



HDF5 Explorer

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Analysis & Applications

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Outline

- Introduction
- HDF5 Explorer package
- GUI & example of plots
- Summary

Introduction

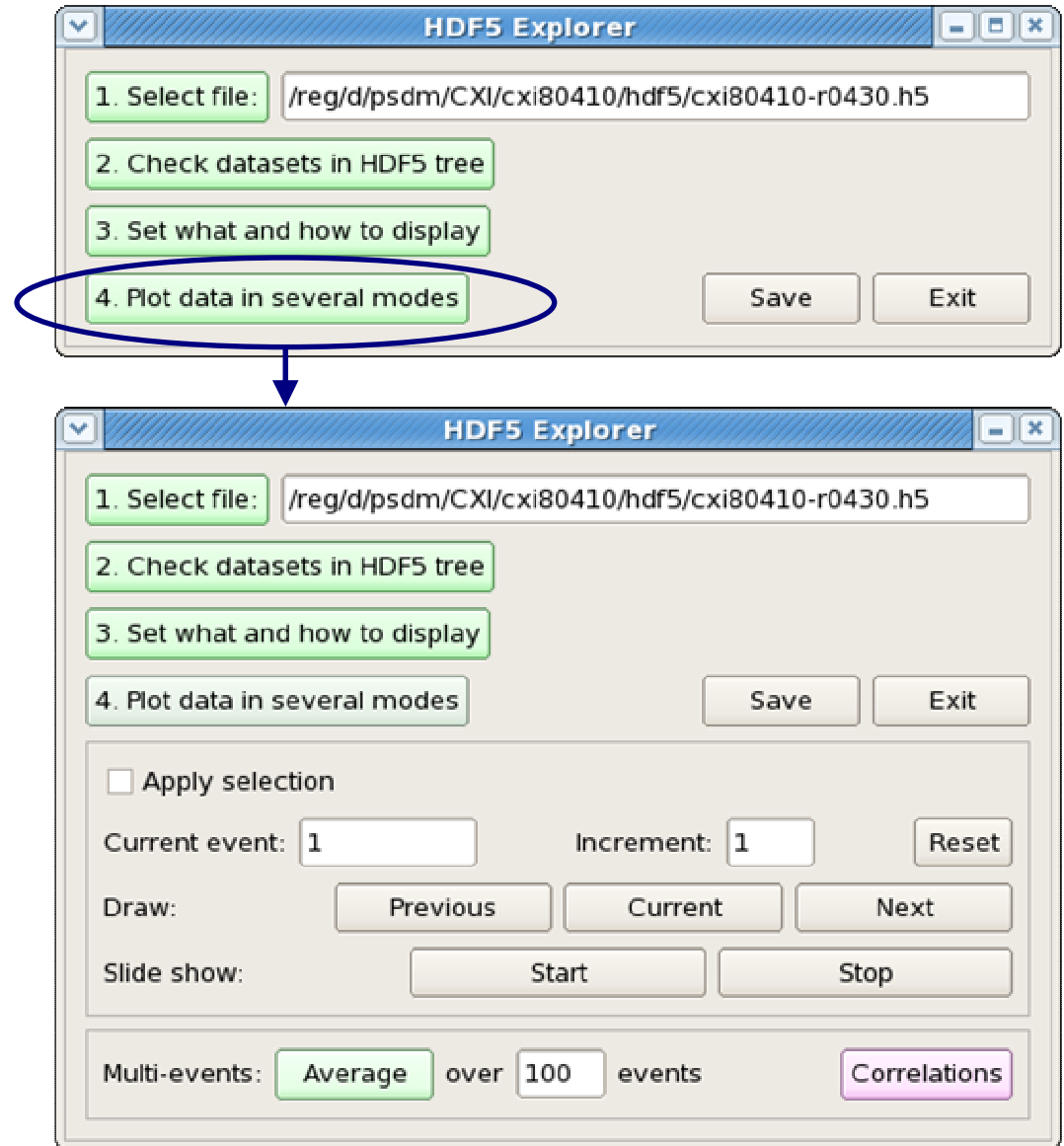
- LCLS users need in flexible interactive tool to look at data in XTC and HDF5 formats.
- I will discuss HDF5, Ingrid – XTC.
- Available external packages for HDF format:
 - HDFView (Java) does not work with LCLS images,
 - ViTables does not have any graphics (except GUI)Re-implementation assumes deep intervention in quite specific code.
- We decided to create our own package on Python, using libs:
 - h5py – for access to hdf5 data,
 - matplotlib – for graphics,
 - PyQt4 – for GUI.

HDF5 Explorer package

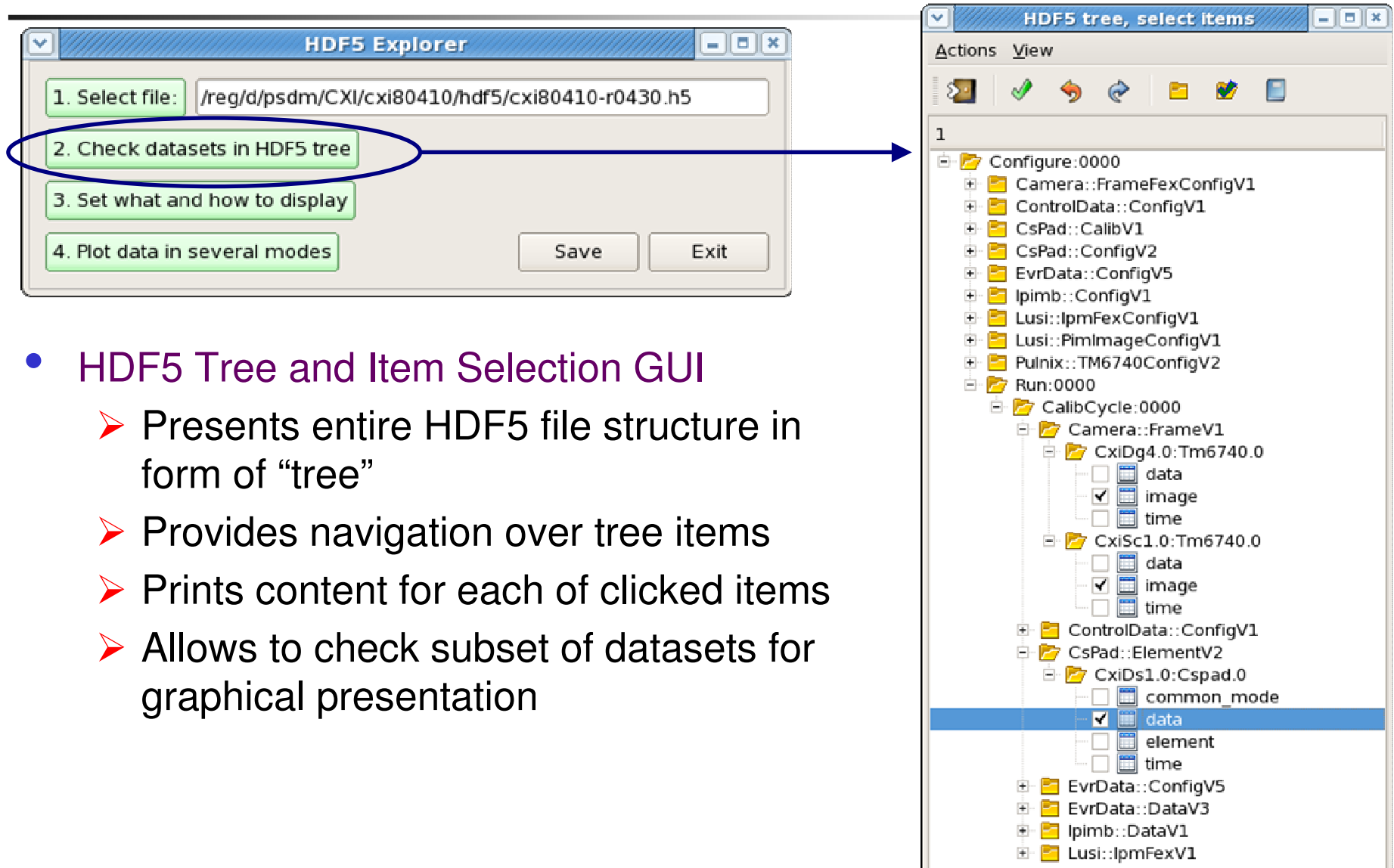
- Package name: HDF5Explorer
- Documentation:
<https://confluence.slac.stanford.edu/display/PCDS/HDF5+Explorer>
- To run this program use command on psana
[for now one need to create release and add package]
 - hdf5explorer
- Control GUI is split for three windows:
 - HDF5 Explorer or Main GUI
 - HDF5 Tree and Item Selection GUI
 - What and how to display GUI
 - Sub-GUIs for parameter settings.

Main GUI

- Main GUI has step-by-step order of buttons
- Color of button is changed when the step is passed
- Button 4: expands/collapses the Main GUI for long/short version
- Long version contains “player” buttons for immediate drawing.



HDF5 Tree and Item Selection GUI

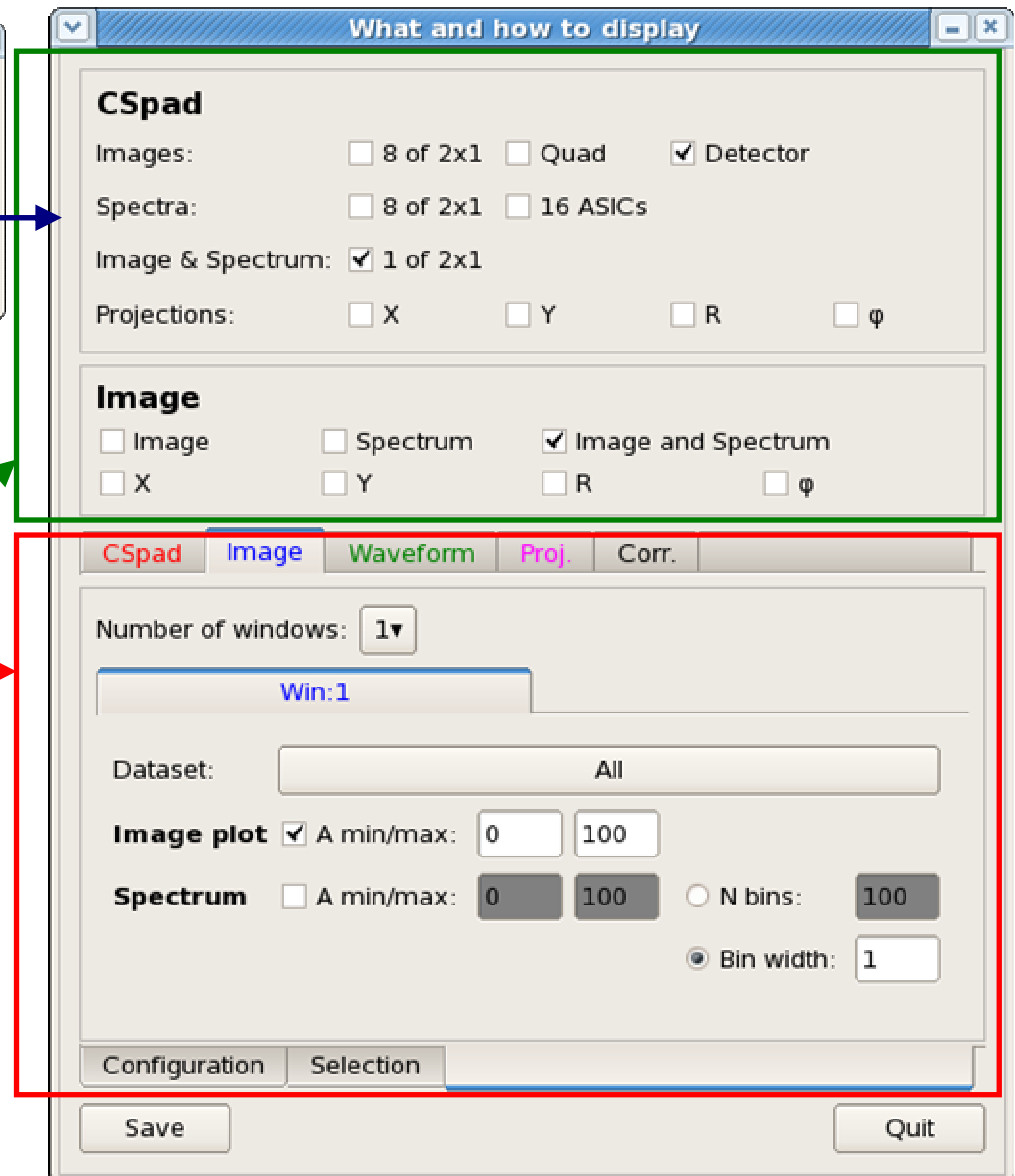


- HDF5 Tree and Item Selection GUI
 - Presents entire HDF5 file structure in form of “tree”
 - Provides navigation over tree items
 - Prints content for each of clicked items
 - Allows to check subset of datasets for graphical presentation

What and how to display GUI



- What and how to display GUI is a dynamic-content window:
 - Top – check box section
 - Bottom – sub-GUI window, controlled by two toolbars
 - Save and Quit buttons



Check box sections

- Top check box sections depend on selected datasets
- May have up to three check box sections:

The image shows three stacked panels, each containing a title and several check box options. The first panel is titled 'CSpad' and includes options for 'Images', 'Spectra', 'Image & Spectrum', and 'Projections'. The second panel is titled 'Image' and includes options for 'Image', 'Spectrum', 'Image and Spectrum', and four projection types. The third panel is titled 'Other' and includes options for 'Waveform' and 'Correlations'.

CSpad

Images: ☐ 8 of 2x1 ☐ Quad ☒ Detector

Spectra: ☐ 8 of 2x1 ☐ 16 ASICs

Image & Spectrum: ☒ 1 of 2x1

Projections: ☐ X ☐ Y ☐ R ☐ ϕ

Image

☐ Image ☐ Spectrum ☒ Image and Spectrum

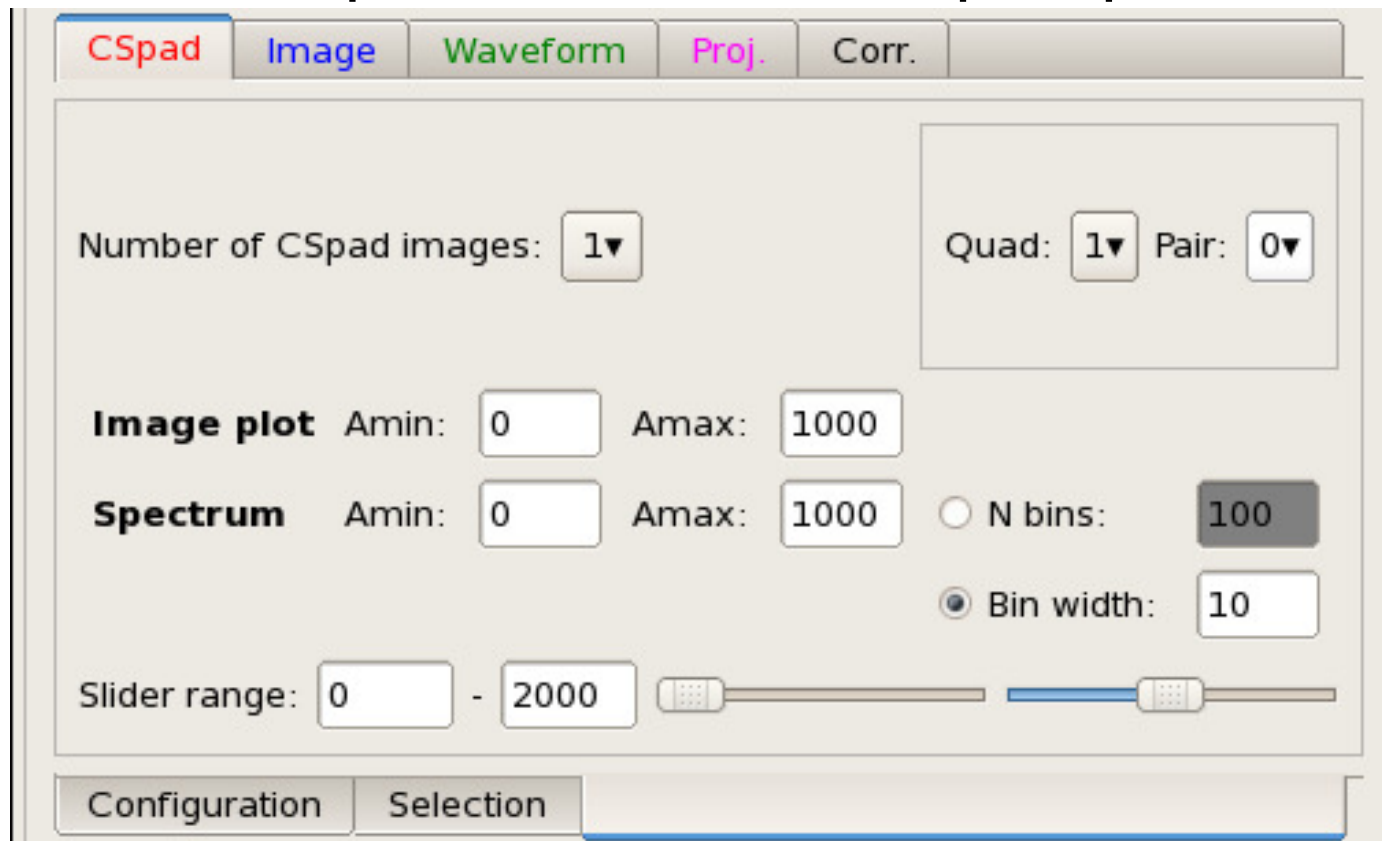
☐ X ☐ Y ☐ R ☐ ϕ

Other

☒ Waveform ☐ Correlations

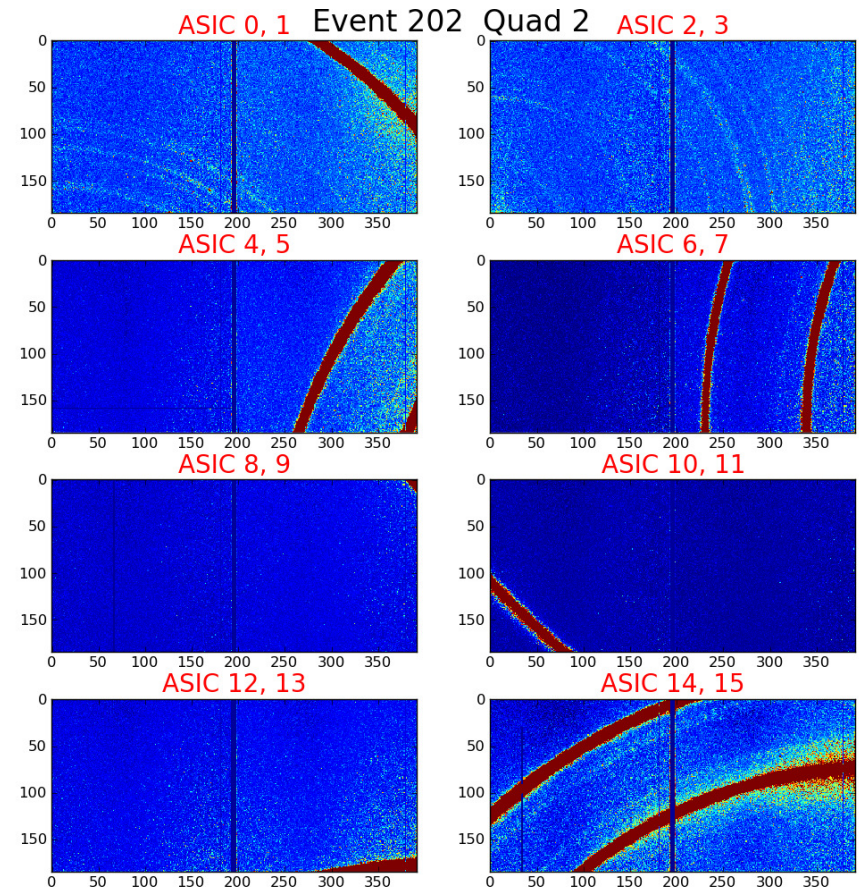
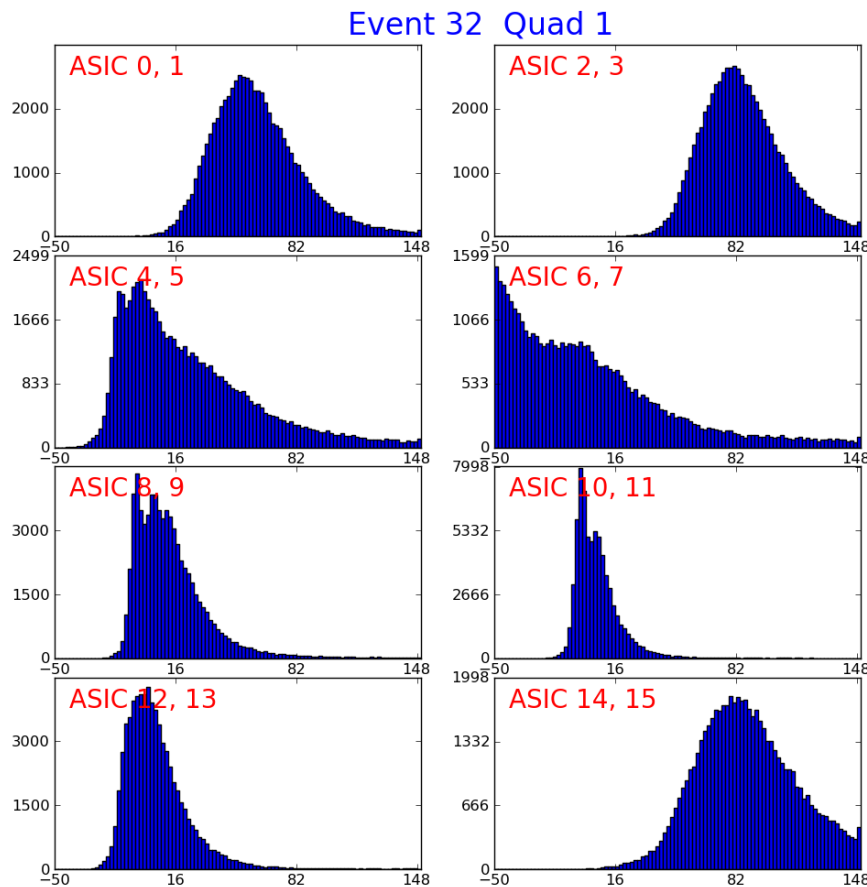
CSpad parameters sub-GUI

- CSpad sub-GUI is activated by checkbox or tabbar
- Allows to set parameters for CSpad plots



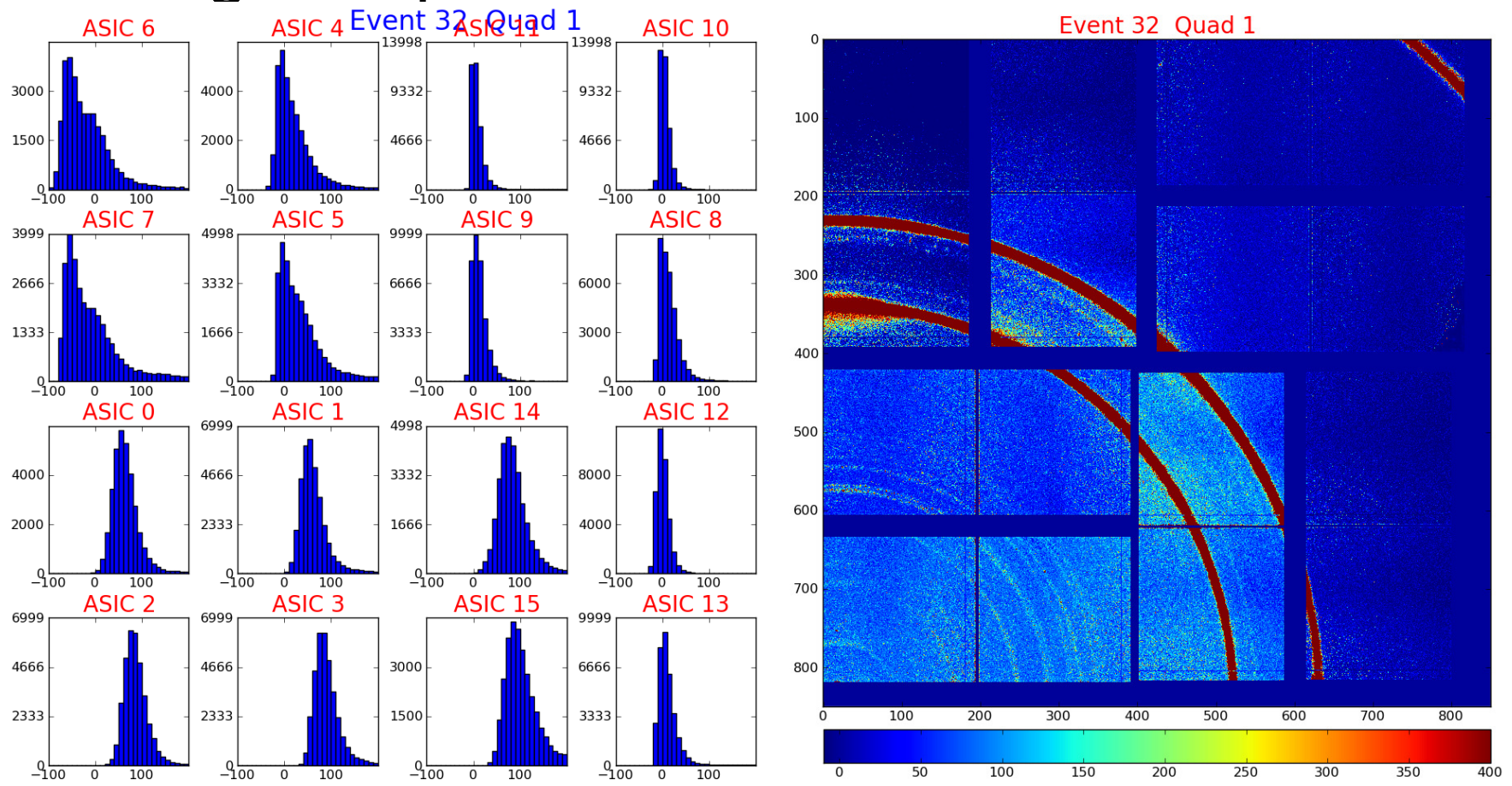
CSpad plots (1)

- Spectra of 2x1 sensors
- Images of 2x1 sensors



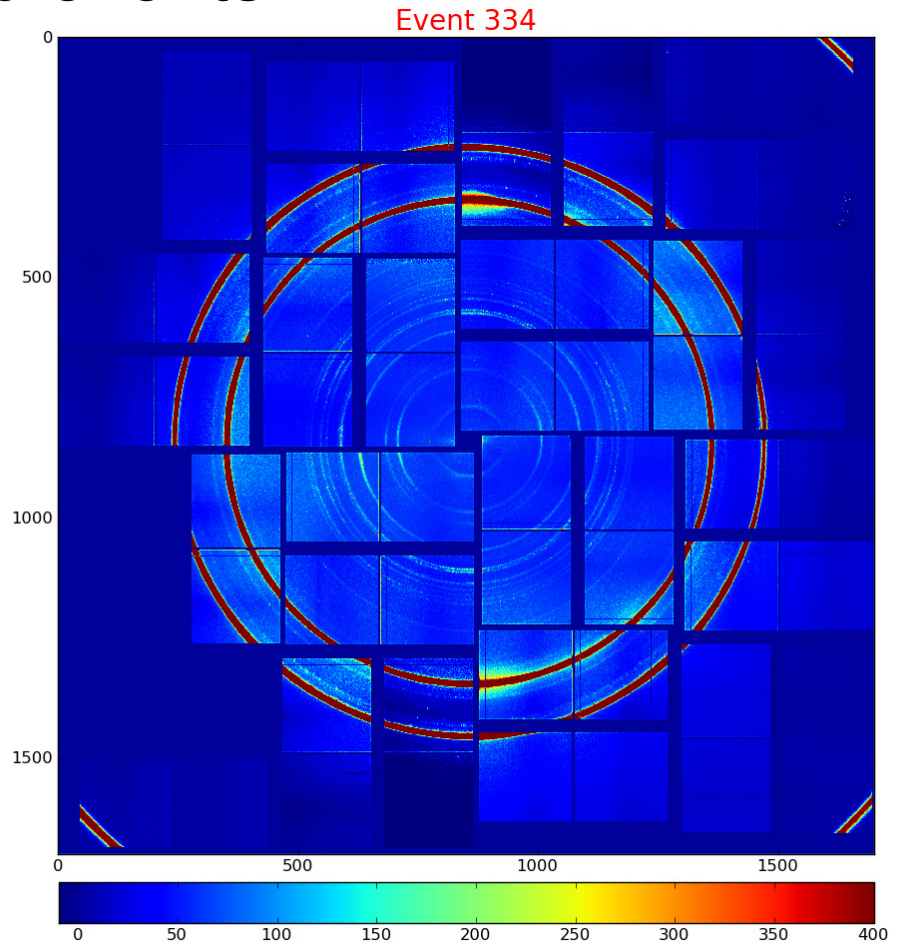
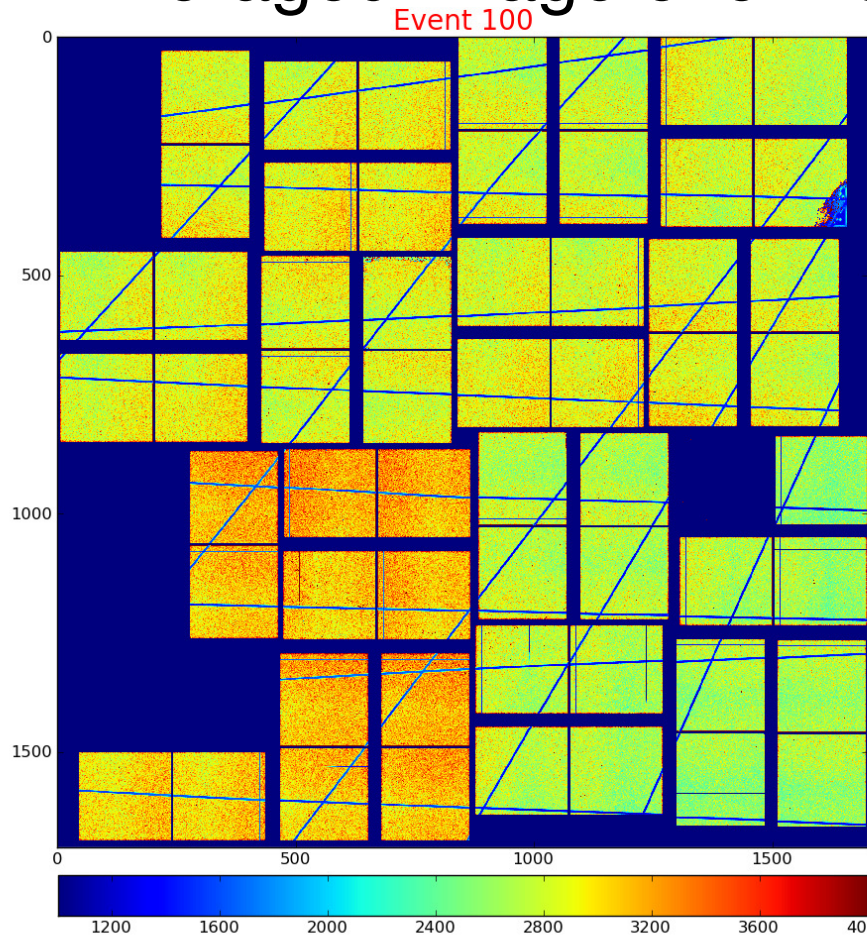
CSpad plots (2)

- Spectra of ASICs – position-wise numeration for quad
- Image of quad



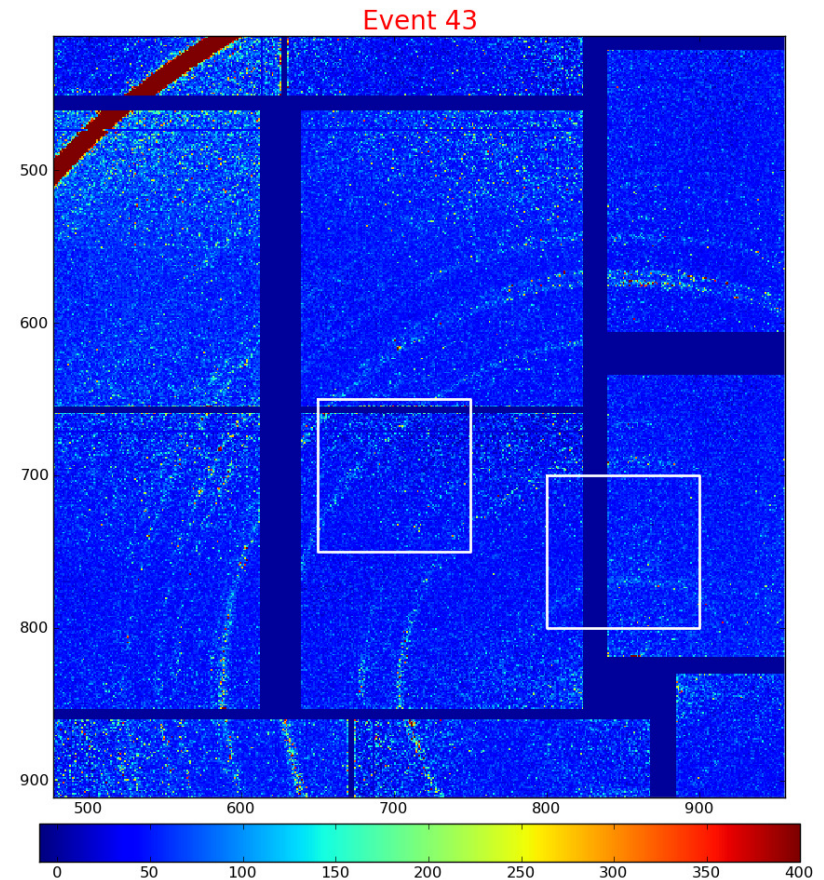
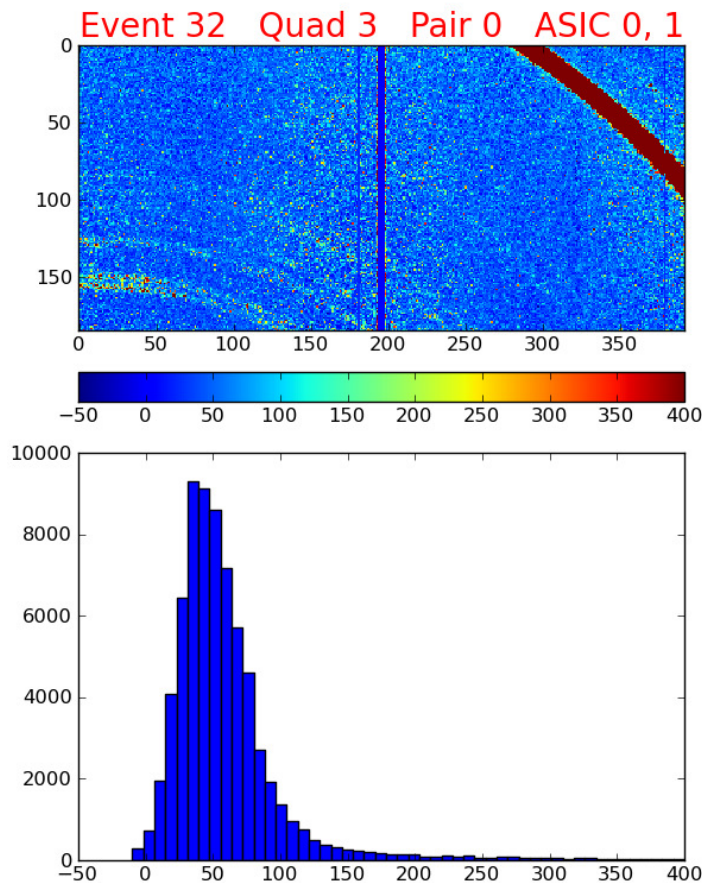
CSpad plots (3)

- Image of the CSpad detector
- Averaged image over 100 events



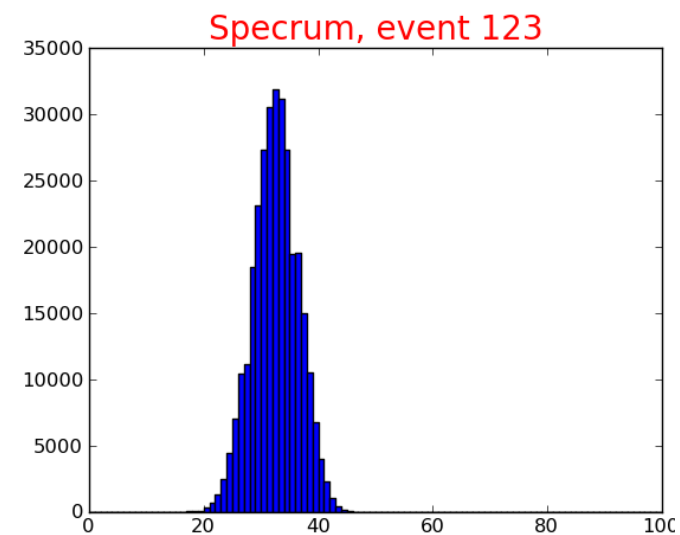
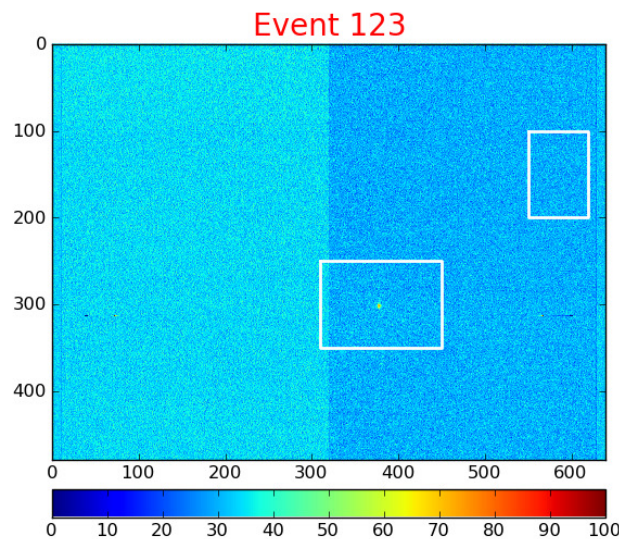
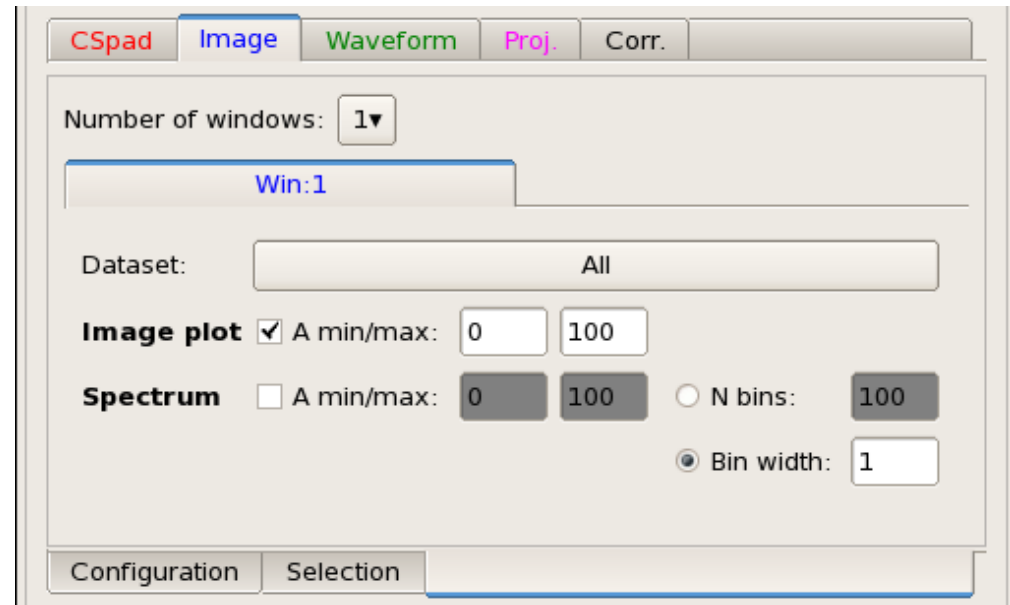
CSpad plots (4)

- Combined image and spectrum of 2x1
- Zoomed-in image of the CSpad with selection boxes



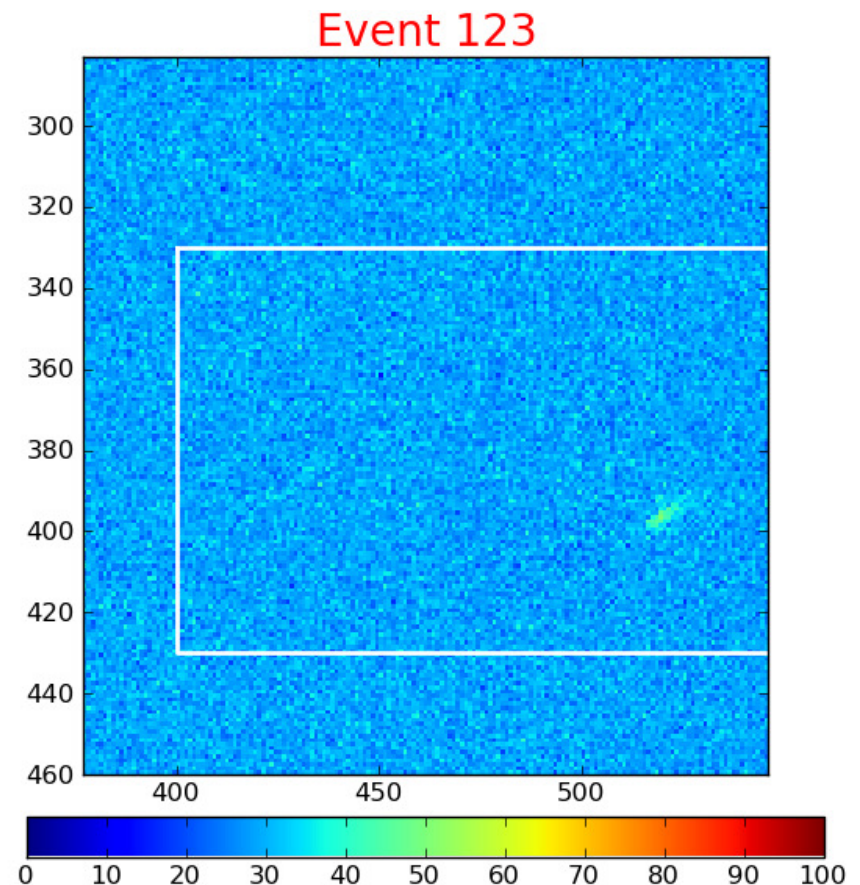
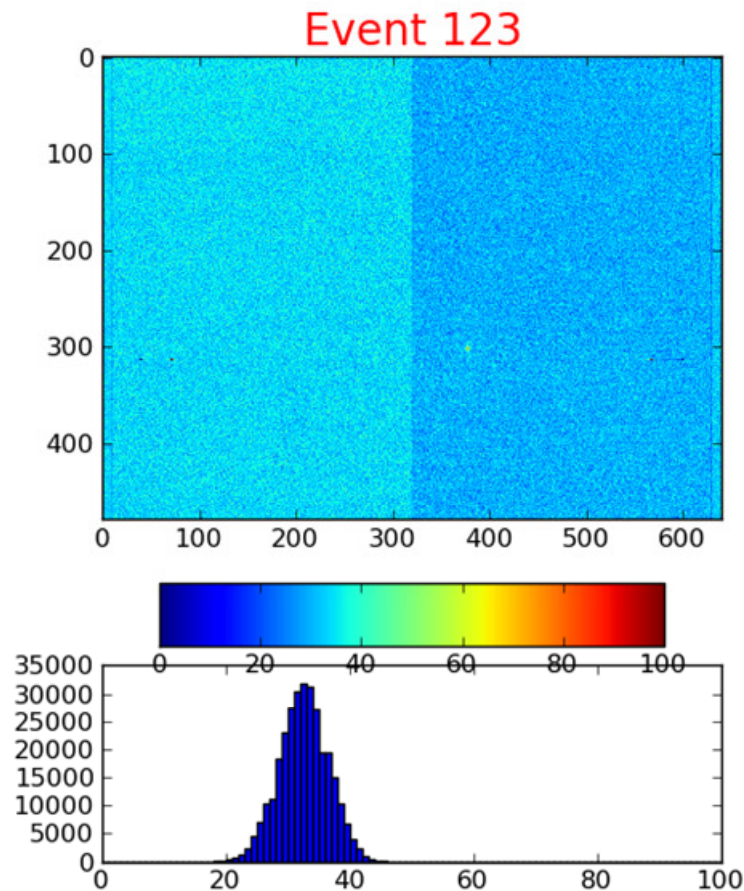
Camera image sub-GUI

- Image sub-GUI is activated by checkbox or tabbar
- Allows to set parameters for camera image plots



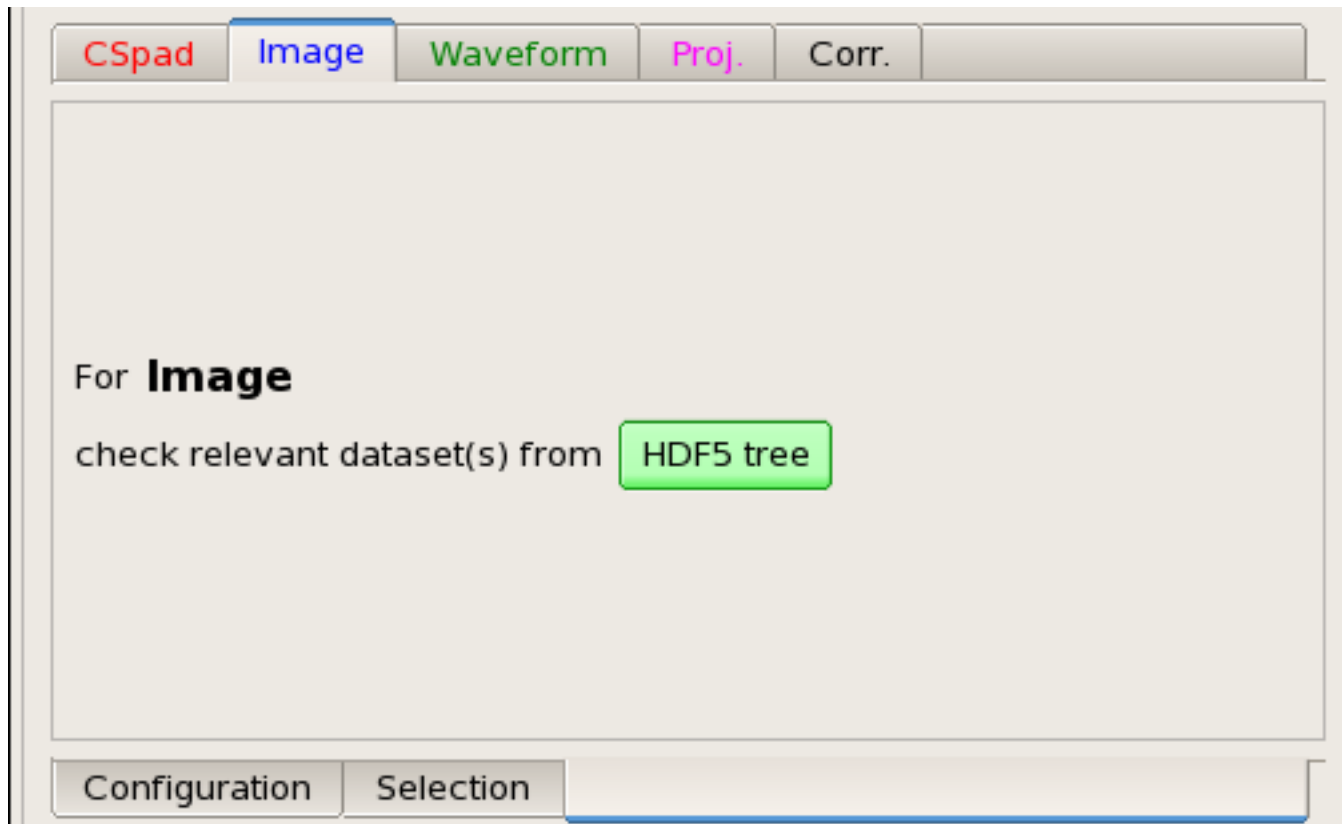
More plots for camera image

- Combined camera image and spectrum
- Zoomed-in camera image



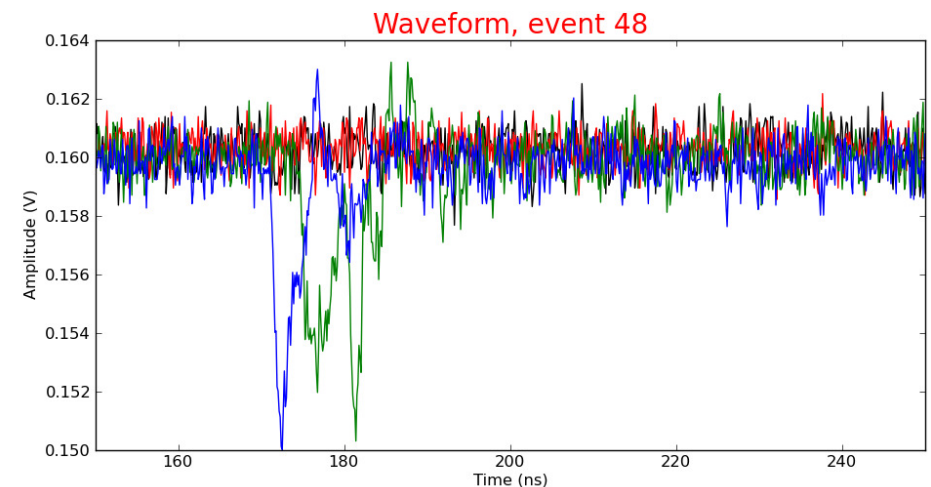
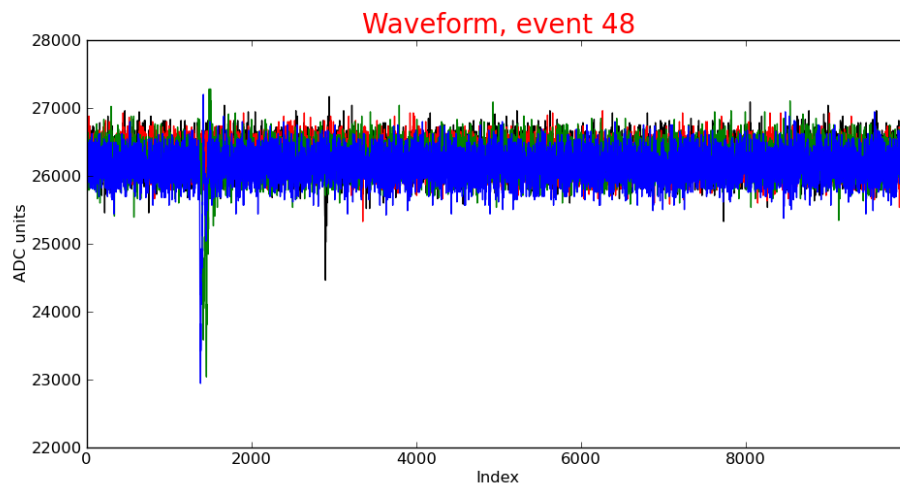
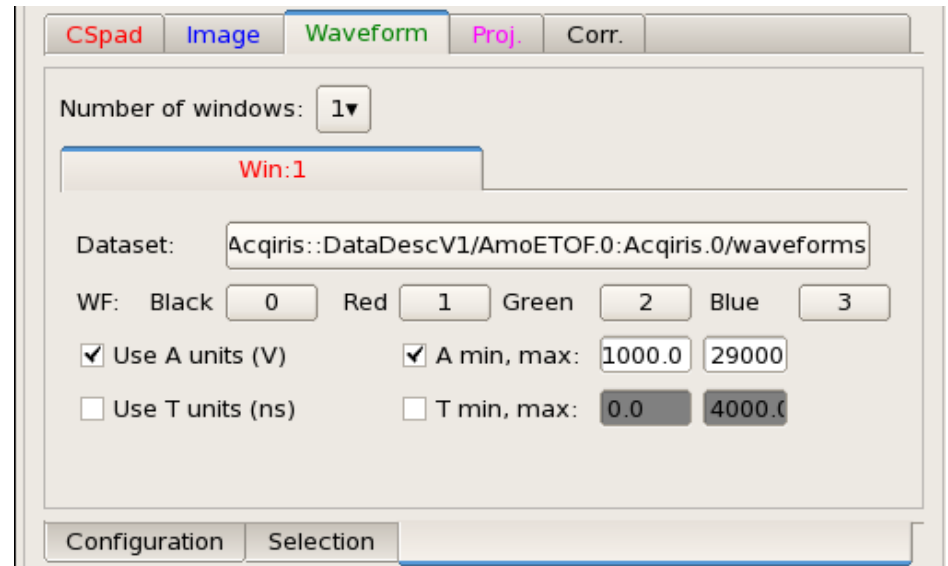
If dataset is not checked...

- Program advises to check it in HDF5 three:



Waveform sub-GUI

- One dataset per window
- 4 waveforms of different colors per window
- Auto/manual limits
- On/Off units



“Correlation” sub-GUI

CSpad Image Waveform Proj. **Corr.**

Number of correlation plots: 5▼

Plot:1 Plot:2 Plot:3 Plot:4 Plot:5

Y-par: :DataV1/CxiDg4.0:lpimb.0/data channel1

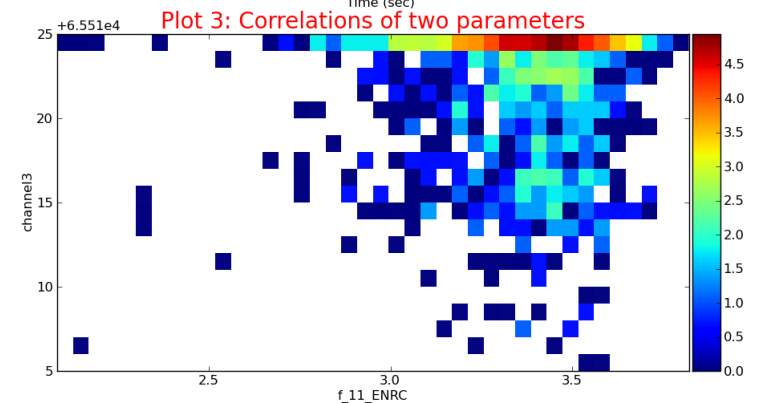
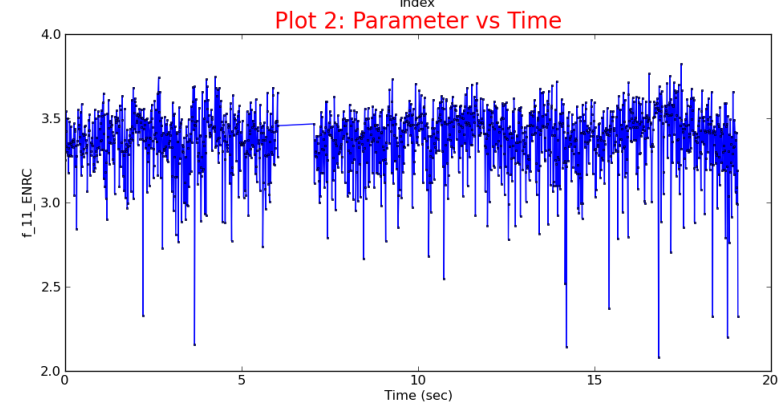
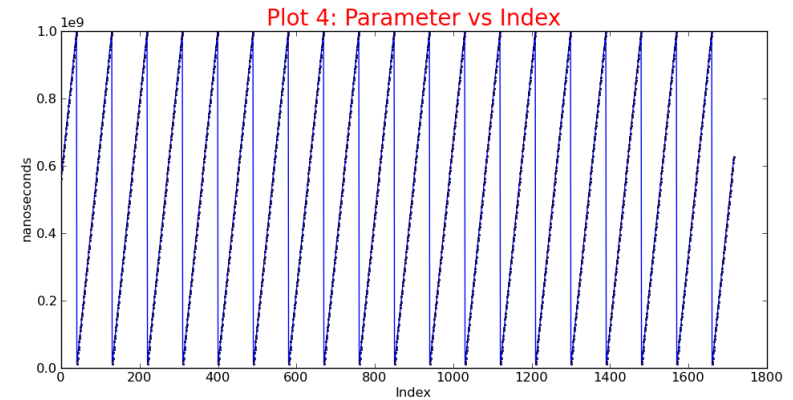
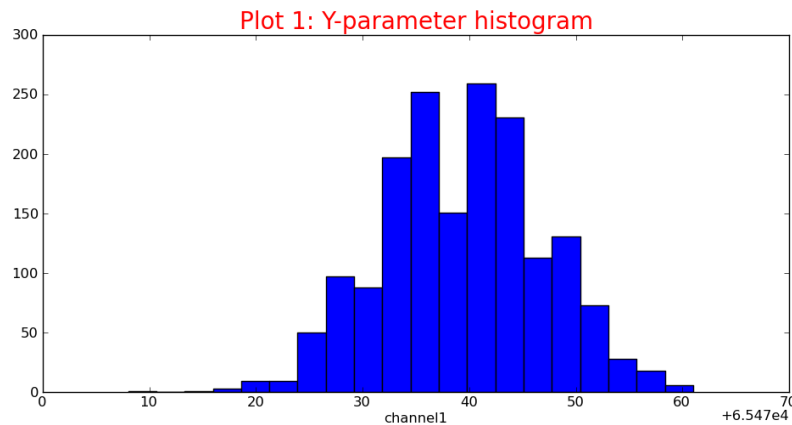
Versus: ☐ Index ☐ Time ☐ X-par ☒ Y-histo.

X-par: Is-not-used None

☒ Ylims: 105 505 Y Nbins: 20 ☒ lin Z

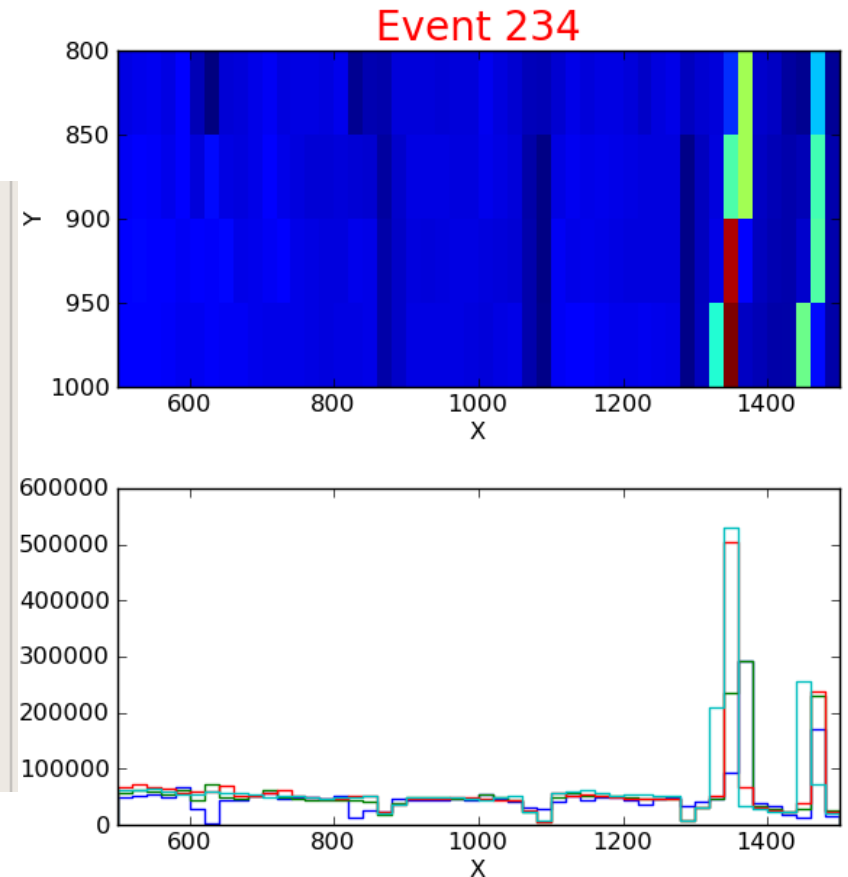
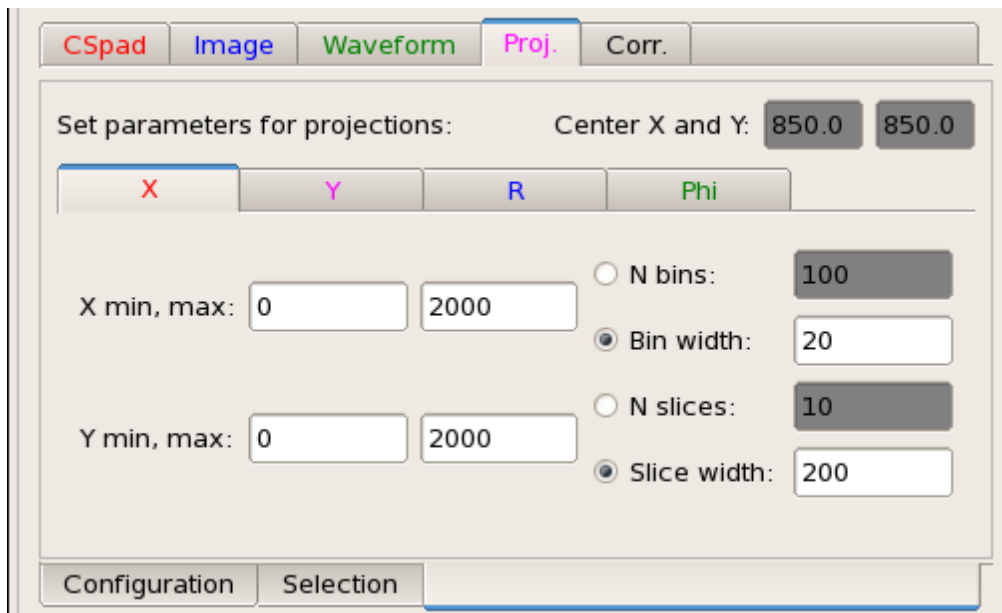
☐ Xlims: 200 600 X Nbins: 40 ☐ log Z

Configuration Selection



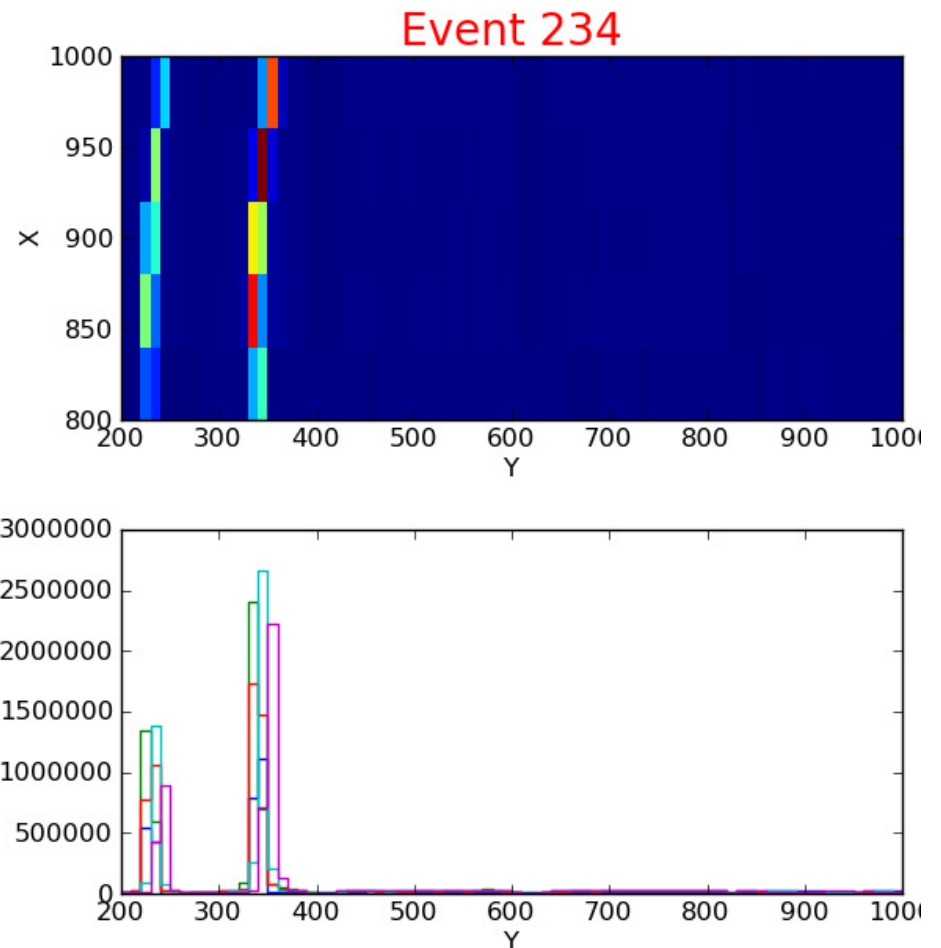
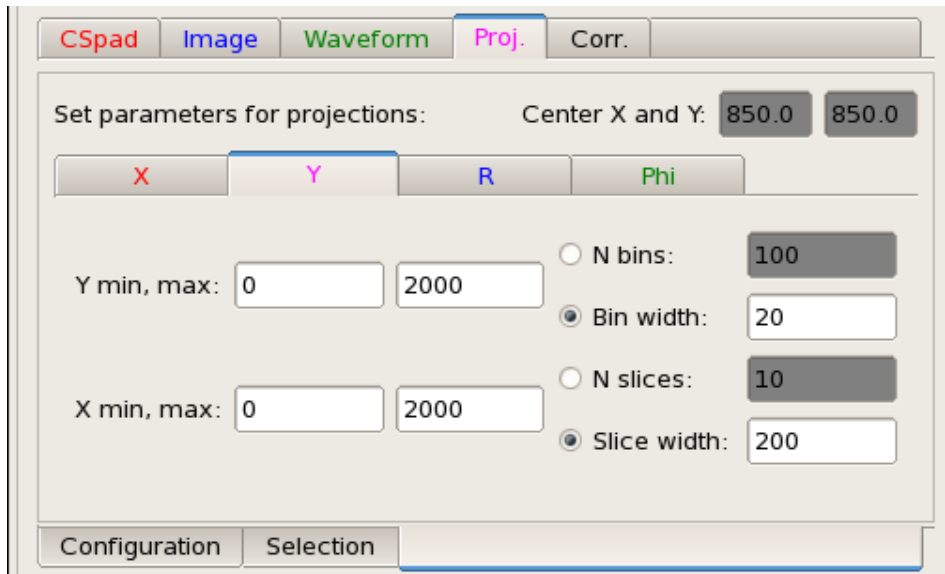
X-projection sub-GUI and plot

- Histograms in X
- For slices in Y



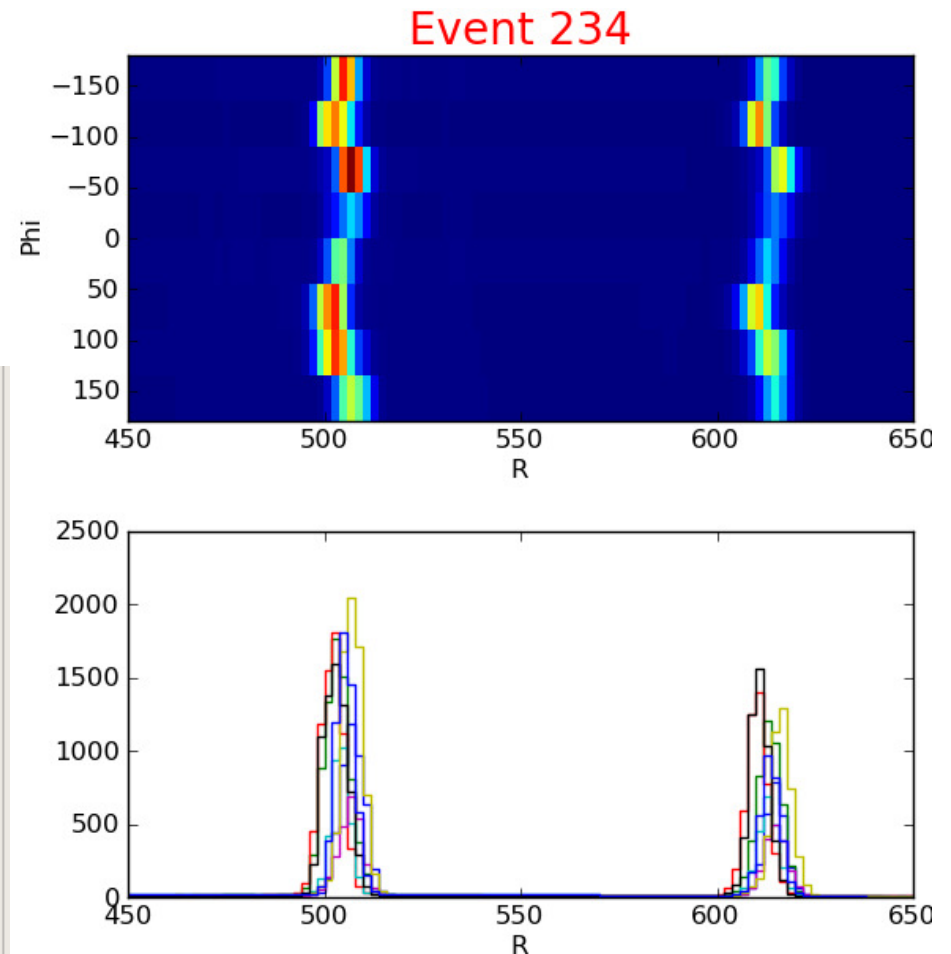
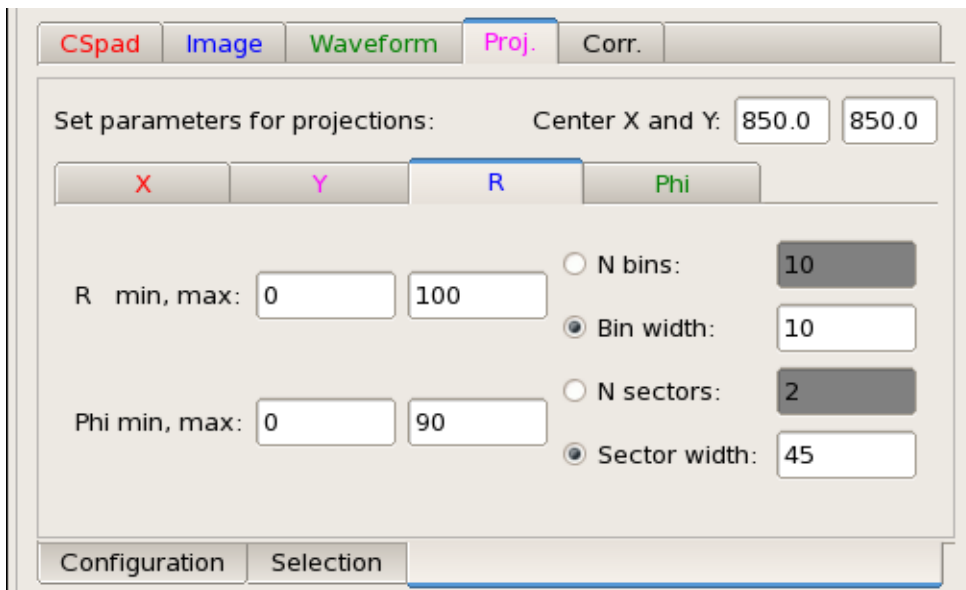
Y-projection sub-GUI and plot

- Histograms in Y
- For slices in X



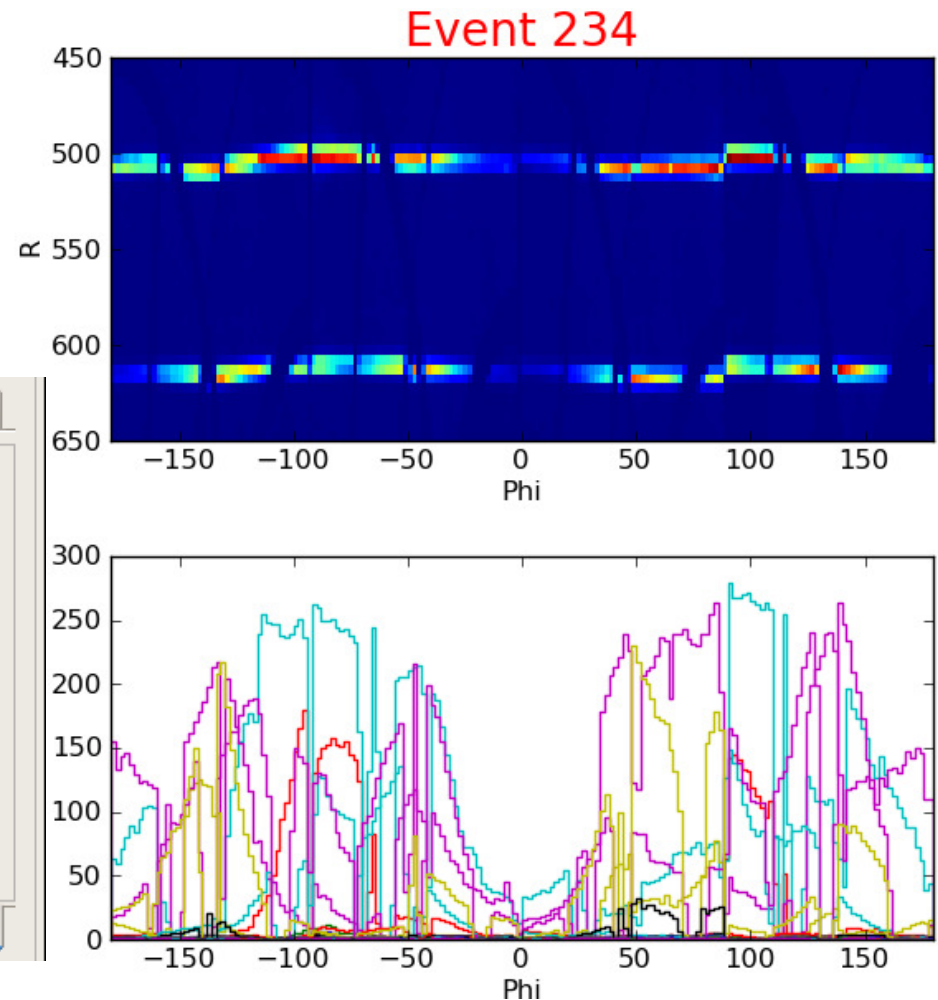
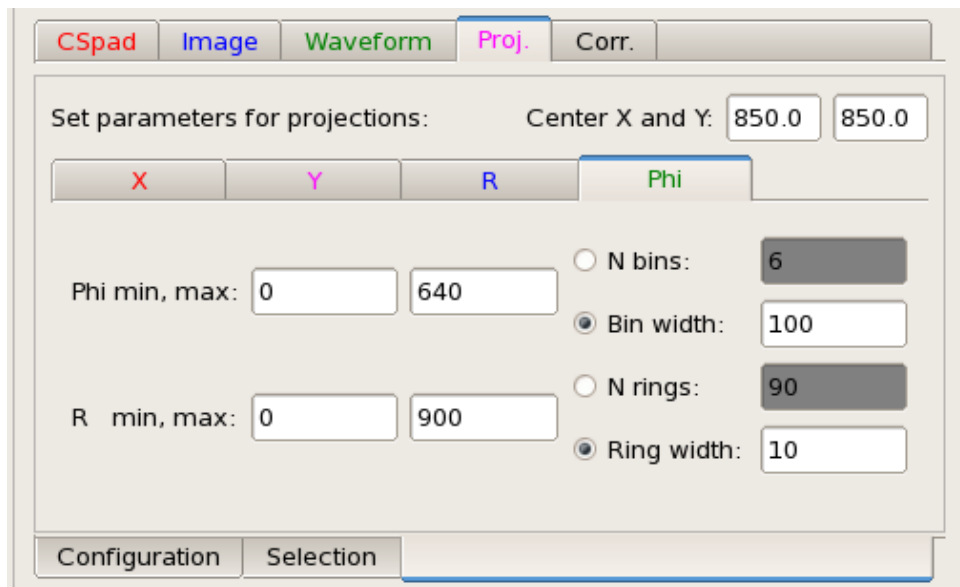
R-projection sub-GUI and plot

- Histograms in R
- For sectors in Phi
- Needs in center coord.



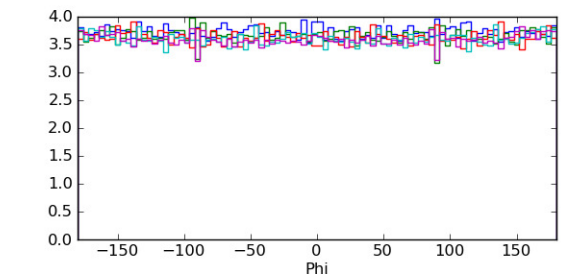
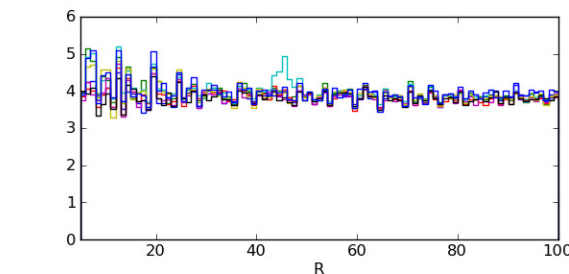
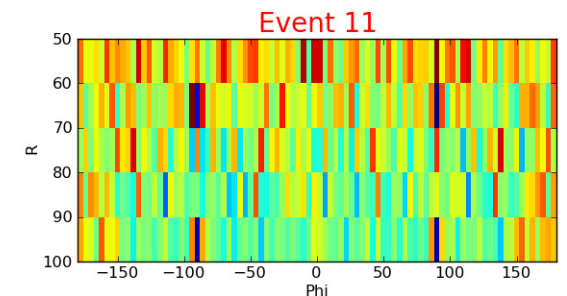
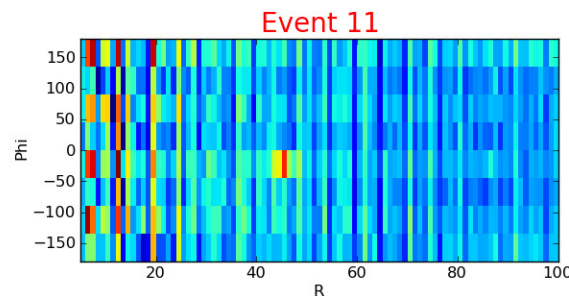
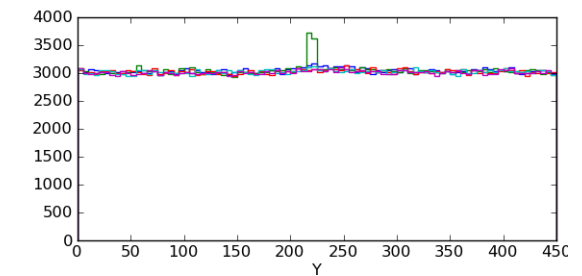
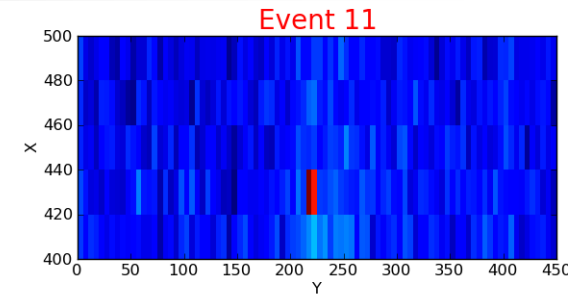
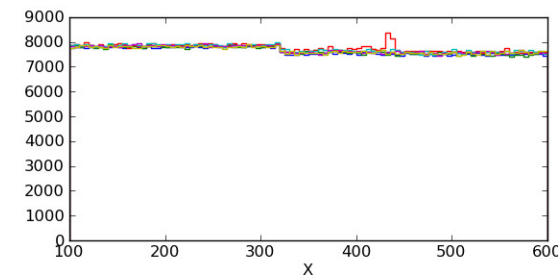
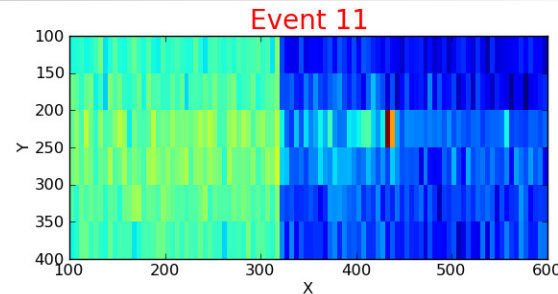
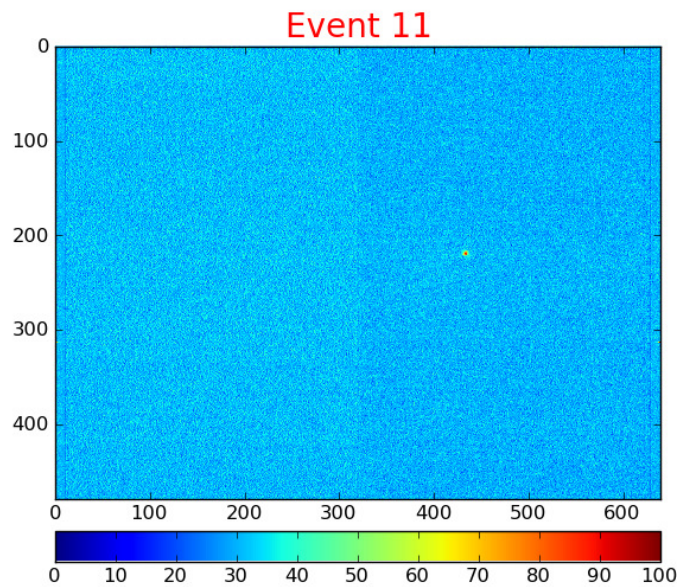
Rhi - projection sub-GUI and plot

- Histograms in Phi
- For rings in R
- Needs in center coord.



Projections for camera image

- Use the same GUI
- X, Y, R, Phi projections of the camera image



Selection and Configuration sub-GUIs

- Selection GUI – set the image-window(s) parameters for threshold selection
- Configuration GUI – manipulates with configuration parameters for HDF5 Explorer

The Selection GUI is shown with tabs for CSpad, Image, Waveform, Proj., and Corr. The 'Image' tab is active. It features a 'Number of regions for selection' dropdown set to 2. Below this are two tabs for 'Region:1' and 'Region:2'. The 'Region:1' tab is selected, showing a 'Dataset' dropdown set to 'None'. Under 'Threshold on intensity', there is a text input field with '111' and two radio buttons: 'maximal' (selected) and 'integral'. At the bottom, there are input fields for 'Xmin, Xmax' (values: 11, 1111) and 'Ymin, Ymax' (values: 1, 111). The bottom of the window has tabs for 'Configuration' and 'Selection', with 'Selection' being the active tab.

The Configuration GUI is shown with tabs for CSpad, Image, Waveform, Proj., and Corr. The 'Image' tab is active. It features a 'File with configuration parameters:' label above a text input field containing './hdf5expconfig' and a 'Browse' button. Below this is a section labeled 'Operations on configuration parameters:' containing four buttons: 'Read', 'Save', 'Reset default', and 'Print current'. The bottom of the window has tabs for 'Configuration' and 'Selection', with 'Configuration' being the active tab.

Summary

- HDF5 Explorer allows to look at data saved in HDF5 files.
- Program control is performed through the GUI.
- Interface is quite intuitive, instruction available in confluence.
- Graphics is specially designed for LCLS tools.
 - Program allows to explore HDF5 tree and print info about its items' structure, data types etc.
 - Graphic plots are implemented for camera images, CSpad images, image projections, Acqiris waveforms, correlation plots for time-matched scalar-arrays etc.
- Feedback is appreciated