Quantum DETECTORS

# Vs Attenuators

Roger Goldsbrough

# Attenuators

- Use of fast V2F100s – reduces statistical error
- Zebra



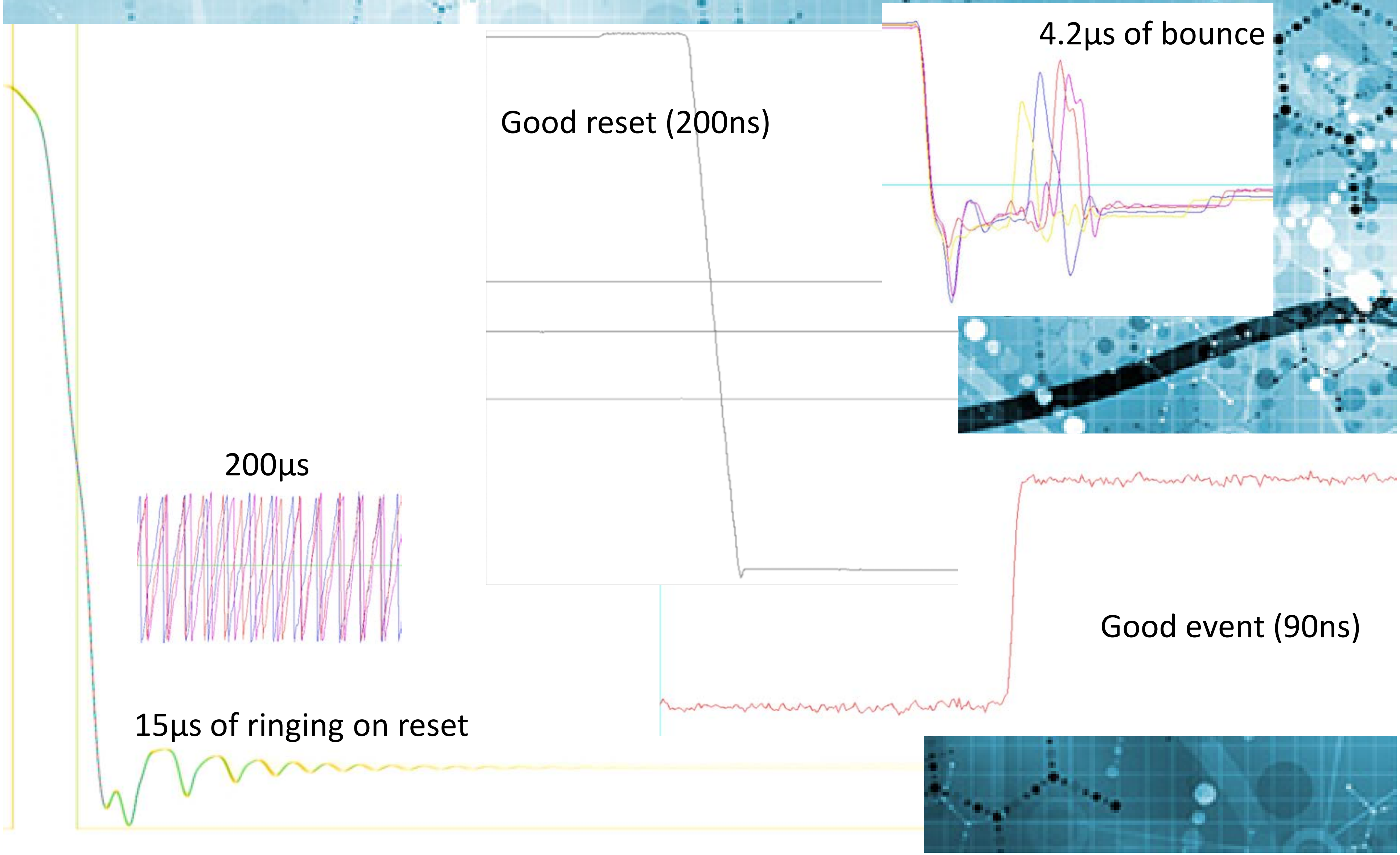
- Use of Merlin (Medipix 3RX) – 1200 fps


- Use of Xspress 3
  - ICRs over 20 Mcps measured at APS

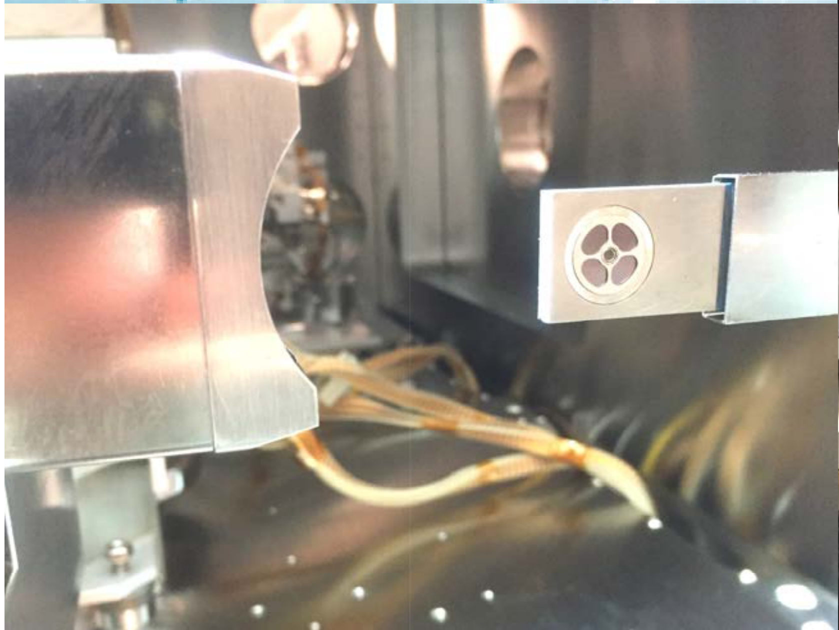
# The challenge for readout systems

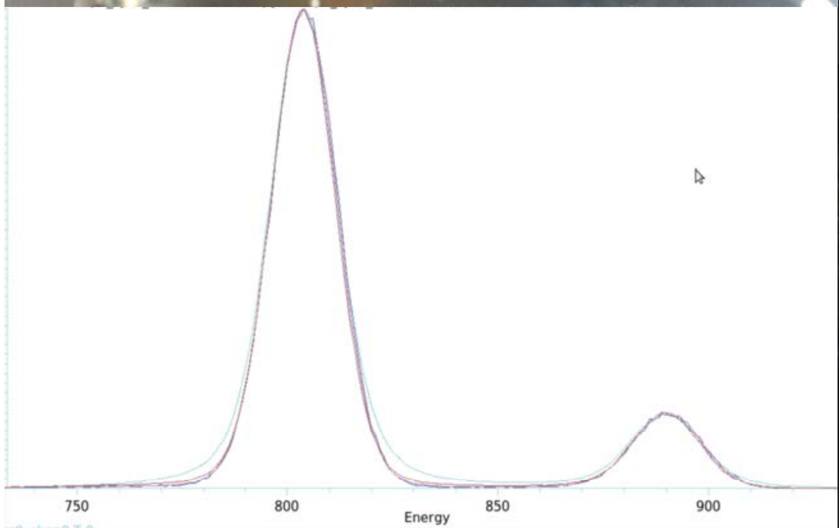
"50,000 attenuation" Peter Cloetens

# What QD has to offer



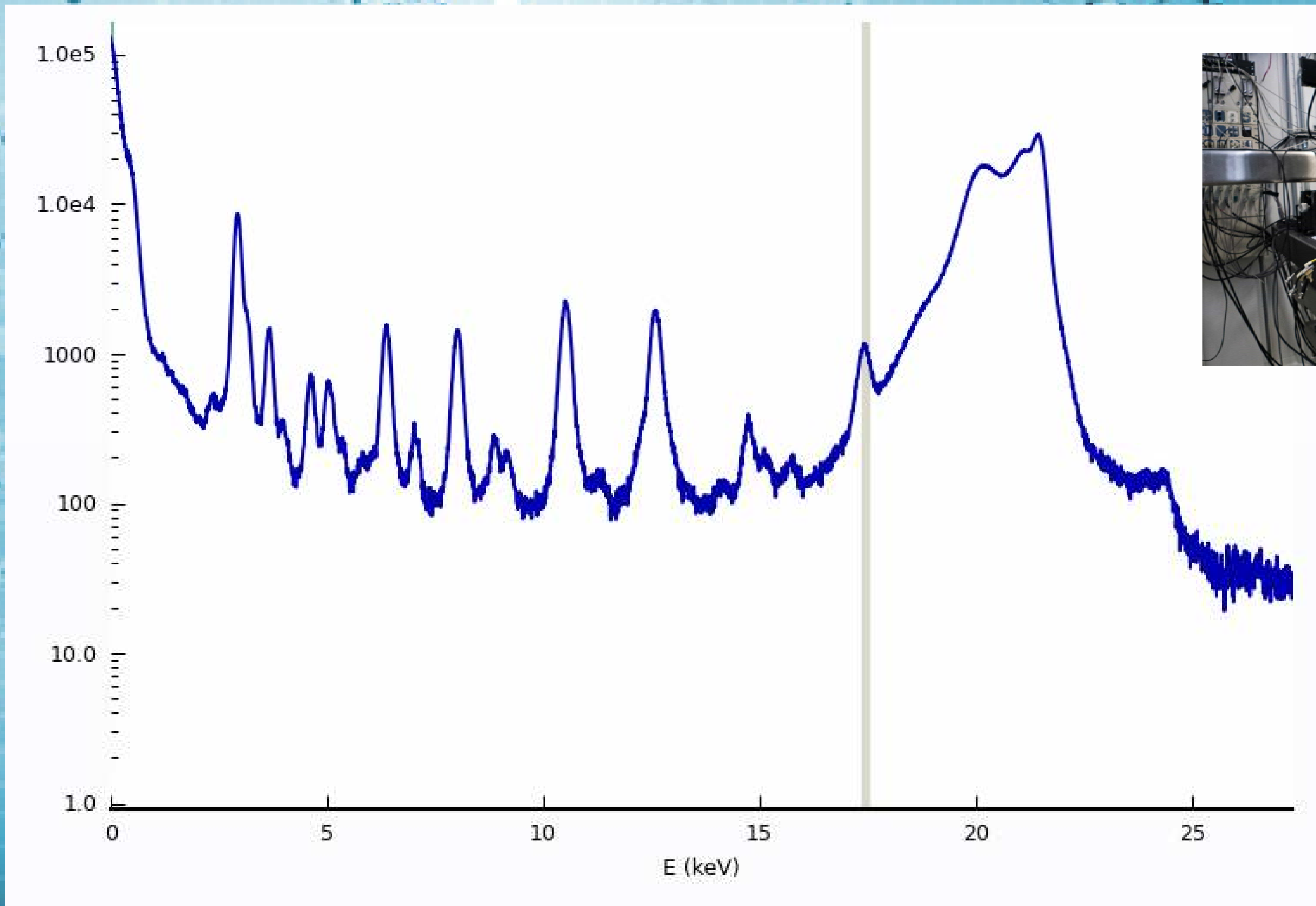
# NSLS-II HXN

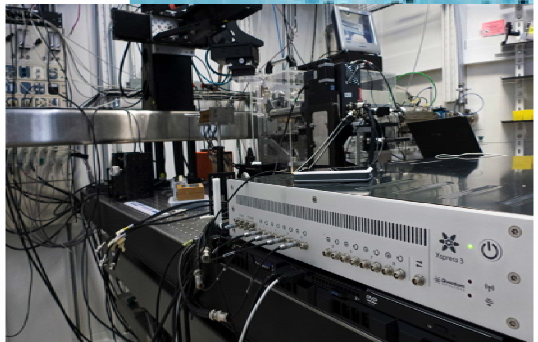



750
800
850
900
Energy


Xspress 3
Quantum
HXN
B4 CH2
B4 CH3
B4 CH4

# APS 13-ID-E: GSECARS



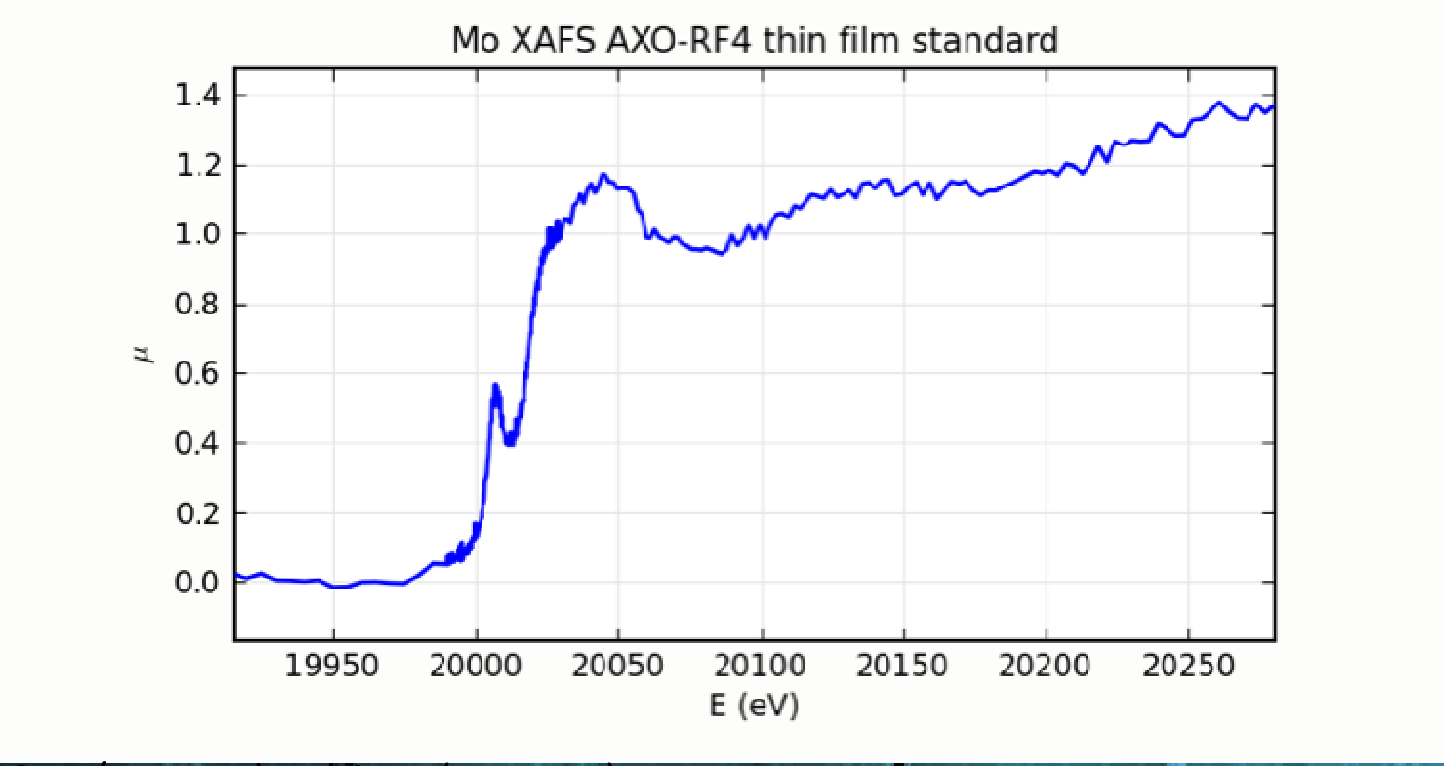
AXO$RF'4$thin$film$standard:$$Mo$concentra9on$is$1.3$ng$/mm2$$$$
highest$I0$flux$gave$800$KHz$(no$DTC)$
With%a%2%x%5%µm%beam,%there%are%13%femtograms%of%Mo%in%the%beam.%

# APS 13-ID-E: GSECARS

Mo XAFS at Mo K-edge on AXO RF-4 thin film standard:
Mo concentration is 1.3 ng /mm2 , so total mass measured ~ 15 fg.

Mo Ka counts: ~25 kHz total, and ~5 kHz net, on top of a ~1.2 MHz total count rate per channel (not DTC), using 1mm thick Vortex.

1 second per point, sum of 3 working channels.

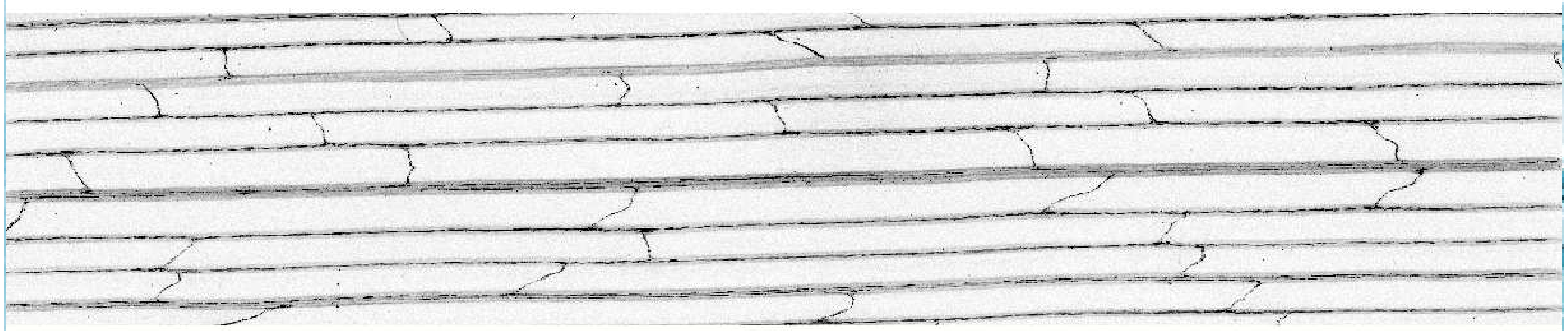



Independent DTC calc 80ns / event deadtime (average)

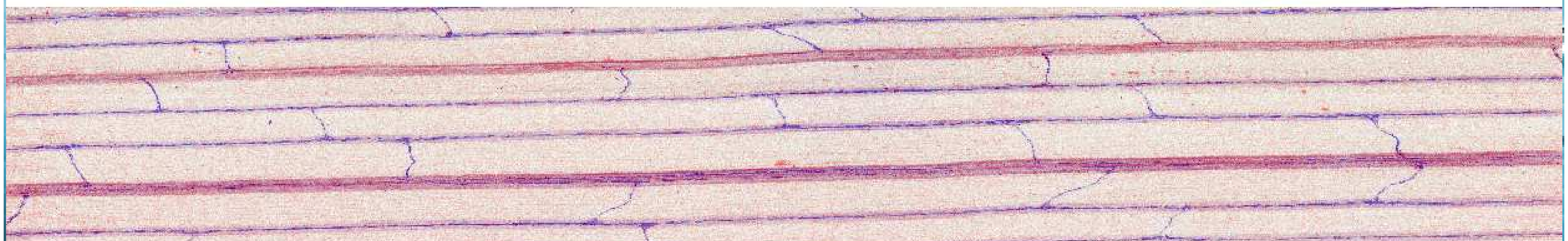
# APS 13-ID-E: GSECARS

15#mm#x#3#mm,#mapped#at#10#micron#esolul on,#10#msec#per#pixel#(3.5#hours)#

Zn#



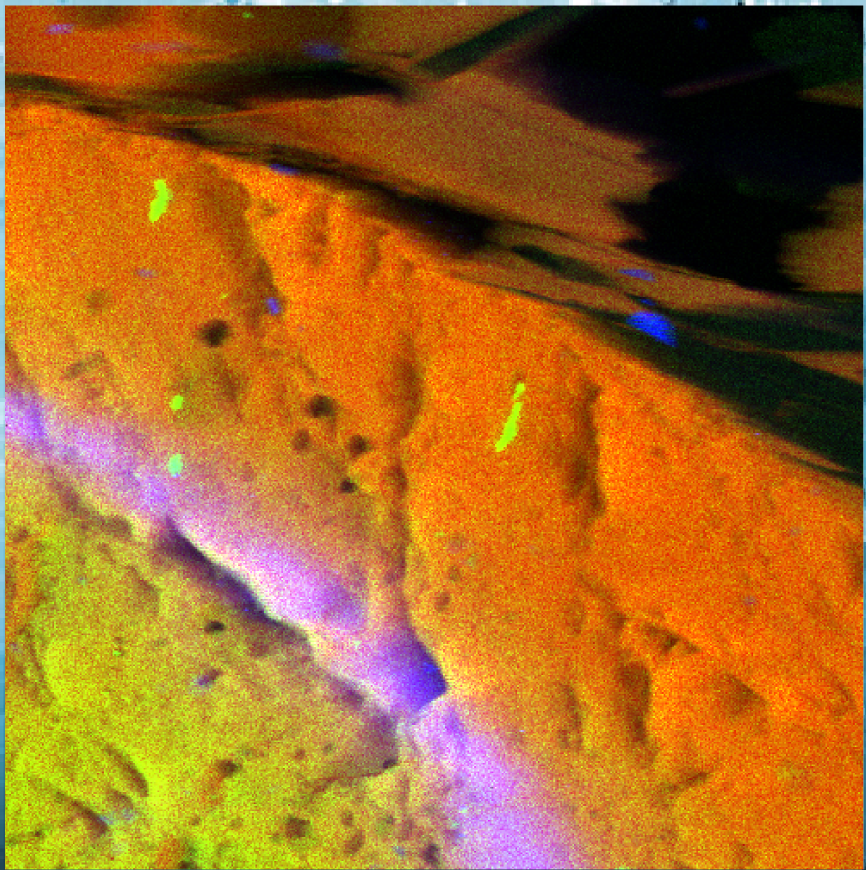
Mn#(red),#Zn#(blue)#

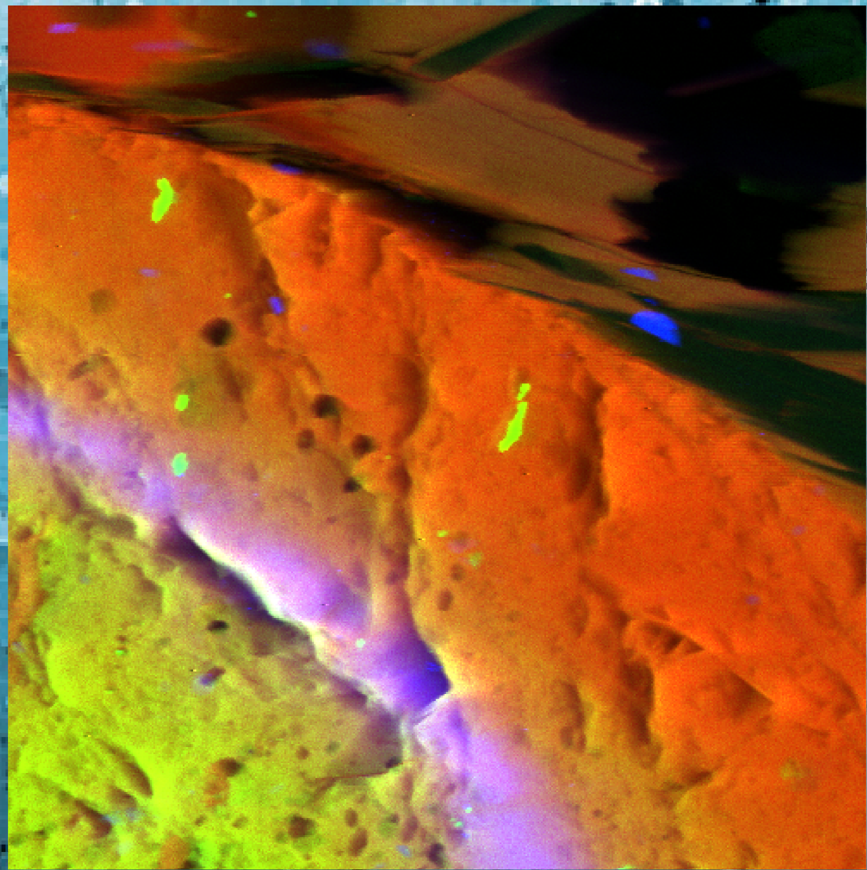


# XRF Mapping with Xspress3 and Vortex ME-4

Data collected at GSECARS, APS 13-ID-E with ~2 x 2 micron X-ray beam at 18 keV.
1 x 1 mm area, 2 x 2 μm pixels, 10 ms per pixel (~45 minute acquisition).
Using standard electronics (1 μs peaking time) and Xspress3 electronics.

Sample: polished thin section of garnet with zoning in yttrium (the purple band).


Standard readout Fe / Ca / Y

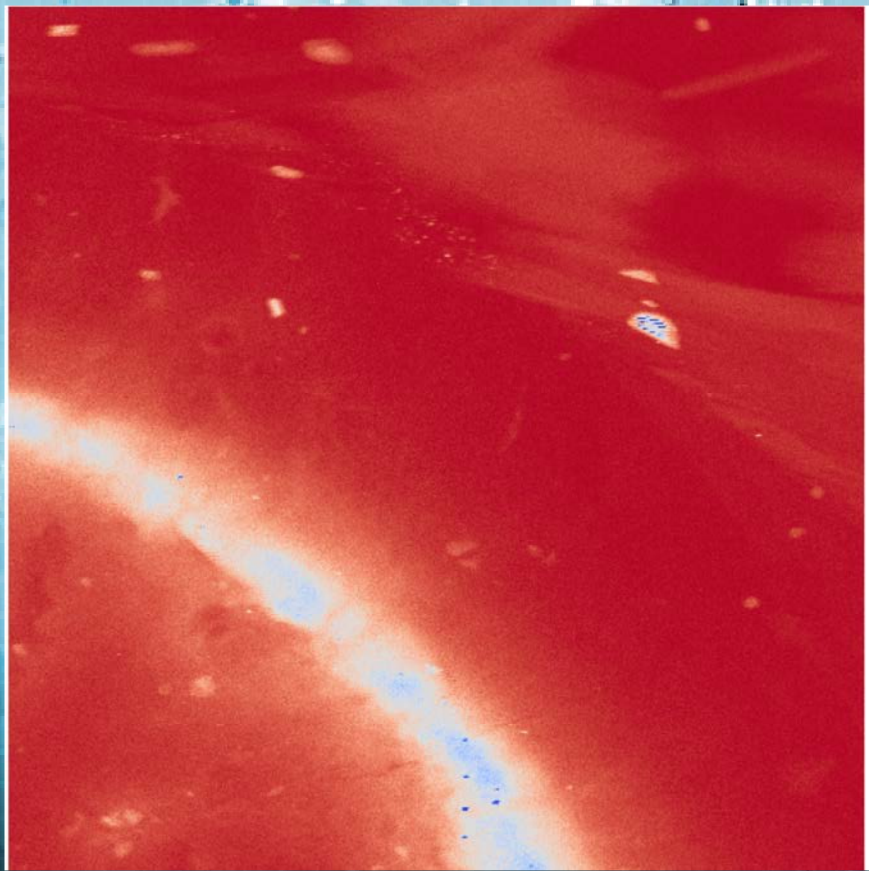

Xspress3 Fe / Ca / Y

# XRF Mapping with Xspress3 and Vortex ME-4

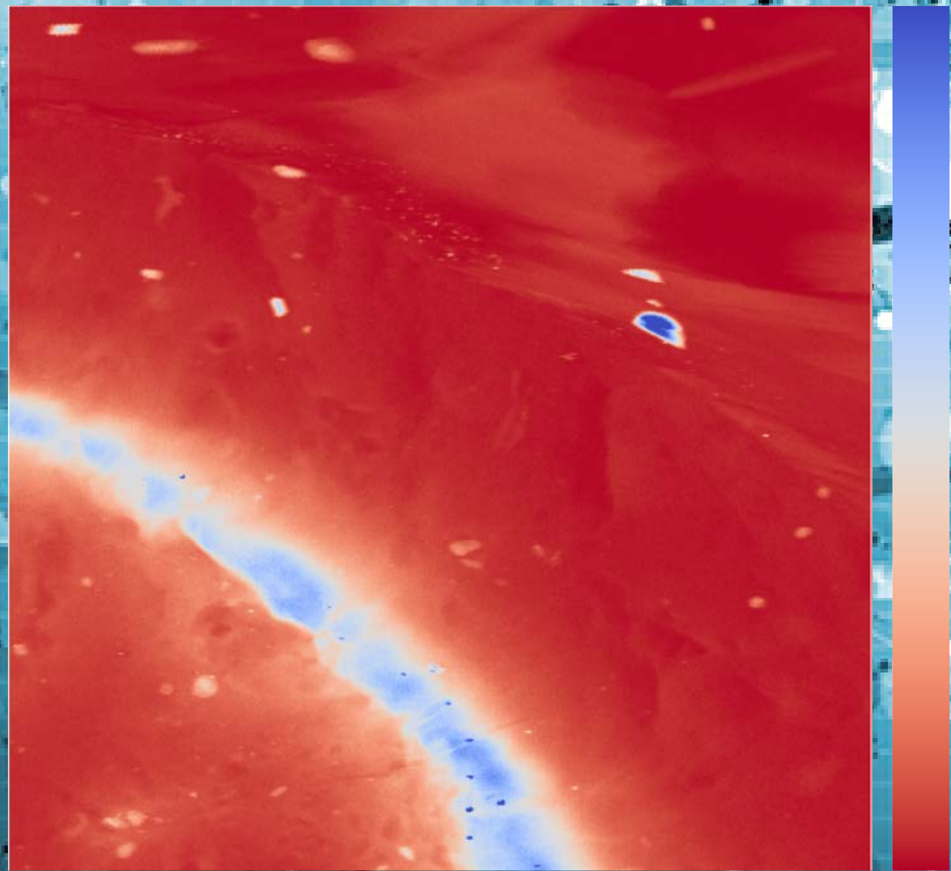
sample–detector distance ~ 40 mm for Xspress3, 65 mm for Standard (to avoid saturation)

Y intensity map (blue = high intensity)

Signal-to-noise and image contrast are noticeably improved with Xspress3.



Standard



Xspress3

# XRF Mapping with Xspress3 and Vortex ME-4

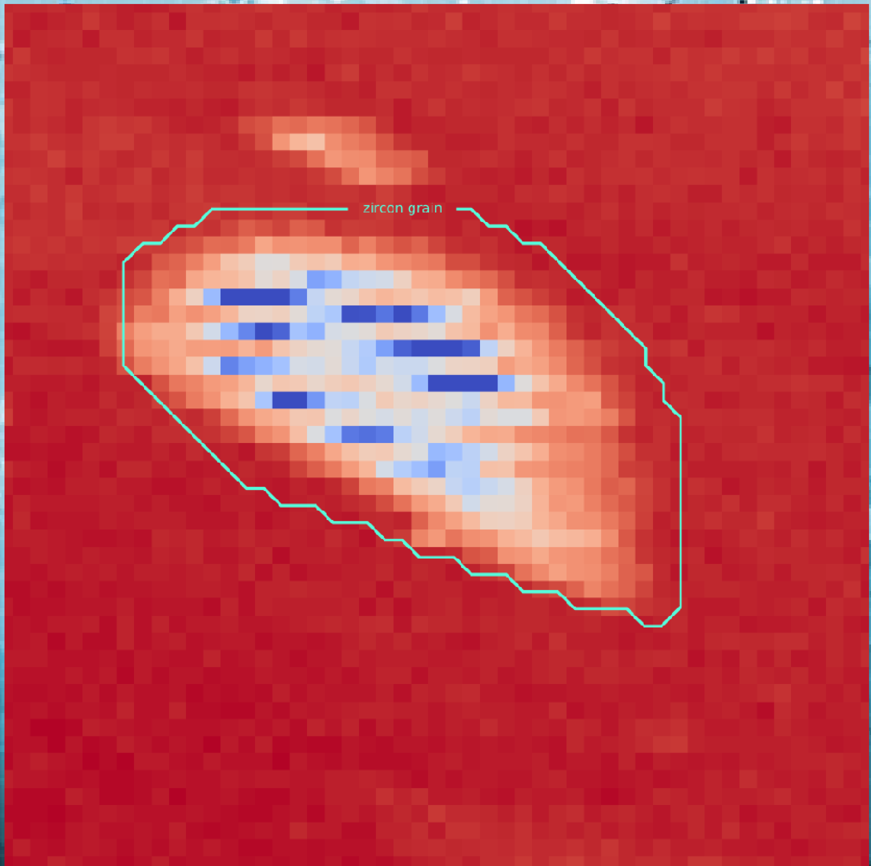
Saturation effects: Standard

Y intensity map (blue = high intensity)

Maps are built by scanning rows right-to-left and then left-to-right.

At high count rate, the Standard shows a zig-zag pattern.

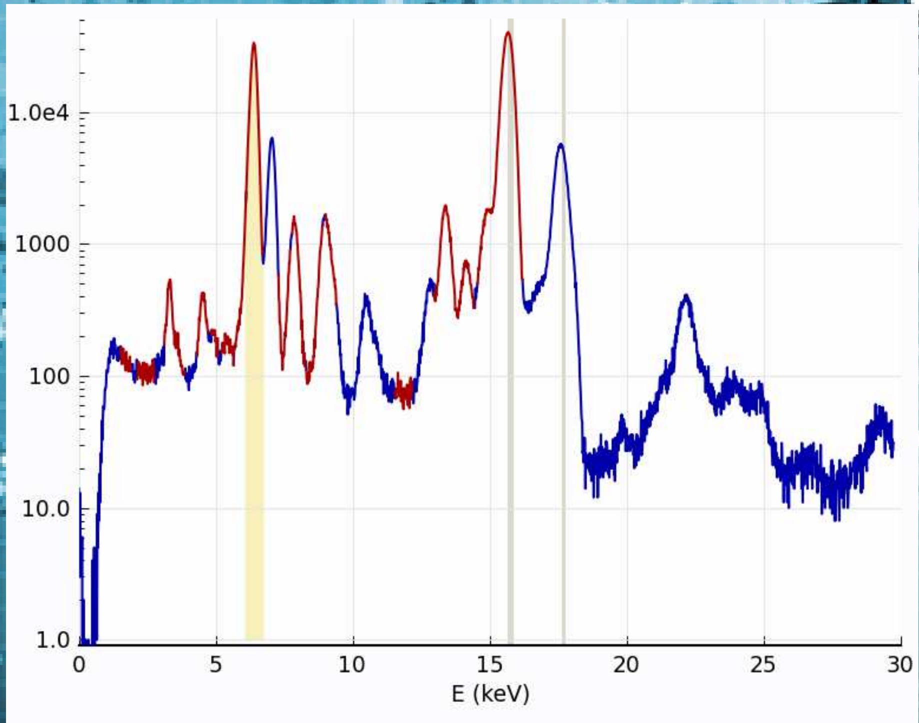
Y map detail: zircon grain (upper left)




XRF extracted from zircon grain (574 pixels, 5.7 sec):

Count rates (sum of 4 elements, DT corrected):

**0.456 MHz total**, 0.106 MHz Fe Ka, 0.211 MHz Zr Ka




xMAP

# XRF Mapping with Xspress3 and Vortex ME-4

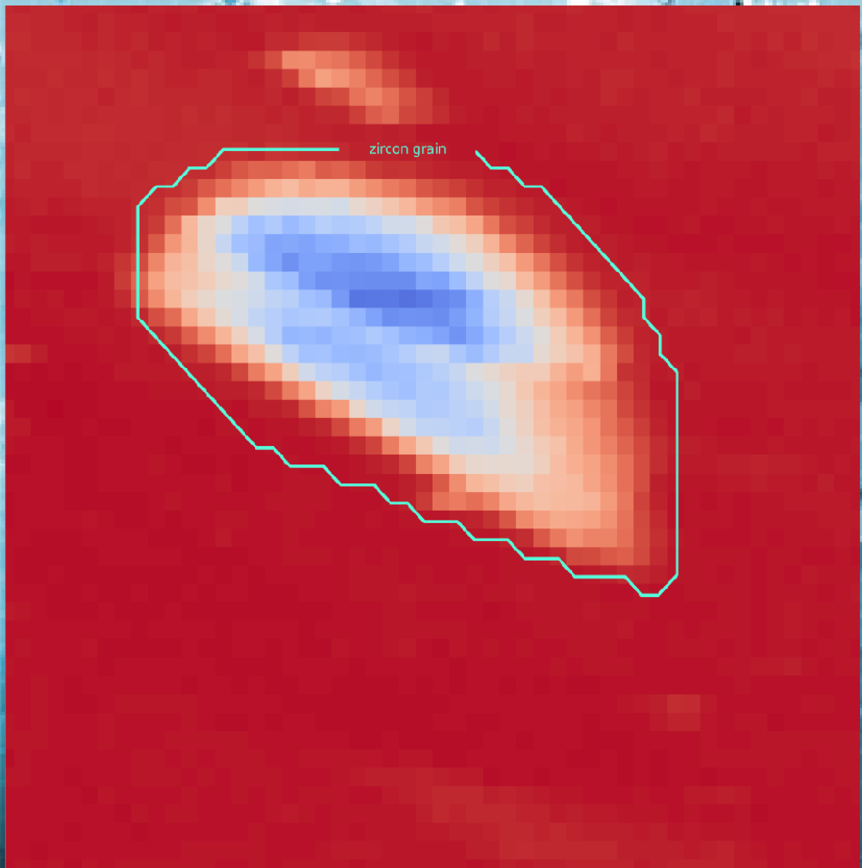
Saturation effects: Xspress3

Y intensity map (blue = high intensity)

At very high count rate (10x that of Standard), the Xspress3 shows some peak broadening,

but no obvious problems in the image.

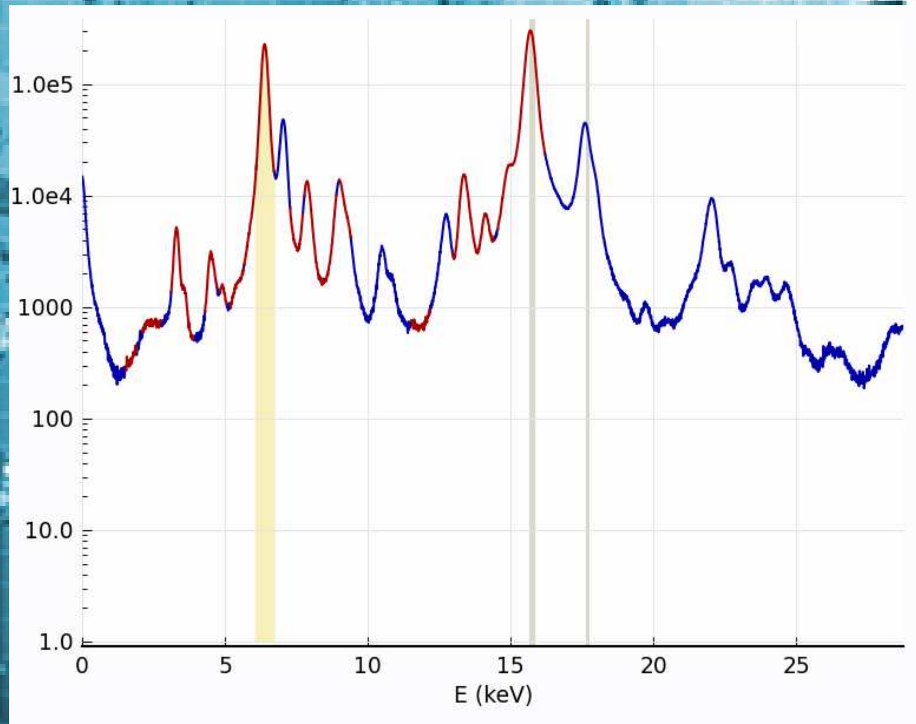
## Y map detail: zircon grain (upper left)




XRF extracted from zircon grain (574 pixels, 5.7 sec)

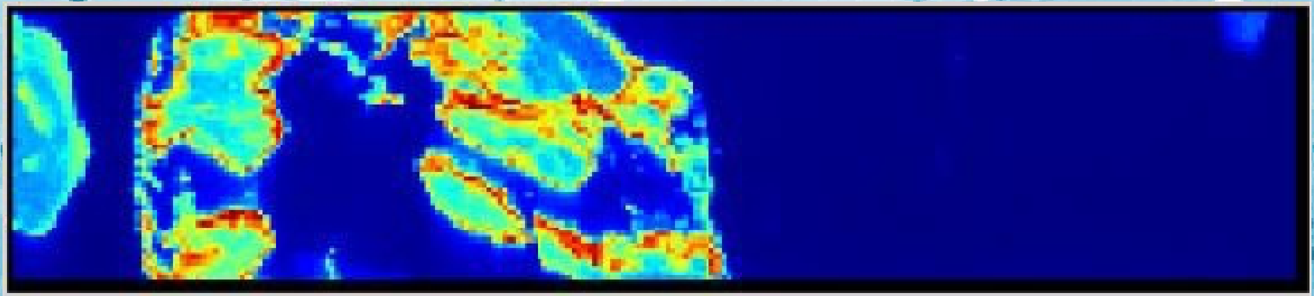
Count rates (sum of 4 elements, DT corrected):

5.538 MHz total, 1.083 MHz Fe Ka, 2.194 MHz Zr Ka

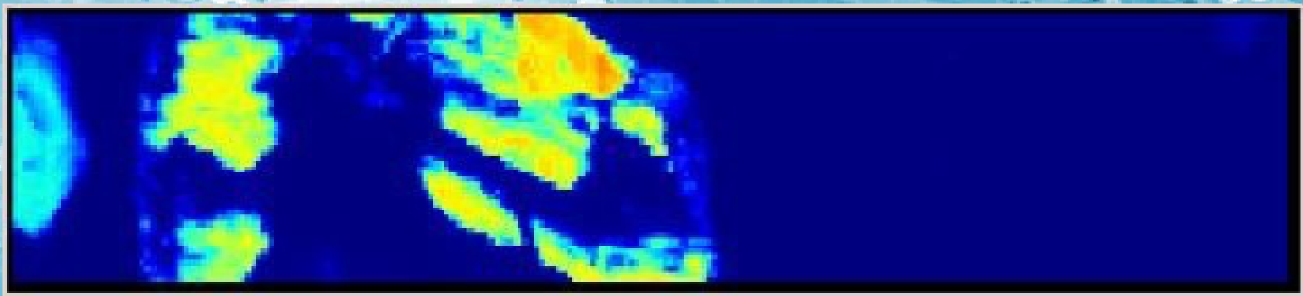



Xspress3

# SSRL

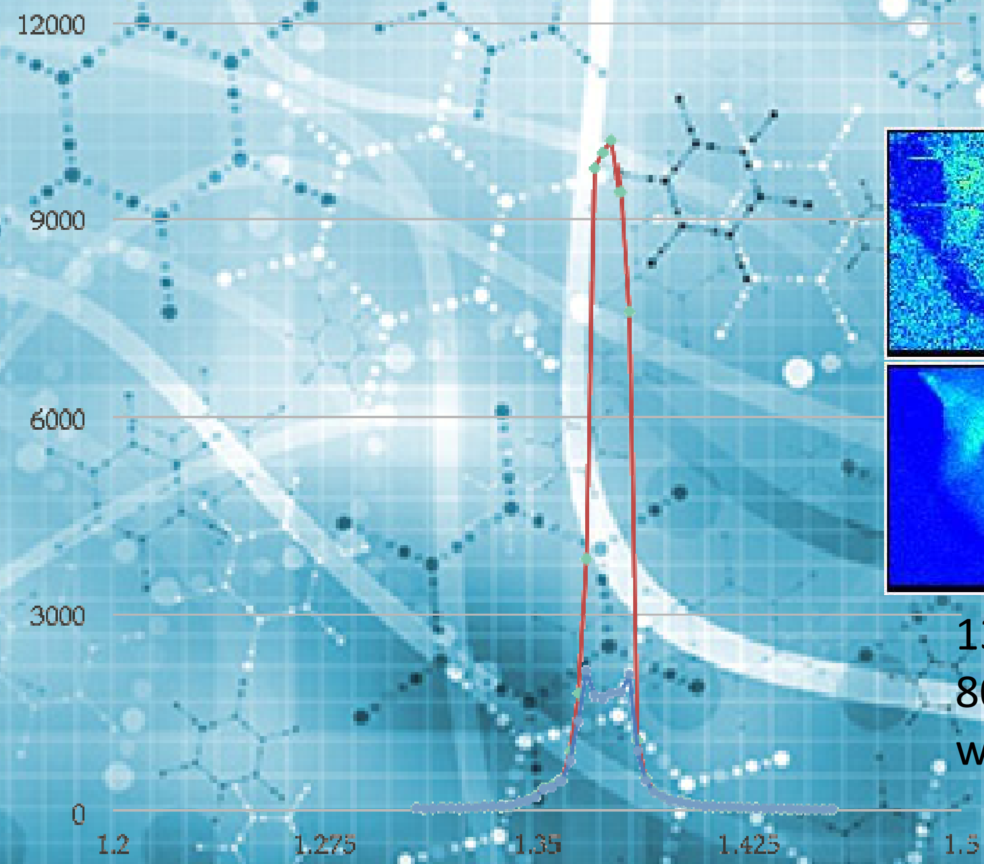


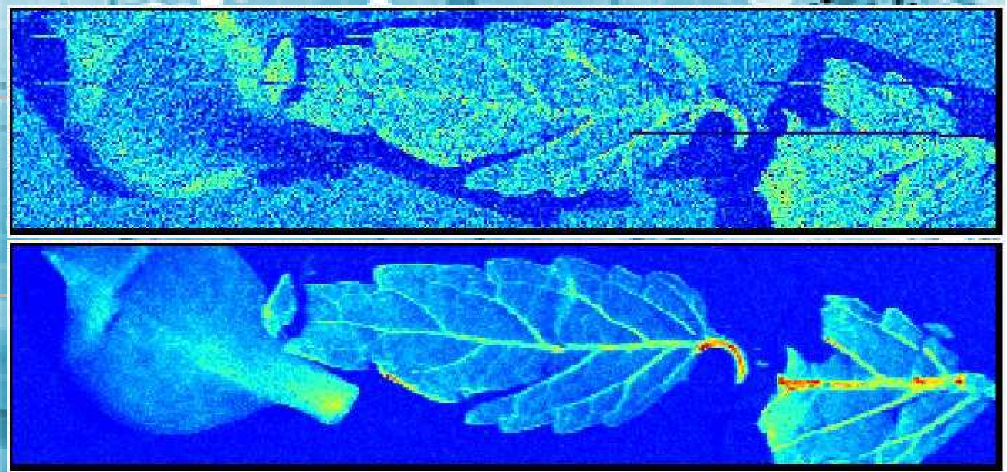
Cu channel, raw Std



Cu channel, Xspress3

# SSRL

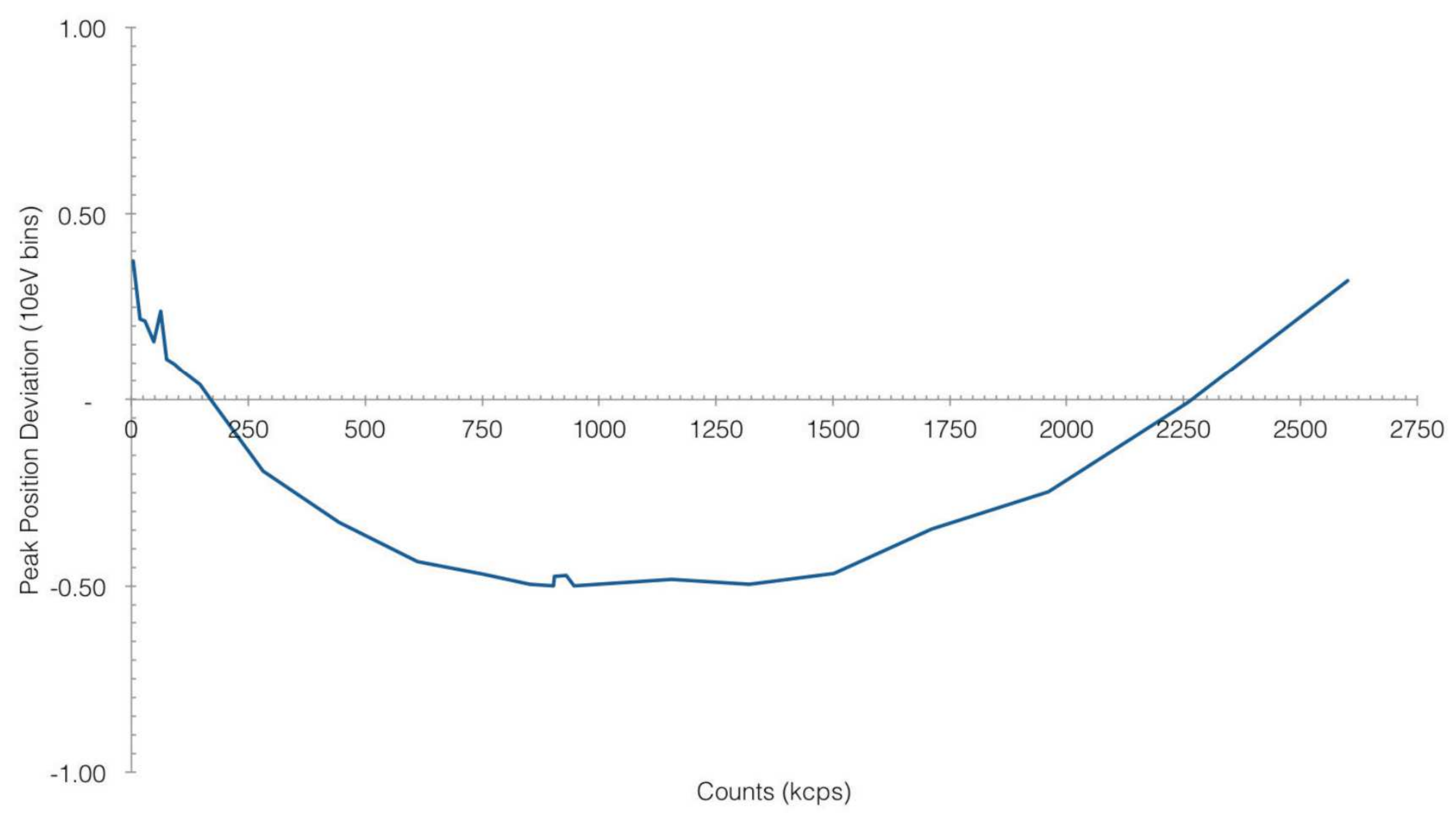


13.5 keV, dwell time of 30 ms per pixel, with 80x80 micron pixels. ICR on the Xspress 3 was from 500 kHz to 2.5 mHz

~15 micron thick copper wire.
Rapid imaging scans performed at 25ms dwell per pixel with 3 micron pixel size

# Peak Shift



1.00
0.50
-
-0.50
-1.00
Peak Position Deviation (10eV bins)
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
Counts (kcps)

# Xspress 3: Mature Product

- 35 Units installed
  - Nanoprobe / microfocus beamlines with Xspress 3 include:
    - NSLS-II: **HXN**, SRX
    - Diamond: I18, **I14**
    - SSRL: 2-2, 2-3, 10-2
    - APS: GSECARS
    - etc.
- EPICS
  - Developed at Diamond
  - Ongoing development at Diamond / APS / SSRL
- TANGO
  - Development for ESRF
  - In use: Maxlab (for Max IV)
  - Tested PETRA III / ESRF

# Where next?

- Crosstalk projects with Diamond
- Collaboration with SLAC
- Enthusiastic to start new projects