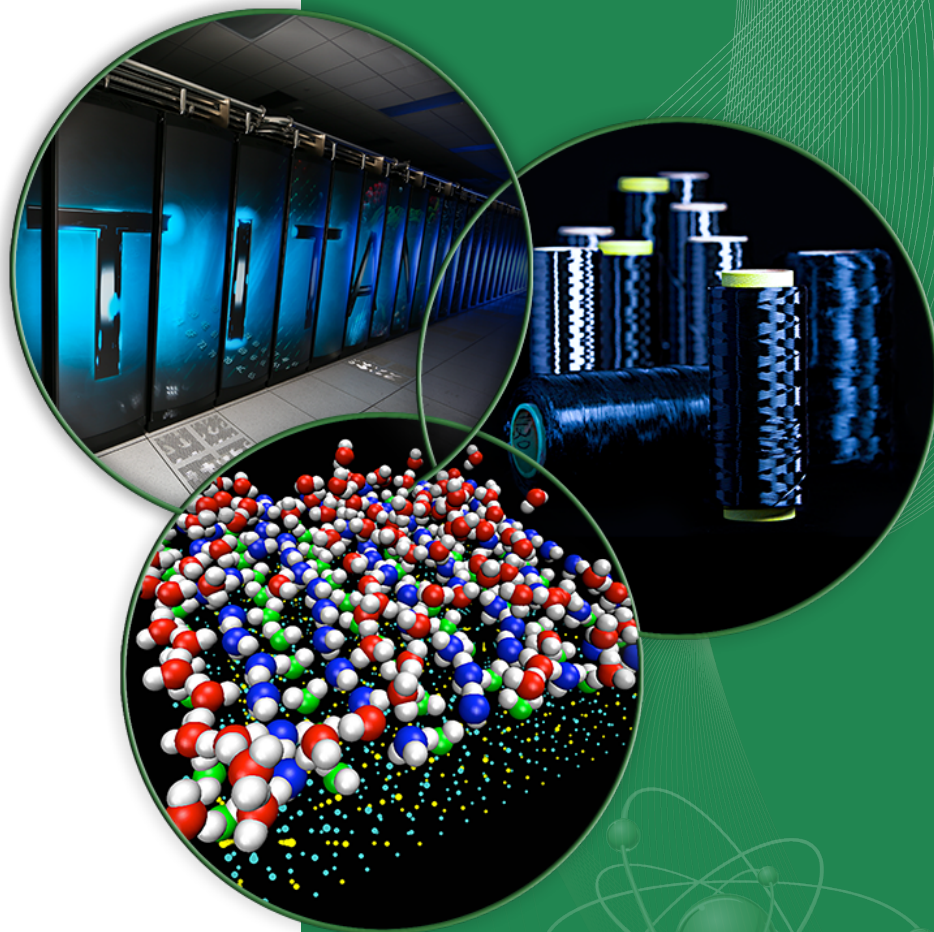


ADnED

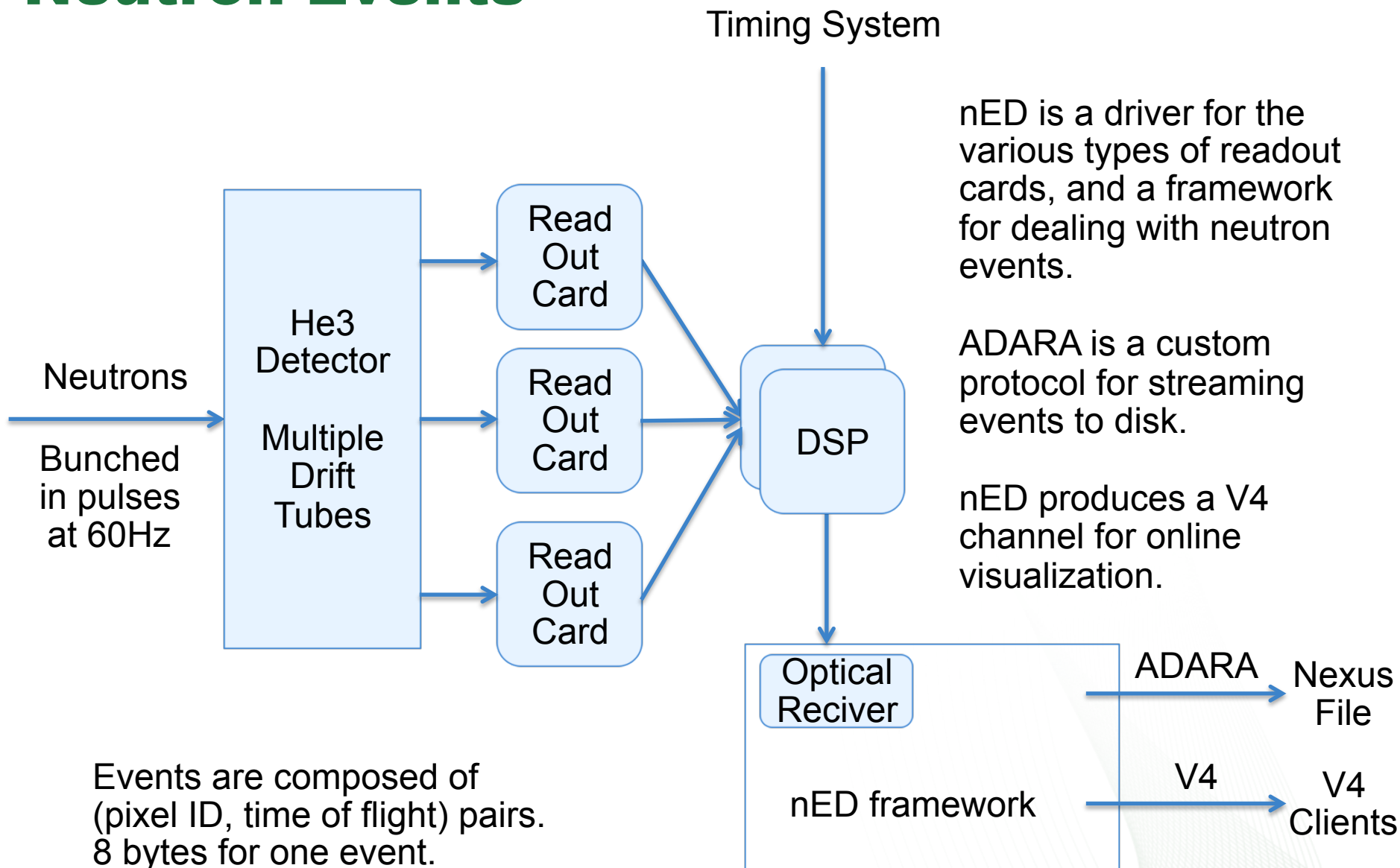
V4 Neutron Event Data in areaDetector

Matt Pearson
SNS ORNL

Sept 2016



Neutron Events



Neutron Events (2) – using pvData

```
structure
time_t timeStamp
NTScalar proton_charge
    double value

// Time-of-Flight values for N neutron events
NTScalarArray time_of_flight
    uint[] value

// Pixel IDs for N neutron events
NTScalarArray pixel
    uint[] value
```

Example ‘pvget’:

```
[mkp@bl99-dassrv1 ~]$ pvget neutrons
neutrons
structure
time_t timeStamp 2015-04-28T09:34:51.844 35
epics:nt/NTScalar:1.0 proton_charge
    double value 6e+08
epics:nt/NTScalarArray:1.0 time_of_flight
    uint[] value [63755,94783,45297,83246,74134,86331,85143,60222,84875,73684]
epics:nt/NTScalarArray:1.0 pixel
    uint[] value [946,2093,735,2358,938,2858,453,2843,869,2647]
```

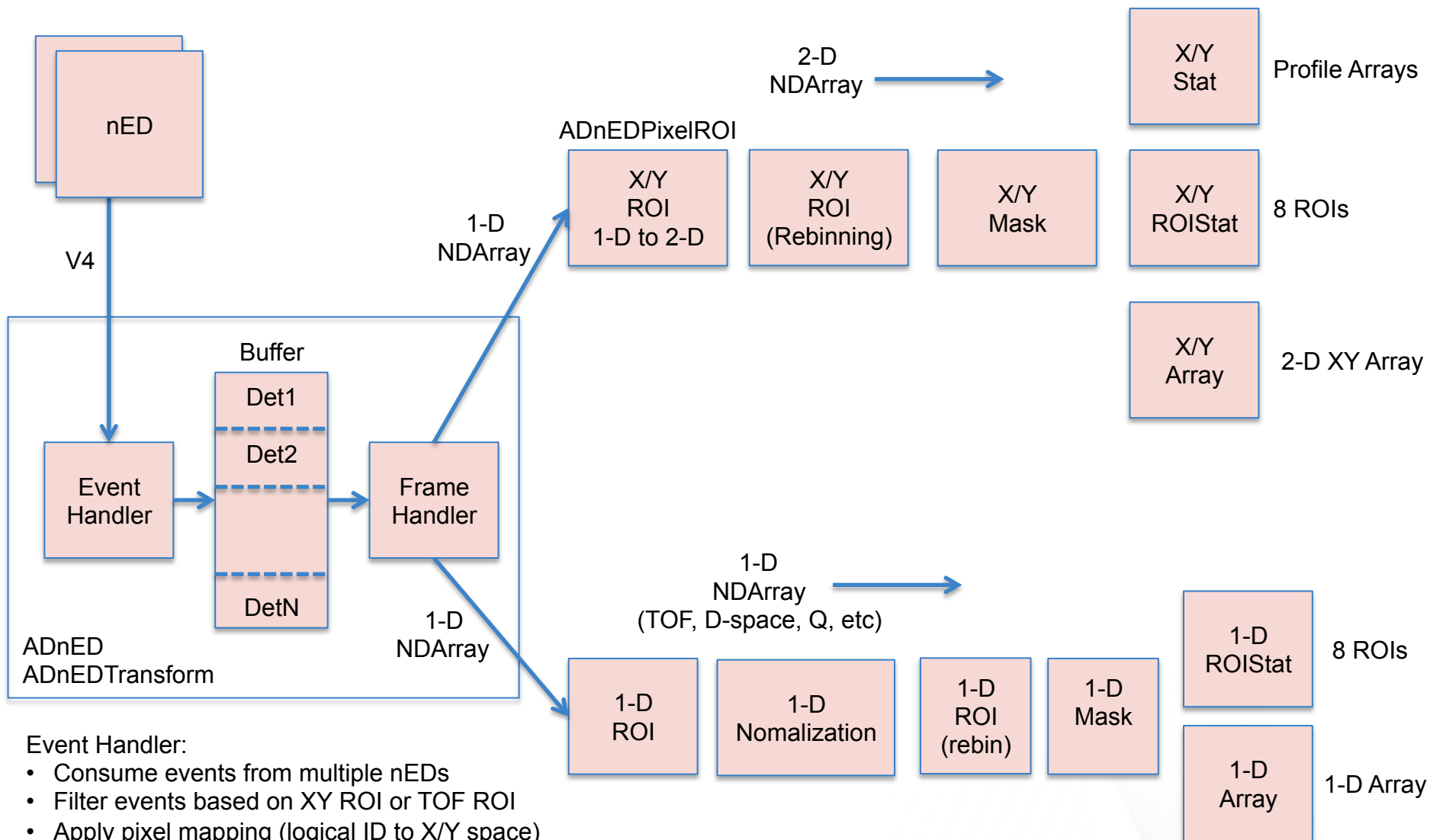
ADnED Driver Features

- Integrate event data for X/Y plot (also means mapping pixels to 2-D X/Y plot)
- Integrate TOF data for 1-D spectrum
- Calculate multiple ROI for all plots
- Filter events going into TOF spectrum based on a X/Y ROI
- Filter events going into X/Y plot based on a TOF ROI
- Monitor multiple V4 channels (each nED instance is one V4 channel)
- Handle data from N detectors in one channel, or spread between channels.
- Support put_callback on a start acquisition for high level software
- Adjustable binning on TOF spectrum
- Calculate d-space, energy transfer, etc, based on pixel ID and TOF.
- Detect error conditions (missing packets, bad timestamps).
- Pause acquisition without resetting data

ADnED uses areaDetector framework

A lot of the functionality is free (waveform, ROIs, Statistics, binning, etc).
What we developed:

- ADnED driver:
 - Monitors V4 channels
 - Filter events based on ROIs
 - Performs pixel mapping & optional calculations (eg. d-space)
 - Integrates events based on detector pixel ID ranges
 - Produces 1-D NDArray objects for N detectors
- NDPluginROIStat (released in ADCore 2-2)
- ADnEDPixelROI:
 - Custom ROI plugin to convert 1-D NDArray to 2-D NDArray
- ADnEDMask:
 - Pass/Reject an ROI in 1-D or 2-D NDArray.
- ADnEDNomalization:
 - Background subtract and normalize 1-D array (To-Do)
- ADnEDTransform:
 - Library of calculations for d-space, etc.



ADnED Top Level Screen

BL1B ADnED Main

ADnED Control

Start	Stop	Acquire
Not Paused	Acquiring Events	
nED Source PV 0	BL1B:Det:Neutron	BL1B:Det:Neutron
nED Source PV 1		
nED Source PV 2		
nED Source PV 3		
Number Of Detectors	7	7
Number Of Channels	1	1

ADnED Data Frame Control

Frame Control & Period	Enable	500	500 ms
Number Of Frames	3286		
Frame Rate	2.00 Hz		Max
Pool Used Mem	2.4896E0 MB	1.7592E13 MB	
Pool Used Buffers	0	-1	
IOC CPU Load	3.2 %		

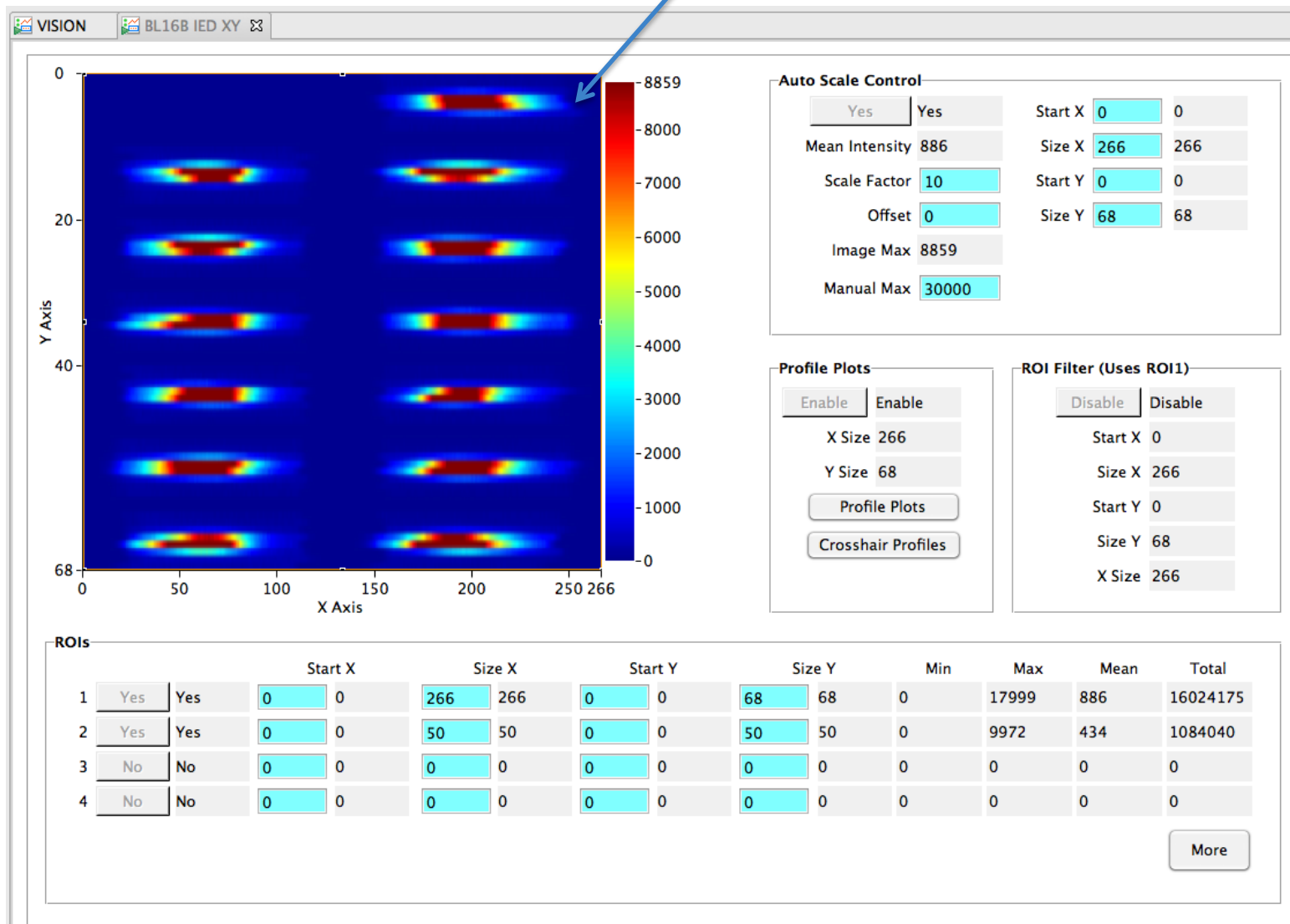
ADnED Data

Pulse Count	98648			
Total Event Rate	314925 e/s			
Proton Charge	1.7221E-5 C			
Integrated Proton Charge	1.6908E0 C	1.6908E12 pC		
Sequence Count	104939	0	0	0
Sequence ID	130981	0	0	0
Missing Sequence ID	0	0	0	0
Num Missing Sequence	0	0	0	0
Timestamp Status	Ok	Ok	Ok	Ok
Update Period	1000	1000 ms		
Overall Status	Ok			

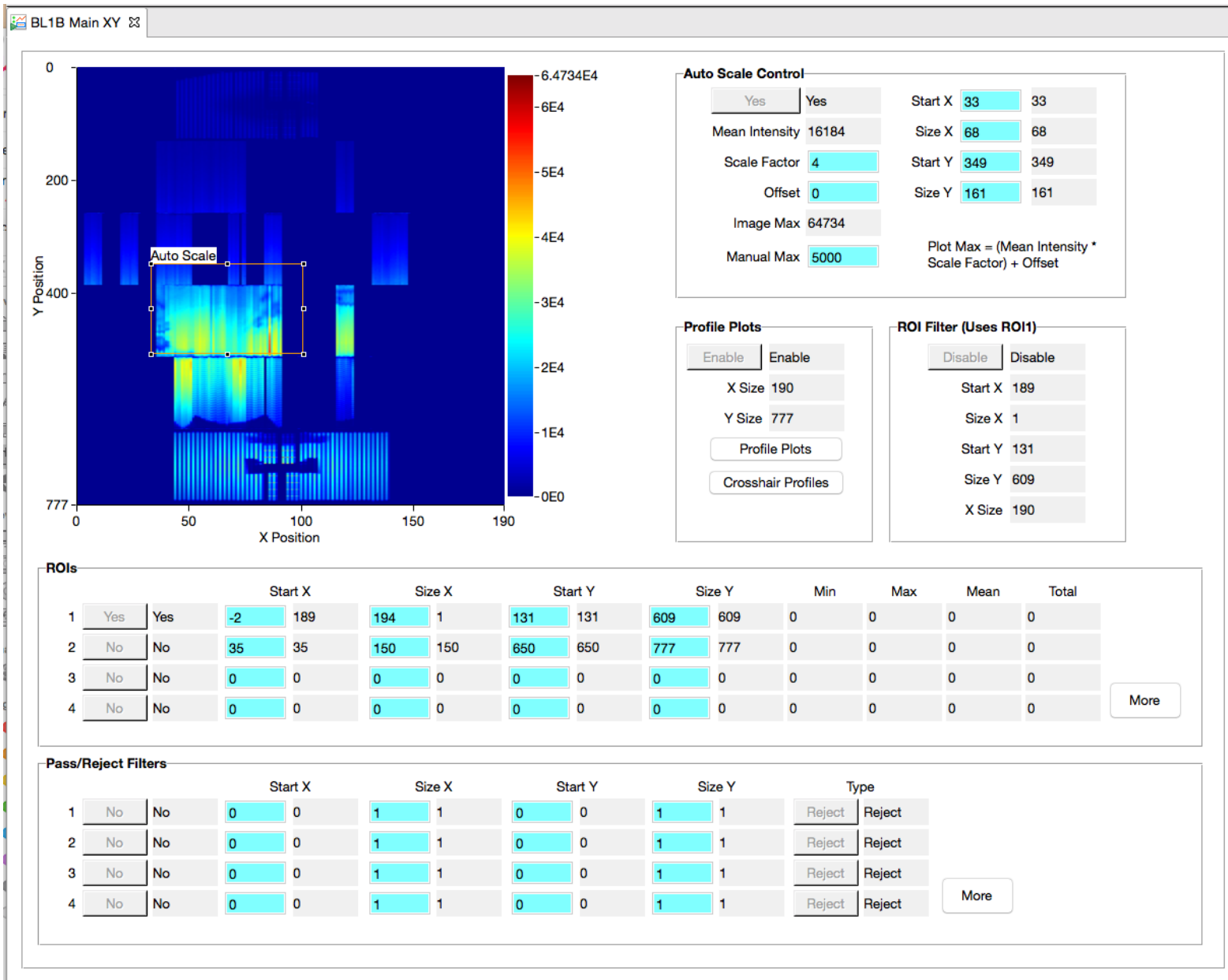
Pixel ID Ranges						
Detector		Start	End	Event Rate	Event Total	
1	Group5 (154	64512	82943	76126 e/s	1.2799E8	Plots
2	Group4 (122	52224	64511	73209 e/s	1.2122E8	Plots
3	Group3 (67	37888	52223	111871 e/s	1.8569E8	Plots
4	Group2 (31	14336	37887	35430 e/s	5.8796E7	Plots
Setup						More Detectors
Mapping Setup						Allocate Space Status Ok

ADnED XY Plot

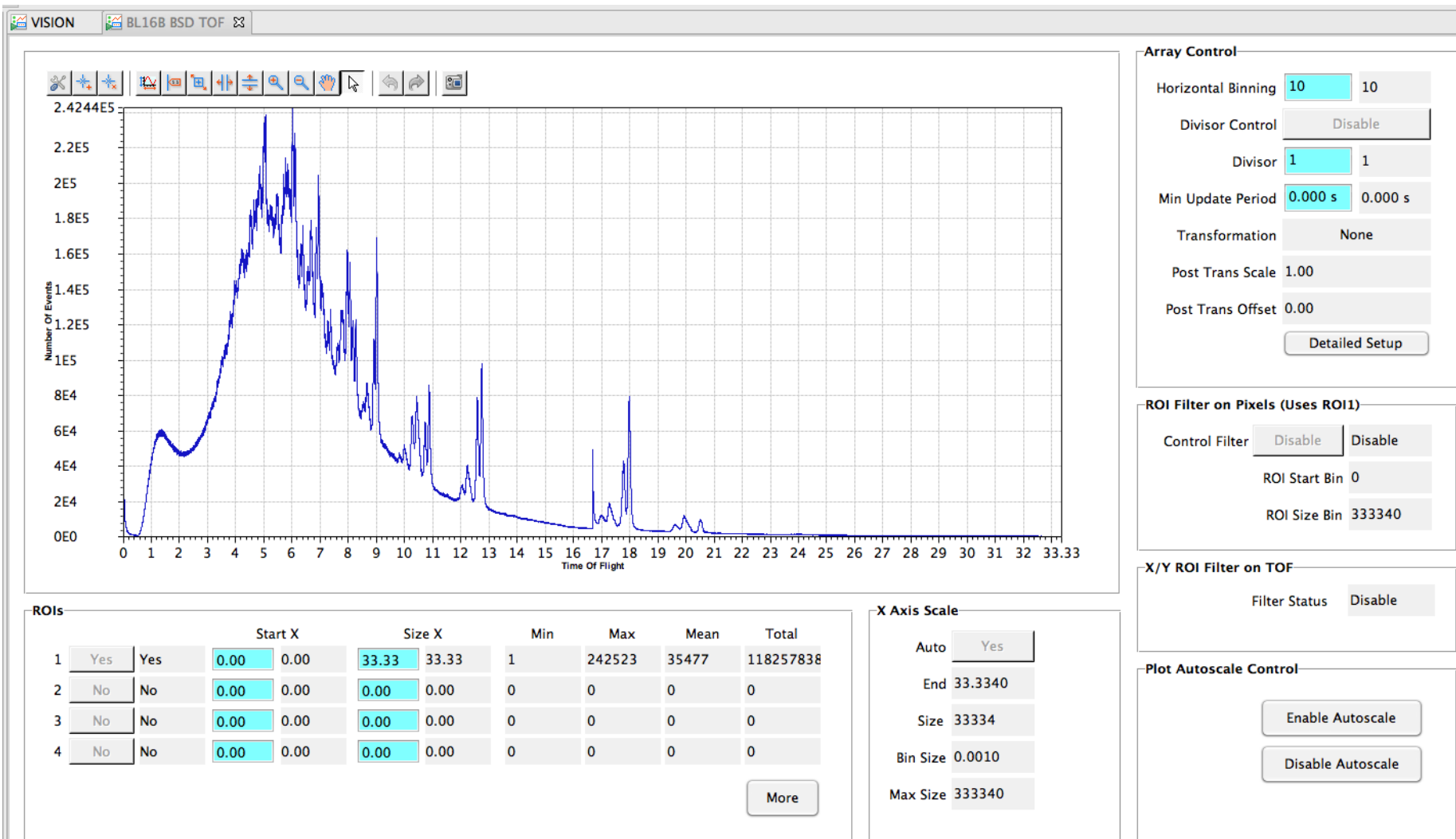
Intensity widget + some rules



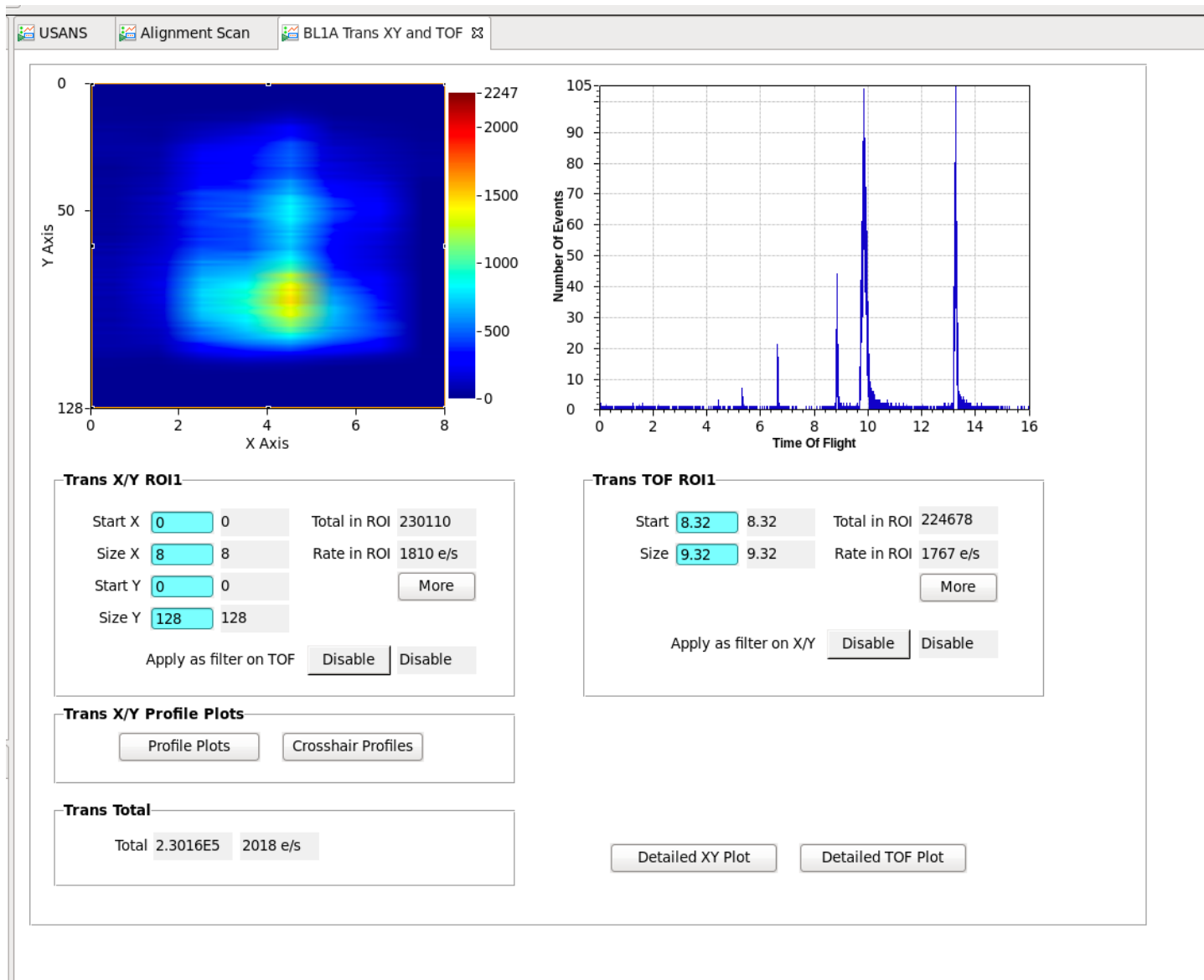
ADnED XY Plot (2)



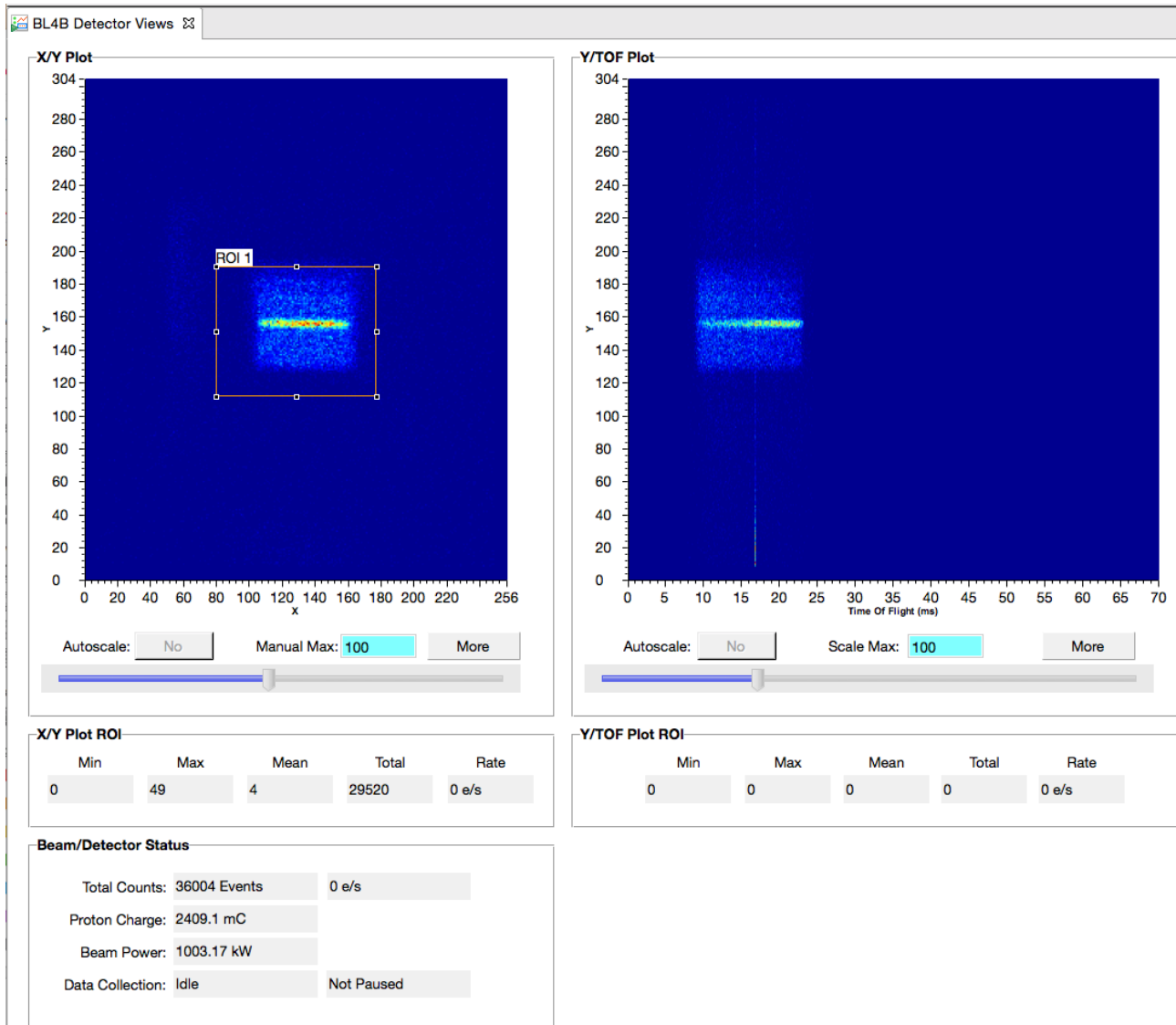
ADnED Time of Flight Spectrum (TOF)



ADnED User Friendly Screen

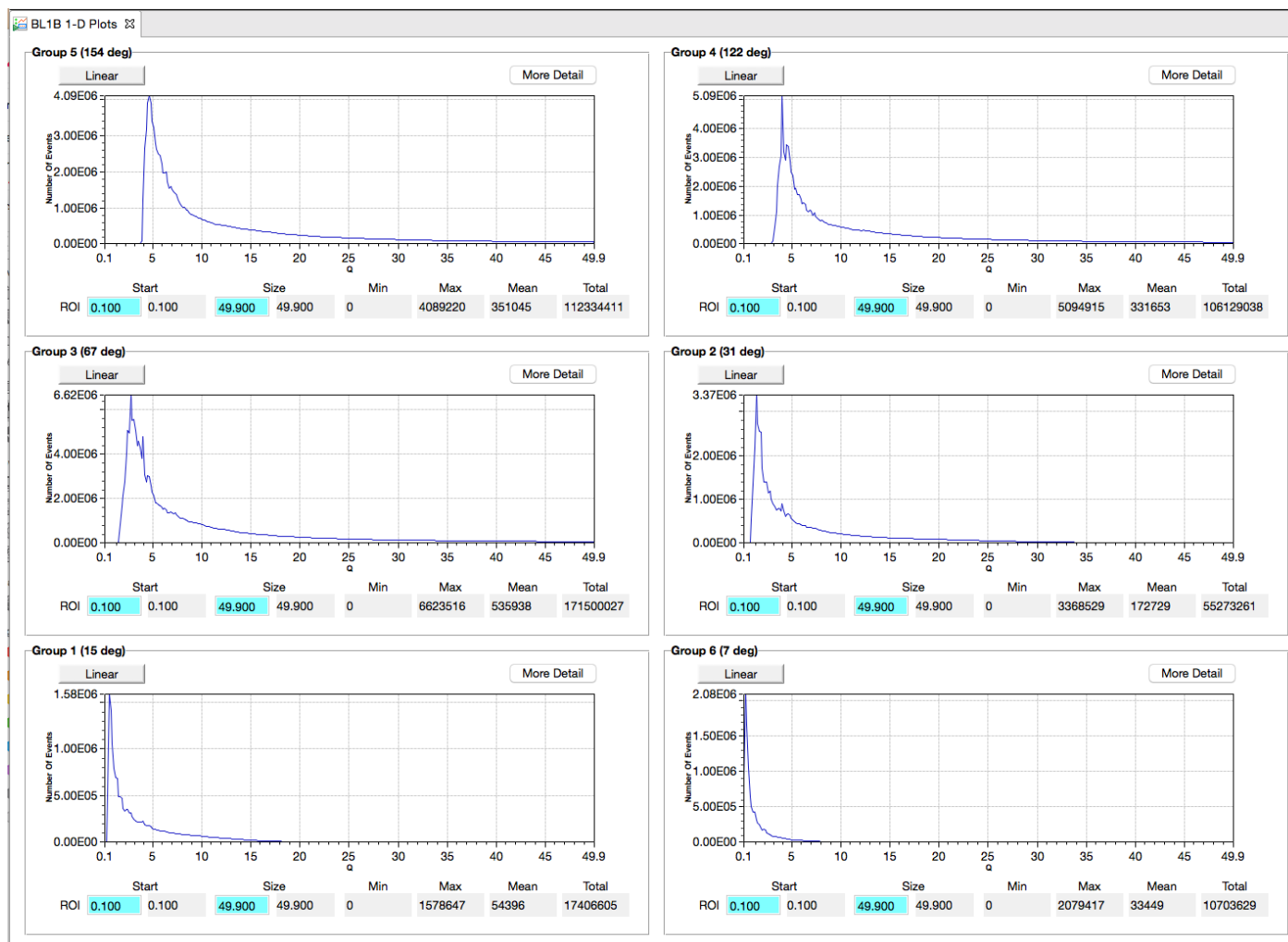


New 2-D plot types



- Y/TOF 2-D Plot
- X/TOF 2-D Plot
- Pixel ID/TOF Plot

Can now define up to 20 detectors



Can switch these between TOF, d-space and Q at runtime.
We use pcasPy to deal with this.

ADnED So Far

- Deployed on 8 beamlines at SNS (will be on all 18)
- Being tested at the CSNS.

ADnED can be used as-is with all the plugins and OPIs:

- Example IOC in the ADnED module.
- Driver and required plugins are built into a single template.
- Templated st.cmd

To-Do

- Background subtraction / normalization plugin
- Use V4 NTNDArray plugin instead of StdArray plugin
(convert at the same time we move to CS-Studio Display Builder)
- Actually write some documentation.

ADnED:

<https://github.com/areaDetector/ADnED>

Simulation event server:

<https://github.com/kasemir/EPICSV4Sandbox>