4,000 Spectra or 4,000,000 ROIs per Second: EPICS Support for High-Speed Digital X-ray Spectroscopy with the XIA xMap

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Outline

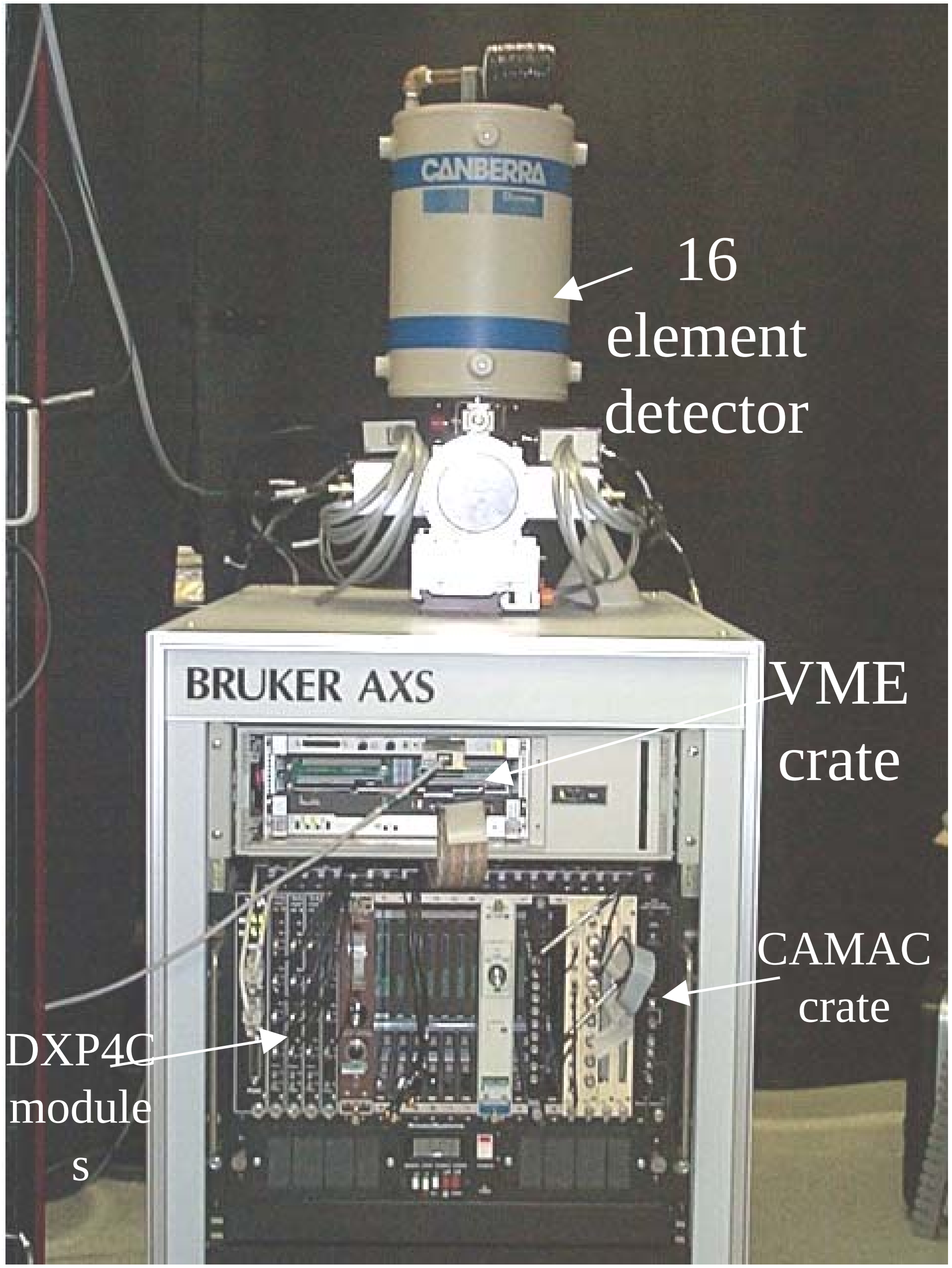
- Overview of EPICS Interface to XIA DXP electronics for x-ray fluorescence detectors
- New features in dxp R3-0; support for high-speed mapping with xMAP module
- First results with xMAP from 13-ID
- Bonus: What’s new in areaDetector R1-6
  - Probably won’t get a chance for a dedicated TWG talk on this, but new features to present

Motivation

- Need a cost-effective way to collect XRF spectra from multi-element detector arrays
- Modern detectors, particularly silicon drift diodes (SDD) can run at >250,000 cps per detector, or >1,000,000 cps for a 4-element array like the quad Vortex
- Depending on the application, can thus get a usable signal (1,000 counts) in 1 ms.
  - Need to keep the overhead less than that!

XIA Fast DSP Electronics for X-ray Fluorescence Detectors
4 Models

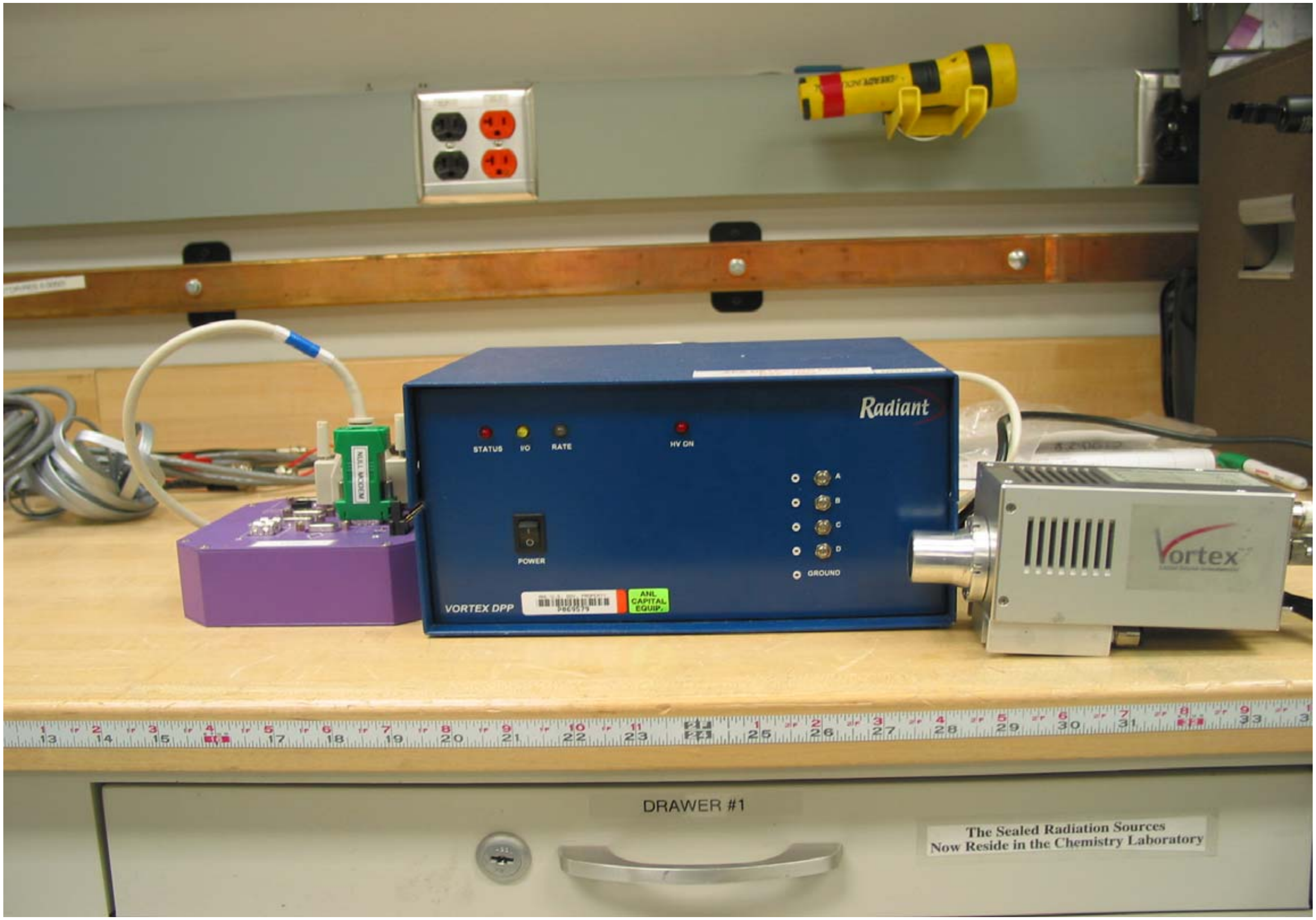
- DXP4C2X: CAMAC module for multi-element detectors. 4 detectors per CAMAC module. Obsolete, but still in use at some beamlines.
- Saturn: standalone unit for single-element detectors. This is also sold in an OEM version inside the Vortex electronics from SII
- xMAP: PXI module for multi-element detectors. 4 detectors per PXI module. Faster than Saturn and DXP2X, and with high-performance features.
- Mercury: New 4-channel module very similar to the xMAP, but in a standalone box like the Saturn with a USB 2.0 interface.


CANBERRA
16 element detector
BRUKER AXS
VME crate
CAMAC crate
DXP4C module s

XIA Saturn

MAGNIFIER/ BRUSHES
MINI-WRENCHES & SOCKET
SCREWDRIVERS
APS/BCDA
INTERCONNECTIONS
GSECARS
001007
XIA
Spectrum Series
SATURN
STATUS
I/O
RATE
DIGITAL X
DETECTOR BIAS CONTROL
ENABLE
V
ADJUST
RED WHEN ENABLED
POWER
DXP
X-RAY SPECTROMETER

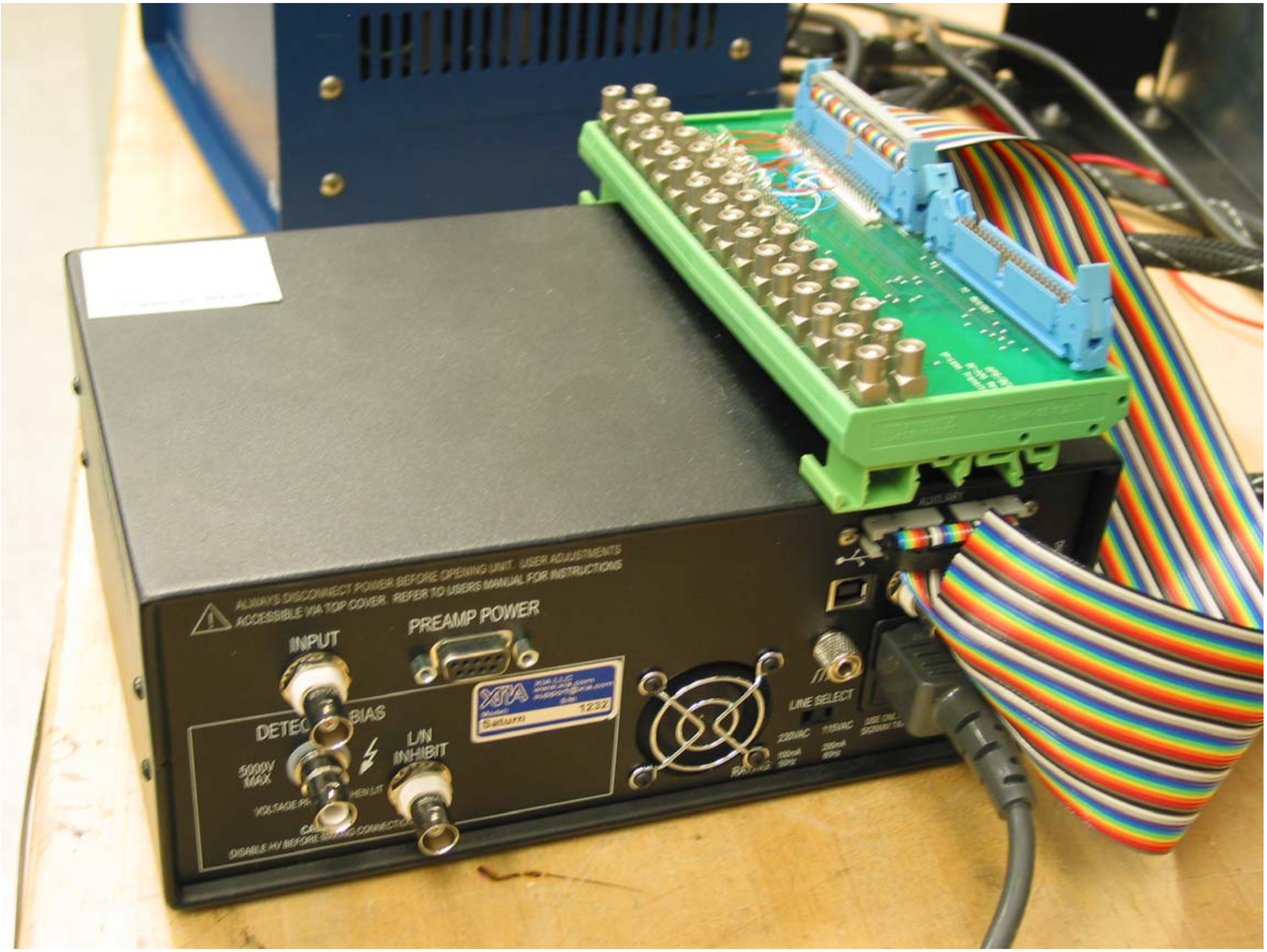
SII (formerly Radiant) Vortex detector and electronics
Saturn OEM version inside



Saturn electronics

- Older Saturns had parallel port (EPP) and USB 1.1 interface. Older Vortexes had EPP only.
- Newer Saturns and Vortexes have USB 2.0 only.
  - USB 2.0 is significantly faster than USB 1.1 and ~30% faster than EPP.
- Saturns available with an “ROI” option. When an x-ray within the energy window of the ROI is detected a pulse is output on 1 of 16 TTL output lines.
  - This allows very fast data collection, when used for example, with an SIS (Struck) multichannel scaler. 10 microsecond dwell times are possible.
- EPICS software propagates MCA record ROIs to the Saturn hardware ROIs.
- EPICS software runs on Linux and Windows for all 3 interfaces (EPP, USB 1.0, USB 2.0)

Saturn with TTL ROI outputs going to BCDA breakout panel



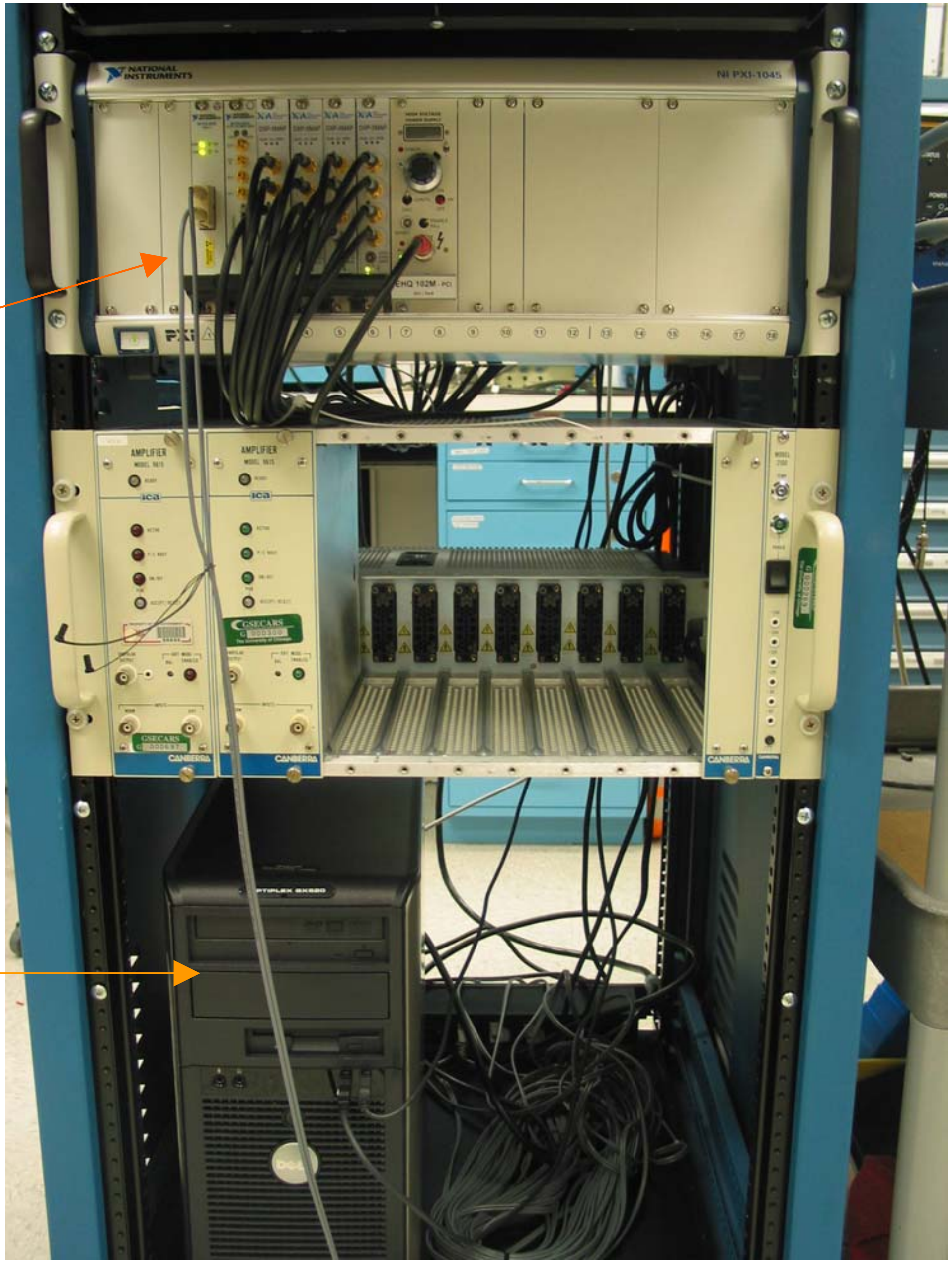
xMAP electronics

- 4 channels per module
- 4 MB of memory per module. Used to buffer spectra or ROIs for very data collection
- Double-buffered to support simultaneous readout and acquisition
- 1 LEMO input for gate and trigger functions.
- Peaking times down to 125ns
- Supports both RC and reset preamps
- PXI/PCI interface which acheives ~30 MB/sec when reading out xMAP. More than 30 times faster than CAMAC.

xMAP

PXI crate with 4 xMAP units (16 channels) and fiber PXI to PCI interface

Windows control computer



EPICS "dxp" module software
New features of Release 3-0

- Major rewrite
- Eliminate the special DXP record. Now all parameter control of the XIA electronics is done with standard EPICS records (ao, ai, bo, bi, etc.)
  - Single driver for parameter control and data acquisition
  - Still uses MCA record for simple data acquisition
  - Simpler, easier to maintain.
  - More features available
- Previously the DXP record had to be processed to get ICR and OCR for accurate live time correction
- ICR, OCR and trigger counts and output counts are now always updated when the spectrum is read.
- Trigger live time and energy live time now both available

Saturn features in Release 3-0

- Correct live time. Previously the live time of the trigger filter was reported. Now it is the correct energy-filter live time.
  - No need to collect ICR/OCR to compute correct live time any more.
- Saturn firmware is included to use the ROI TTL output feature if the Saturn is equipped with that option. Very fast mapping with ROI counts (not full spectra).
- Performance: ~40 spectra/second with .01 sec acquire time, USB 2.0 interface on Windows, saving 2048 channel full spectra to disk
- Many thousands of ROIs/second using TTL outputs to SIS multichannel scaler

xMAP Mapping Modes in Release 3-0

- MCA mapping
  - Spectra are buffered into onboard 4MB of memory
  - Double buffered for simultaneous readout and acquisition
  - With 2048 channel spectra each buffer holds 124 pixels maximum.
  - Performance: Limited by readout rate of xMAP over PXI/PCI, ~4,000 2048 channel spectra per second. For a 4-channel system (e.g. quad Vortex) this is 1,000 pixels/second. For a 100-element EXAFS detector it is 40 points/second
  - The first pixel in each buffer is sent to the MCA records for visual feedback on the data.
    - The buffer size can be decreased from 124 pixels when mapping slowly to get more rapid feedback.
- ROI (SCA) mapping
  - Total counts in up to 16 ROIs per detector are collected into onboard 4MB of memory
  - Double buffered for simultaneous readout and acquisition
  - With 16 ROIs each buffer holds 5457 pixels maximum
  - Performance: Limited by xMAP overhead in pixel advance to about 100 microseconds/pixel, i.e. 10,000 pixels/second.
  - For a 16-element detector with 16 ROIs/detector this is 2.5M ROIs/second.

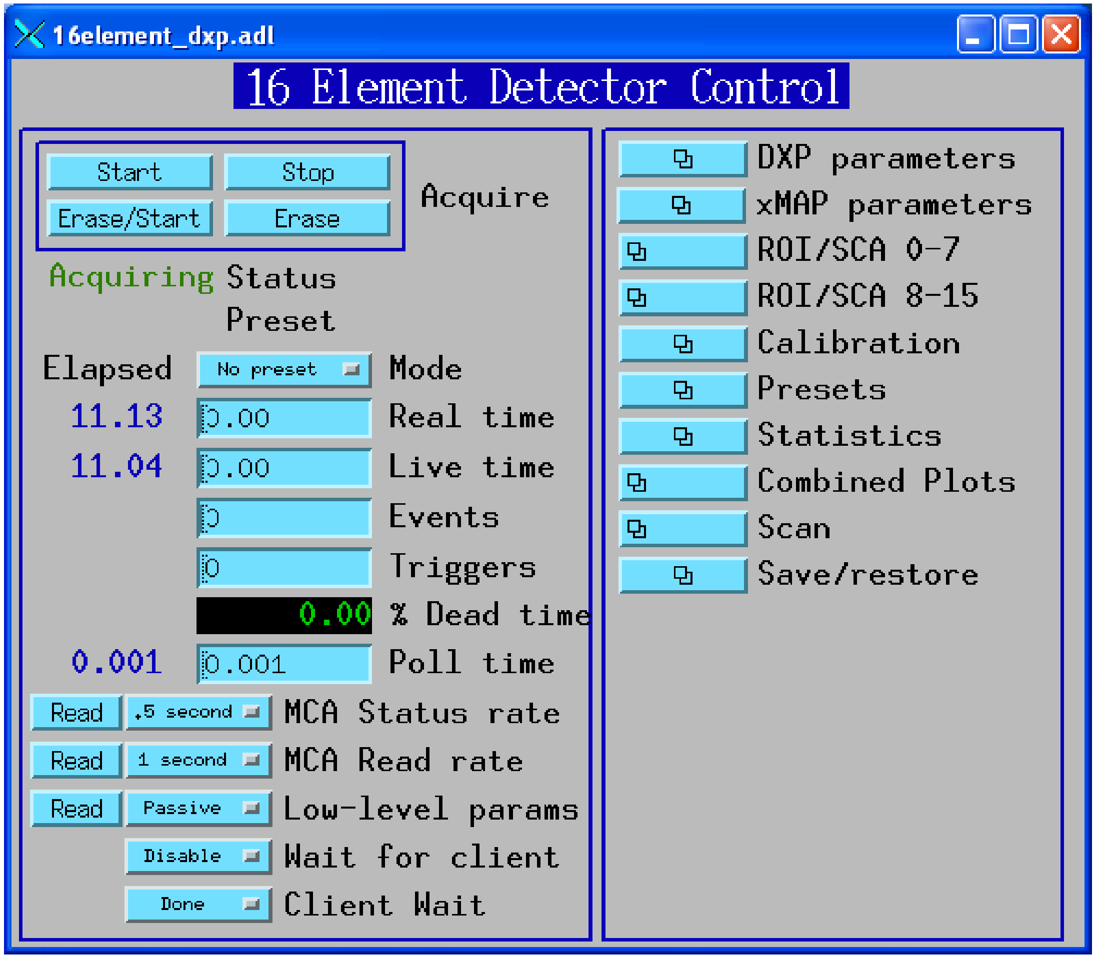
xMAP Mapping Modes in Release 3-0

- Pixel advance sources:
  - Software: This is a PV that can be written to at any time
  - External trigger: Trigger input to LEMO connector.
  - External sync: Like external trigger, but with option to divide input by N. Can be used to divide stepper motor pulses, for example, to have each pixel be 25 motor steps.
- Data acquisition
  - When buffer fills up the EPICS software automatically reads it out and calls any NDArray plugins (from the areaDetector module) that have registered for callbacks.
  - The data are 16-bit 2-D arrays, 1047808 x N_modules.
    - The data in each array is a buffer containing the spectral data, as well as live time, real time, input counts and output counts.
  - The plugins will normally be file-saving plugins. The netCDF, TIFF and NeXus/HDF plugins from areaDetector can all be directly used. The JPEG plugin will not be useful!
  - The netCDF plugin can stream data continuously to a single netCDF file. The TIFF plugin writes each 2-D array to a separate TIFF file
  - IDL and Python routines are available to extract the data from the netCDF files.
  - Continuously streaming data at the rates on the previous slide

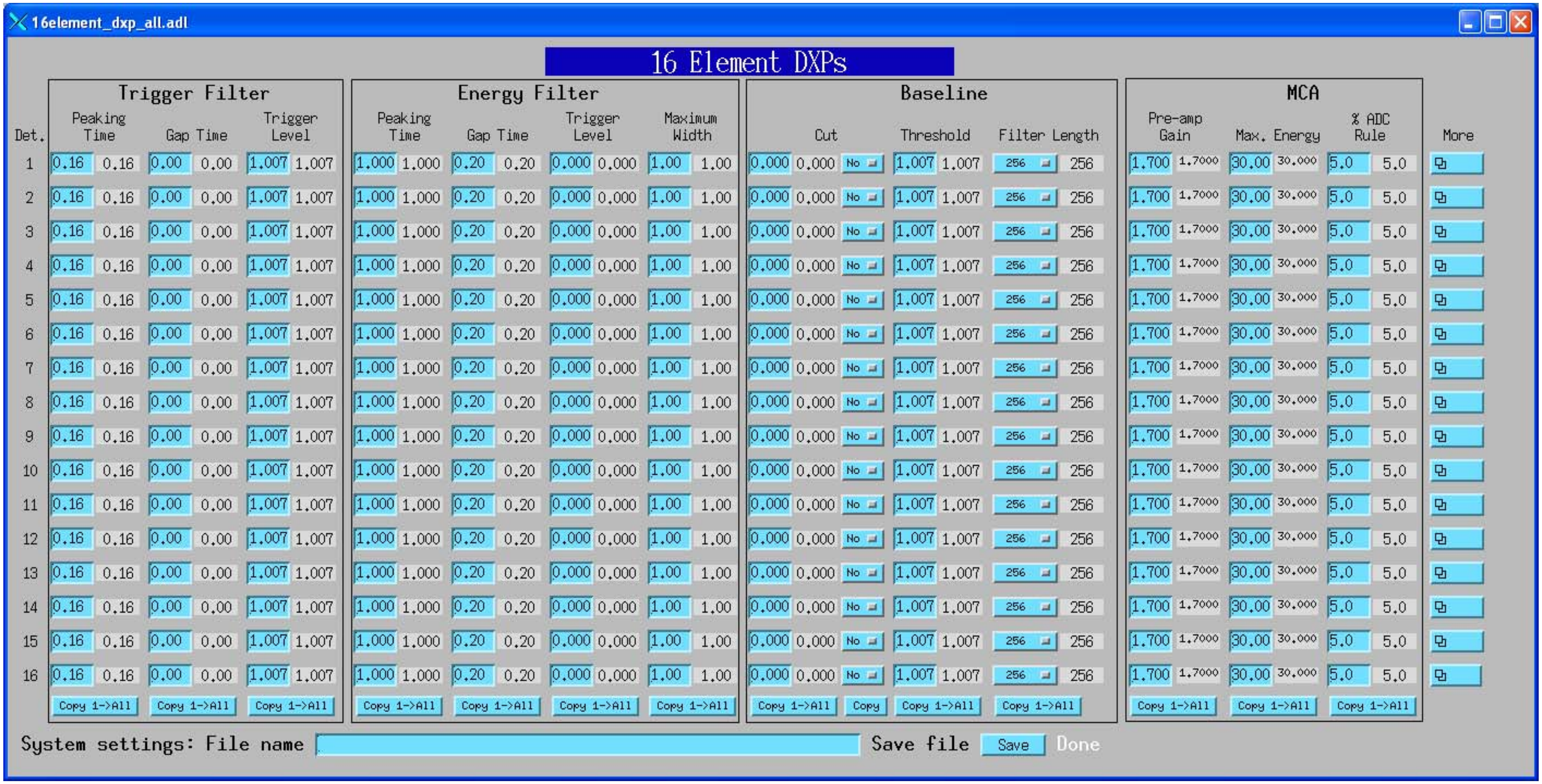
Other multi-element features in Release 3-0

- More preset modes with xMAP: None, real time, live time, triggers, events (total counts).
- Time to start up xMAP at EPICS iocInit reduced from >3 minutes to <30 seconds for 16 channel detector system.
- Time to copy ROIs to SCAs reduced from >1 minute to 1 second.
- Copy DSP parameters from detector 1 to all detectors
- Copy ROIs from detector 1 to all detectors, by channel or by energy
- Copy ROIs (MCA record) to SCAs (XIA hardware) for all detectors for all ROIs.
- Several additional diagnostic trace plots

16 element top-level medm screen



16 element high level parameters



16element_dxp_all.adl

16 Element DXPs

	Trigger Filter						Energy Filter								Baseline							MCA						
Det.	Peaking Time		Gap Time		Trigger Level		Peaking Time		Gap Time		Trigger Level		Maximum Width		Cut			Threshold		Filter Length		Pre-amp Gain		Max. Energy		% ADC Rule		More
1	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
2	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
3	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
4	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
5	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
6	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
7	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
8	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
9	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
10	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
11	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
12	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
13	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
14	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
15	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
16	0.16	0.16	0.00	0.00	1.007	1.007	1.000	1.000	0.20	0.20	0.000	0.000	1.00	1.00	0.000	0.000	No	1.007	1.007	256	256	1.700	1.7000	30.00	30.000	5.0	5.0	
	Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy	Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		Copy 1->All		

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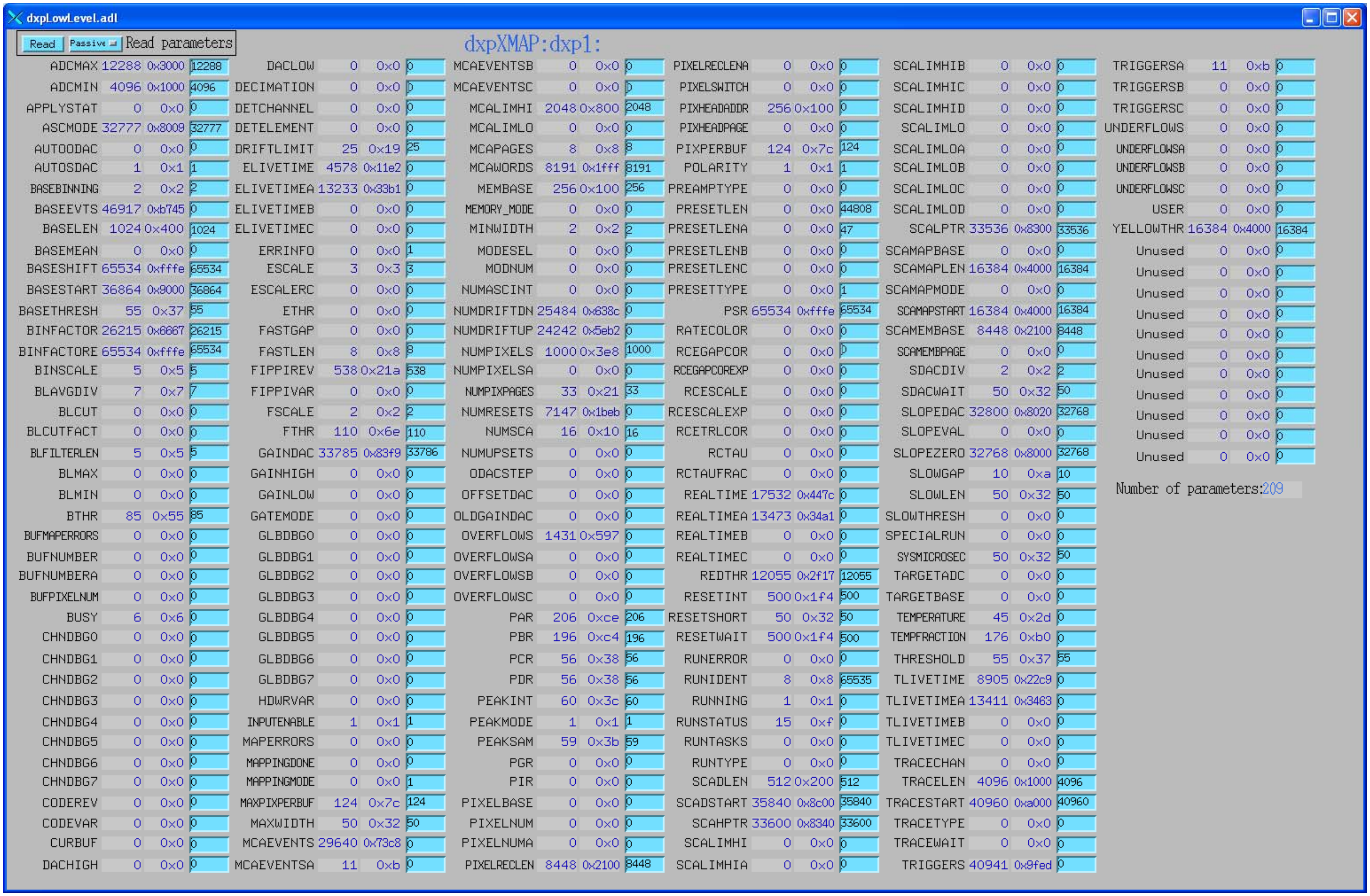
Single channel low-level parameters



dxpLowLevel.adl

Read | Passive | Read parameters

dxpXMAP:dxp1:

ADCMAX	12288	0x3000	12288
ADCMIN	4096	0x1000	4096
APPLYSTAT	0	0x0	0
ASCMODE	32777	0x8009	32777
AUTODDAC	0	0x0	0
AUTOSDAC	1	0x1	1
BASEBINNING	2	0x2	2
BASEEVTS	46917	0xb745	0
BASELEN	1024	0x400	1024
BASEMEAN	0	0x0	0
BASESHIFT	65534	0xfffe	65534
BASESTART	36864	0x9000	36864
BASETHRESH	55	0x37	55
BINFACTOR	26215	0x6667	26215
BINFACTORE	65534	0xfffe	65534
BINSCALE	5	0x5	5
BLAVGDIV	7	0x7	7
BLCUT	0	0x0	0
BLCUTFACT	0	0x0	0
BLFILTERLEN	5	0x5	5
BLMAX	0	0x0	0
BLMIN	0	0x0	0
BTHR	85	0x55	85
BUFMAPERRORS	0	0x0	0
BUFNUMBER	0	0x0	0
BUFNUMBERA	0	0x0	0
BUFPIXELNUM	0	0x0	0
BUSY	6	0x6	0
CHNDBG0	0	0x0	0
CHNDBG1	0	0x0	0
CHNDBG2	0	0x0	0
CHNDBG3	0	0x0	0
CHNDBG4	0	0x0	0
CHNDBG5	0	0x0	0
CHNDBG6	0	0x0	0
CHNDBG7	0	0x0	0
CODEREV	0	0x0	0
CODEVAR	0	0x0	0
CURBUF	0	0x0	0
DACHIGH	0	0x0	0

DACLOW	0	0x0	0
DECIMATION	0	0x0	0
DETCHANNEL	0	0x0	0
DETELEMENT	0	0x0	0
DRIFTLIMIT	25	0x19	25
ELIVETIME	4578	0x11e2	0
ELIVETIMEA	13233	0x33b1	0
ELIVETIMEB	0	0x0	0
ELIVETIMEC	0	0x0	0
ERRINFO	0	0x0	1
ESCALE	3	0x3	3
ESCALERC	0	0x0	0
ETHR	0	0x0	0
FASTGAP	0	0x0	0
FASTLEN	8	0x8	8
FIPPIREV	538	0x21a	538
FIPPIVAR	0	0x0	0
FSCALE	2	0x2	2
FTHR	110	0x6e	110
GAINDAC	33785	0x83f9	33786
GAINHIGH	0	0x0	0
GAINLOW	0	0x0	0
GATEMODE	0	0x0	0
GLBDBG0	0	0x0	0
GLBDBG1	0	0x0	0
GLBDBG2	0	0x0	0
GLBDBG3	0	0x0	0
GLBDBG4	0	0x0	0
GLBDBG5	0	0x0	0
GLBDBG6	0	0x0	0
GLBDBG7	0	0x0	0
HDWRVAR	0	0x0	0
INPUTENABLE	1	0x1	1
MAPERRORS	0	0x0	0
MAPPINGDONE	0	0x0	0
MAPPINGMODE	0	0x0	1
MAXPIXPERBUF	124	0x7c	124
MAXWIDTH	50	0x32	50
MCAEVENTS	29640	0x73c8	0
MCAEVENTSA	11	0xb	0

MCAEVENTSB	0	0x0	0
MCAEVENTSC	0	0x0	0
MCALIMHI	2048	0x800	2048
MCALIMLO	0	0x0	0
MCAPAGES	8	0x8	8
MCAWORDS	8191	0x1fff	8191
MEMBASE	256	0x100	256
MEMORY_MODE	0	0x0	0
MINWIDTH	2	0x2	2
MODESEL	0	0x0	0
MODNUM	0	0x0	0
NUMASCINT	0	0x0	0
NUMDRIFTDN	25484	0x638c	0
NUMDRIFTUP	24242	0x5eb2	0
NUMPIXELS	1000	0x3e8	1000
NUMPIXELSA	0	0x0	0
NUMPIXPAGES	33	0x21	33
NUMRESETS	7147	0x1beb	0
NUMSCA	16	0x10	16
NUMUPSETS	0	0x0	0
ODACSTEP	0	0x0	0
OFFSETDAC	0	0x0	0
OLDGAINDAC	0	0x0	0
OVERFLOWS	1431	0x597	0
OVERFLOWSA	0	0x0	0
OVERFLOWSB	0	0x0	0
OVERFLOWSC	0	0x0	0
PAR	206	0xce	206
PBR	196	0xc4	196
PCR	56	0x38	56
PDR	56	0x38	56
PEAKINT	60	0x3c	60
PEAKMODE	1	0x1	1
PEAKSAM	59	0x3b	59
PGR	0	0x0	0
PIR	0	0x0	0
PIXELBASE	0	0x0	0
PIXELNUM	0	0x0	0
PIXELNUMA	0	0x0	0
PIXELRECLEN	8448	0x2100	8448

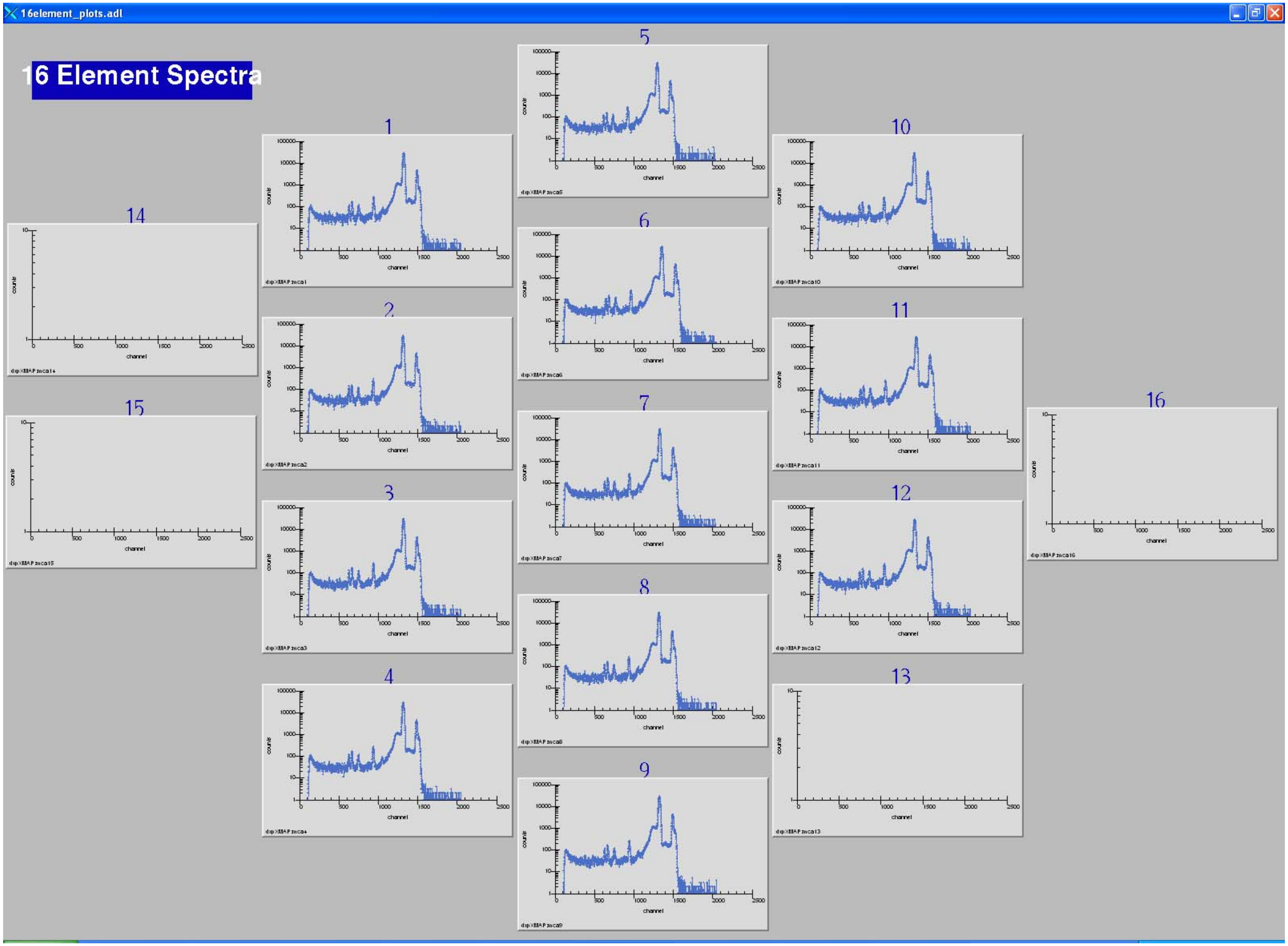
PIXELRECLENA	0	0x0	0
PIXELSWITCH	0	0x0	0
PIXHEADADDR	256	0x100	0
PIXHEADPAGE	0	0x0	0
PIXPERBUF	124	0x7c	124
POLARITY	1	0x1	1
PREAMPTYPE	0	0x0	0
PRESETLEN	0	0x0	44808
PRESETLENA	0	0x0	47
PRESETLENB	0	0x0	0
PRESETLENC	0	0x0	0
PRESETTYPE	0	0x0	1
PSR	65534	0xfffe	65534
RATECOLOR	0	0x0	0
RCEGAPCOR	0	0x0	0
RCEGAPCOREXP	0	0x0	0
RCESCALE	0	0x0	0
RCESCALEXP	0	0x0	0
RCETRLCOR	0	0x0	0
RCTAU	0	0x0	0
RCTAUFRAC	0	0x0	0
REALTIME	17532	0x447c	0
REALTIMEA	13473	0x34a1	0
REALTIMEB	0	0x0	0
REALTIMEC	0	0x0	0
REDTHR	12055	0x2f17	12055
RESETINT	500	0x1f4	500
RESETSHORT	50	0x32	50
RESETWAIT	500	0x1f4	500
RUNERROR	0	0x0	0
RUNIDENT	8	0x8	65535
RUNNING	1	0x1	0
RUNSTATUS	15	0xf	0
RUNTASKS	0	0x0	0
RUNTYPE	0	0x0	0
SCADLEN	512	0x200	512
SCADSTART	35840	0x8c00	35840
SCAHPTR	33600	0x8340	33600
SCALIMHI	0	0x0	0
SCALIMHIA	0	0x0	0

SCALIMHIB	0	0x0	0
SCALIMHIC	0	0x0	0
SCALIMHID	0	0x0	0
SCALIMLO	0	0x0	0
SCALIMLOA	0	0x0	0
SCALIMLOB	0	0x0	0
SCALIMLOC	0	0x0	0
SCALIMLOD	0	0x0	0
SCALPTR	33536	0x8300	33536
SCAMAPBASE	0	0x0	0
SCAMAPLEN	16384	0x4000	16384
SCAMAPMODE	0	0x0	0
SCAMAPSTART	16384	0x4000	16384
SCAMEMBASE	8448	0x2100	8448
SCAMEMBPAGE	0	0x0	0
SDACDIV	2	0x2	2
SDACWAIT	50	0x32	50
SLOPEDAC	32800	0x8020	32768
SLOPEVAL	0	0x0	0
SLOPEZERO	32768	0x8000	32768
SLOWGAP	10	0xa	10
SLOWLEN	50	0x32	50
SLOWTHRESH	0	0x0	0
SPECIALRUN	0	0x0	0
SYSMICROSEC	50	0x32	50
TARGETADC	0	0x0	0
TARGETBASE	0	0x0	0
TEMPERATURE	45	0x2d	0
TEMPFRACTION	176	0xb0	0
THRESHOLD	55	0x37	55
TLIVETIME	8905	0x22c9	0
TLIVETIMEA	13411	0x3463	0
TLIVETIMEB	0	0x0	0
TLIVETIMEC	0	0x0	0
TRACECHAN	0	0x0	0
TRACELEN	4096	0x1000	4096
TRACESTART	40960	0xa000	40960
TRACETYPE	0	0x0	0
TRACEWAIT	0	0x0	0
TRIGGERS	40941	0x9fed	0

TRIGGERSA	11	0xb	0
TRIGGERSB	0	0x0	0
TRIGGERSC	0	0x0	0
UNDERFLOWS	0	0x0	0
UNDERFLOWSA	0	0x0	0
UNDERFLOWSB	0	0x0	0
UNDERFLOWSC	0	0x0	0
USER	0	0x0	0
YELLOWTHR	16384	0x4000	16384
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0
Unused	0	0x0	0

Number of parameters:209

16 element combined spectra



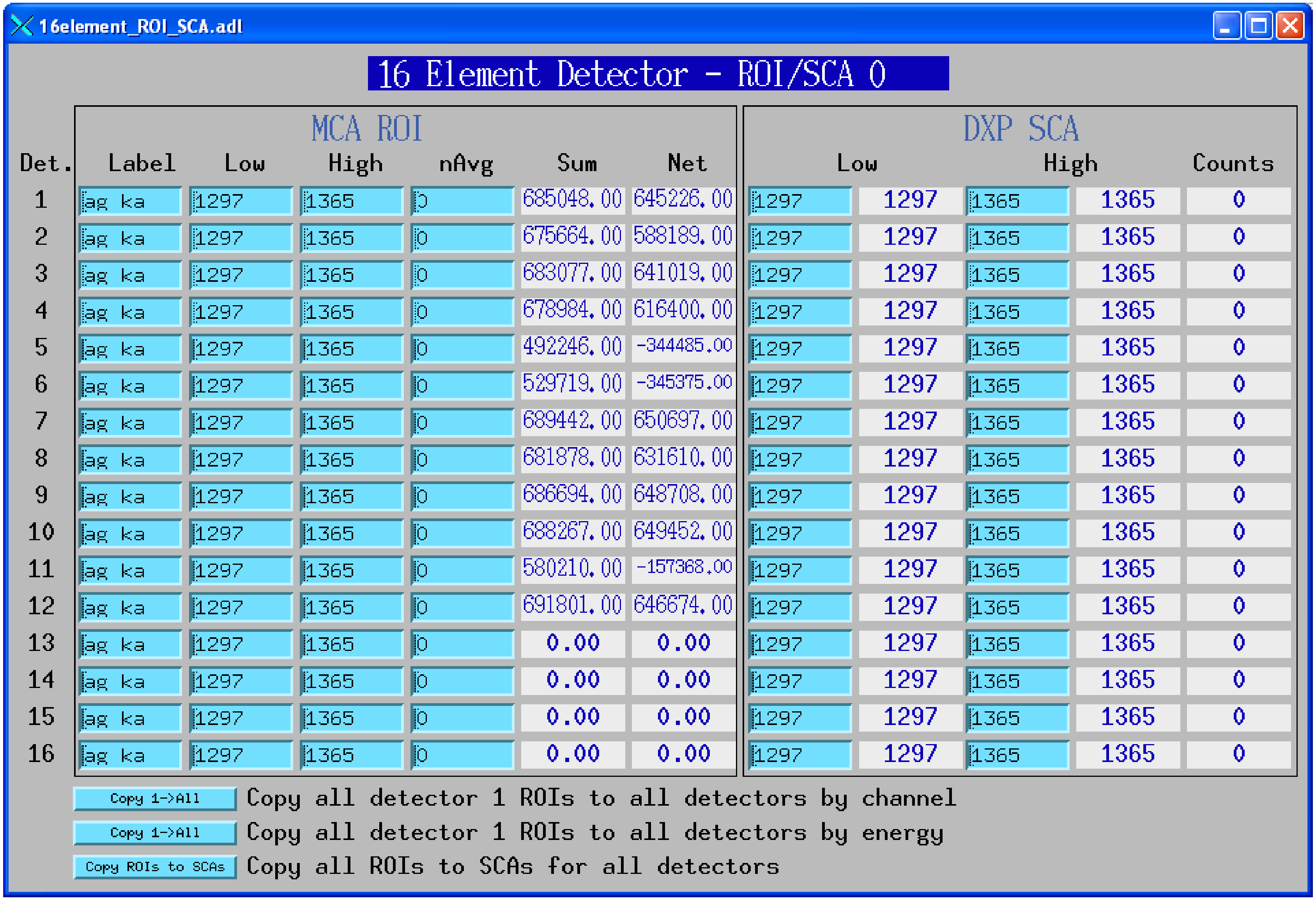
16 element statistics

16element_dxp_statistics.adl

16 Element Detector Statistics

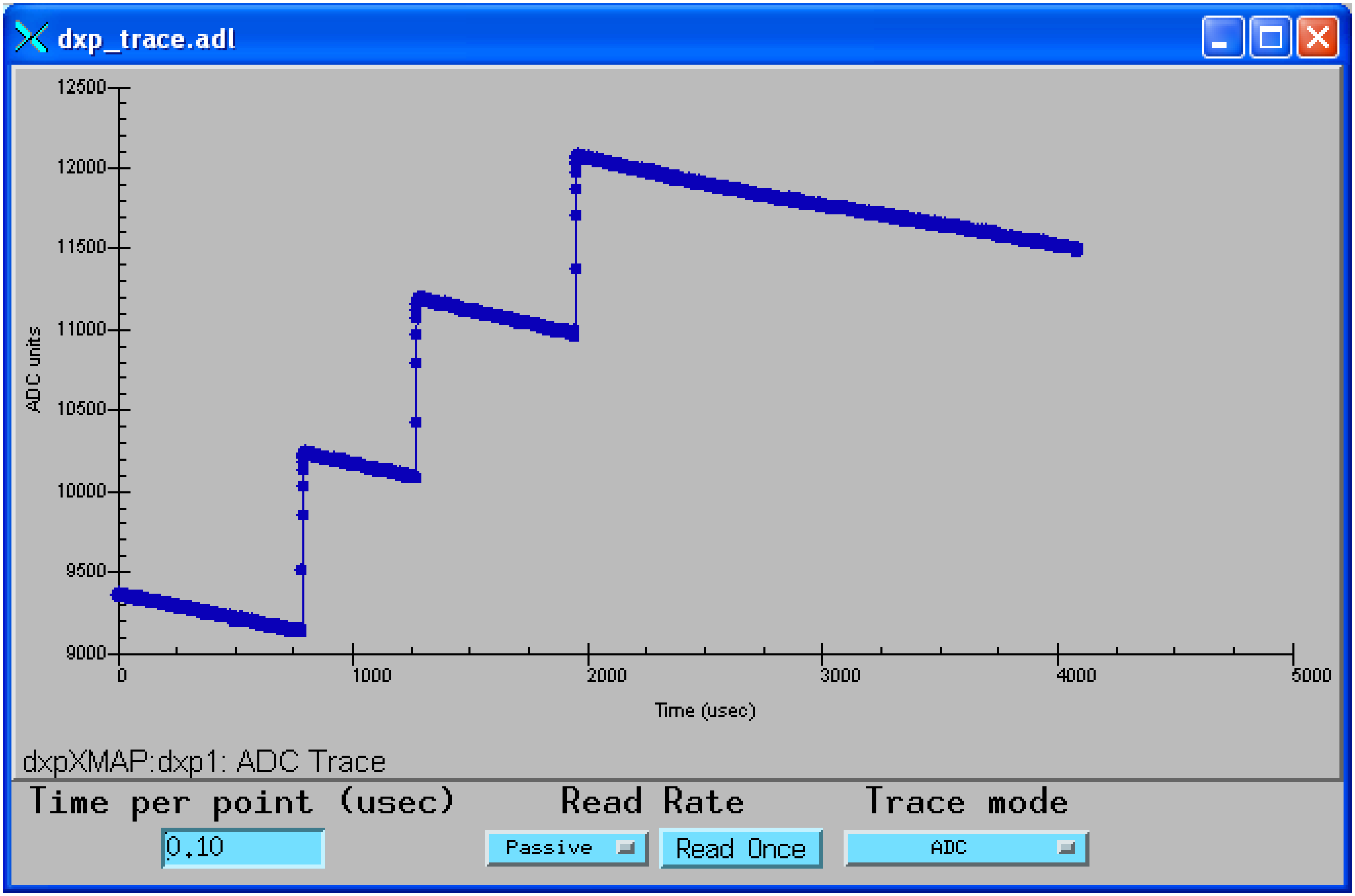
Det.	Elapsed Real	Elapsed Live	Trigger Live	Elapsed Triggers	Elapsed Events	ICR	OCR	Acquire Status	Dead Time
1	348.40	342.29	346.781	967126	952793	2788.9	2740.0	Done	1.75
2	348.40	342.28	346.787	967065	952674	2788.6	2739.6	Done	1.76
3	348.40	342.27	346.781	967086	952710	2788.7	2739.7	Done	1.76
4	348.38	342.29	346.788	967129	952773	2788.8	2740.1	Done	1.75
5	358.35	352.12	356.719	967406	953126	2712.0	2664.9	Done	0.00
6	358.34	352.10	356.647	967953	953787	2714.0	2666.8	Done	0.00
7	358.35	352.04	356.679	967846	953449	2713.5	2665.8	Done	0.00
8	358.34	352.13	356.691	967670	953463	2712.9	2665.8	Done	0.00
9	358.37	352.13	356.718	967736	953487	2712.9	2665.7	Done	0.00
10	358.37	352.19	356.715	967795	953670	2713.1	2666.2	Done	0.00
11	358.37	352.18	356.687	967950	953883	2713.7	2666.8	Done	0.00
12	358.37	352.21	356.713	967878	953824	2713.3	2666.7	Done	0.00
13	358.40	358.39	358.394	0	0	0.0	0.0	Done	0.00
14	358.40	358.35	358.351	0	0	0.0	0.0	Done	0.00
15	358.40	358.36	358.357	0	0	0.0	0.0	Done	0.00
16	358.40	358.35	358.349	0	0	0.0	0.0	Done	0.00

16 element ROIs and SCAs

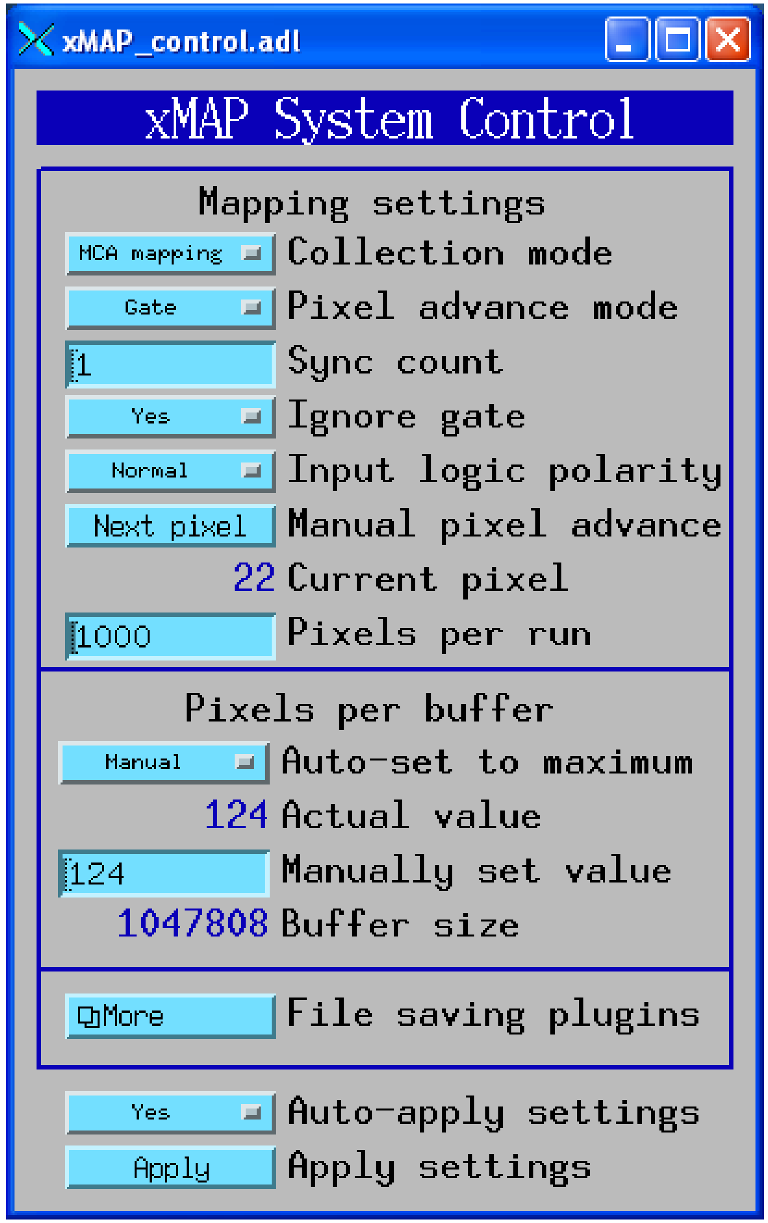


	MCA ROI						DXP SCA				
Det.	Label	Low	High	nAvg	Sum	Net	Low		High		Counts
1	ag ka	1297	1365	0	685048.00	645226.00	1297	1297	1365	1365	0
2	ag ka	1297	1365	0	675664.00	588189.00	1297	1297	1365	1365	0
3	ag ka	1297	1365	0	683077.00	641019.00	1297	1297	1365	1365	0
4	ag ka	1297	1365	0	678984.00	616400.00	1297	1297	1365	1365	0
5	ag ka	1297	1365	0	492246.00	-344485.00	1297	1297	1365	1365	0
6	ag ka	1297	1365	0	529719.00	-345375.00	1297	1297	1365	1365	0
7	ag ka	1297	1365	0	689442.00	650697.00	1297	1297	1365	1365	0
8	ag ka	1297	1365	0	681878.00	631610.00	1297	1297	1365	1365	0
9	ag ka	1297	1365	0	686694.00	648708.00	1297	1297	1365	1365	0
10	ag ka	1297	1365	0	688267.00	649452.00	1297	1297	1365	1365	0
11	ag ka	1297	1365	0	580210.00	-157368.00	1297	1297	1365	1365	0
12	ag ka	1297	1365	0	691801.00	646674.00	1297	1297	1365	1365	0
13	ag ka	1297	1365	0	0.00	0.00	1297	1297	1365	1365	0
14	ag ka	1297	1365	0	0.00	0.00	1297	1297	1365	1365	0
15	ag ka	1297	1365	0	0.00	0.00	1297	1297	1365	1365	0
16	ag ka	1297	1365	0	0.00	0.00	1297	1297	1365	1365	0

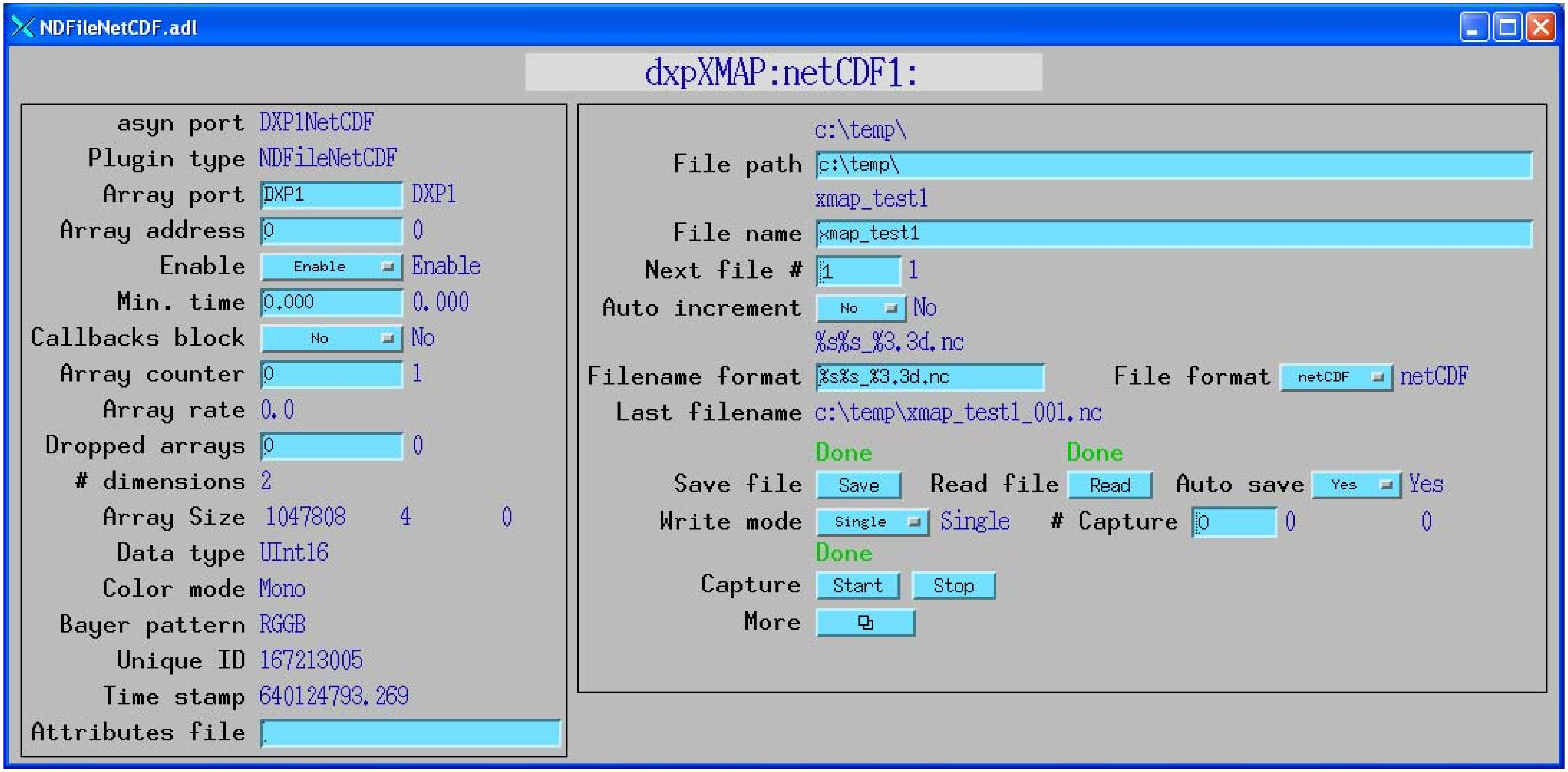
Single channel diagnostic trace of pre-amp input using xMAP like a digital scope



xMAP mapping mode setup



netCDF file saving plugin for mapping modes

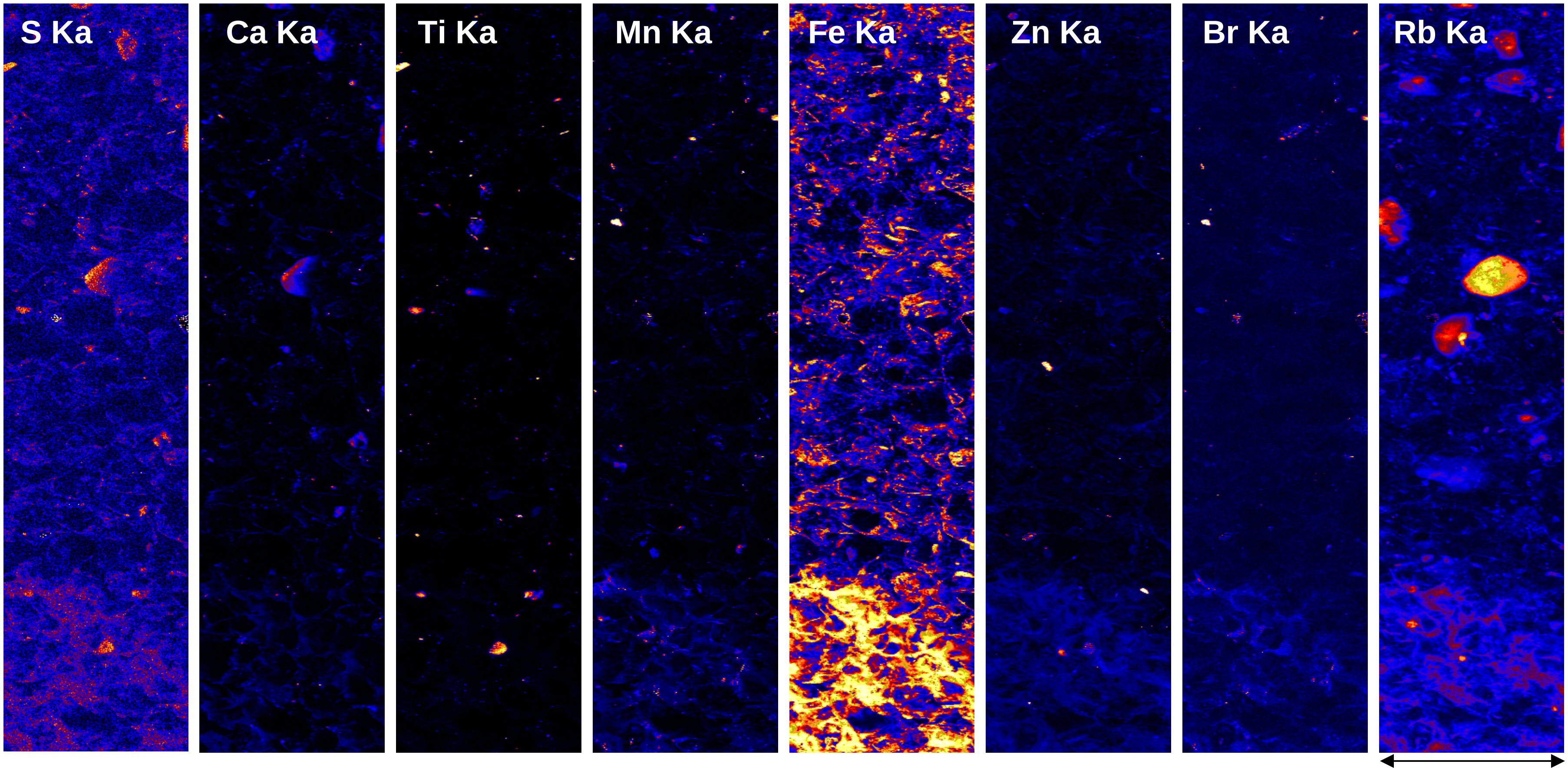


First Results with xMAP MCA Mapping Mode
Matt Newville, 13-ID-C

- SII quad Vortex detector
- Sample stage driven with Newport XPS motor controller running trajectory scanning software, continuous stage motion
- Bi-directional stage motion
- XPS puts out a trigger pulse at each pixel
- XPS captures actual stage position when each trigger pulse is output
- Trigger pulse goes to channel advance on SIS multichannel scaler to capture I0 from ion chamber & V/F converter
- SIS output pulse triggers xMAP trigger input
- Current version of software collects 1 row of image in xMAP buffer and writes to netCDF file
  - Could do an entire image into a single file to lower overhead.
  - Need to see if another process can read the file for display update
- Python software reads file, converts to an older format that can be displayed by Matt's Python collection software.
  - Adds additional overhead, but will be replaced with a new system Matt is designing

XRF Fast Mapping Mode example 1

G. Morin, F. Juillot Univ Paris VI



Maps of XRF intensity in sediment sampled near zinc smelter.

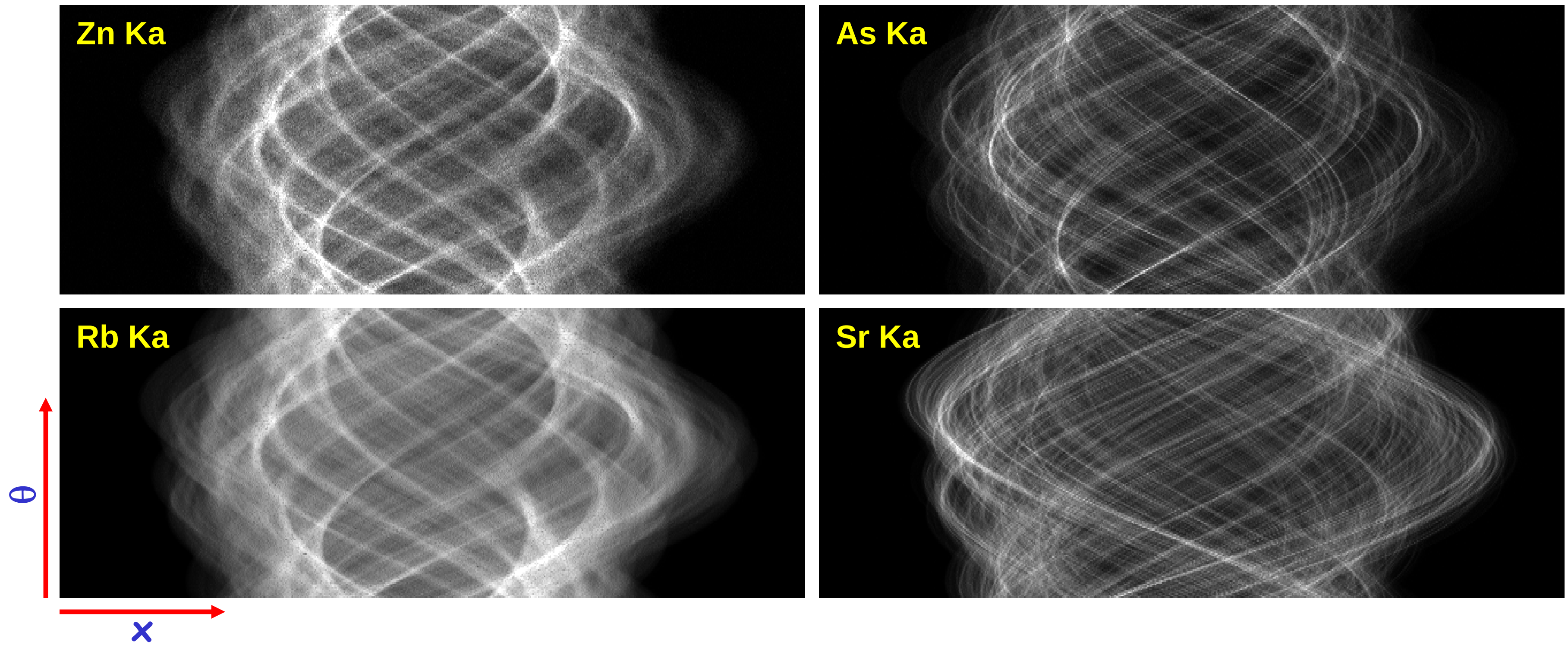
Data collection: 201 x 801 pixels (pixel: 5μm x 5μm) collected at 25ms per pixel

Time per Row = 5.025sec collection + ~2 sec overhead per line
Total Time = 1:37:10 (would be 1:13:47 if done as 801 x 201!!)

At 0.5sec per pixel (previous max rate), total collection time would be 22:21:41

XRF Fast Mapping Mode example 2: Fluorescence Tomography

Anne-Marie Carey, U. of Aberdeen, Kirk Scheckel US-EPA:
Distribution of Heavy Metals, especially As, in Rice



X-θ maps of XRF intensity in panicle (small stem to grain) in rice, grown in As(III)-spiked solution

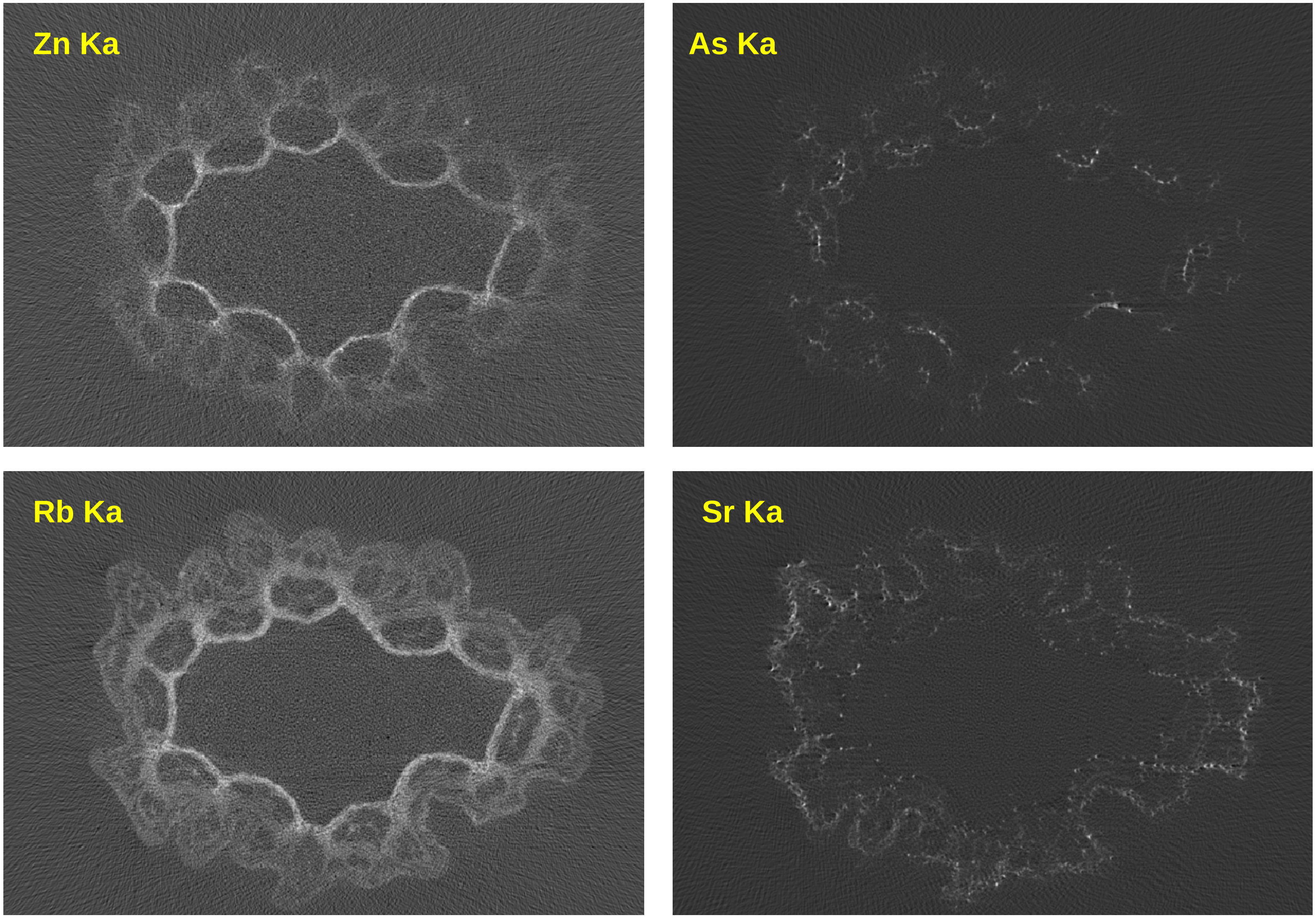
Data collection: 648 x 181 pixels (pixel: 2μm x 1degree) collected at 30ms per pixel

Time per Row = 20.5sec collection + ~2 sec overhead per line
Total Time = 1:07:20

At 0.5sec per pixel, total collection time would be 17:11:42

XRF Fast Mapping Mode example 2: Reconstructed Slices

Anne-Marie Carey, U. of Aberdeen, Kirk Scheckel US-EPA



Rb: marks phloem transport

Sr: marks xylem transport

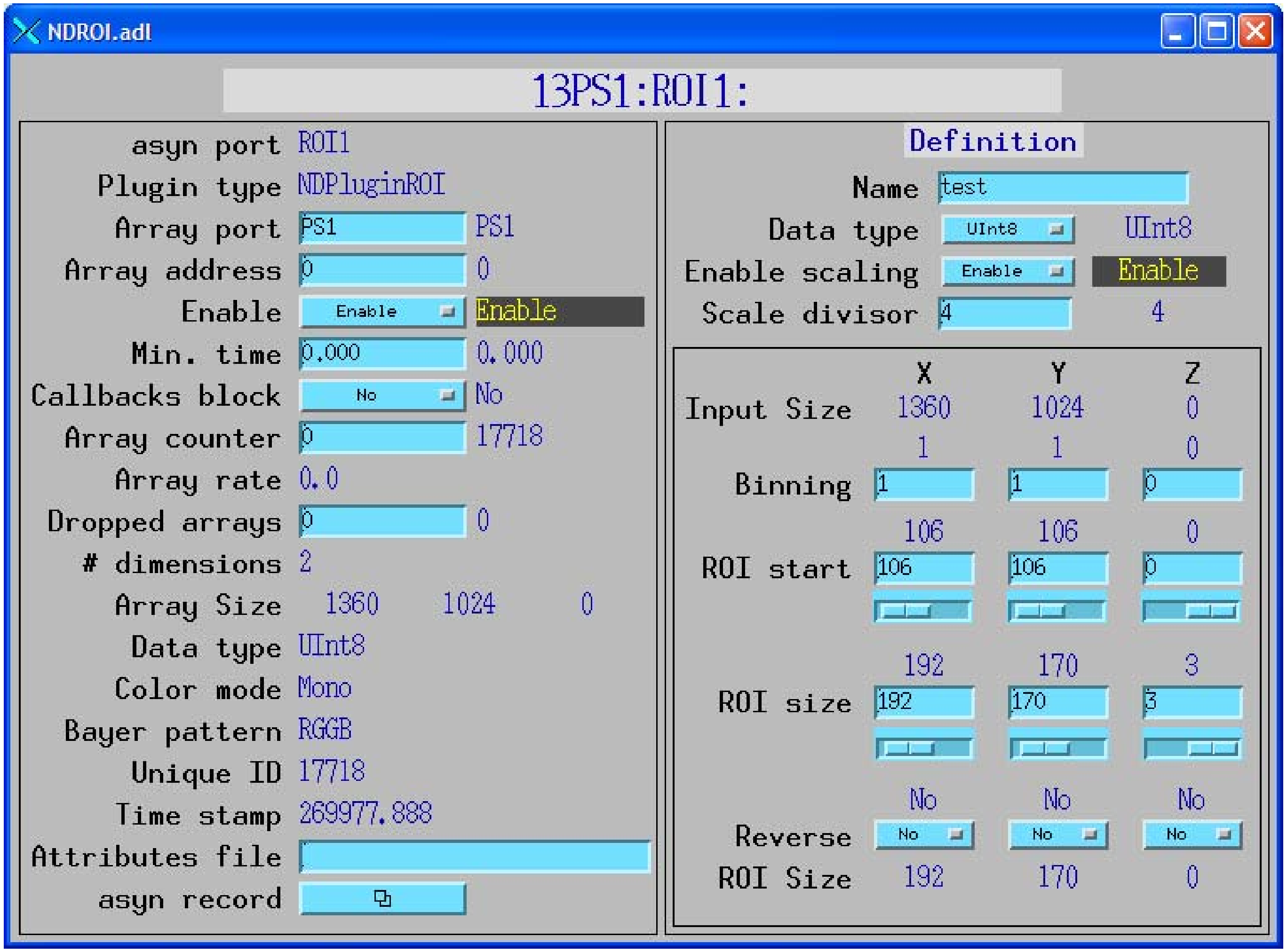
areaDetector R1-6
New features

- NDPluginROI
  - Previously the ROI plugin supported multiple ROIs, performed statistics calculations, and highlighted the ROIs.
  - New version is much simpler; it supports only a single ROI, and does not calculate statistics or do highlighting. Those functions have been moved to new plugins. One new function has been added, the ability to divide the array by a scale factor, which is useful for avoiding overflow when binning.
- NDPluginColorConvert
  - Added conversions from mono to RGB1, RGB2, and RGB3, and from RGB1, RGB2, and RGB3 to mono.
  - Previously this plugin only built on Linux and WIN32. Now it builds and does all conversions except Bayer on all architectures. Bayer conversion is restricted to Linux and WIN32.

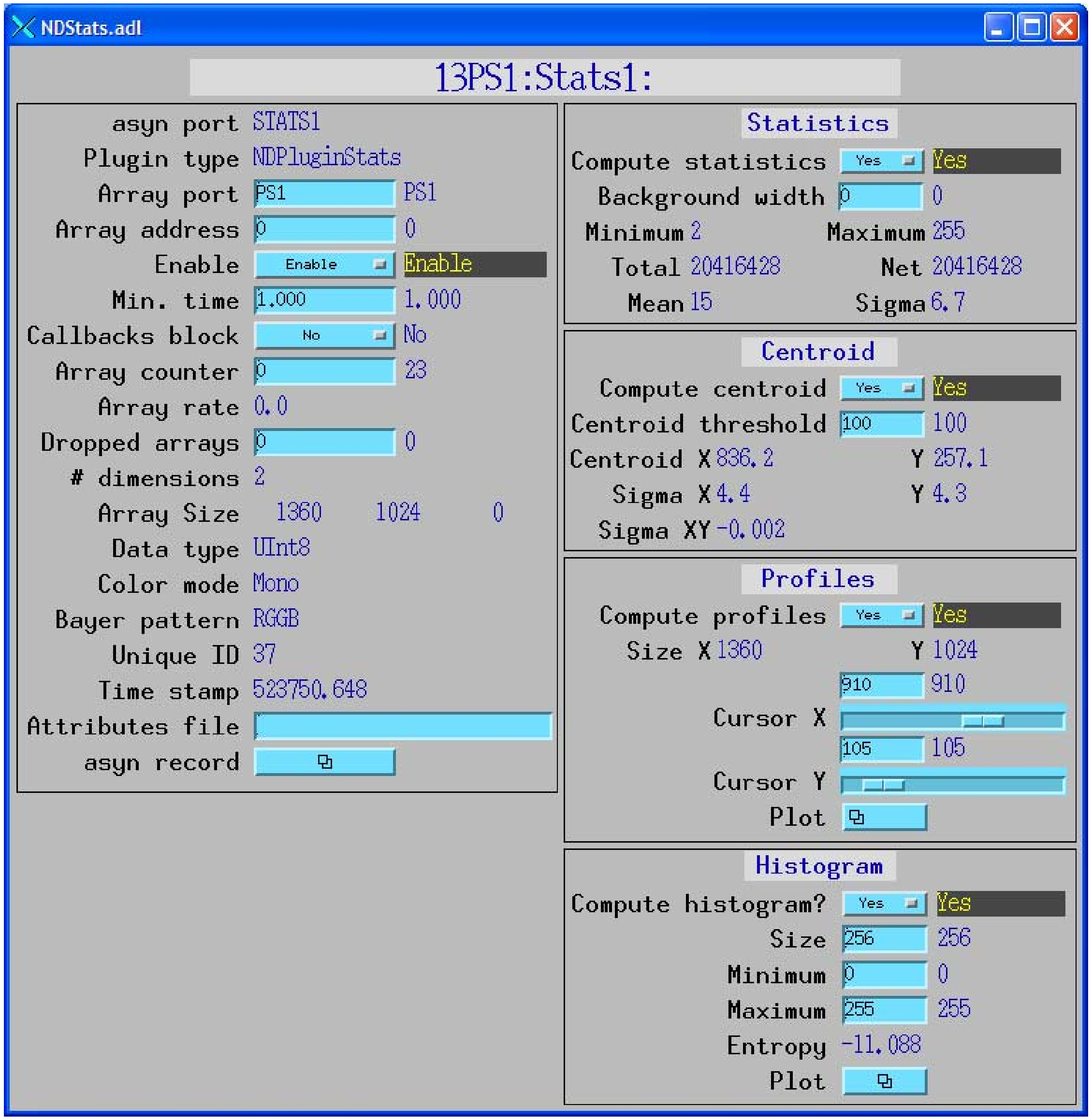
areaDetector R1-6
New features

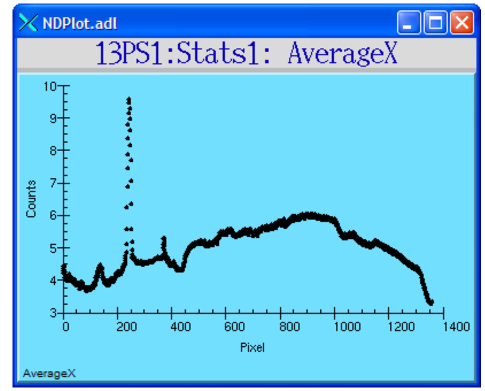
- New NDPluginStats plugin
  - Calculates statistics on an array
  - Replaces the statistics calculations that were previously performed in the ROI plugin.
  - Adds new statistics, including the centroid position and width.
  - Computes X and Y profiles, including average profiles, profiles at the centroid position, and profiles at a user-defined cursor position.
- New NDPluginProcess plugin
  - Does arithmetic processing on arrays
  - Background subtraction.
  - Flat field normalization.
  - Offset and scale.
  - Low and high clipping.
  - Recursive filtering in the time domain.
  - Conversion to a different output data type.
- New NDPluginOverlay plugin
  - Adds graphic overlays to an image.
  - Replaces the "Highligh ROIs" function that was previously provided in the ROI plugin.
  - Much more general, and can be used to display not only ROIs, but multiple cursors, user-defined boxes, etc.

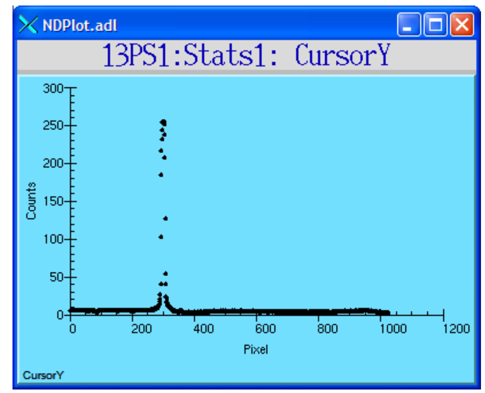
ROI plugin

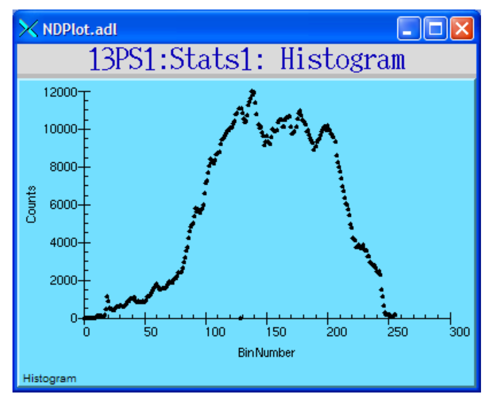

NDROI.adl
13PS1:ROI1:
asyn port ROI1
Plugin type NDPluginROI
Array port PS1 PS1
Array address 0 0
Enable Enable Enable
Min. time 0.000 0.000
Callbacks block No No
Array counter 0 17718
Array rate 0.0
Dropped arrays 0 0
dimensions 2
Array Size 1360 1024 0
Data type UInt8
Color mode Mono
Bayer pattern RGGB
Unique ID 17718
Time stamp 269977.888
Attributes file
asyn record
Definition
Name test
Data type UInt8 UInt8
Enable scaling Enable Enable
Scale divisor 4 4
X Y Z
Input Size 1360 1024 0
1 1 0
Binning 1 1 0
106 106 0
ROI start 106 106 0
192 170 3
ROI size 192 170 3
No No No
Reverse No No No
ROI Size 192 170 0

Statistics plugin

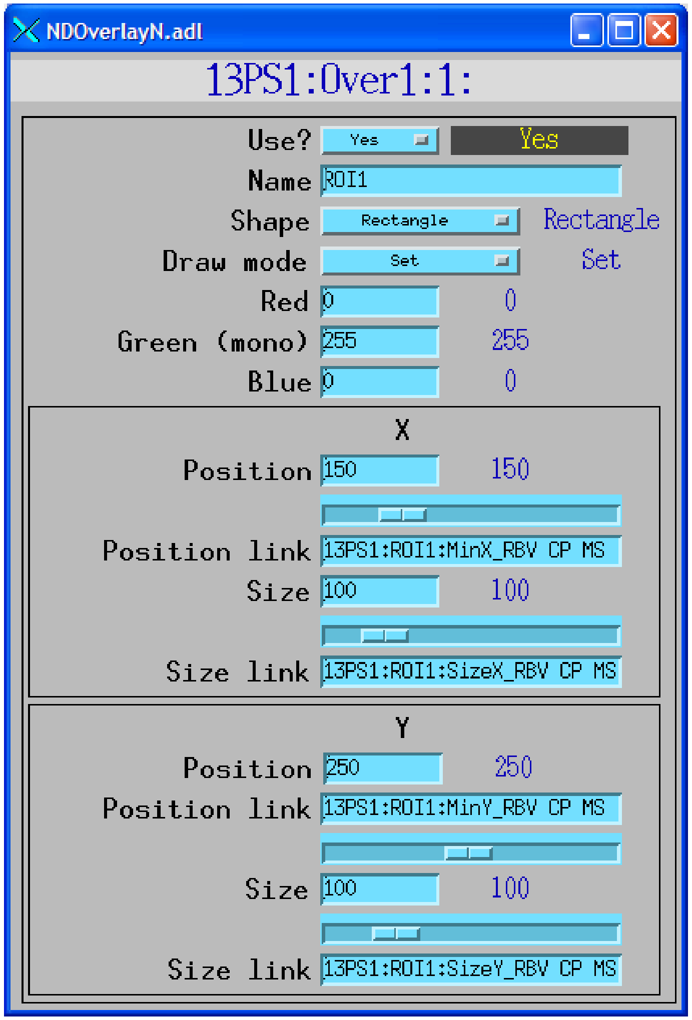








Overlay plugin

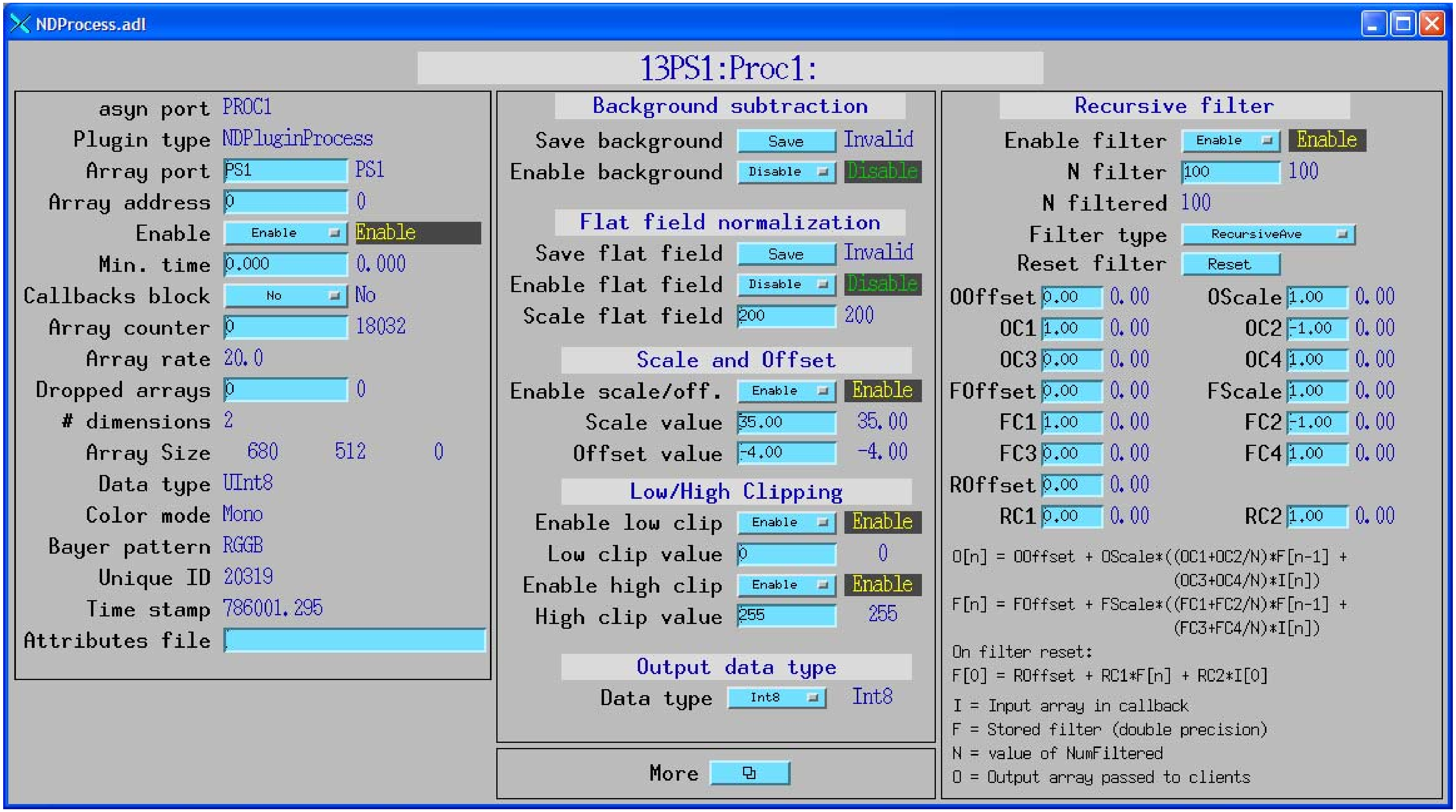


Centroid of laser pointer calculated by statistics plugin

Cursor overlay X, Y position linked to centroid

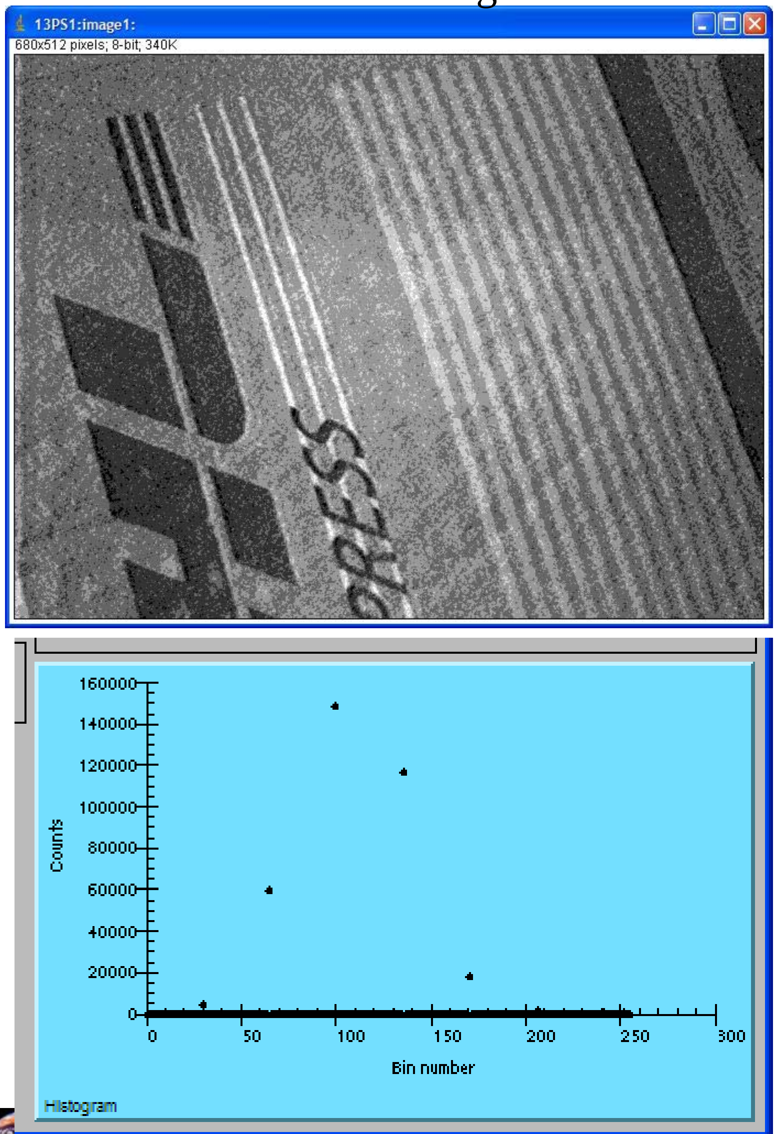
Overlay plugin – 8 overlays on 1 screen

Processing plugin

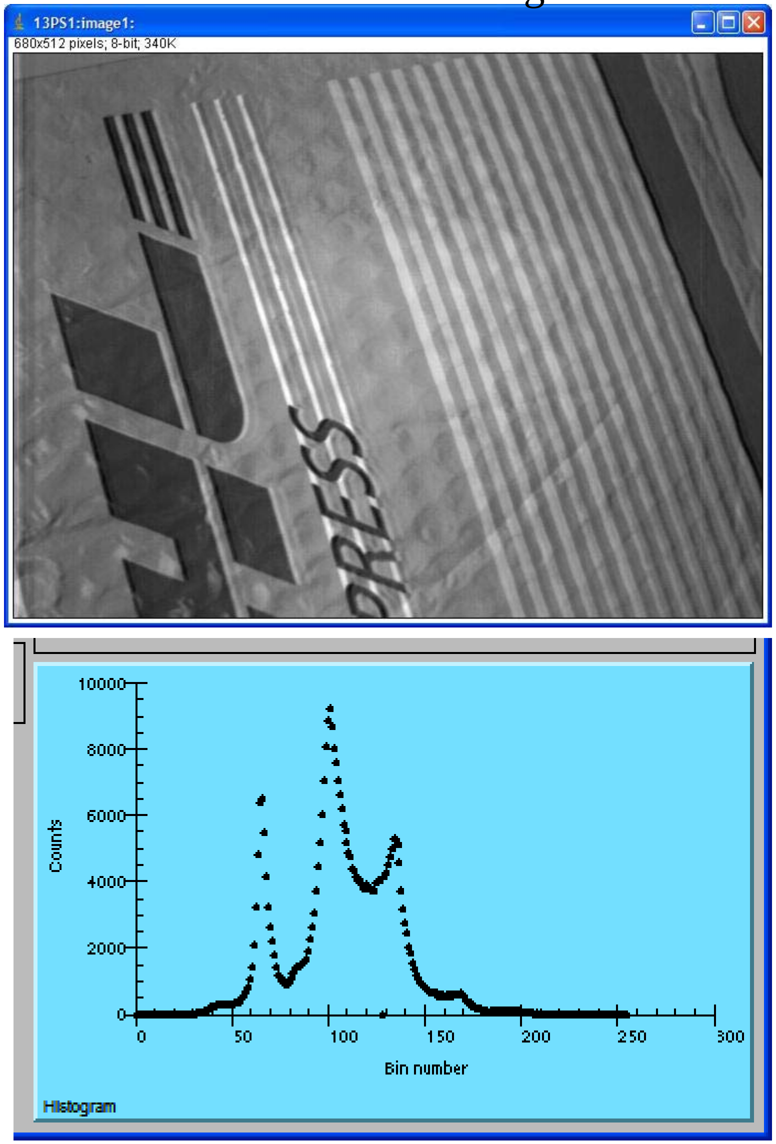


Processing plugin
30 microsec exposure time

No filtering



N=100 recursive average filter



areaDetector R1-6
Other new features

- Added status parameter to indicate if the specified file path (NDFilePath) exists. Added a record to NDFile.template and a status indicator to all medm file saving screens.
- Append a trailing '/' character to file path (NDFilePath) if one is not present.
- Bug fixes for Roper, pvCam, Windows Firewire and ADSC drivers.
- Fixed a bug in the ImageJ EPICS_AD_Viewer.java that required restarting the plugin if it was told to start displaying before any frames had been acquired by the IOC.
- Greatly simplified the st.cmd and auto_settings.req files for each IOC. This was done by creating two new files that define a common set of plugins that are loaded for all example IOCs. They load all of the plugins except the NDPluginStdArrays plugin, because that plugin needs to have its data type and waveform size matched to the specific detector.