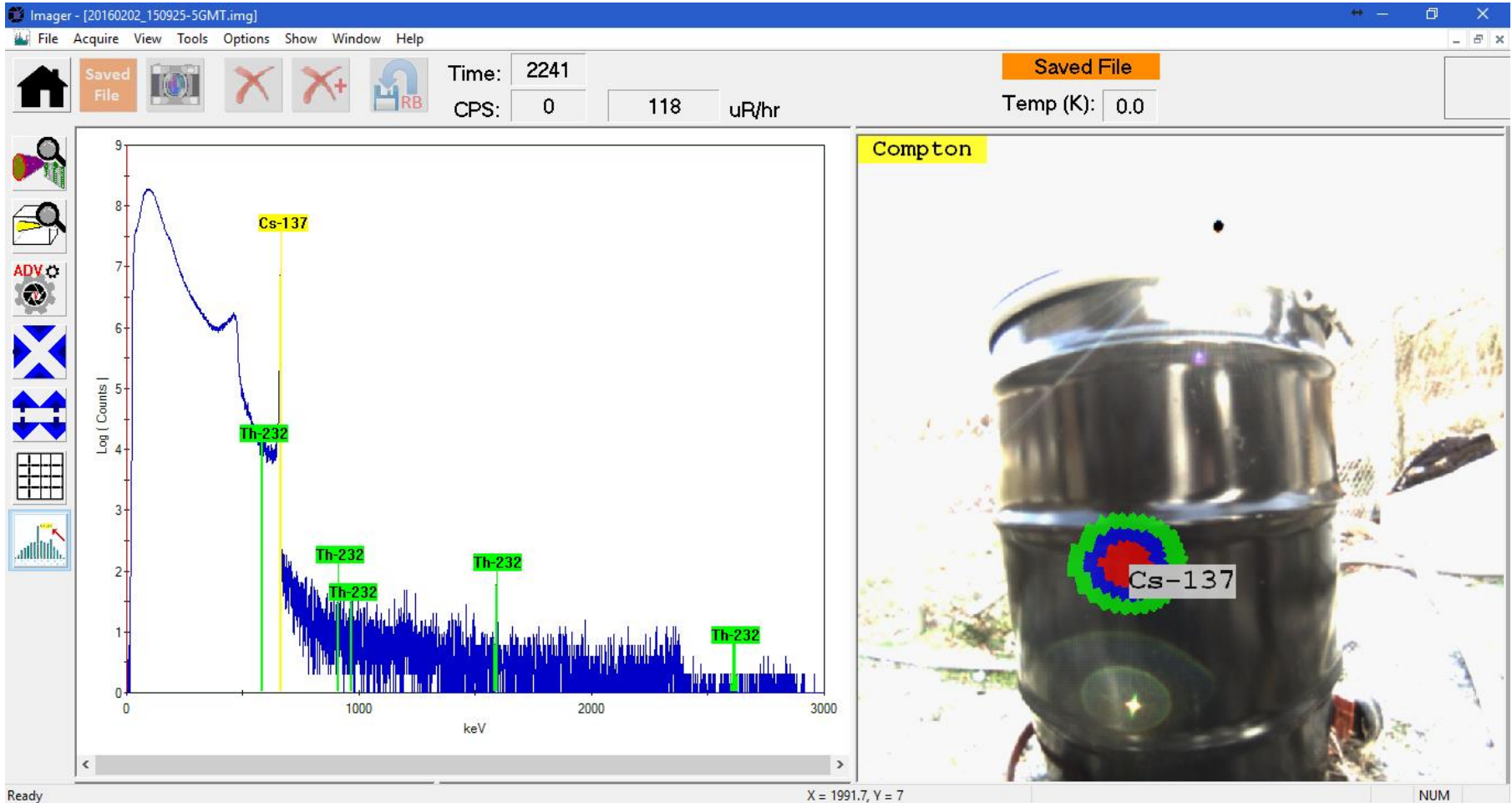




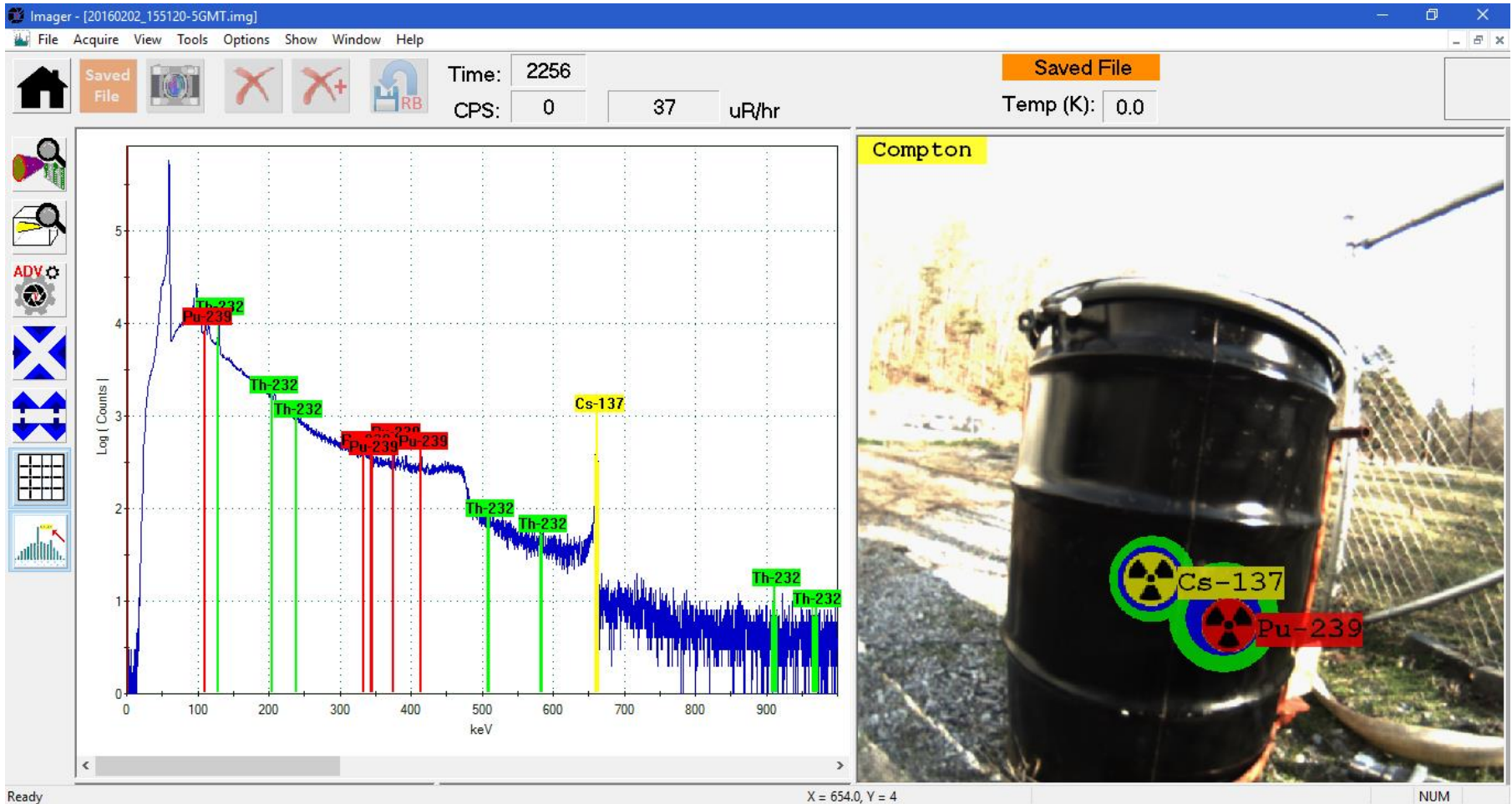
CBRNE Training/Exercise Event: GeGI Imaging Measurements

Target 1 – 55 Gallon Drum



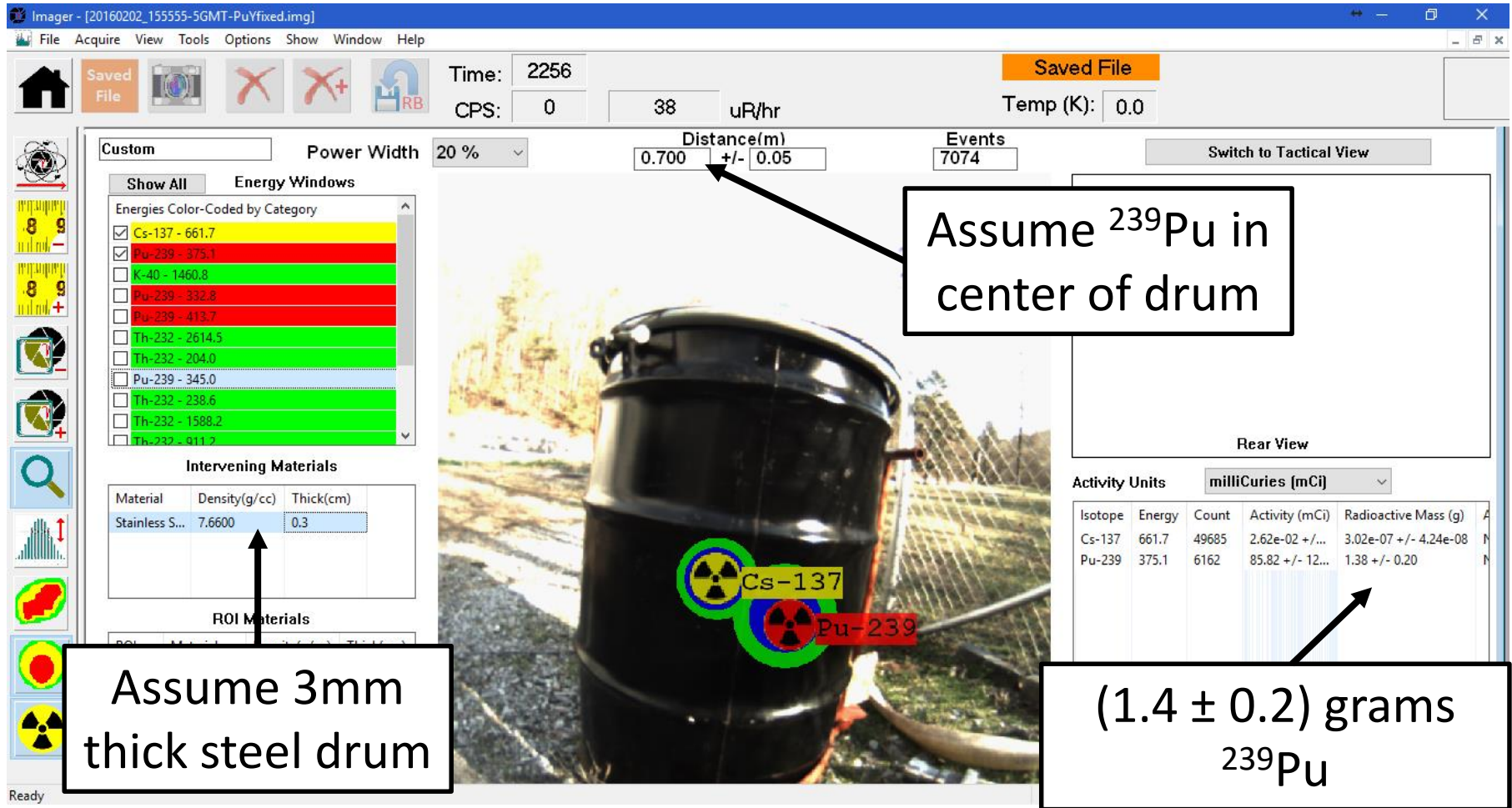
Measurement 1: – Looking directly at ^{137}Cs hotspot
(Compton Image) – No other isotopes evident

Target 1 – 55 Gallon Drum



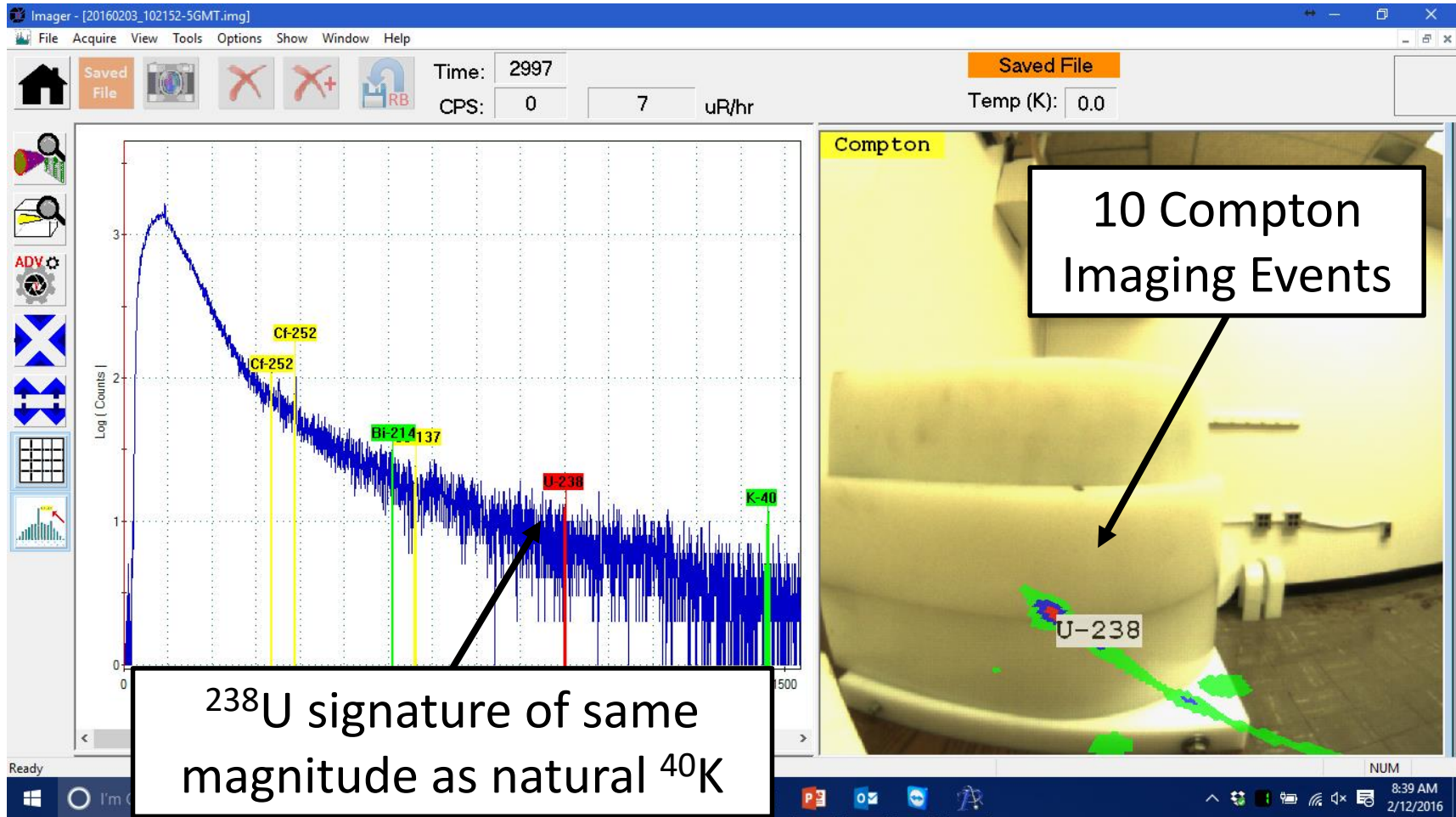
Measurement 2: – Move GeGI around drum 90 degrees
(Compton Image) – ^{137}Cs and ^{239}Pu detected and located!

Target 1 – 55 Gallon Drum Analysis



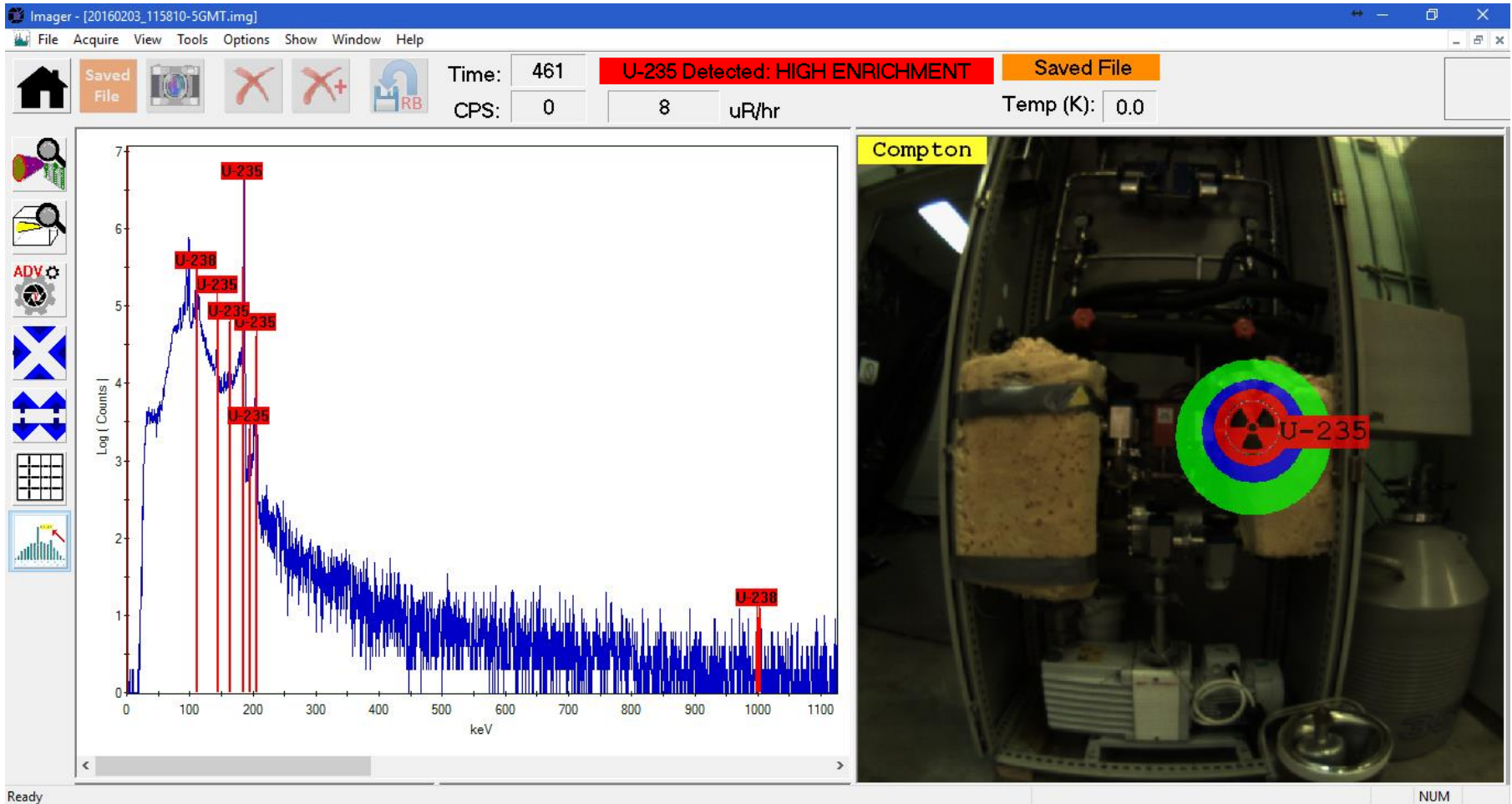
Measurement 2: – Analyze 375 keV counts in image
(Compton Image) – (1.4 ± 0.2) grams ^{239}Pu

Target 2 – Shielded DU Sphere



- DU detected, identified, and imaged correctly
- Located behind 2 cm Al and 10 cm HDPE

Target 3 – U Enrichment Area



- ^{235}U and ^{238}U detected in spectrum
- ^{235}U localized to cabinet

Target 3 – U Enrichment Area Analysis

The screenshot shows the Imager software interface with the following elements:

- Top Bar:** Time: 901, CPS: 0, uR/hr: 8, Temp (K): 0.0. A red banner reads "U-235 Detected: HIGH ENRICHMENT".
- Left Panel:** Energy Windows list with "U-235 - 185.7" checked. Intervening Materials table shows Uranium with Density 18.7000 and Thickness 0.1.
- Center:** Live video feed of a container with a radiation detector overlay showing a red "U-235" label.
- Right Panel:** Activity Units: Curies [Ci]. Table shows U-235 with Count 34408 and Radioactive Mass 85.36 +/- 6.32 g.

Annotations:

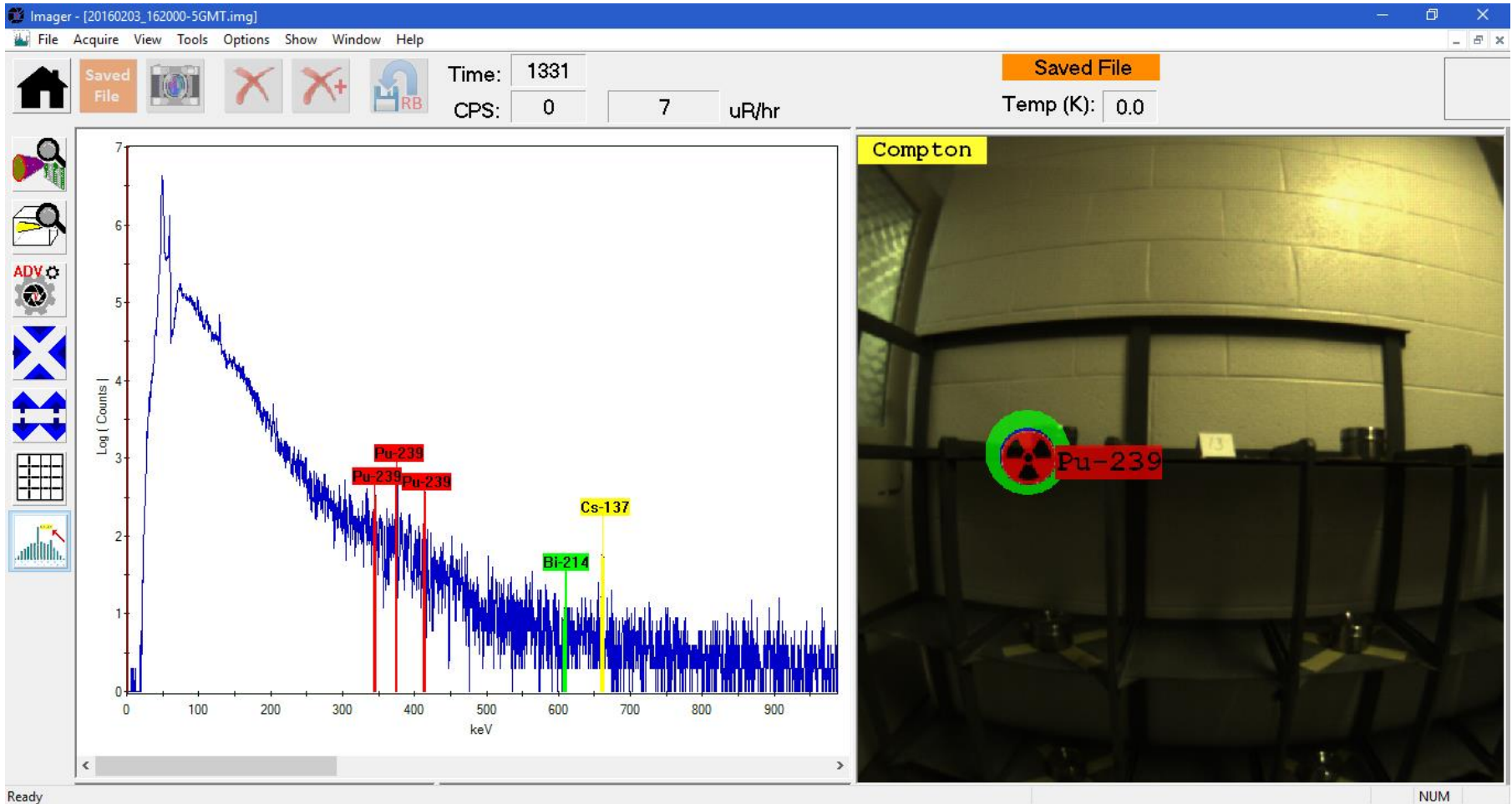
- Arrow from "U-235 Detected: HIGH ENRICHMENT" to "Real-time HEU Indication" box.
- Arrow from "U-235" label to "(85 ± 6) grams ²³⁵U" box.
- Arrow from "Uranium ..." table to "Assume 186 keV from outer 1mm" box.

Material	Density(g/cc)	Thick(cm)
Uranium ...	18.7000	0.1

Isotope	Energy	Count	Radioactive Mass (g)
U-235	185.7	34408	85.36 +/- 6.32

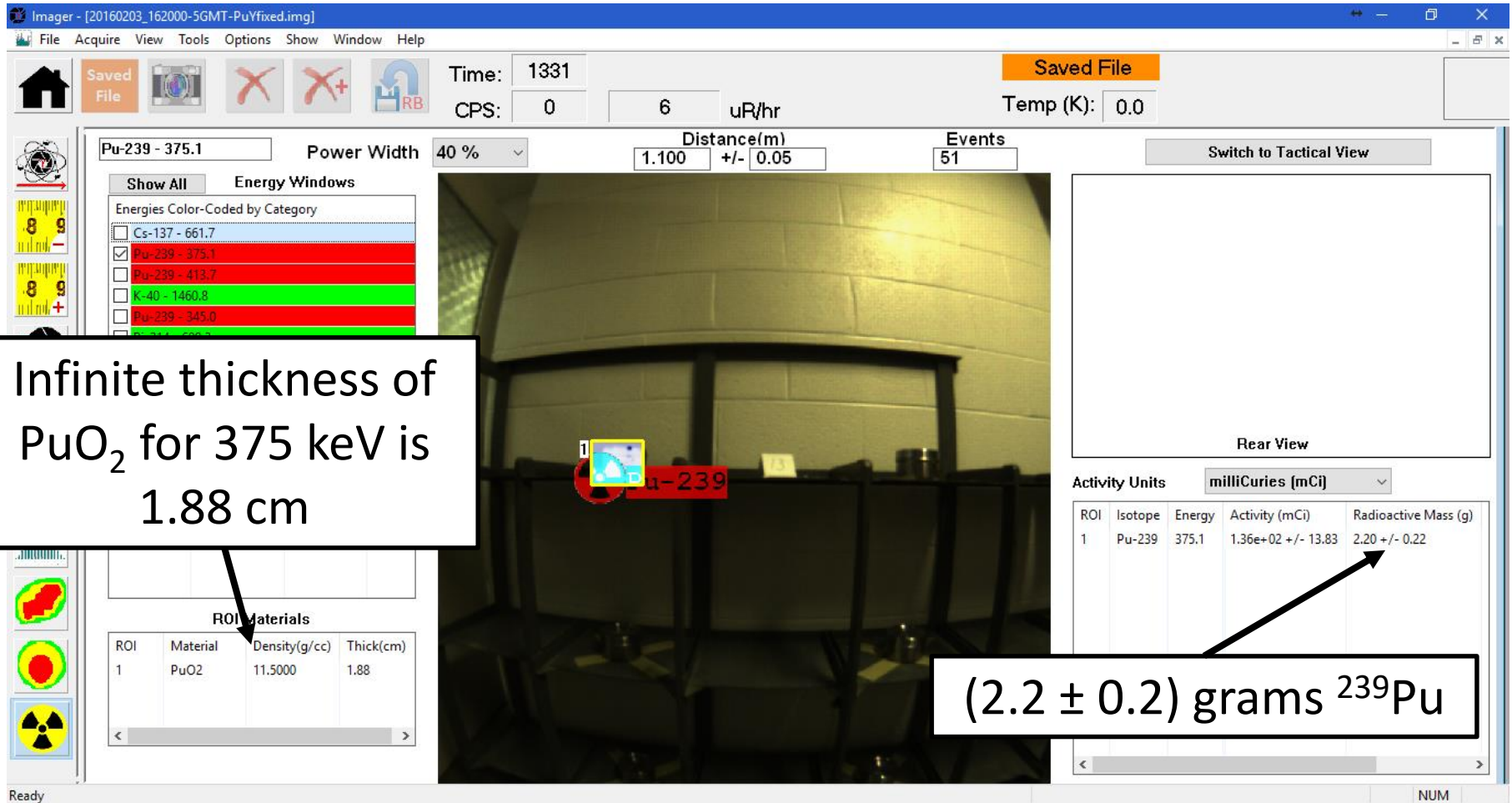
- Real-time indication of HEU
- GeGI calculates ~85 grams of ²³⁵U

Target 4 – Criticality Safety Array



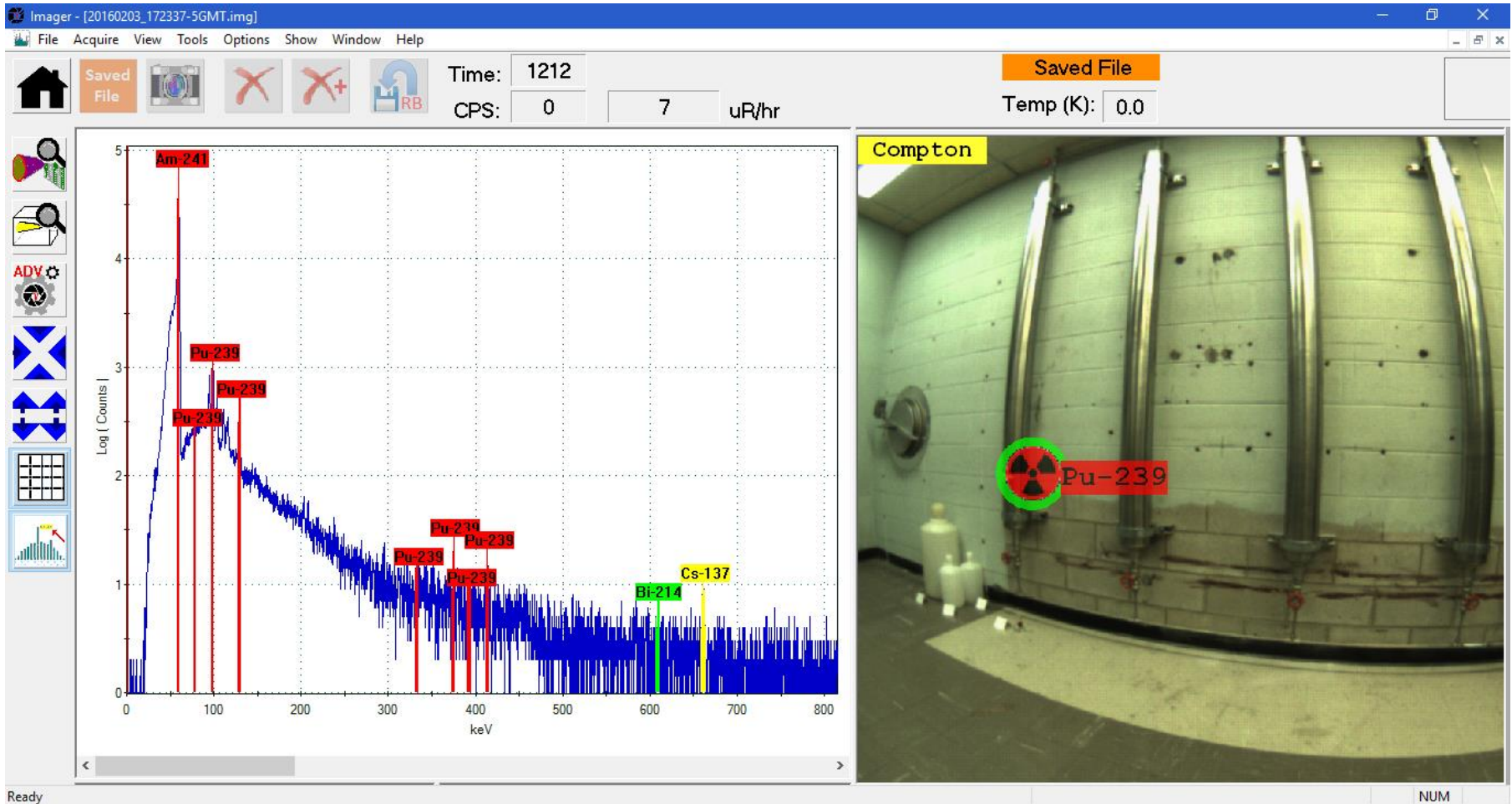
- ^{239}Pu and ^{137}Cs detected (^{137}Cs from Target 1 drum)
- ^{239}Pu located in upper left container

Target 4 – Criticality Safety Array Analysis



- Assume container is full of PuO₂ (conservative)

Target 5 – Vertical Piping



- ^{239}Pu and ^{137}Cs detected (^{137}Cs from drum behind GeGI)
- ^{239}Pu located in leftmost pipe (2.5 meters away)

Target 5 – Vertical Piping Analysis

Imager - [20160203_172337-5GMT.img]

File Acquire View Tools Options Show Window Help

Time: 1212
CPS: 0 9 uR/hr
Temp (K): 0.0

Saved File

Pu-239 - 375.1 Power Width 40 % Distance(m) 2.5 +/- 0.20 Events 51

Switch to Tactical View

Show All Energy Windows

Energies Color-Coded by Category

- Pu-239 - 375.1
- Pu-239 - 413.7
- Cs-137 - 661.7
- Pu-239 - 129.3
- Bi-214 - 609.3
- Pu-239 - 393.1
- Pu-239 - 332.8
- Th-232 - 2614.5

Intervening Materials

Material	Density(g/cc)	Thick(cm)
----------	---------------	-----------

ROI Materials

ROI	Material	Density(g/cc)	Thick(cm)
There are no items to show in this view.			

Rear View

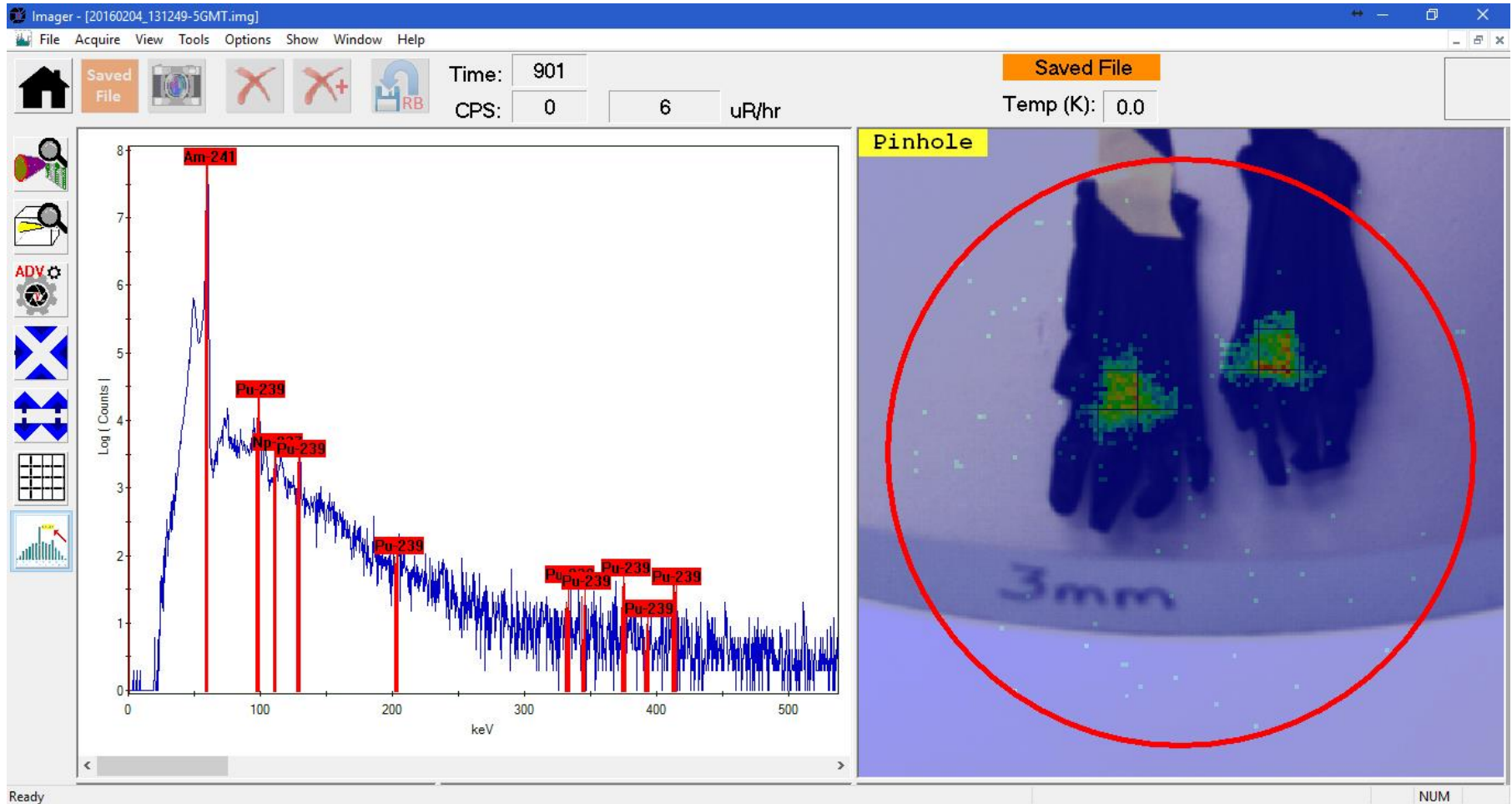
Activity Units Curies [Ci]

Isotope	Energy	Count	Radioactive Mass (g)
Pu-239	375.1	319	1.21 +/- 0.20

(1.2 ± 0.2) grams ²³⁹Pu

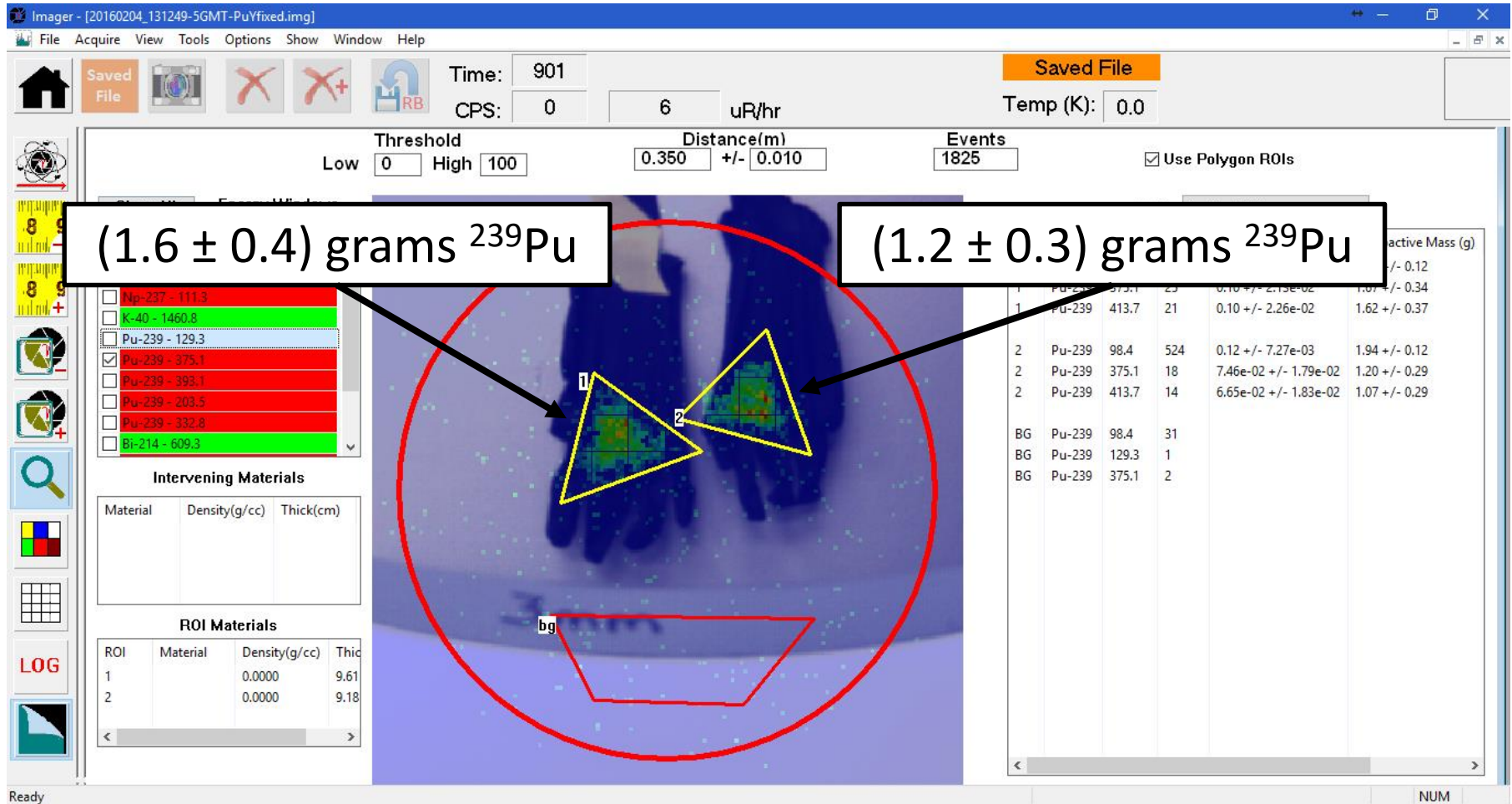
- ²³⁹Pu known to be taped to outside of piping
- No attenuation included in this calculation

Target 6 – ^{239}Pu Sources Demonstration



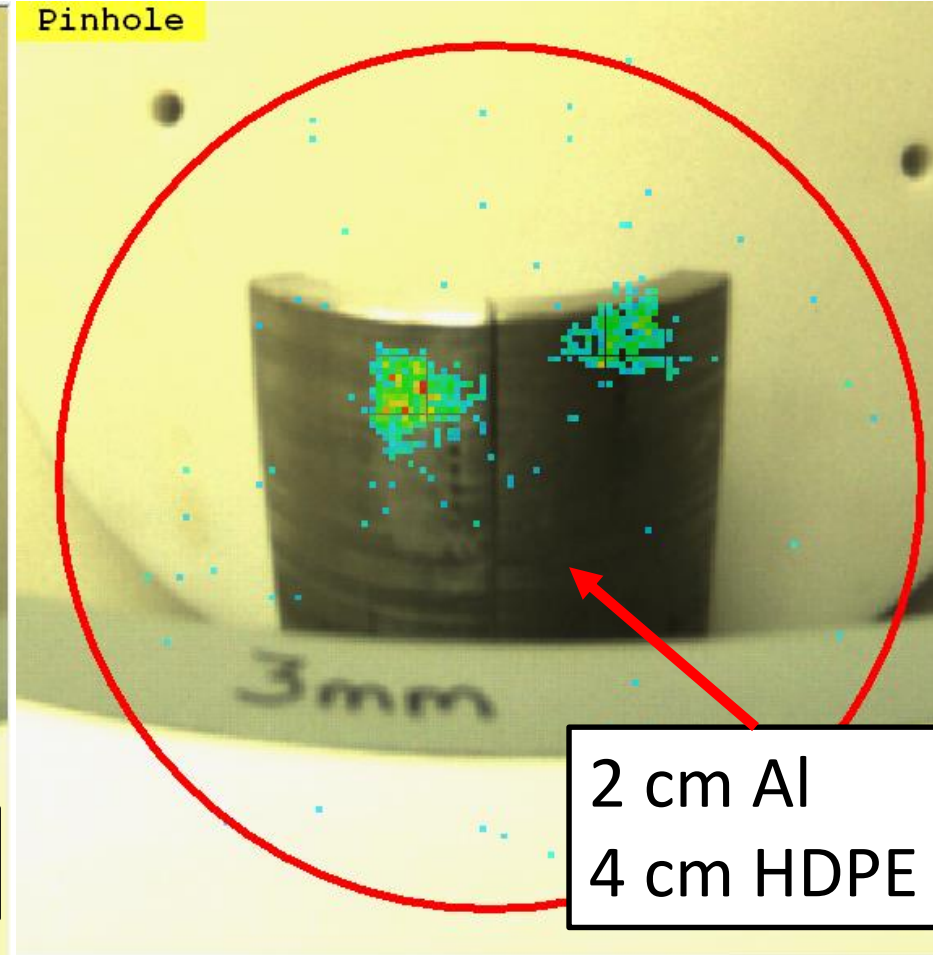
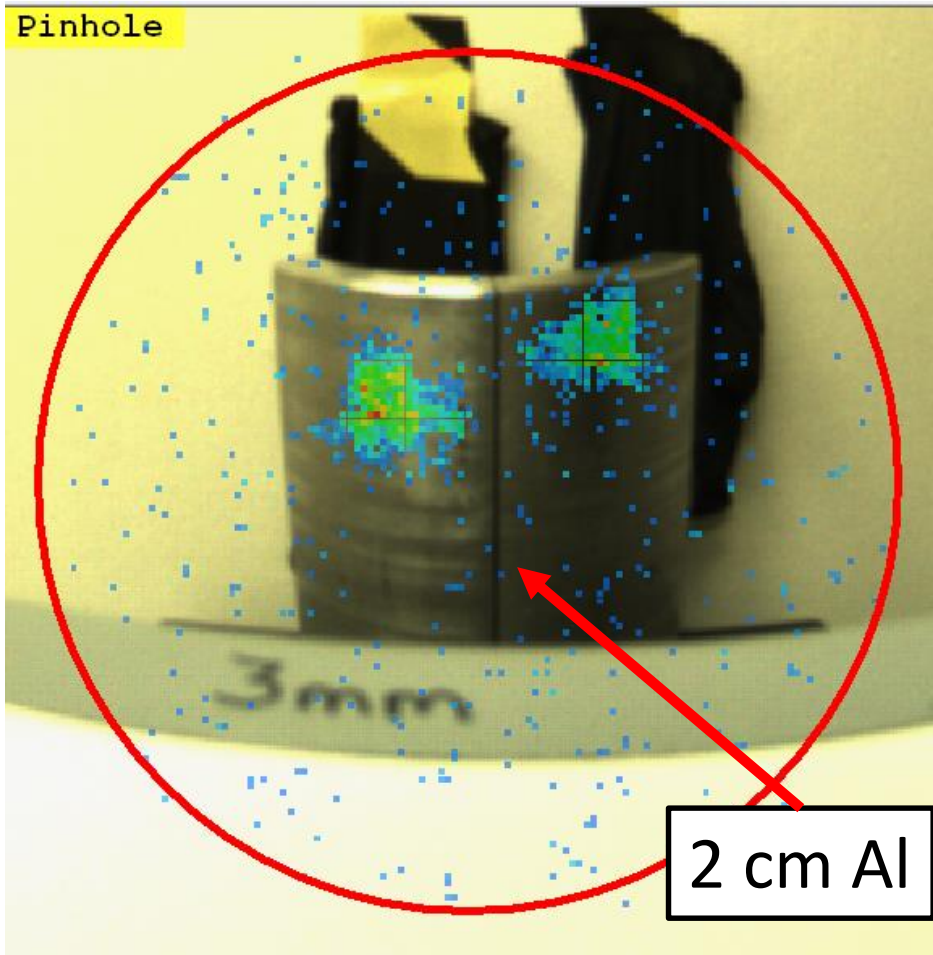
- Pinhole image reveals 2 triangular ^{239}Pu sources
- See following slide for quantitative analysis

Target 6 – ^{239}Pu Sources Analysis



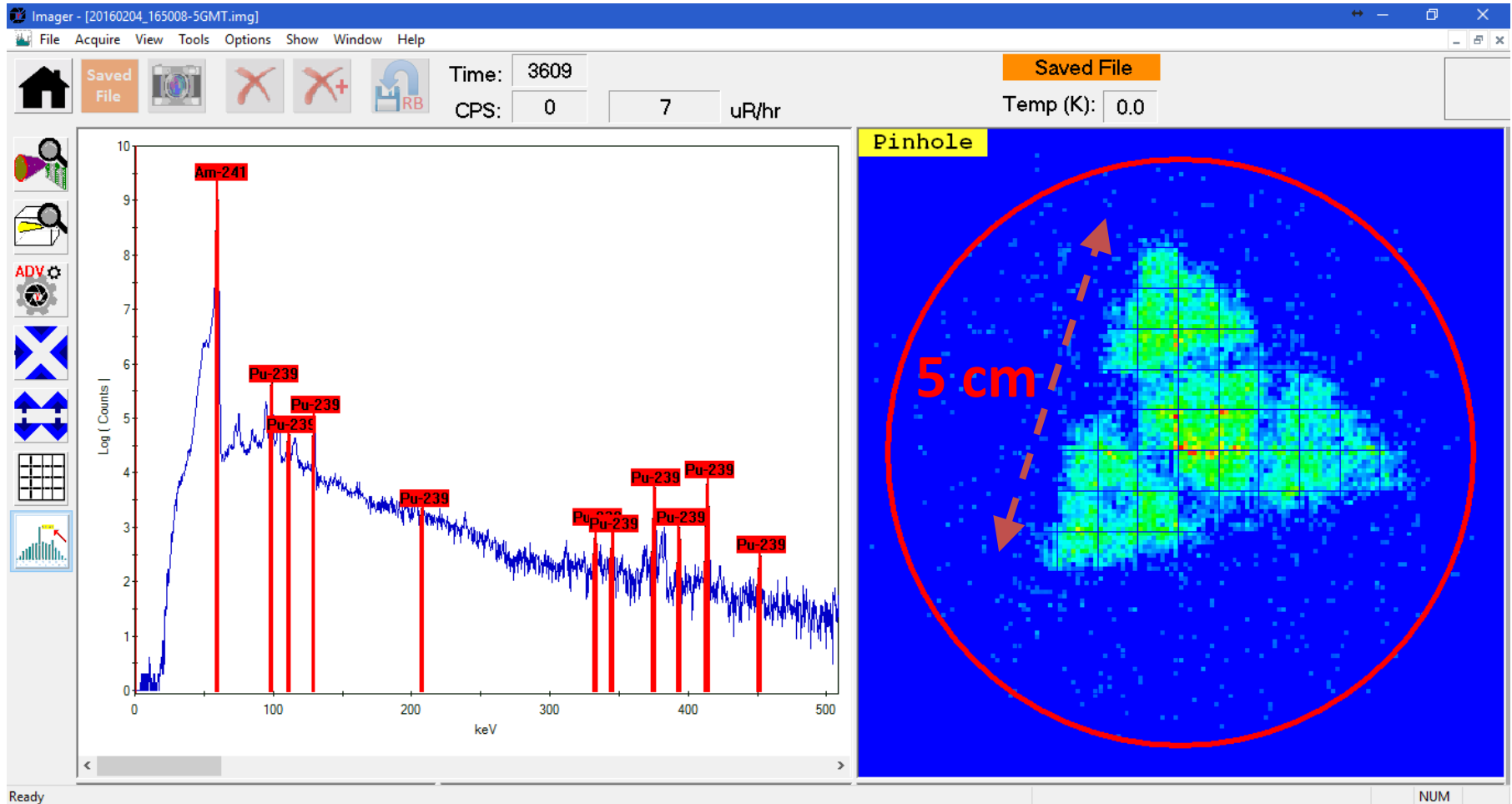
- Select regions of interest in pinhole image for analysis
- Quantitative analysis indicates ~1.4 grams of ^{239}Pu each

Target 6 – ^{239}Pu Sources



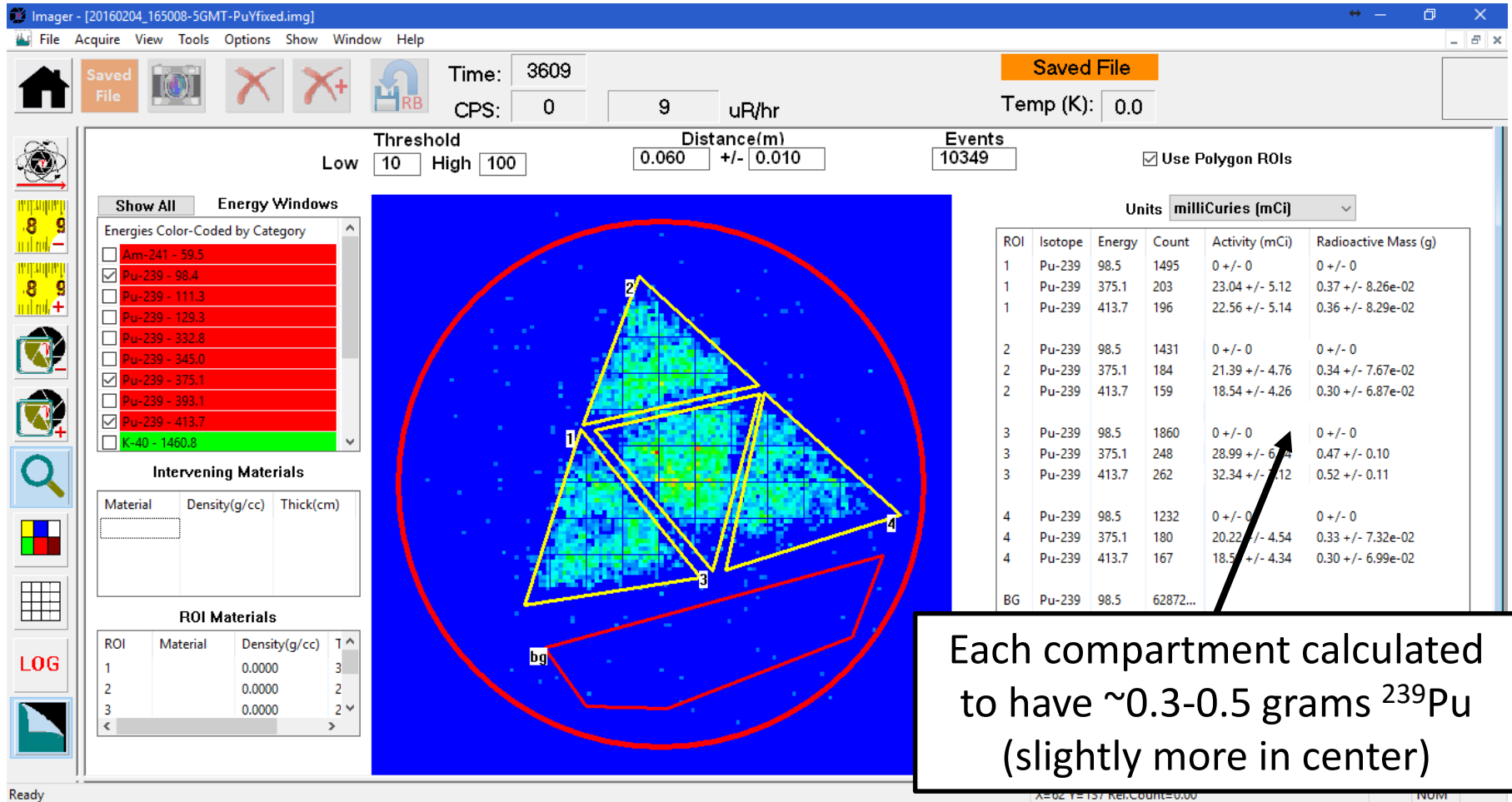
- 2 triangles of ^{239}Pu still evident behind 2 cm Al and 4 cm HDPE (also 2 cm Al and 8 cm HDPE, not shown here)

Target 6 – ^{239}Pu Source (Zoom)



- Zoomed view of 1 of the triangles, shown to be comprised of 4 triangular chambers of ^{239}Pu

Target 6 – ^{239}Pu Source Analysis



- Analyze ^{239}Pu mass in each of the 4 compartments
- Total mass of (1.5 ± 0.2) grams ^{239}Pu

Measurement Summary

- GeGI successfully imaged multiple SNM targets of interest
- GeGI isolated ^{137}Cs and ^{239}Pu in the 55 gallon drum, which was difficult with a non-imaging detector
- GeGI provided a real-time indication of the location and quantity of ^{235}U and ^{239}Pu (also ^{235}U enrichment)
- Pinhole imaging with GeGI revealed the shapes of SNM targets and the quantity of material, including shielded SNM configurations of interest