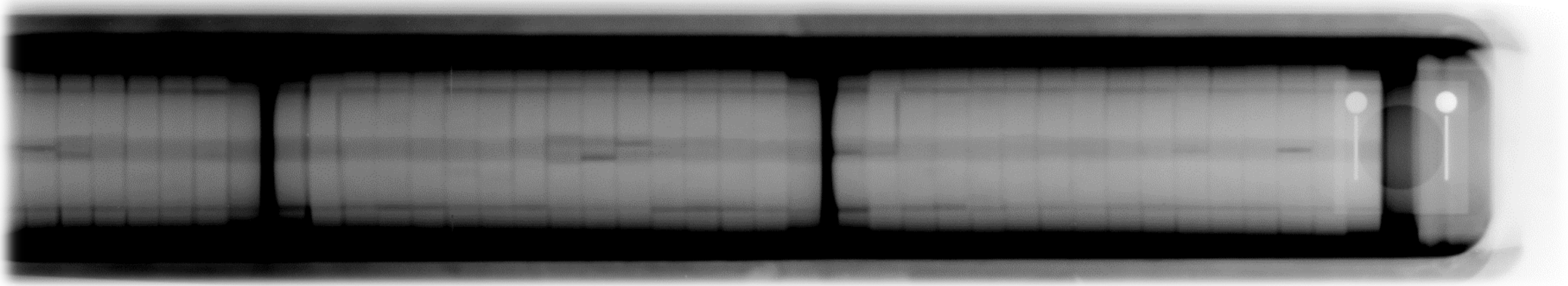
Indirect Neutron Radiography at the Annular Core Research Reactor (ACRR)



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Exceptional Gratitude to:
Derek Balke, Billy Martin, Augie Chapa, Rafe Campbell, Lonnie Martin, and all ACRR Operators & EH&S Personnel

Presentation Roadmap

- Foil Sandwich and Other Applicable Materials
- RAW + Processed Histogram Compositions
- Brightness & Contrast
- SNR to CNR
- Characterizing Configuration
- Rapid Review of Iterations (1) through (3)
- Image Quality Indicators
- Quantification & Coordination
- Summary of Knowledge

The Foil Sandwich:

ALUMINUM

CADMIUM

ALUMINUM

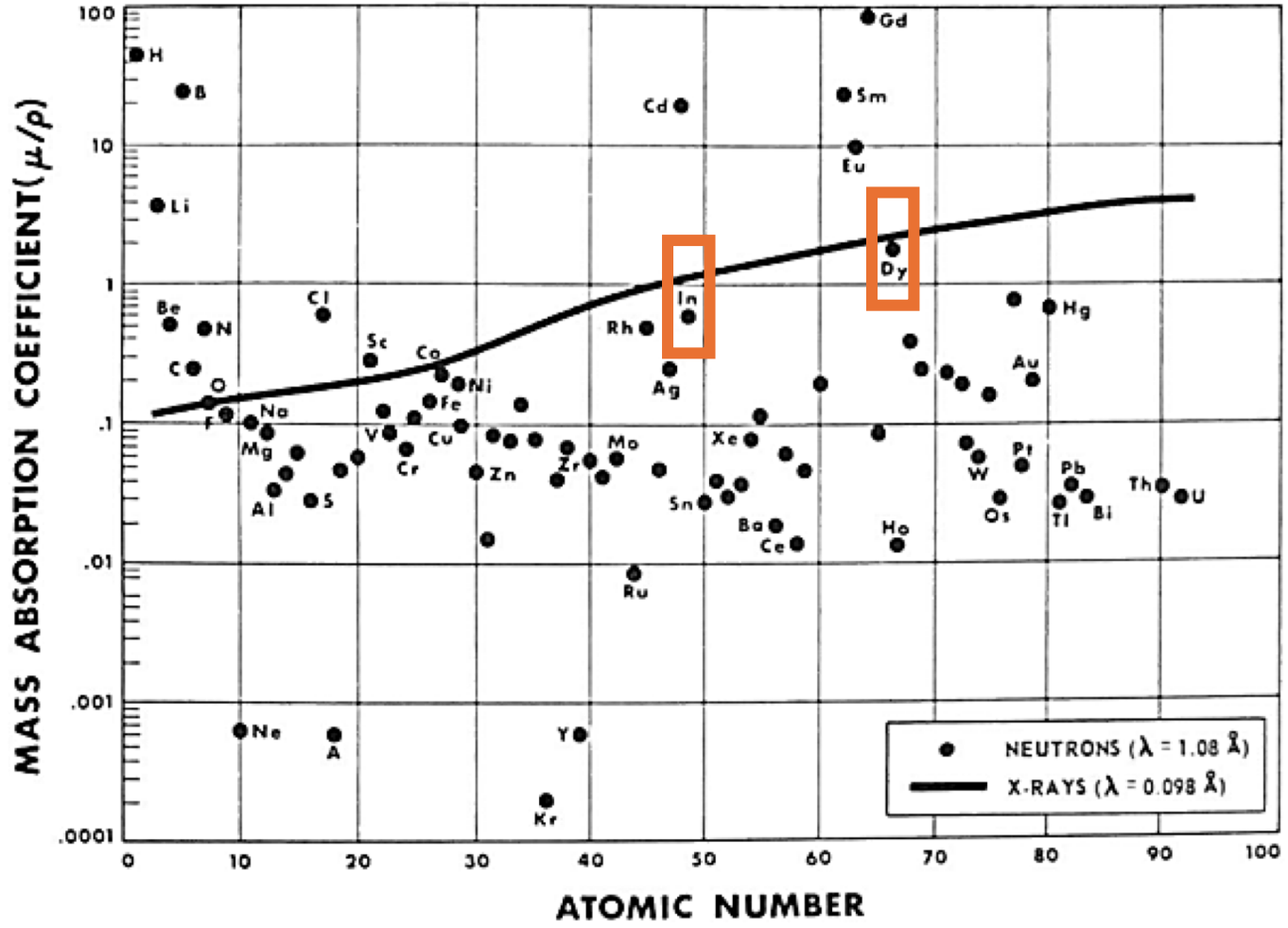
INDIUM

CADMIUM

DYSPROSIUM

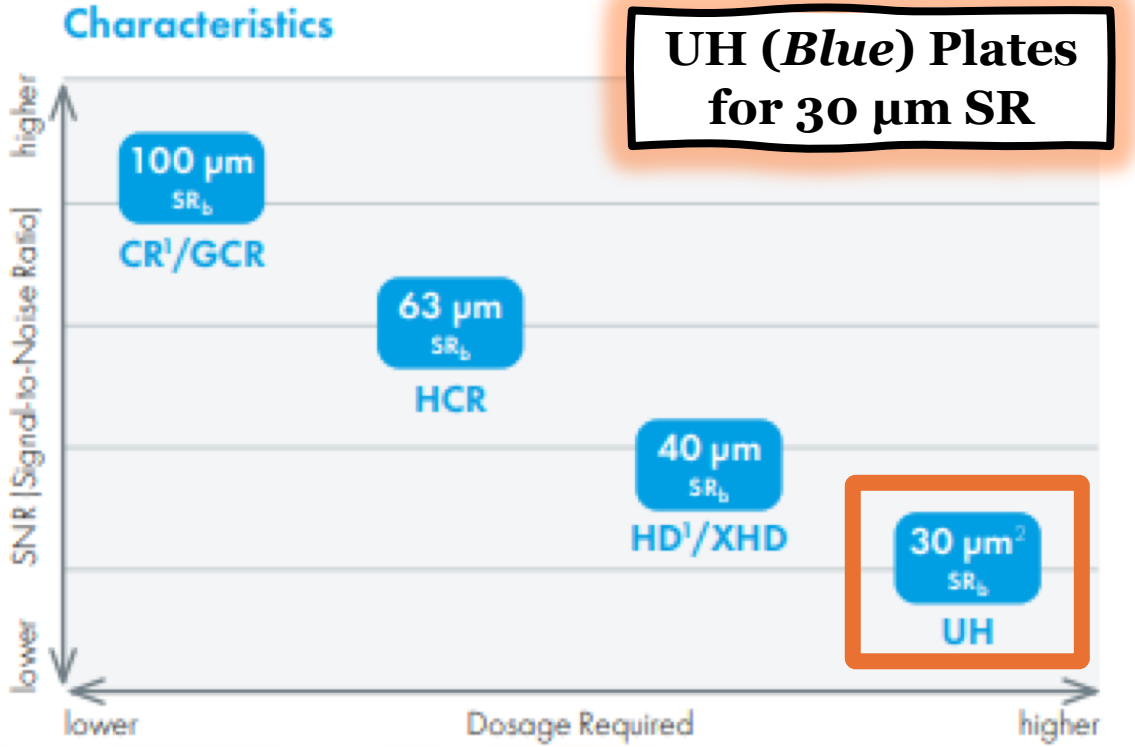
ALUMINUM

NEUTRONS!

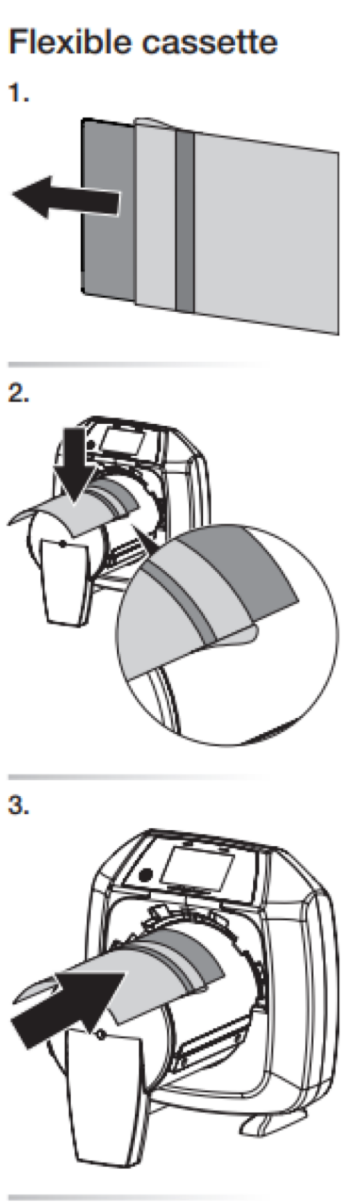


What else we used:

DÜRR NDT
HD-CR 35 NDT CR-Scanner

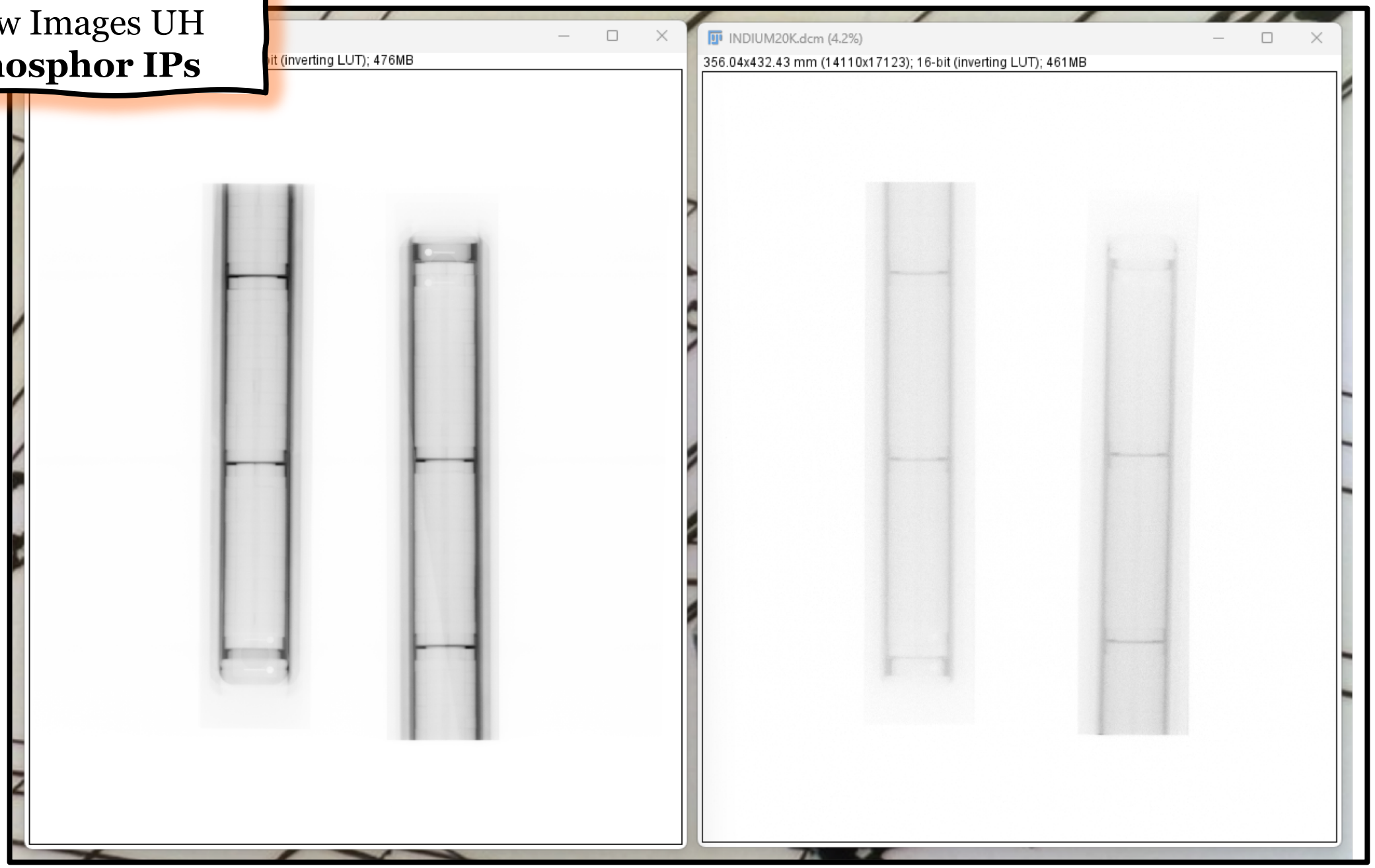


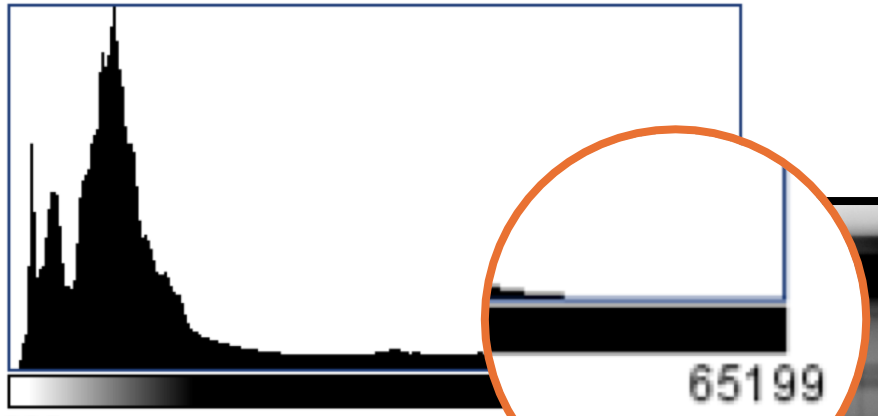
UH (*Blue*) Plates for 30 µm SR



ALARA

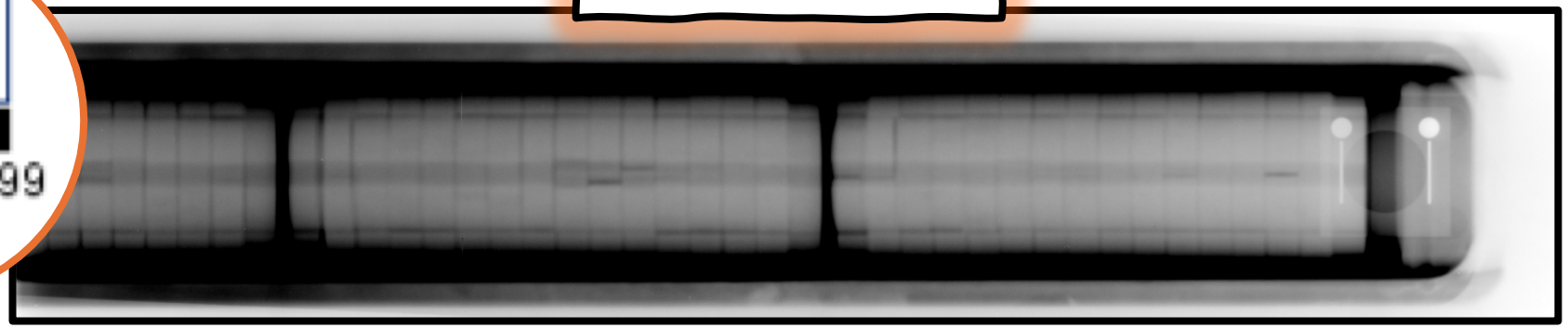
Raw Images UH
Phosphor IPs

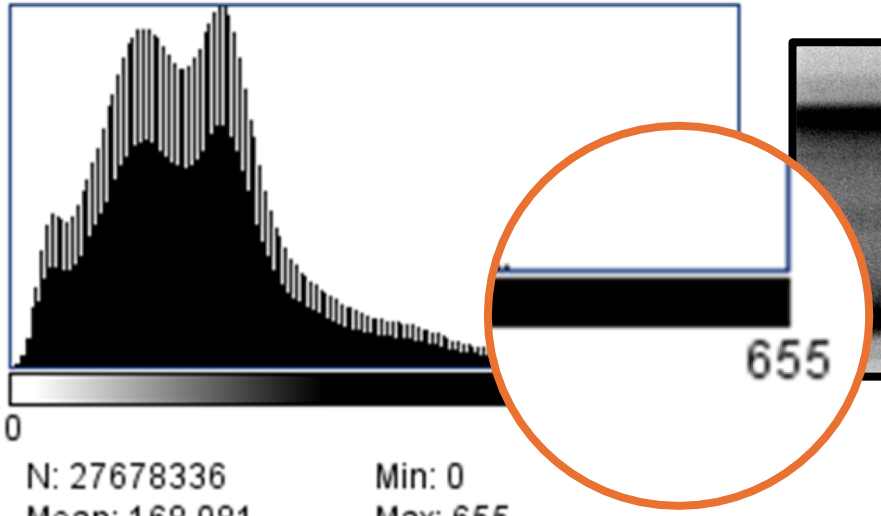




N: 27753600
Mean: 12962.645
StdDev: 10286.978
Bins: 256
Value: 20858.375

Min: 335
Max: 65199
Mode: 9541 (851563)
Bin Width: 253.375
Count: 52773





N: 27678336
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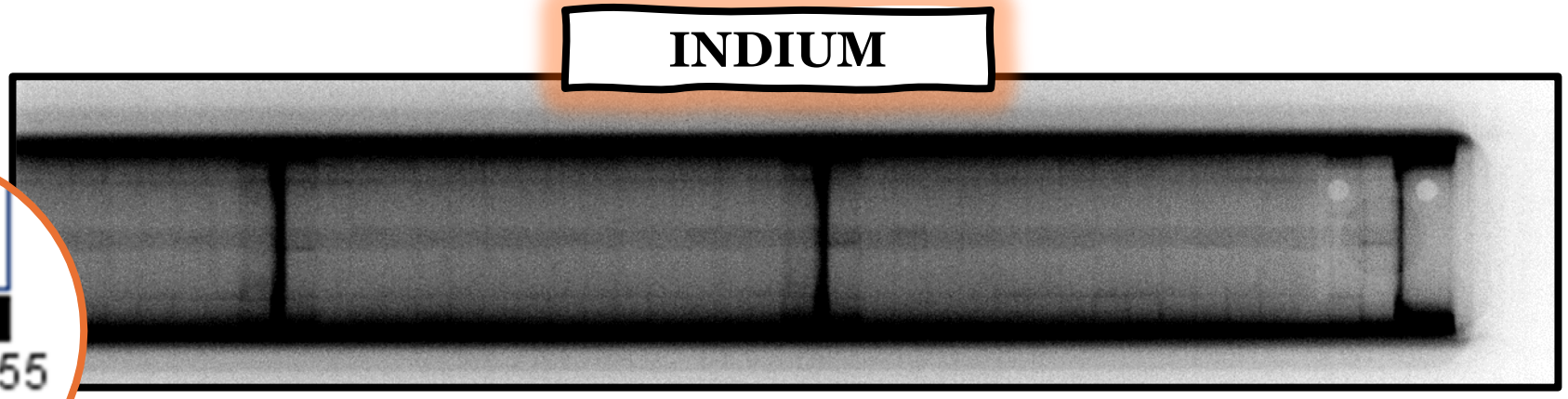
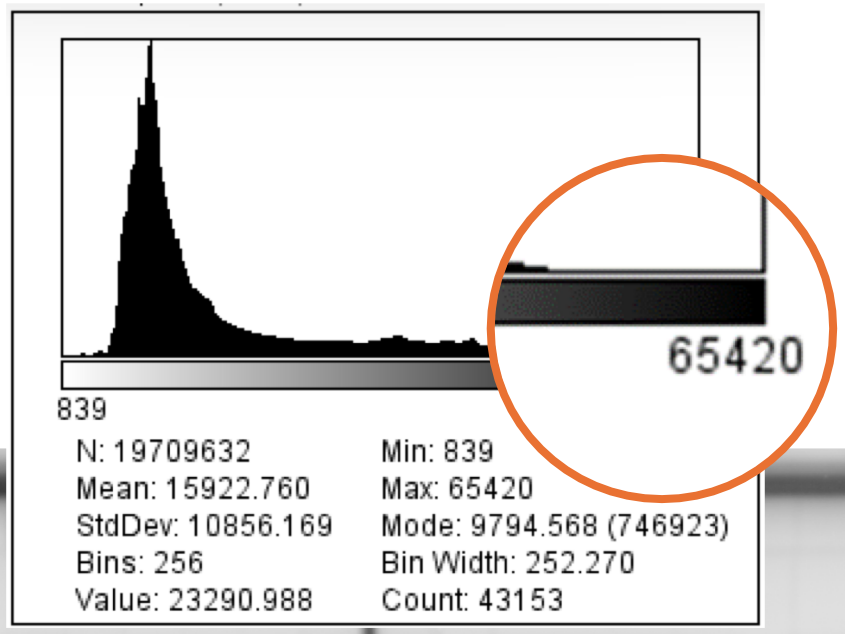
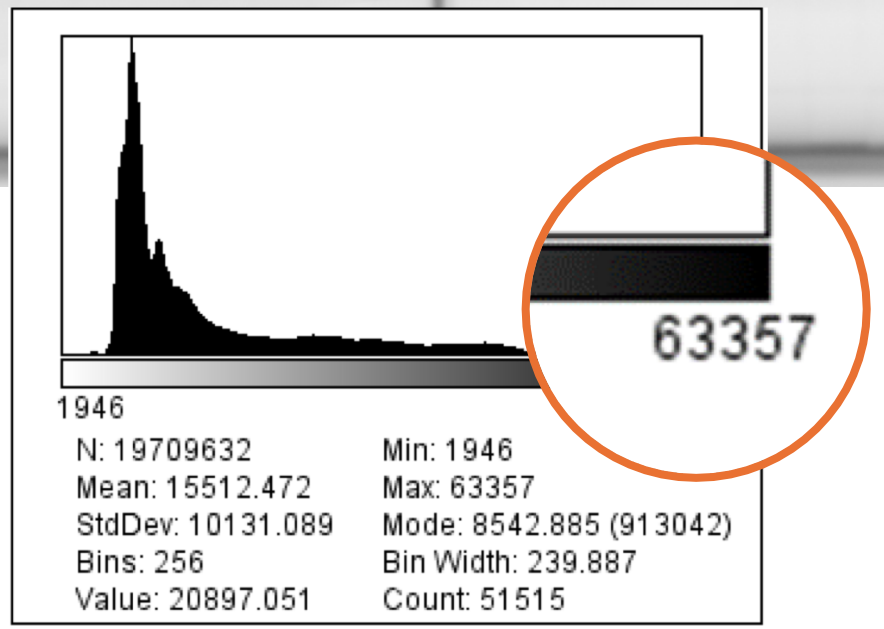
Bins: 256
Value: 647.324

Min: 0
Max: 655
Mode: 188 (439009)
Bin Width: 2.559
Count: 0

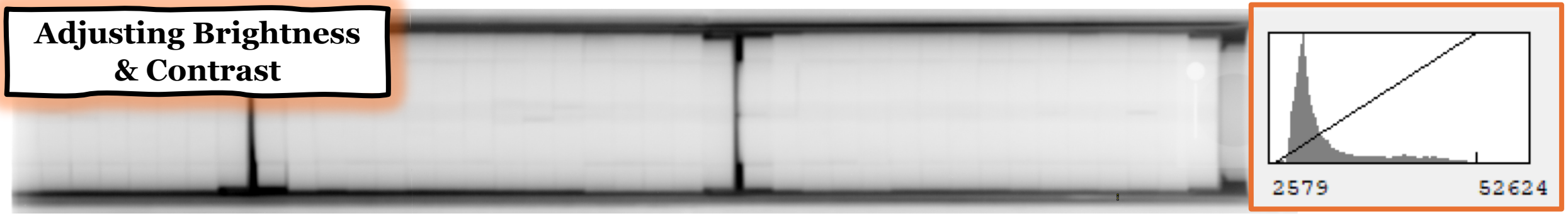


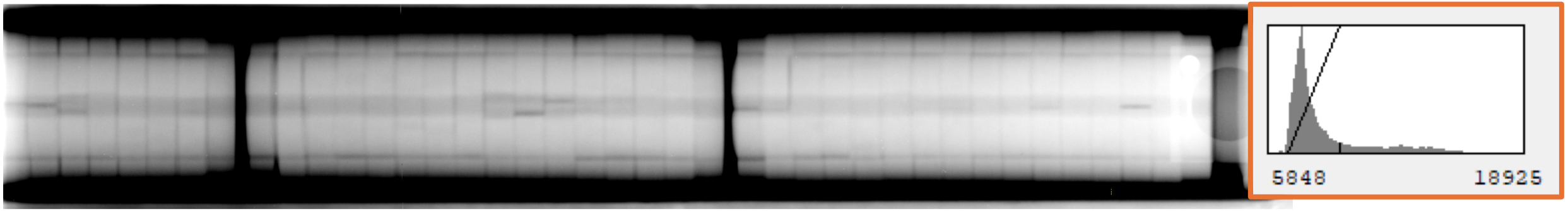
COMBINED DY+IN HISTOGRAMS

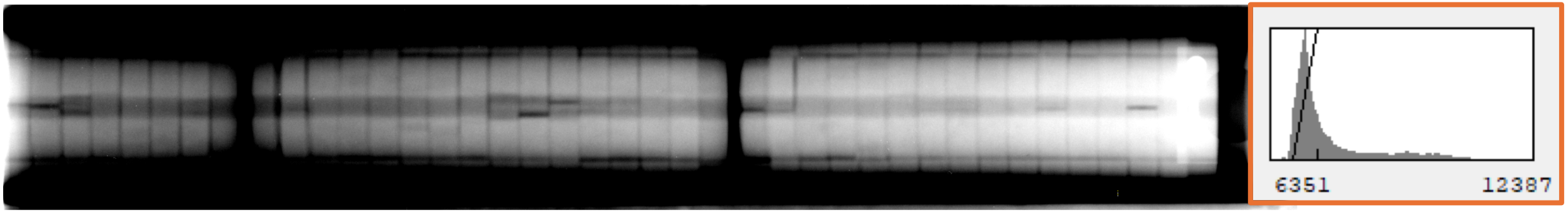


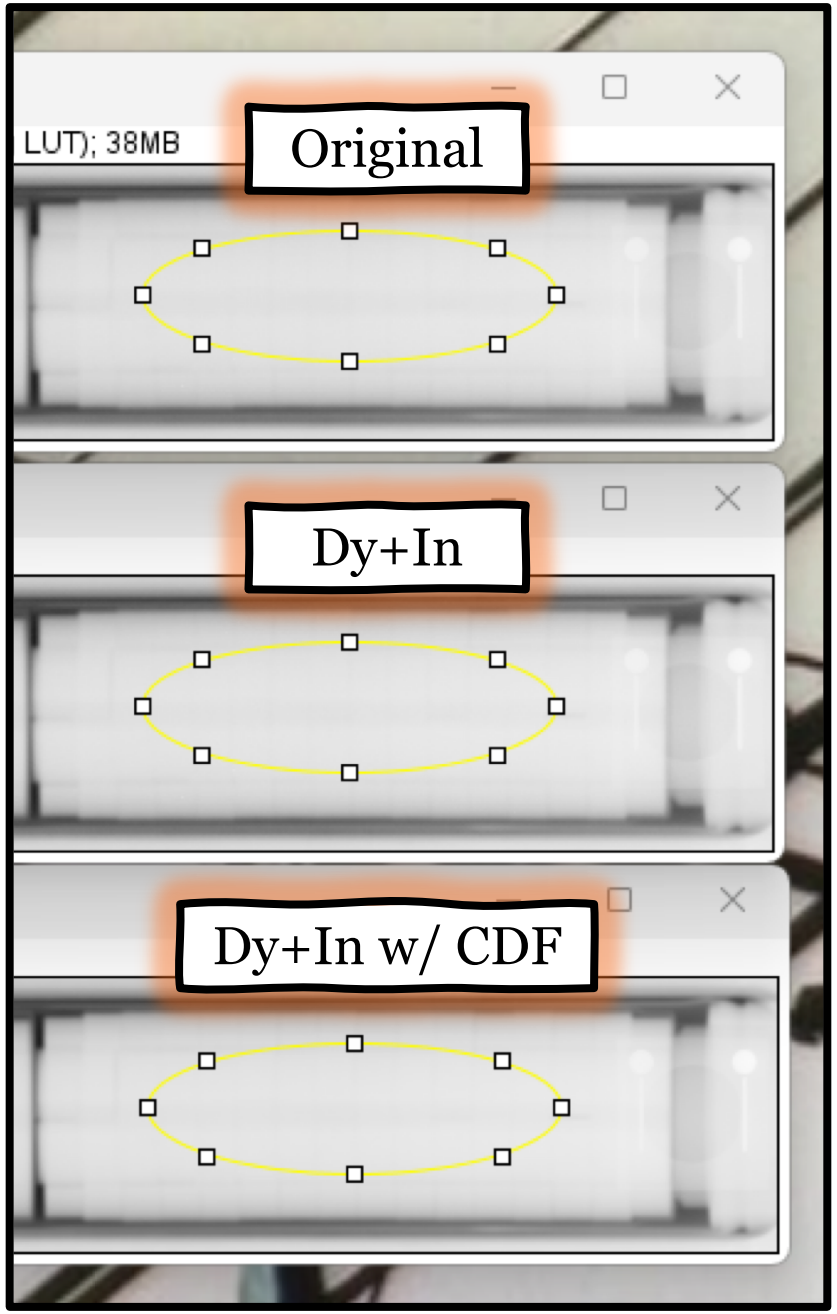


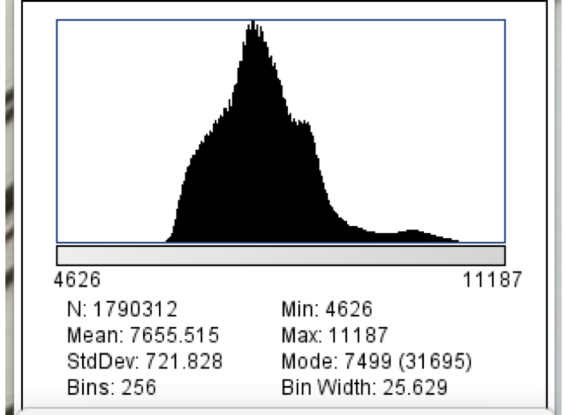
Adjusting Brightness & Contrast

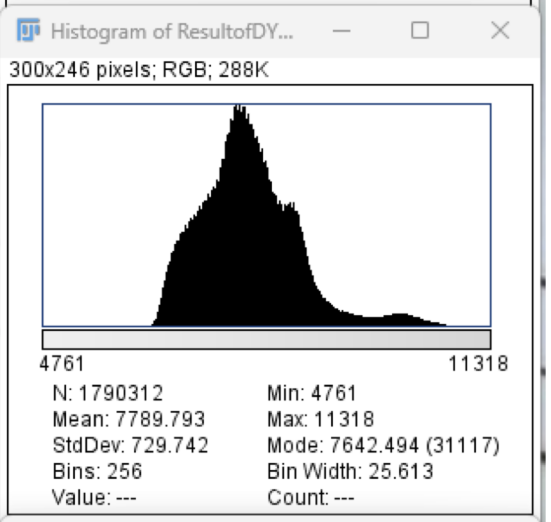


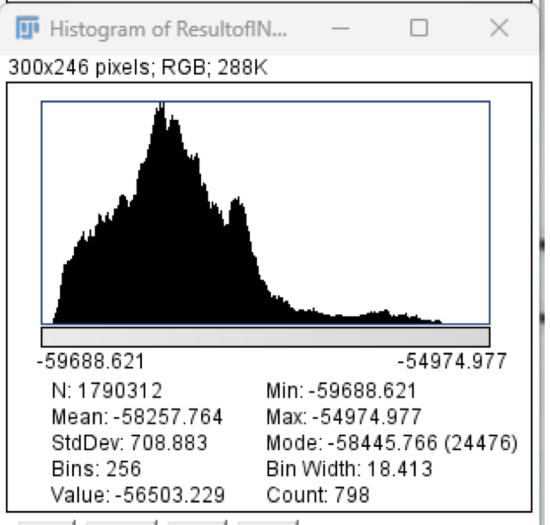


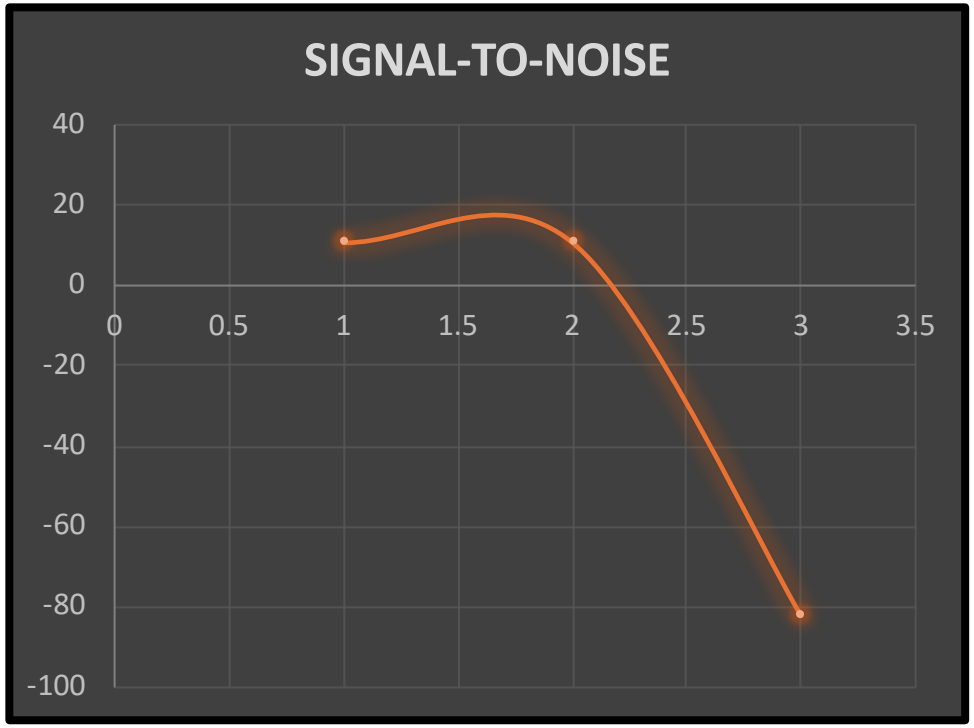


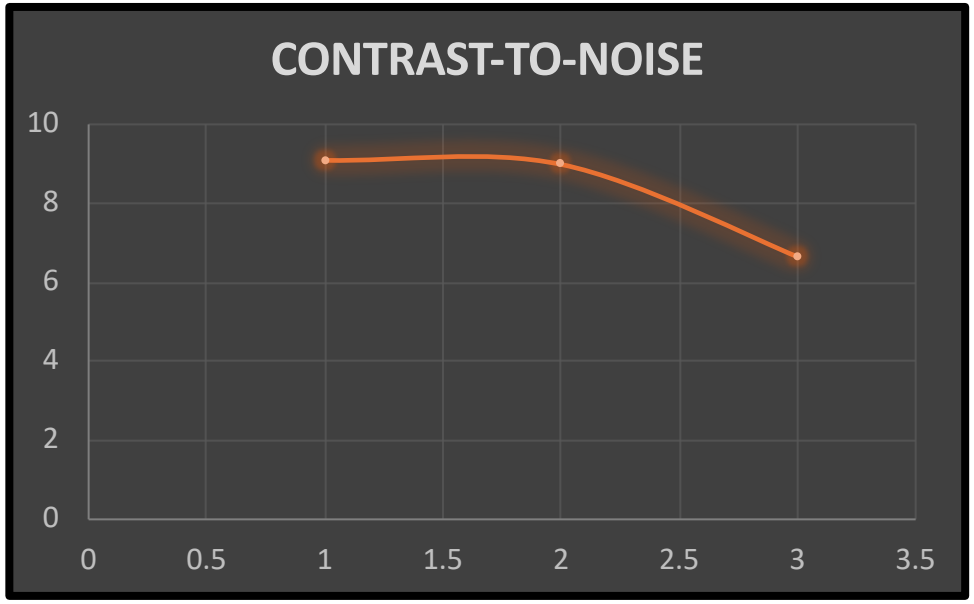

LUT); 38MB
Original
Dy+In
Dy+In w/ CDF


4626
11187
N: 1790312
Mean: 7655.515
StdDev: 721.828
Bins: 256
Min: 4626
Max: 11187
Mode: 7499 (31695)
Bin Width: 25.629

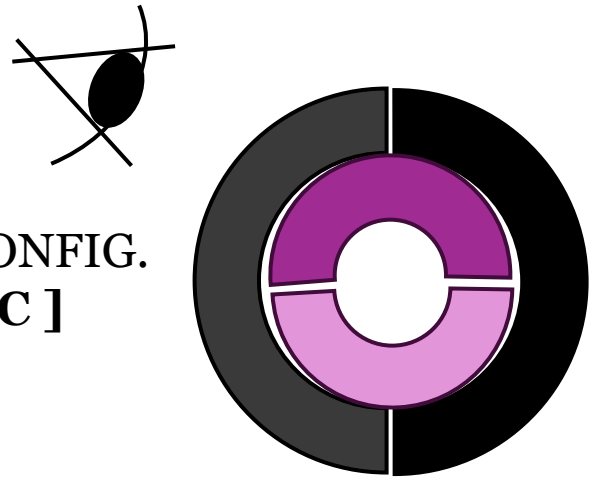

Histogram of ResultofDY...
300x246 pixels; RGB; 288K
4761
11318
N: 1790312
Mean: 7789.793
StdDev: 729.742
Bins: 256
Value: ---
Min: 4761
Max: 11318
Mode: 7642.494 (31117)
Bin Width: 25.613
Count: ---


Histogram of ResultofIN...
300x246 pixels; RGB; 288K
-59688.621
-54974.977
N: 1790312
Mean: -58257.764
StdDev: 708.883
Bins: 256
Value: -56503.229
Min: -59688.621
Max: -54974.977
Mode: -58445.766 (24476)
Bin Width: 18.413
Count: 798

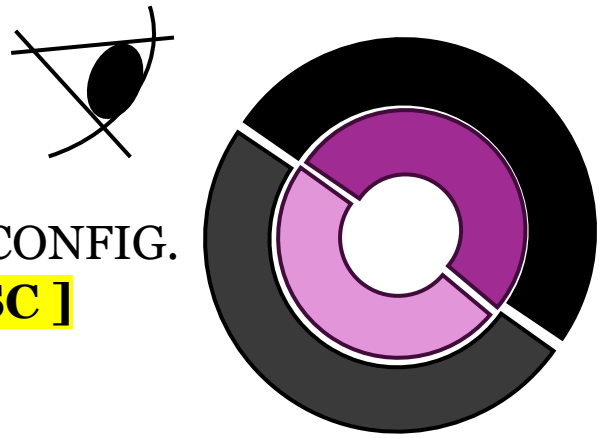

SIGNAL-TO-NOISE
40
20
0
-20
-40
-60
-80
-100
0
0.5
1
1.5
2
2.5
3
3.5


CONTRAST-TO-NOISE
10
8
6
4
2
0
0
0.5
1
1.5
2
2.5
3
3.5

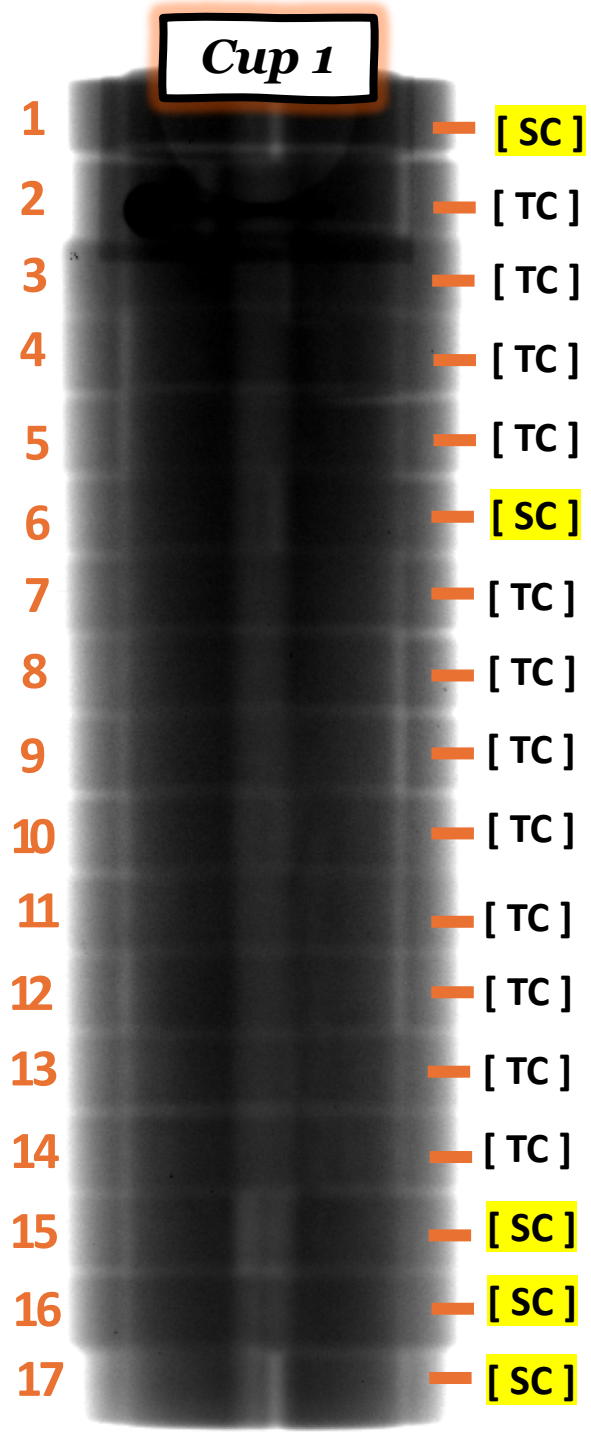
Pellet Configuration/ Quantity per Cup

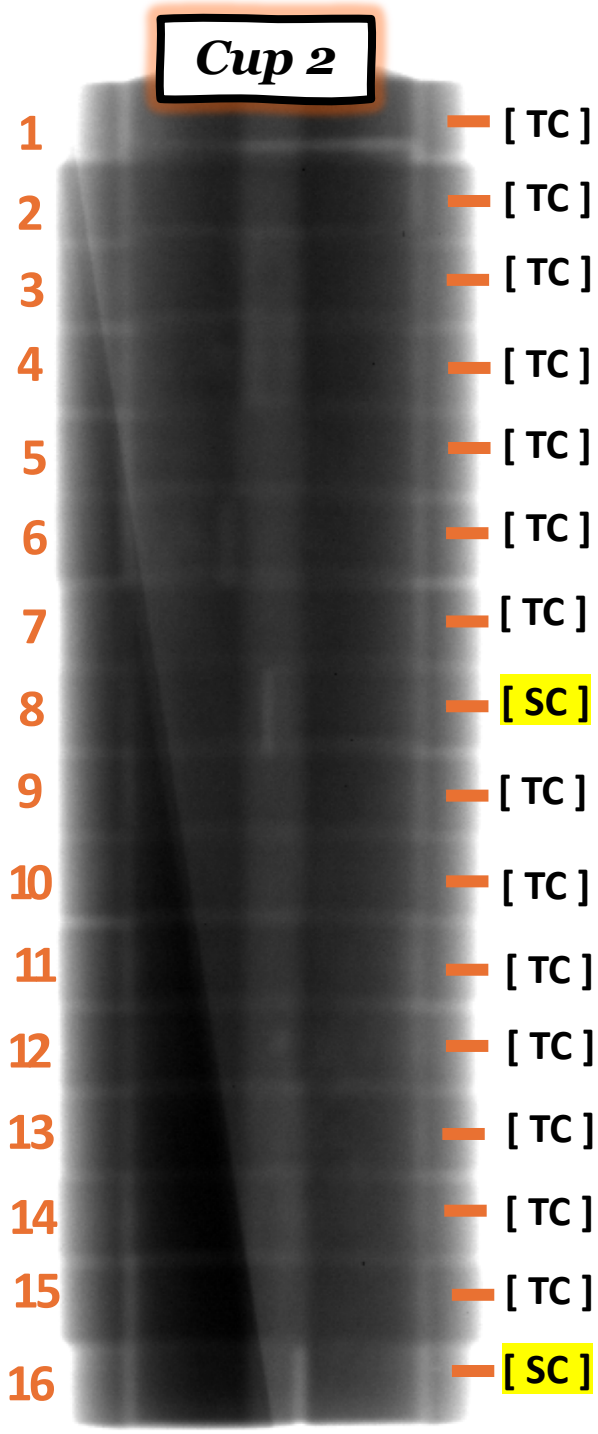


TOP CONFIG.
[TC]

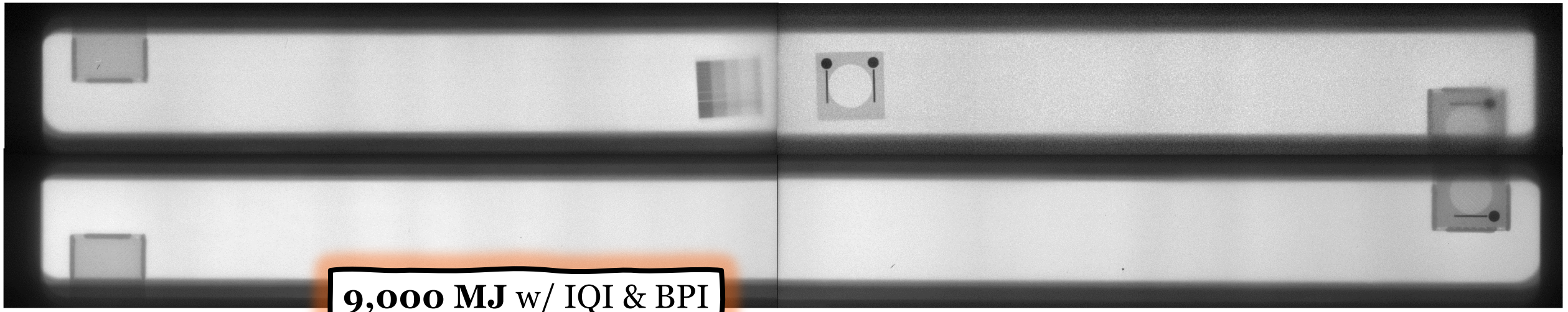


SEAM CONFIG.
[SC]

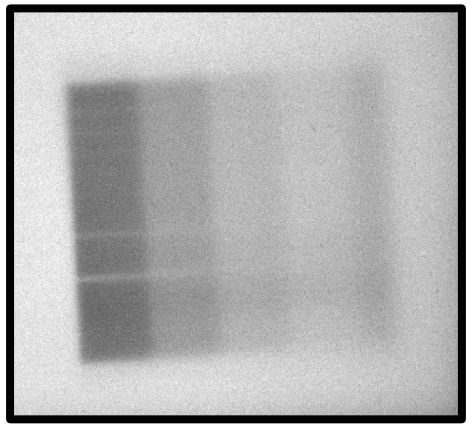


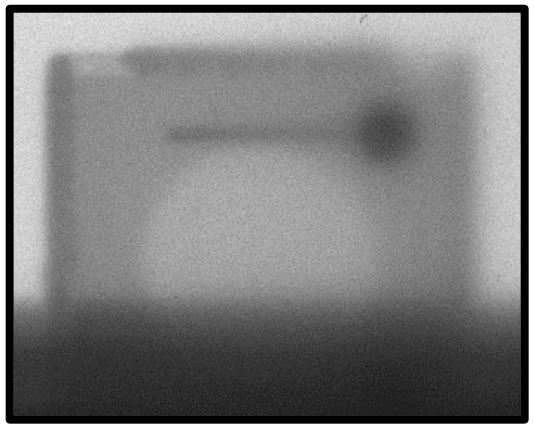


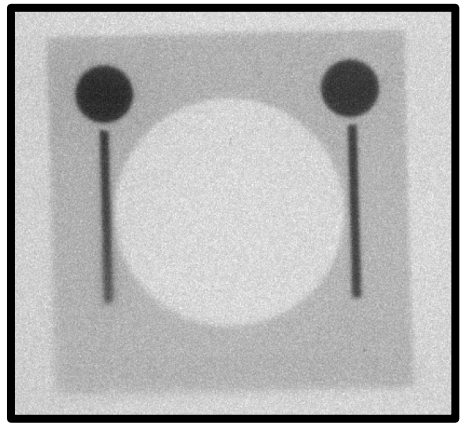
Preliminary Images, *December 2023*

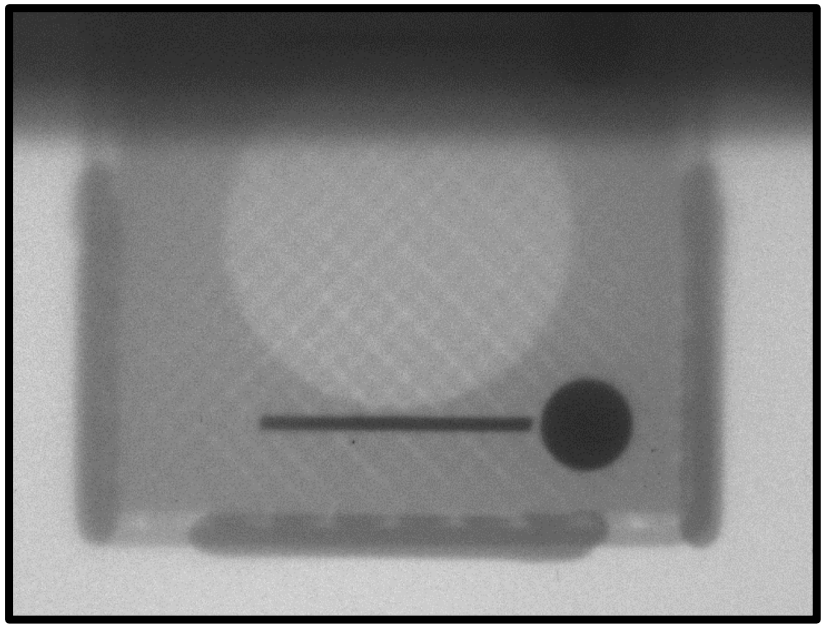


9,000 MJ w/ IQI & BPI
on PLA Foil Holder

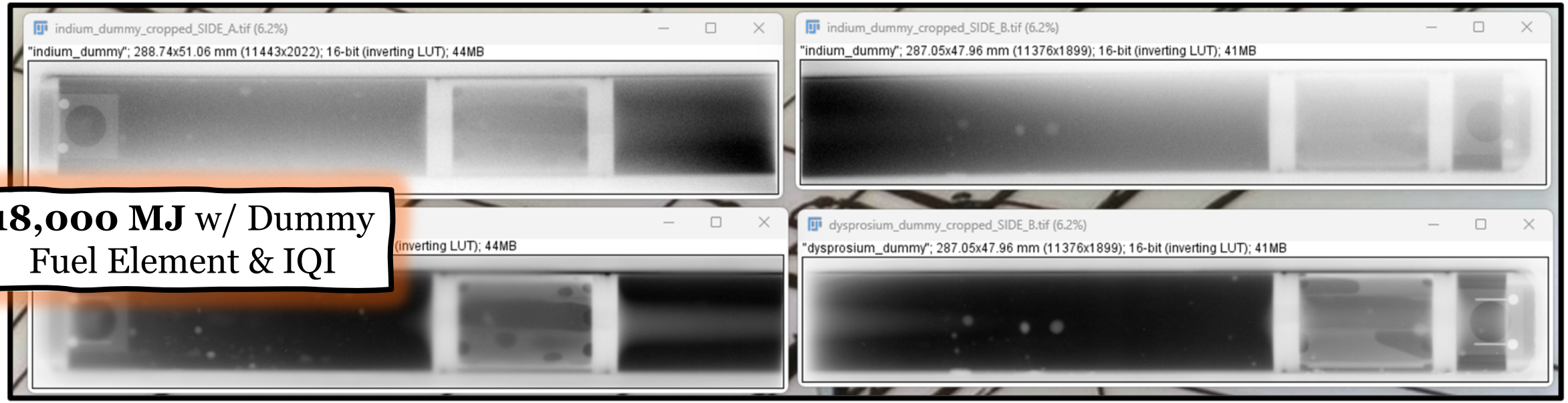




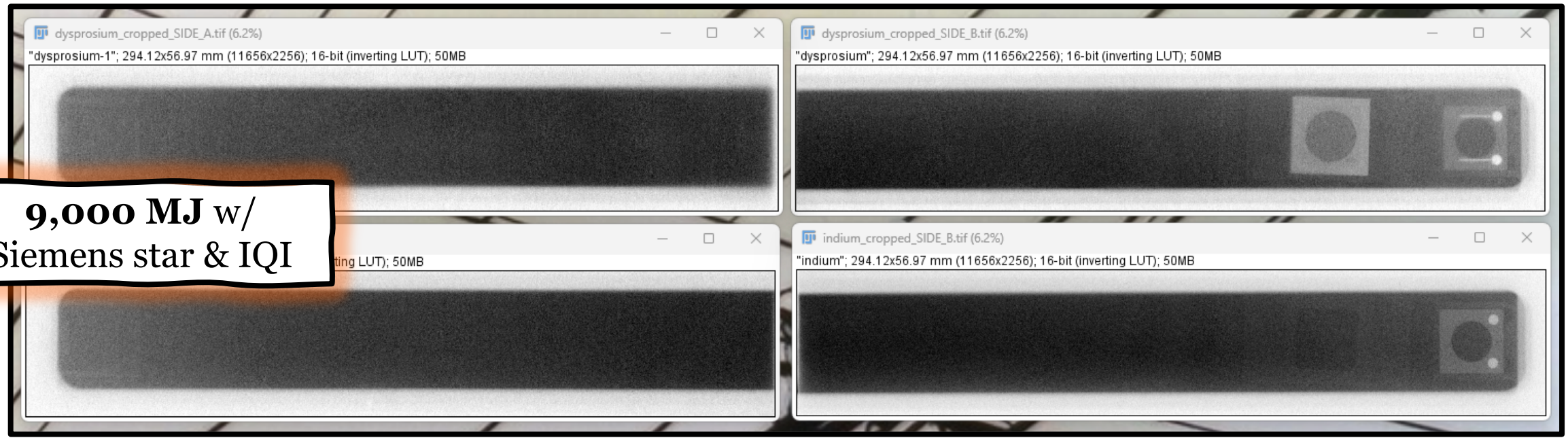




Secondary Images, *December 2023*



18,000 MJ w/ Dummy Fuel Element & IQI

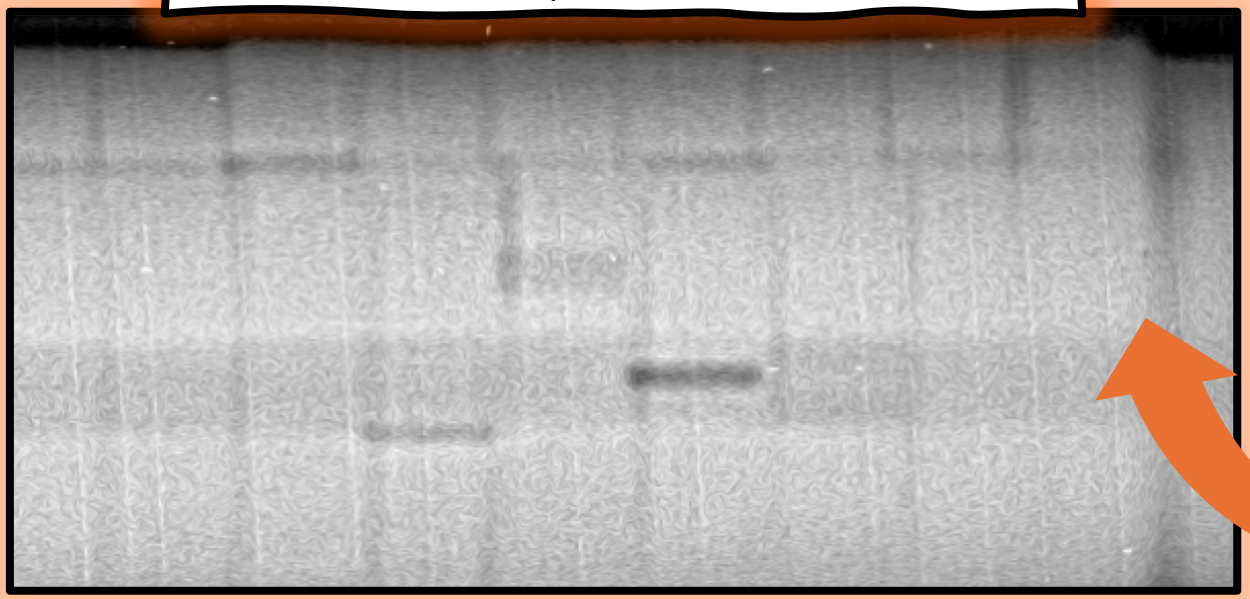


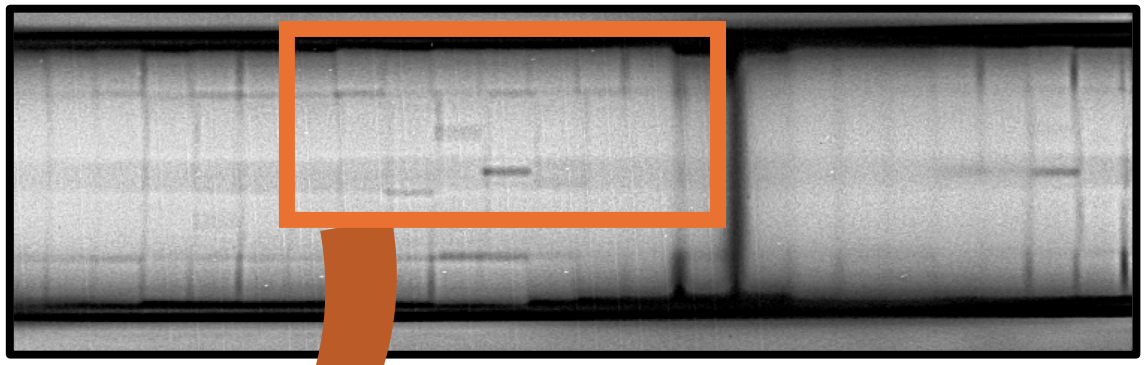
9,000 MJ w/ Siemens star & IQI

Third Round Images, *January 2024*

9,000 MJ w/ Siemens star & IQI

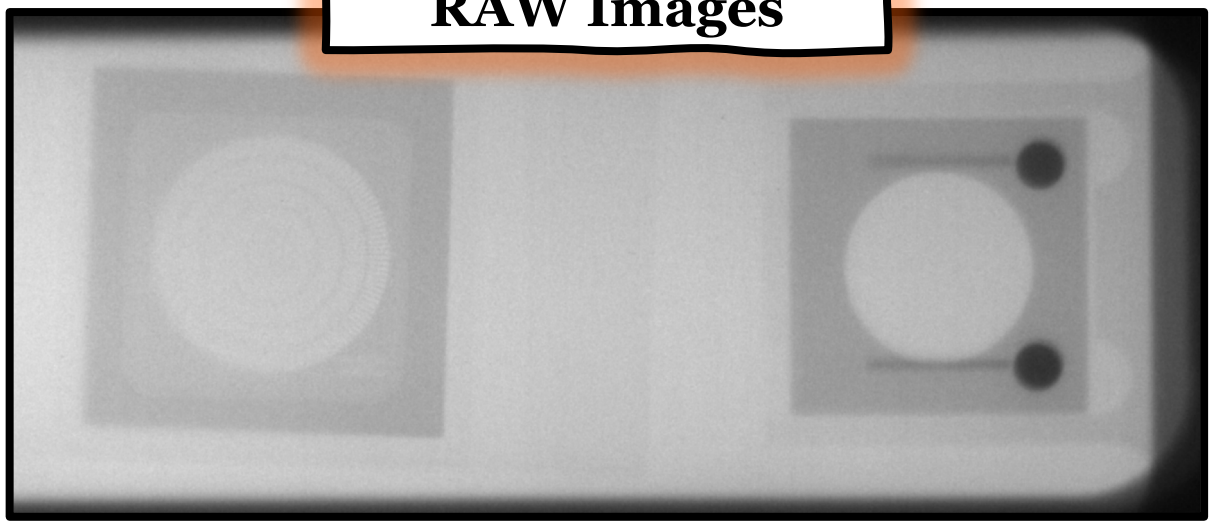
20,000 MJ w/ Fresh Fuel Element

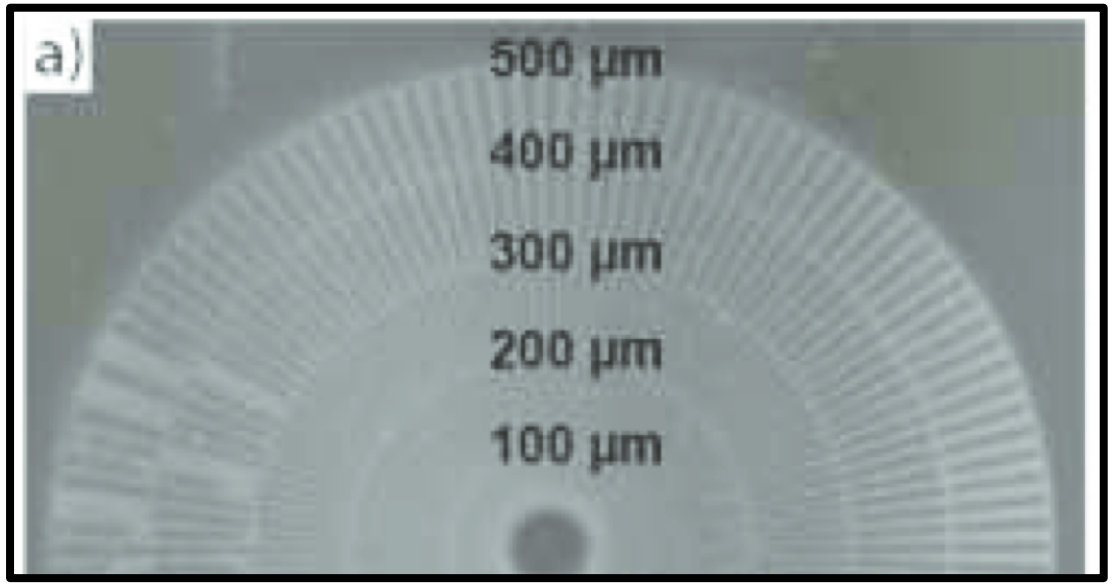




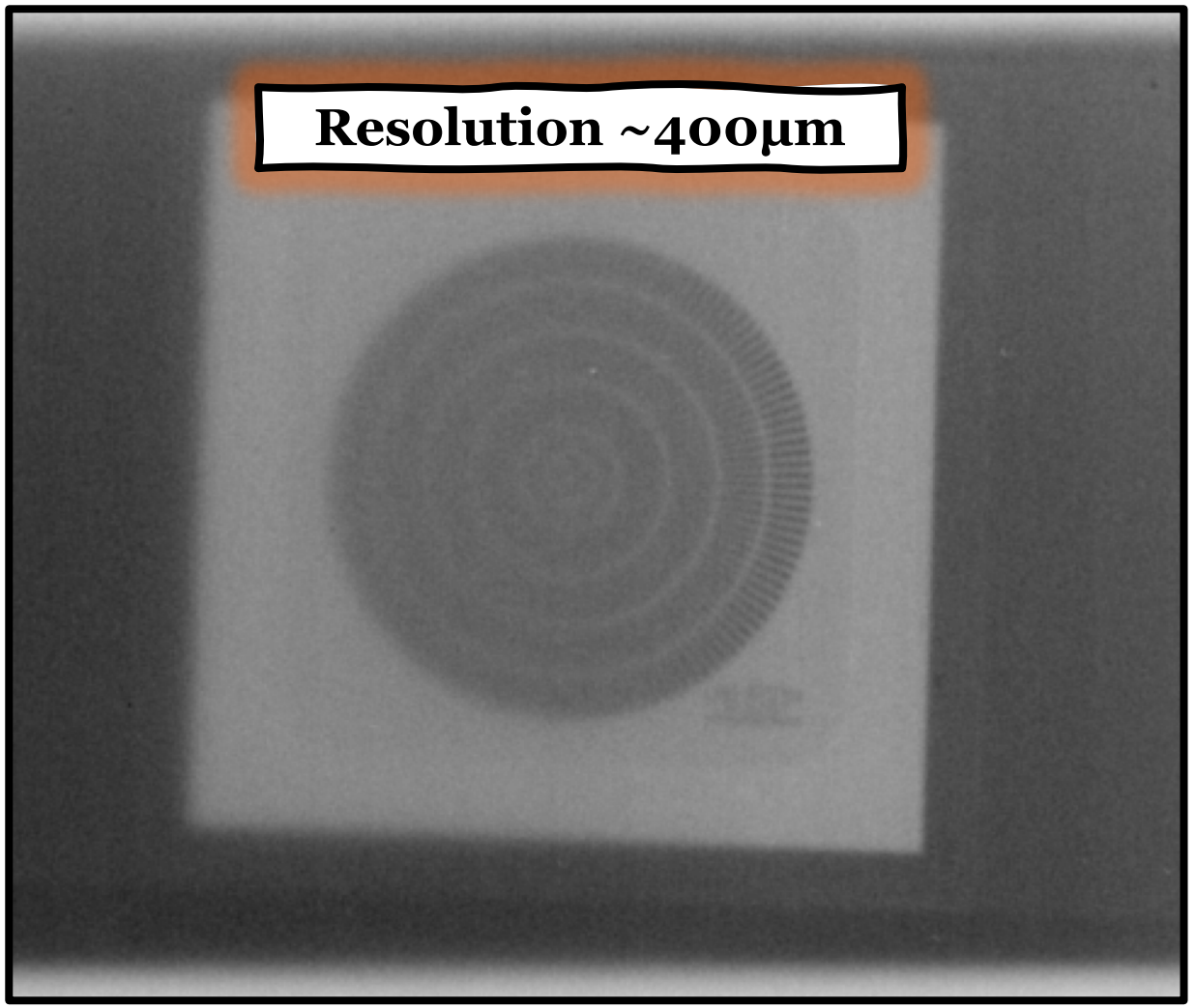
Preliminary Resolution Evaluation, *December 2023*

Combined Dy + In RAW Images

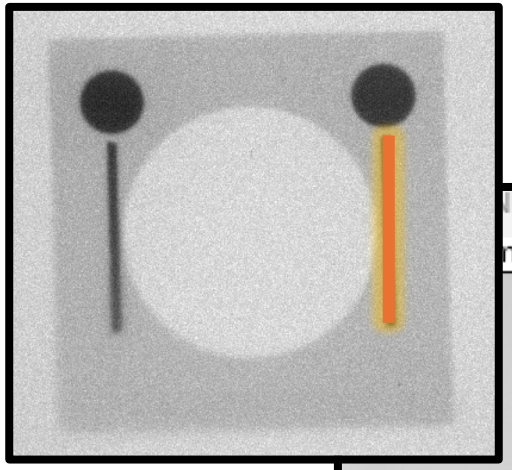


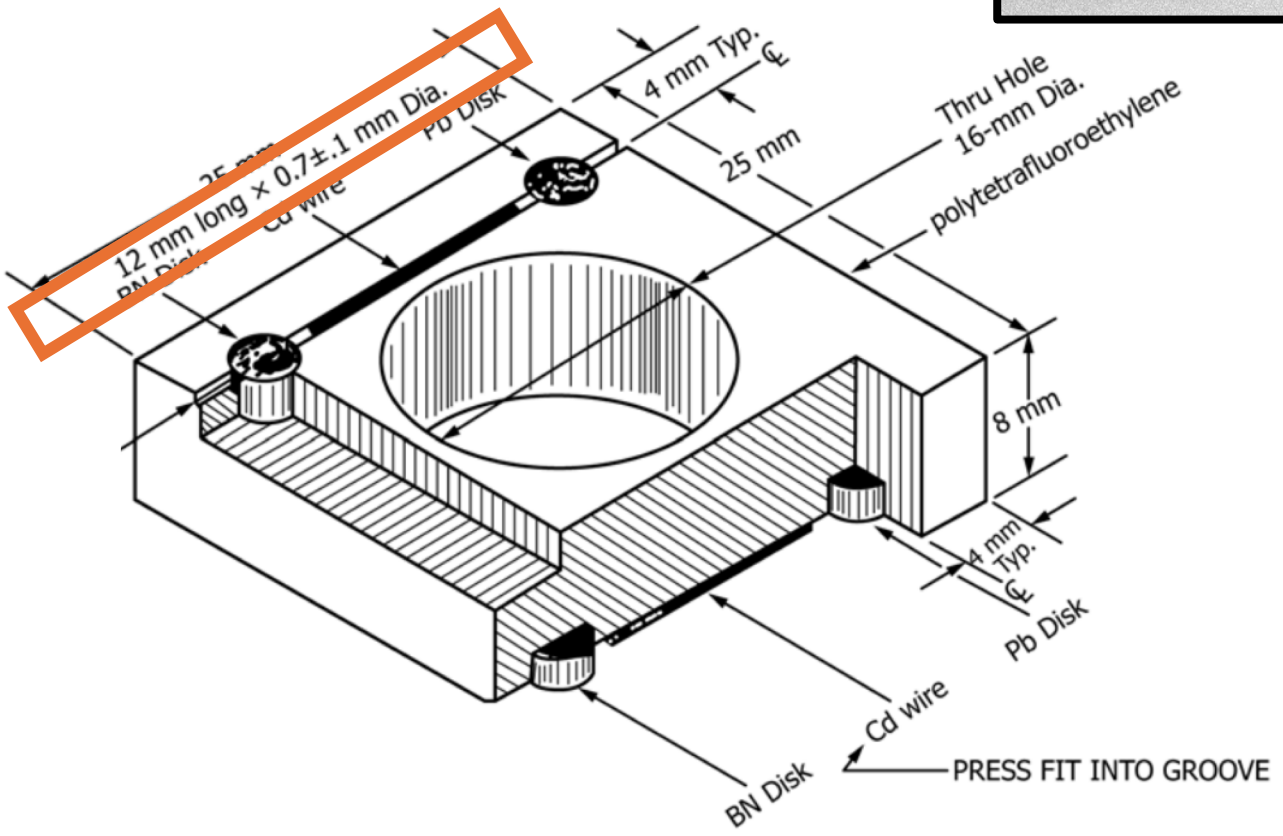


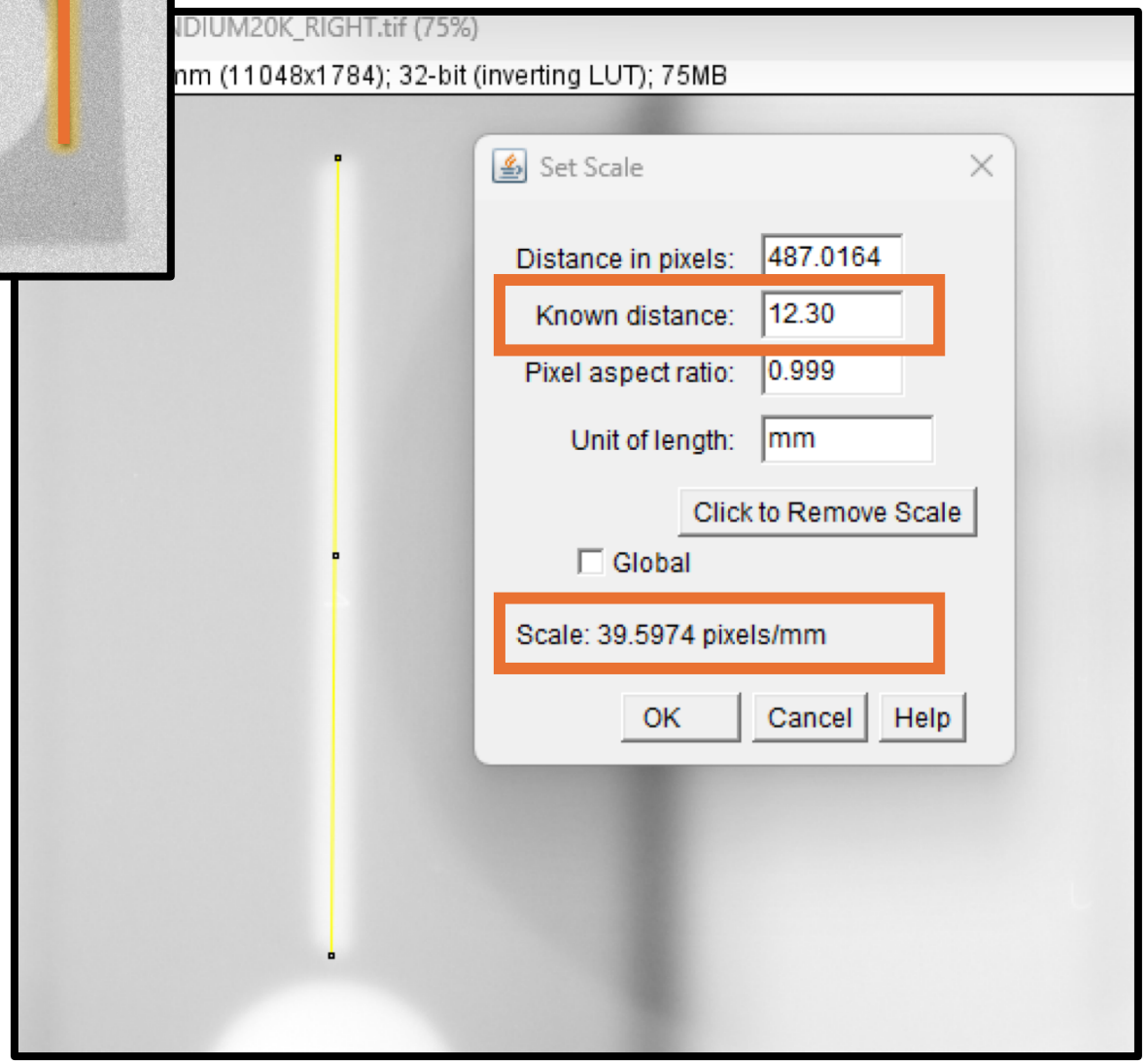
Resolution ~400µm



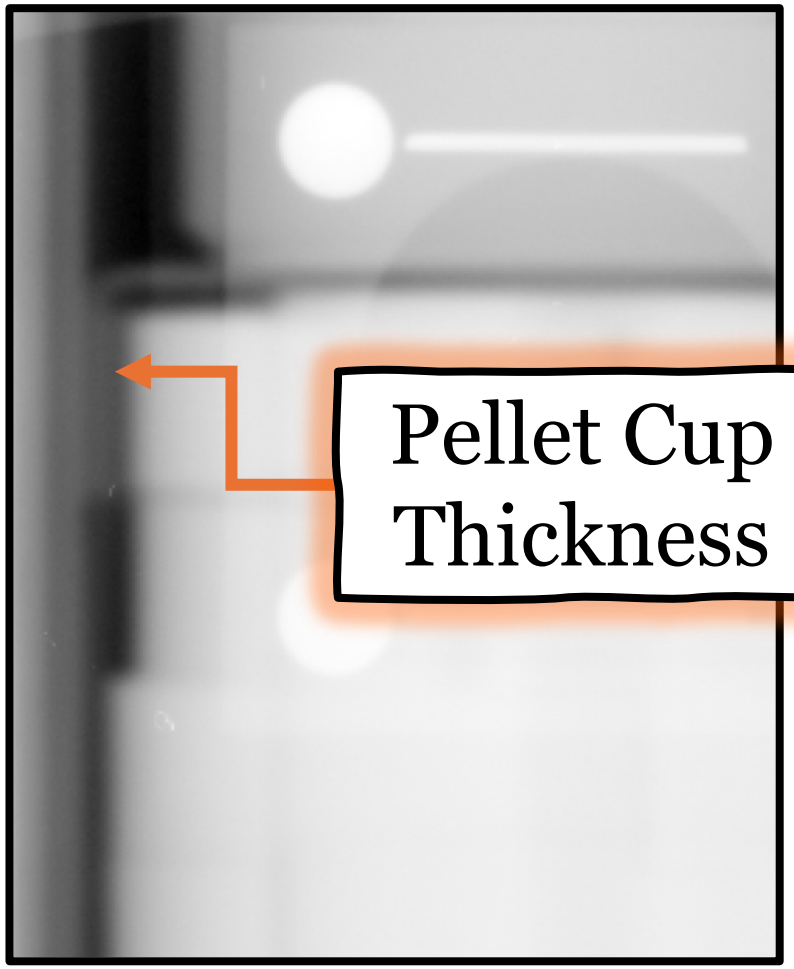
Scaling the Data

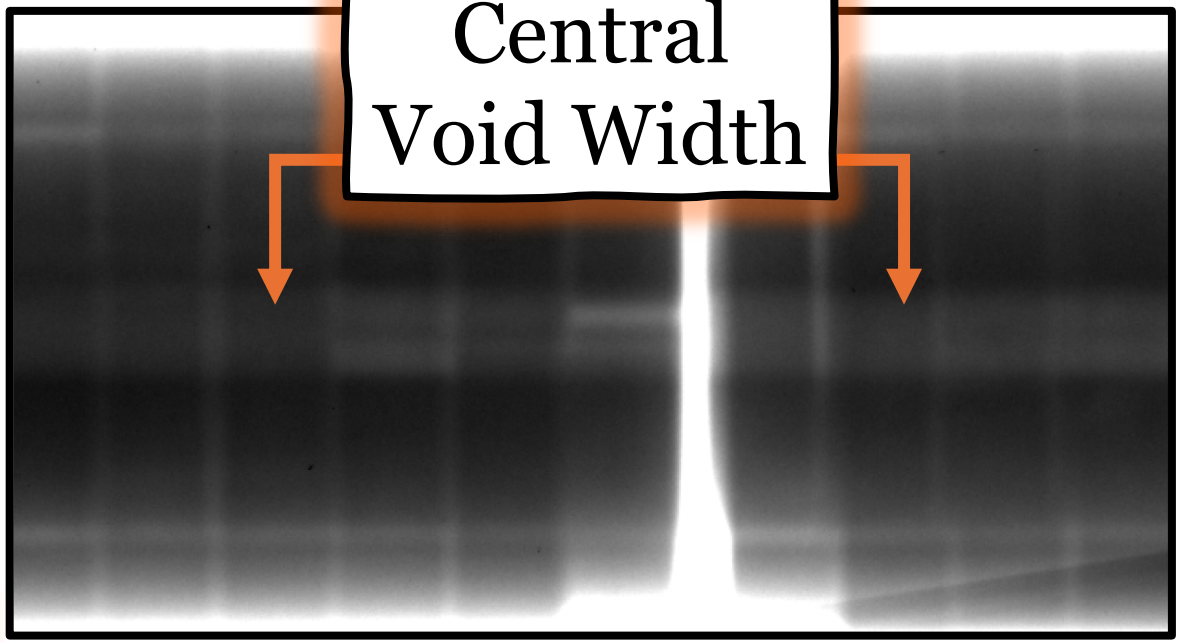


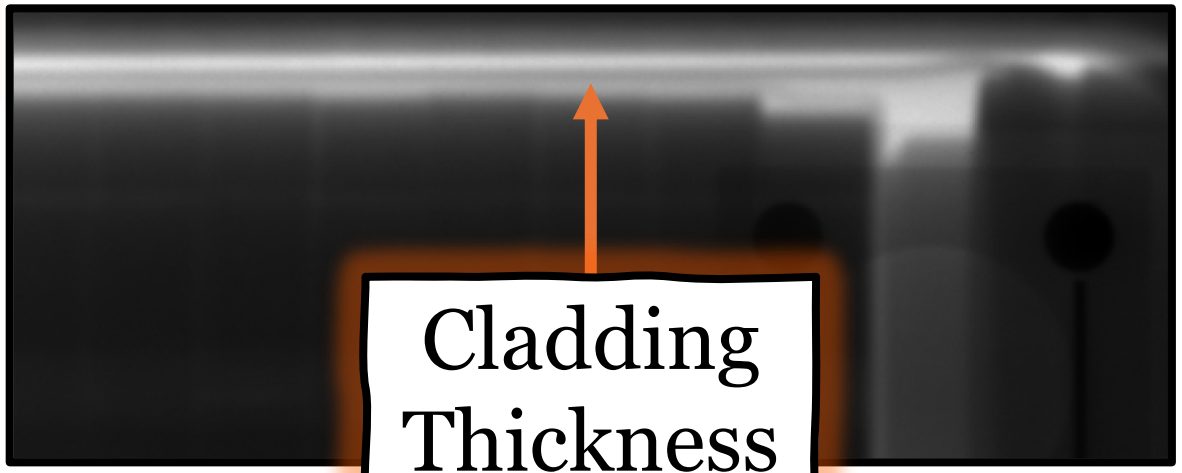




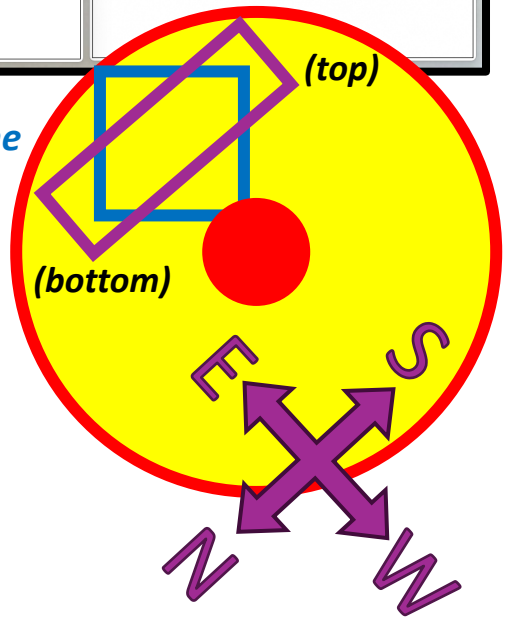
Quantification(s):





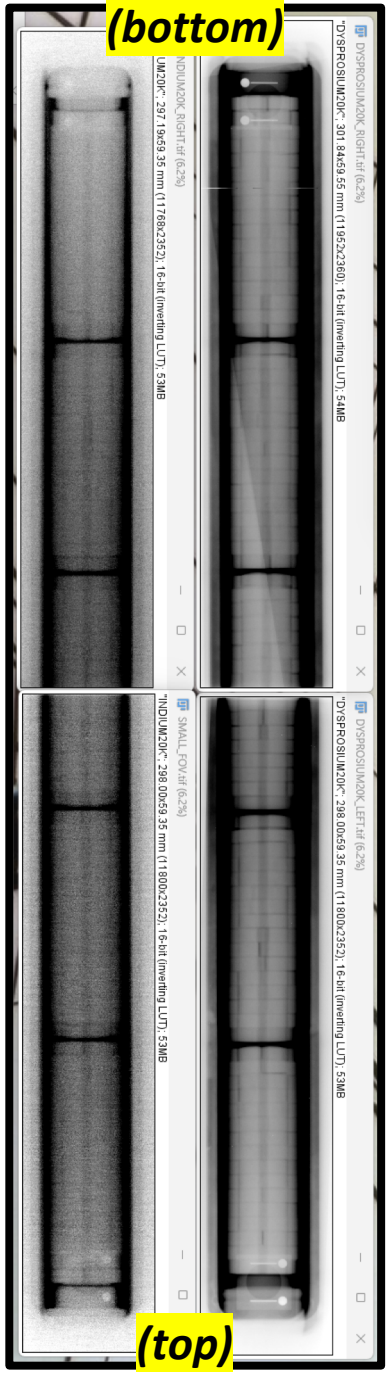


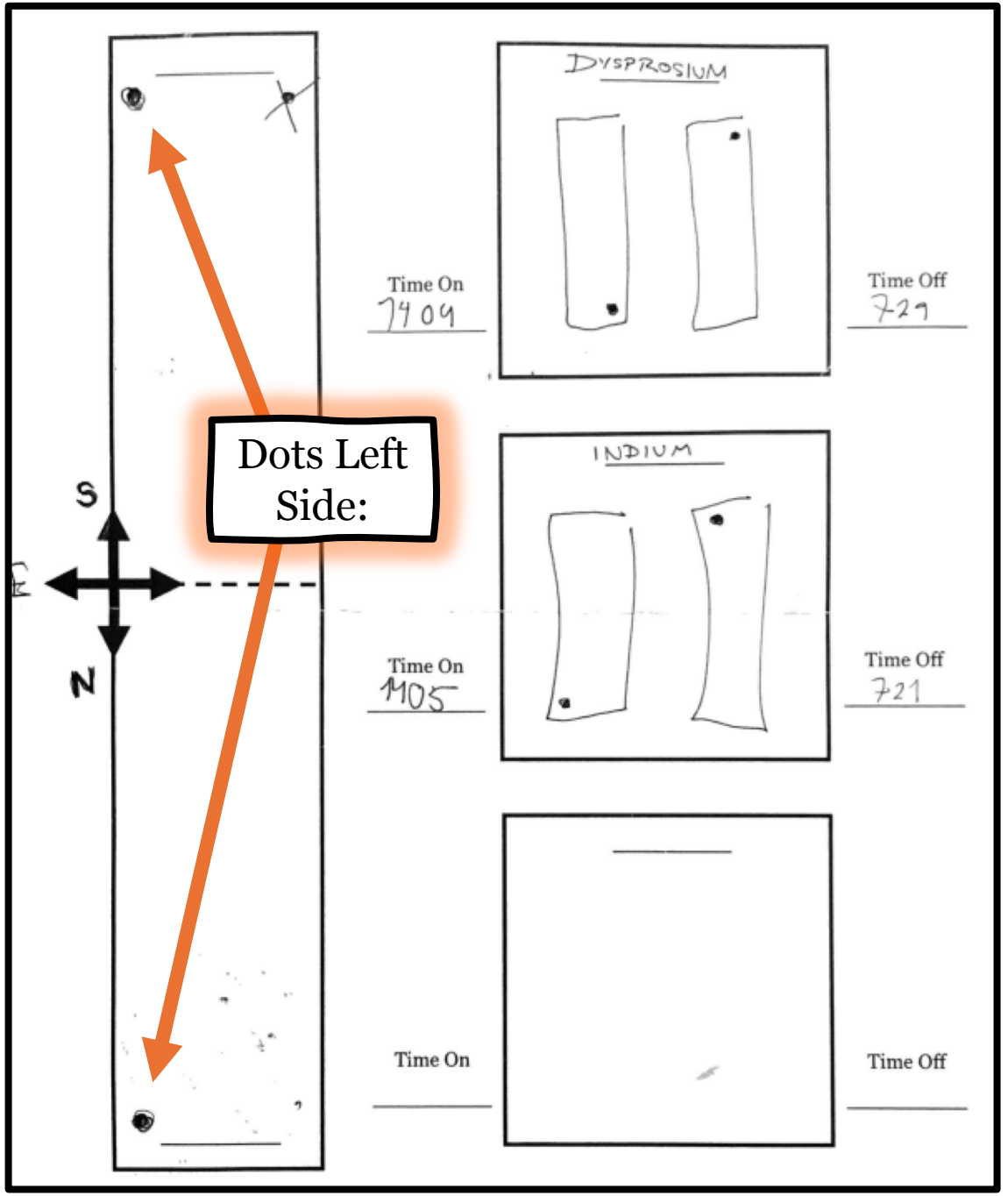
Translating the Experiment Sheet:



Imaging Plane

FENICS Cask





Summary of Knowledge

- Processing images time consuming and **highly variable** given the scanner feeding mechanism; does not leave a significant amount of room for automation
- Pellets **moved very little** (rotation/translation) throughout lifetime
- Several measurements should be collected (resolution, beam flatness, flux magnitude) to **characterize the ACRR beam**
- Other measurements include dimensions of the fuel, volumetric estimations of inner-void, and cup dimensions to compare the fuel to the manufacturing specifications

Thank You!

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Thank you!

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