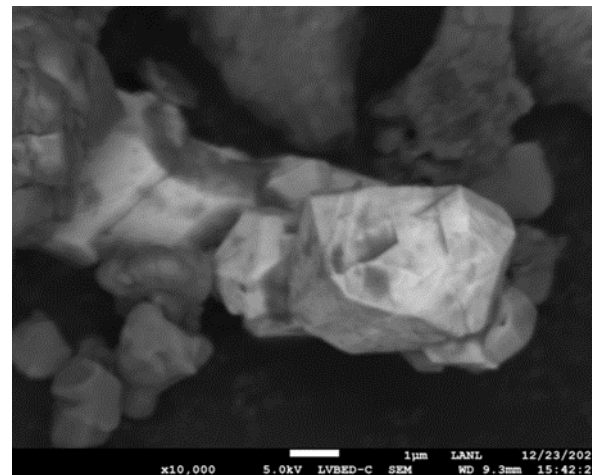
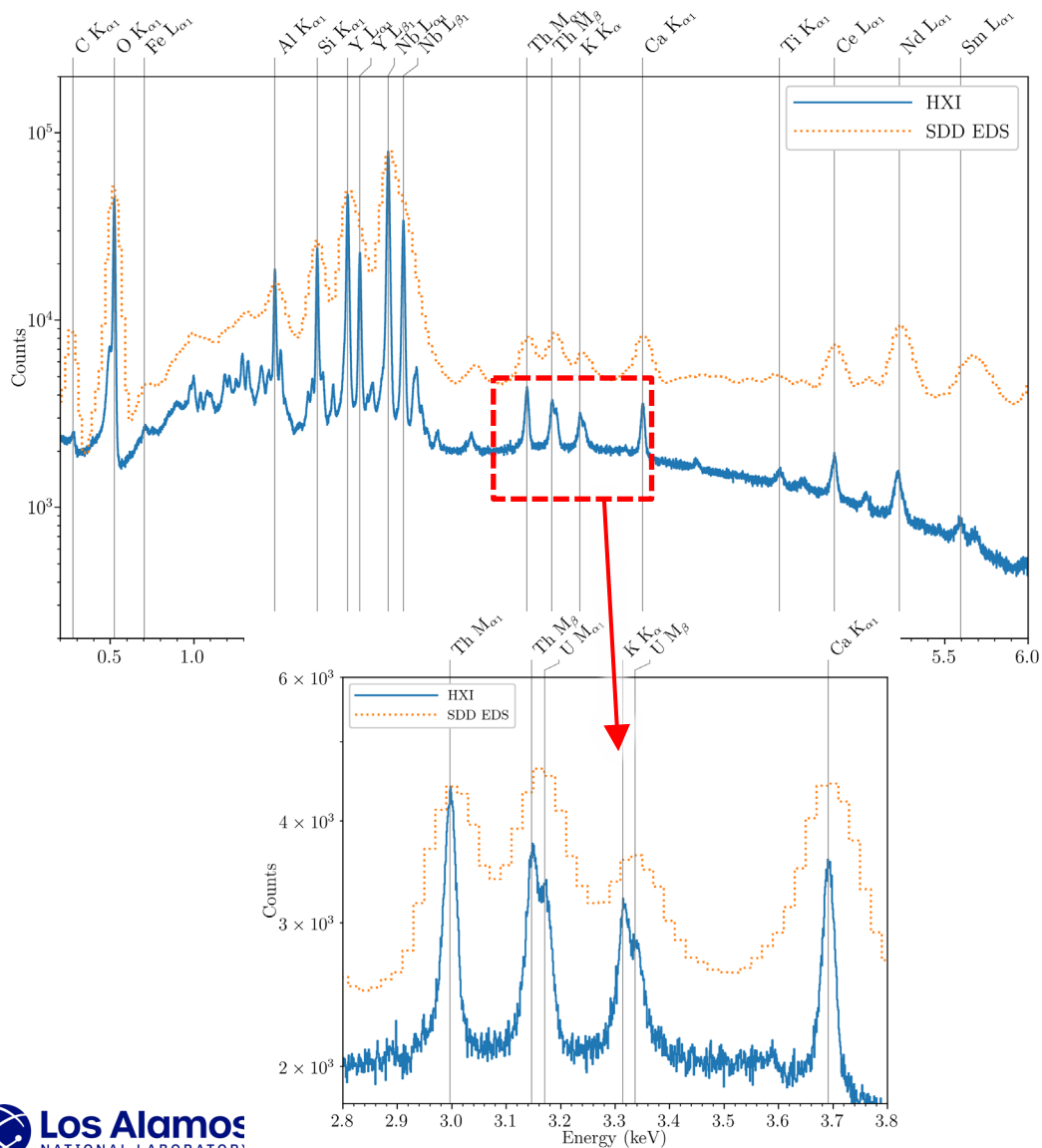


# Hyperspectral X-ray Imaging (HXI)

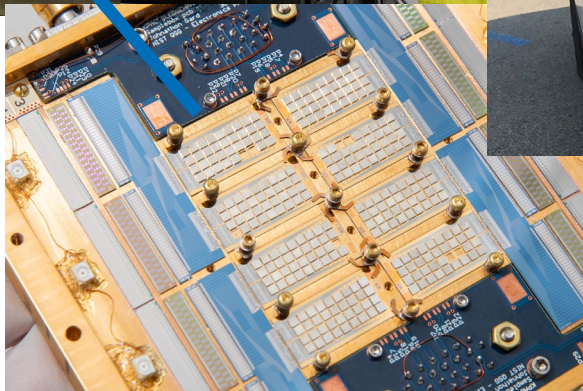




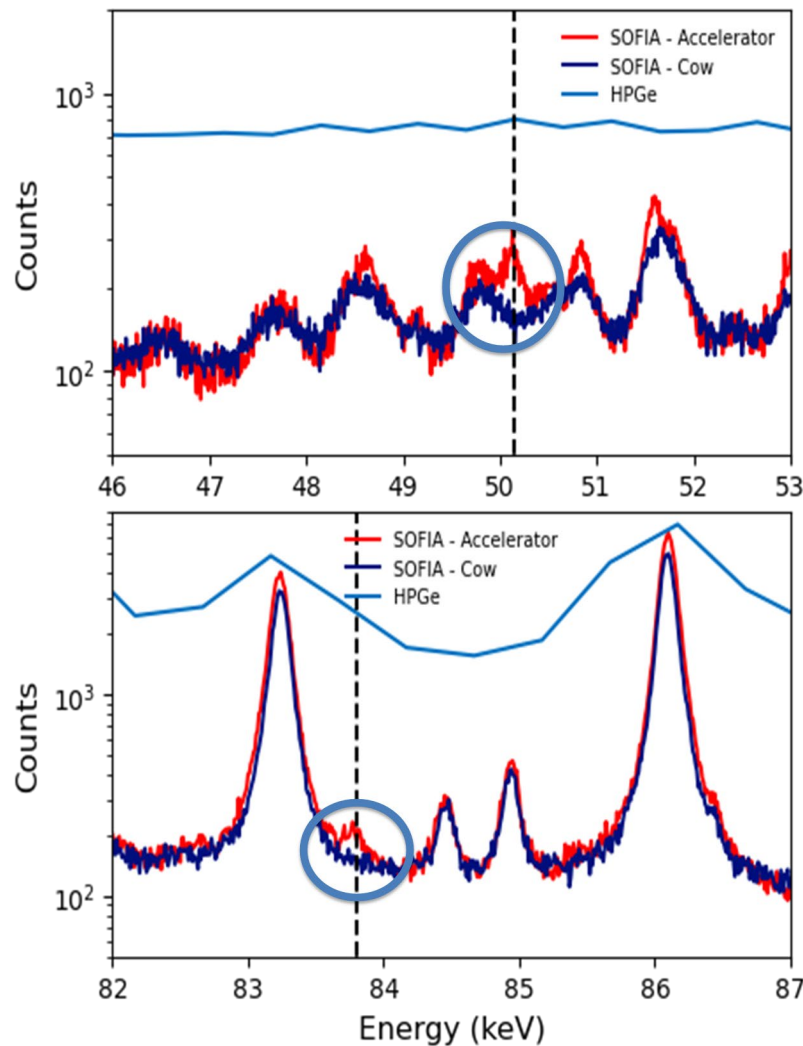
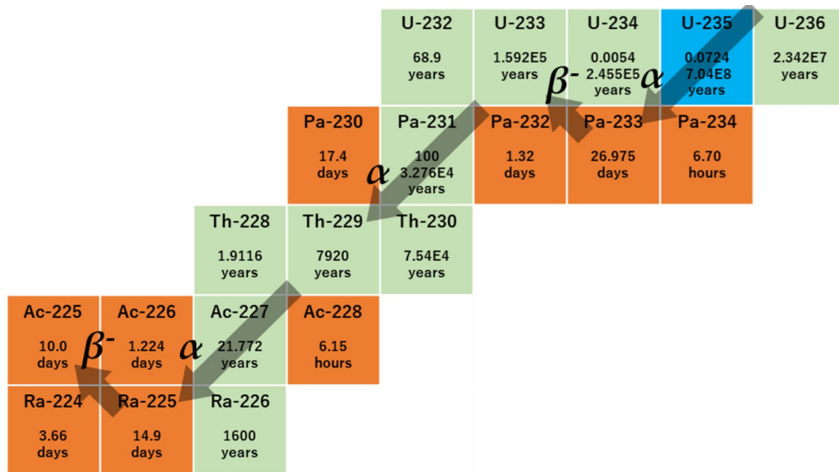
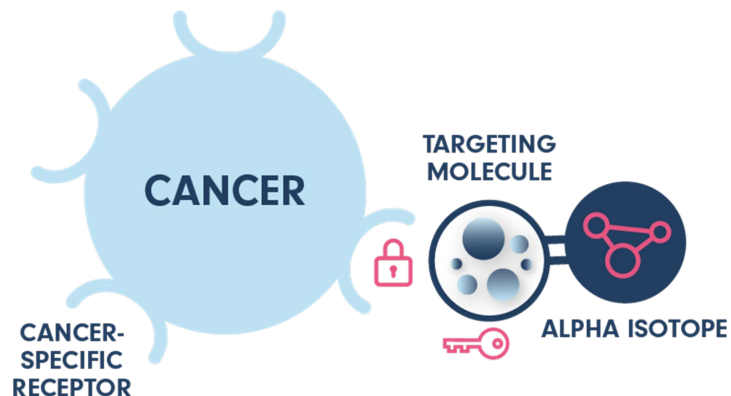
# Hyperspectral X-ray Imaging (HXI)



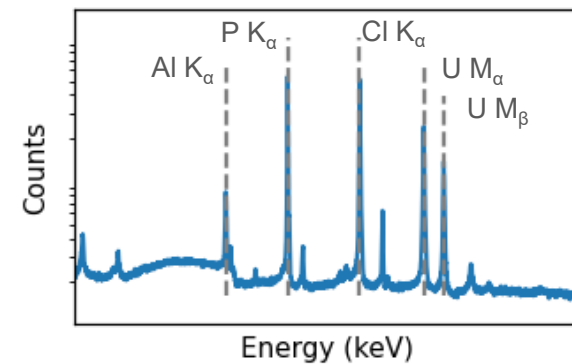
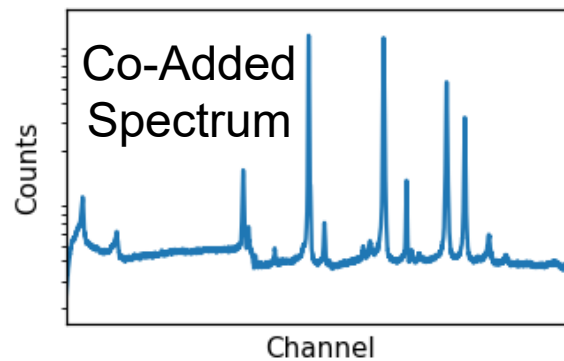
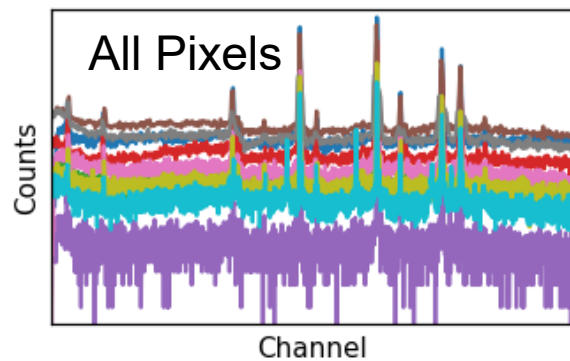
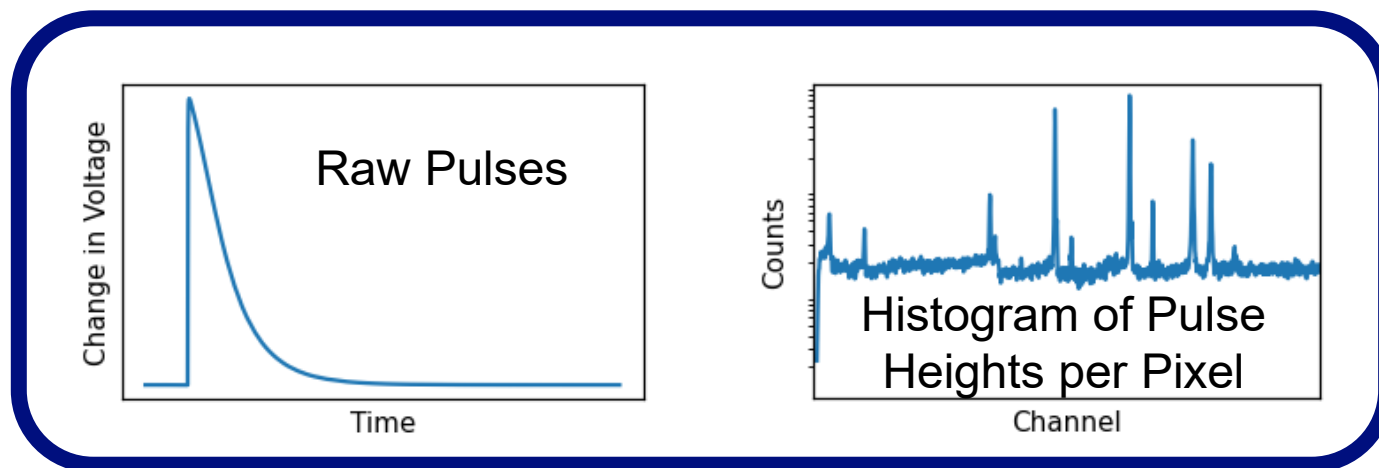
# Spectrometer Optimized for Facility Integrated Applications (SOFIA)



# Targeted Alpha Therapy Using Actinium 225 Measured with SOFIA

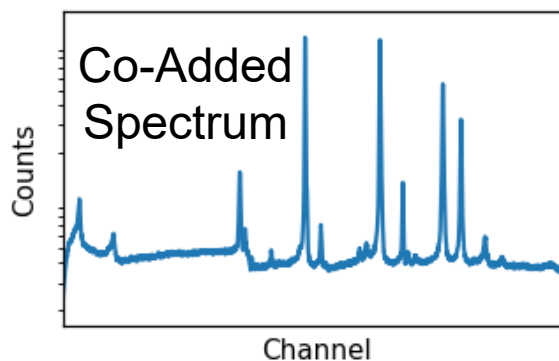
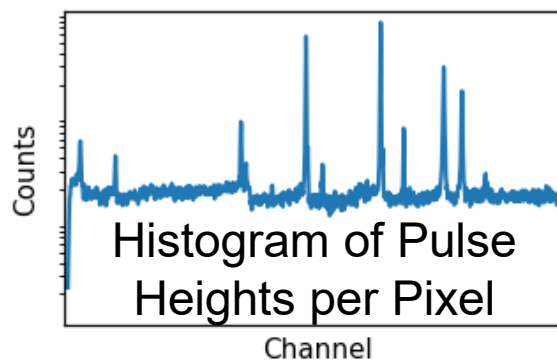
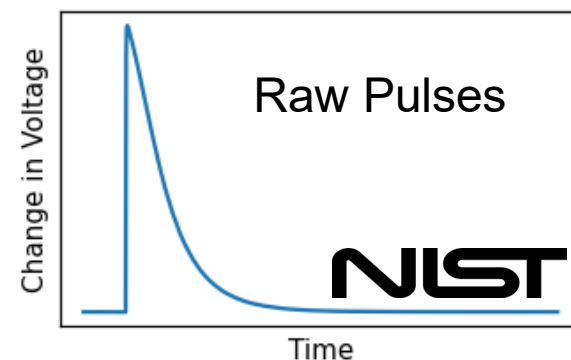


# Raw Data to Spectrum

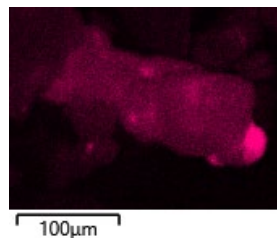
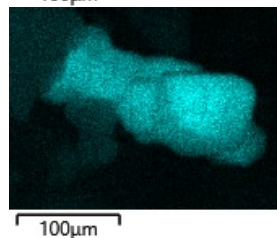
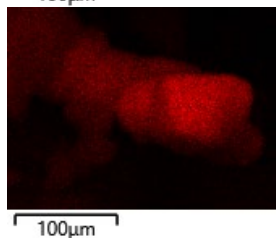
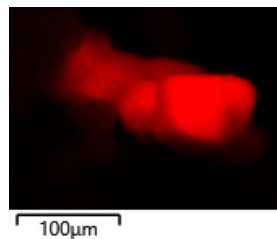
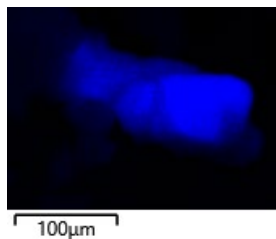
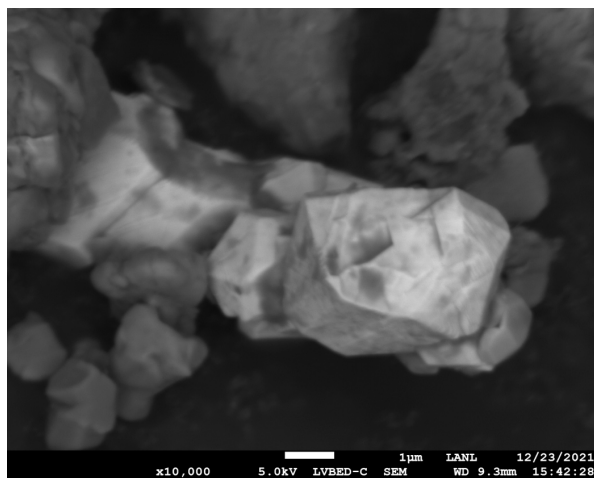




# MicroMatcher

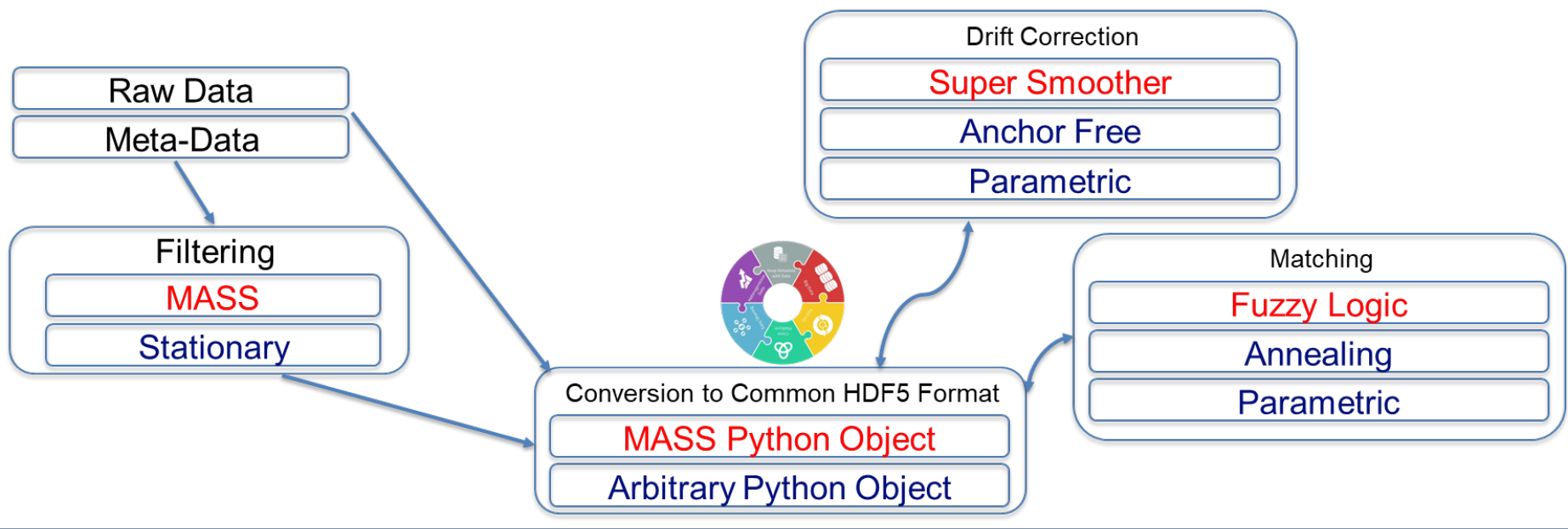


# Next Generation Applications: Spatial Mapping

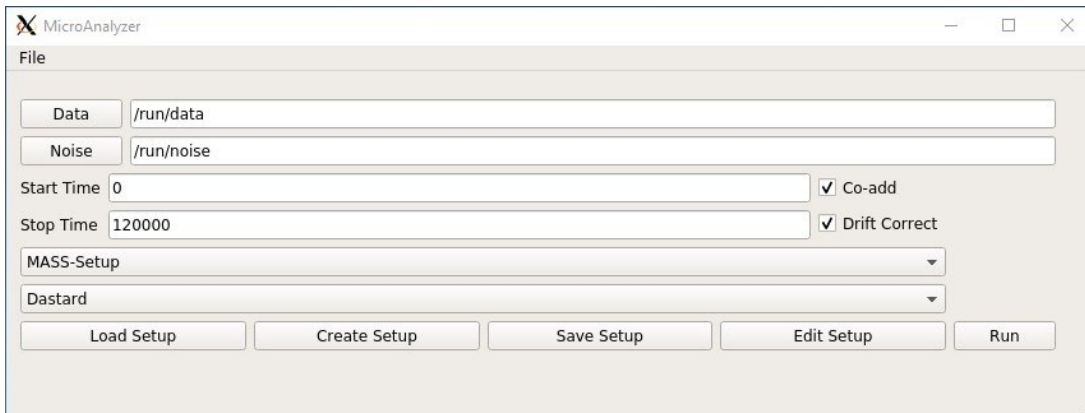


# MicroAnalyzer

## MicroAnalyzer



# MicroAnalyzer UI



The MicroAnalyzer main window features a 'File' menu bar and several input fields for configuration. It includes buttons for 'Data' and 'Noise' to specify file paths, and 'Start Time' and 'Stop Time' to define the acquisition range. Checkboxes for 'Co-add' and 'Drift Correct' are present, along with dropdown menus for 'MASS-Setup' and 'Dastard'. At the bottom, there are buttons for 'Load Setup', 'Create Setup', 'Save Setup', 'Edit Setup', and 'Run'.

File

Data /run/data

Noise /run/noise

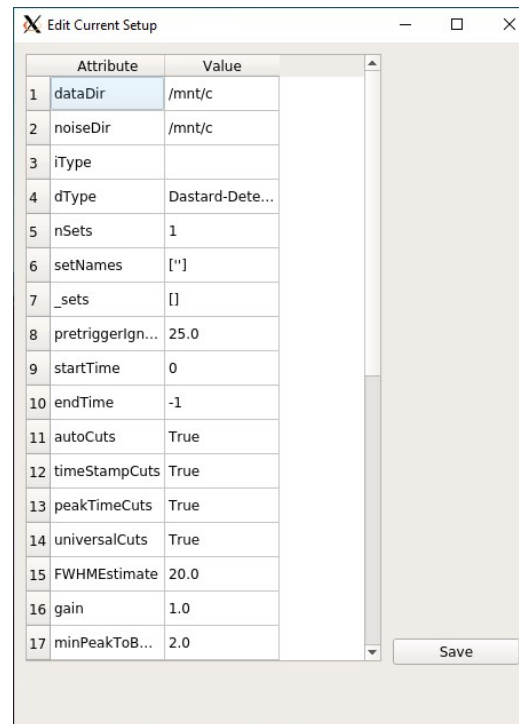
Start Time 0 ☒ Co-add

Stop Time 120000 ☒ Drift Correct

MASS-Setup

Dastard

Load Setup Create Setup Save Setup Edit Setup Run

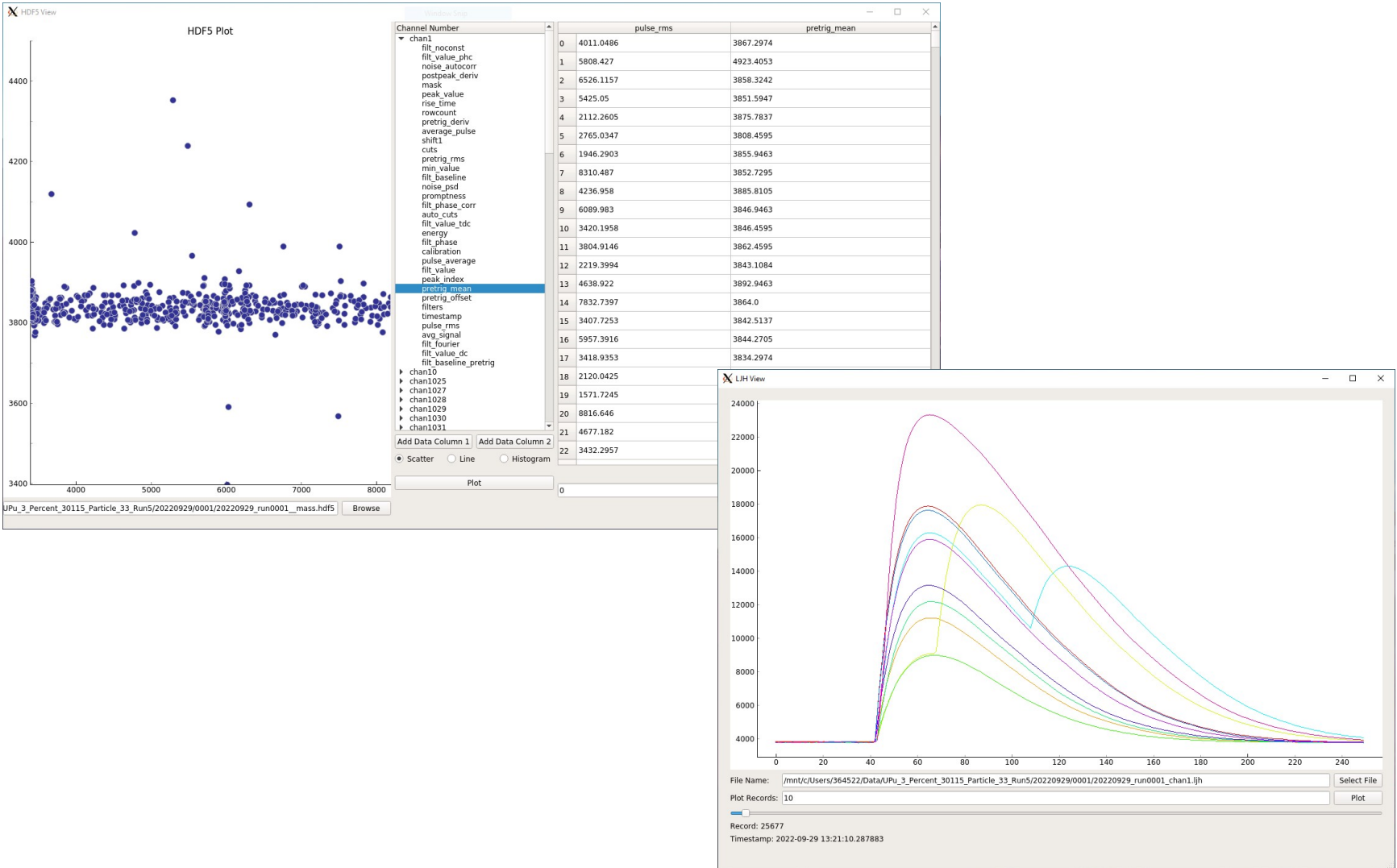


The 'Edit Current Setup' dialog box displays a table of attributes and their values. The table has two columns: 'Attribute' and 'Value'. The attributes are listed in a numbered sequence from 1 to 17. A 'Save' button is located at the bottom right of the dialog.

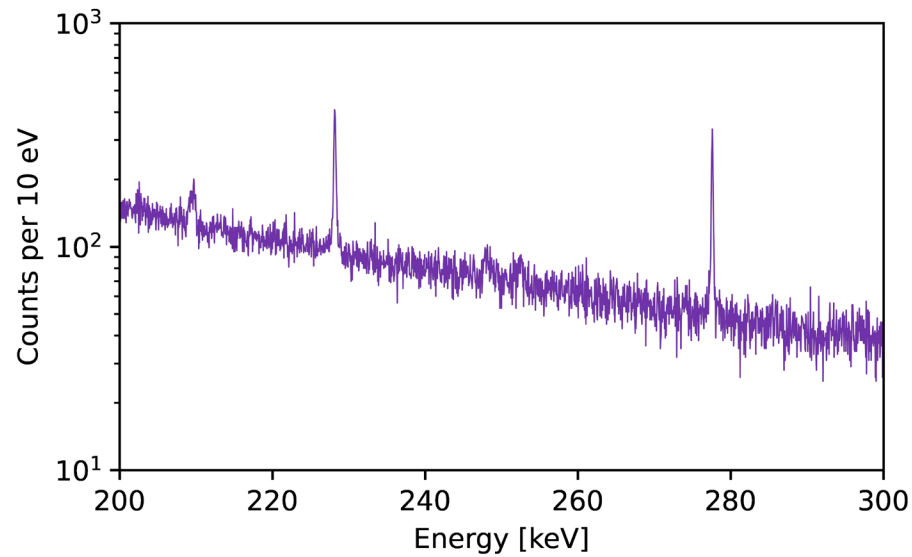
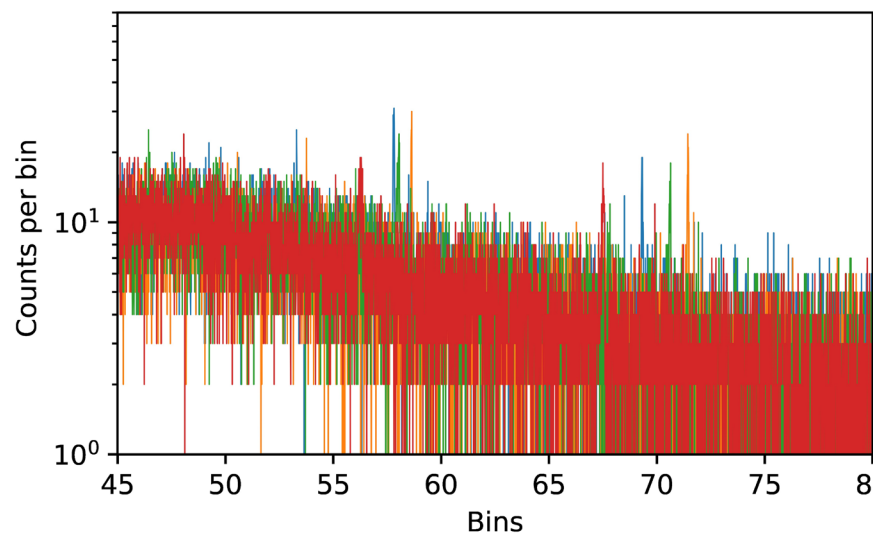
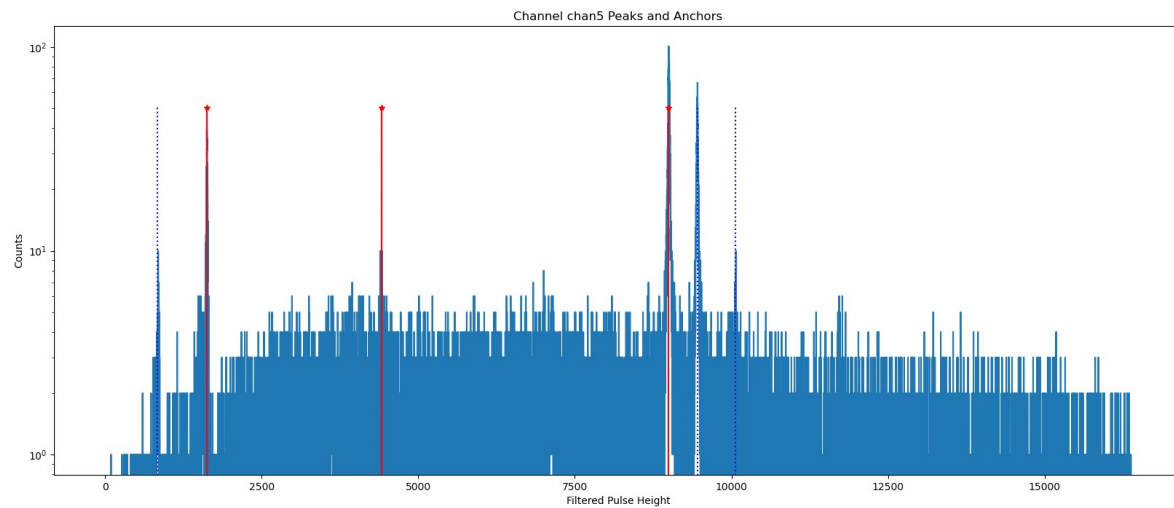
	Attribute	Value
1	dataDir	/mnt/c
2	noiseDir	/mnt/c
3	iType	
4	dType	Dastard-Dete...
5	nSets	1
6	setNames	[""]
7	_sets	[]
8	pretriggerIgn...	25.0
9	startTime	0
10	endTime	-1
11	autoCuts	True
12	timeStampCuts	True
13	peakTimeCuts	True
14	universalCuts	True
15	FWHMEstimate	20.0
16	gain	1.0
17	minPeakToB...	2.0

Save

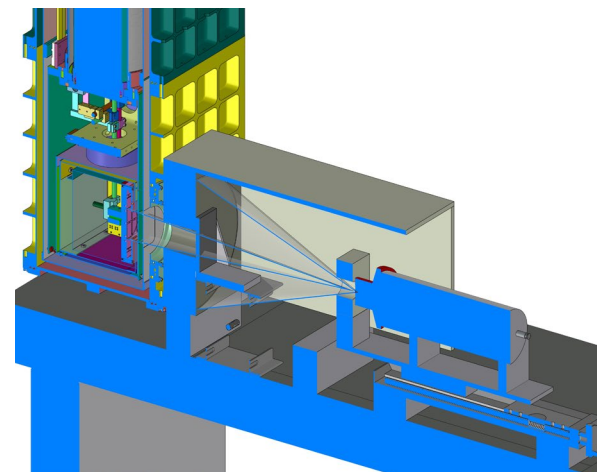
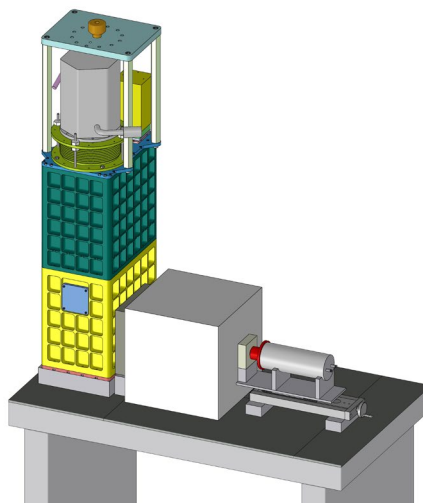
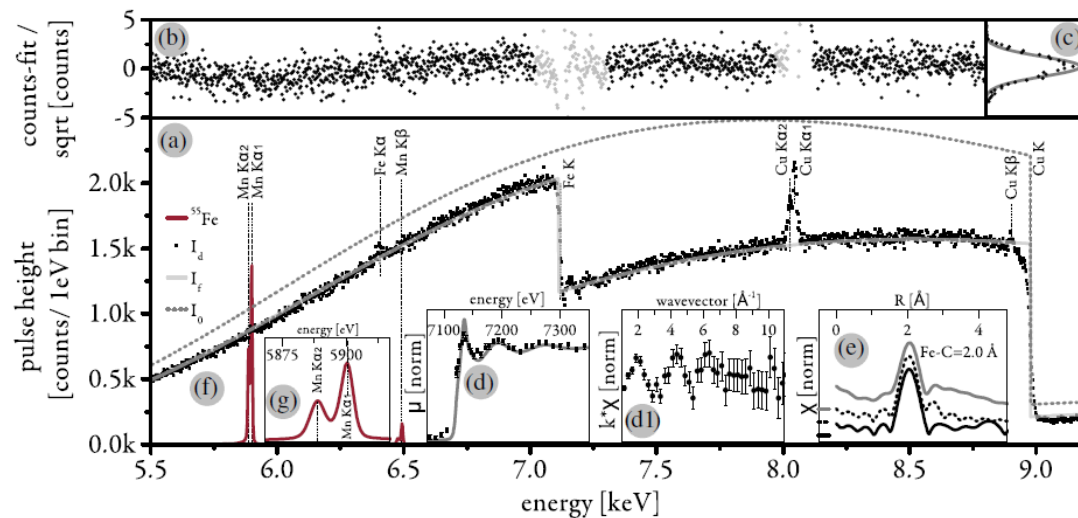
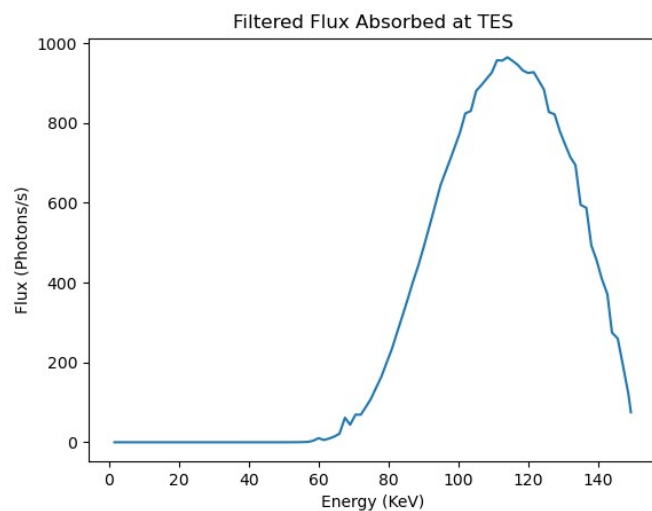
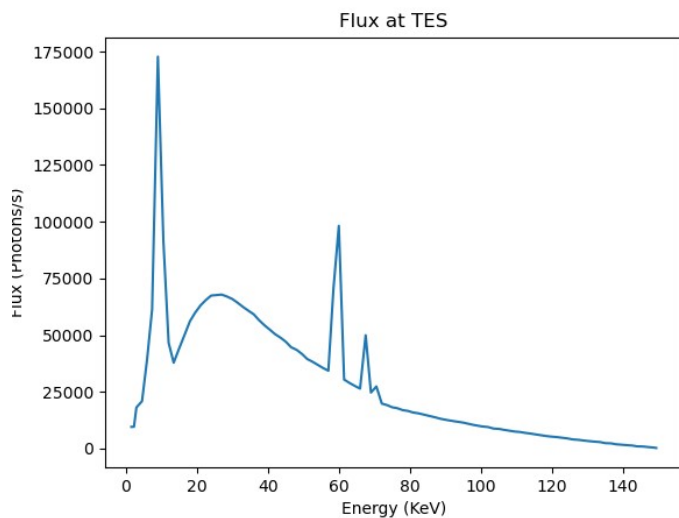
# Analysis Tool Integration



# Diagnostics



# Next Generation Applications: EXAFS



# Acknowledgments

- Low Temperature Detector Team at Los Alamos National Lab
  - Matt Carpenter
  - Kate Schreiber
  - Katrina Koehler
  - Mark Croce
  - Emily Teti
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  - Rico Schoenemann
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