European XFEL

What can we learn from the LCLS running experience for XFEL.EU

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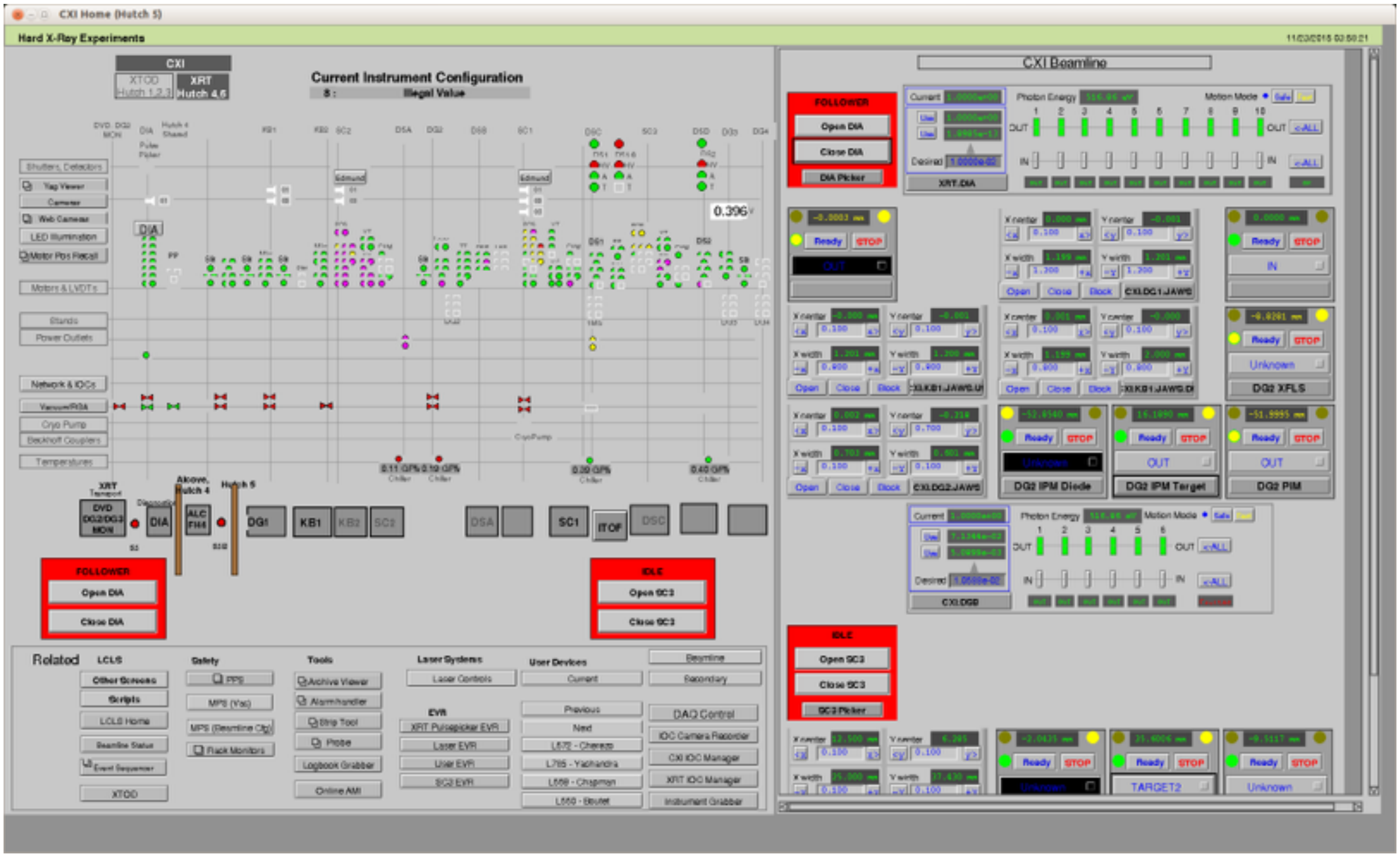
Overview

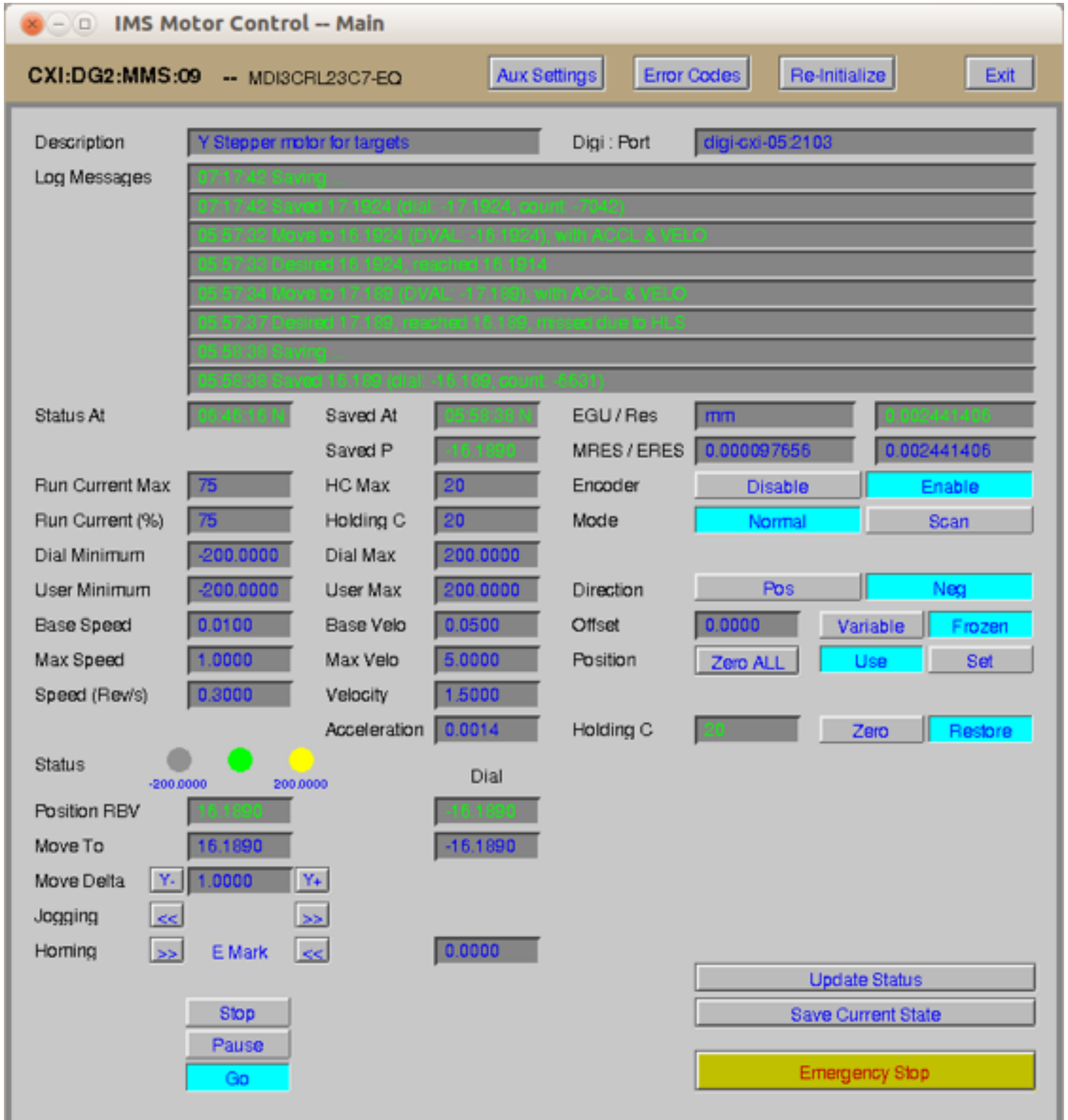
- LCLS controls
- LCLS DAQ
- A brief history of LCLS data analysis frameworks
- Data and Processing rates
- Summary

LCLS controls

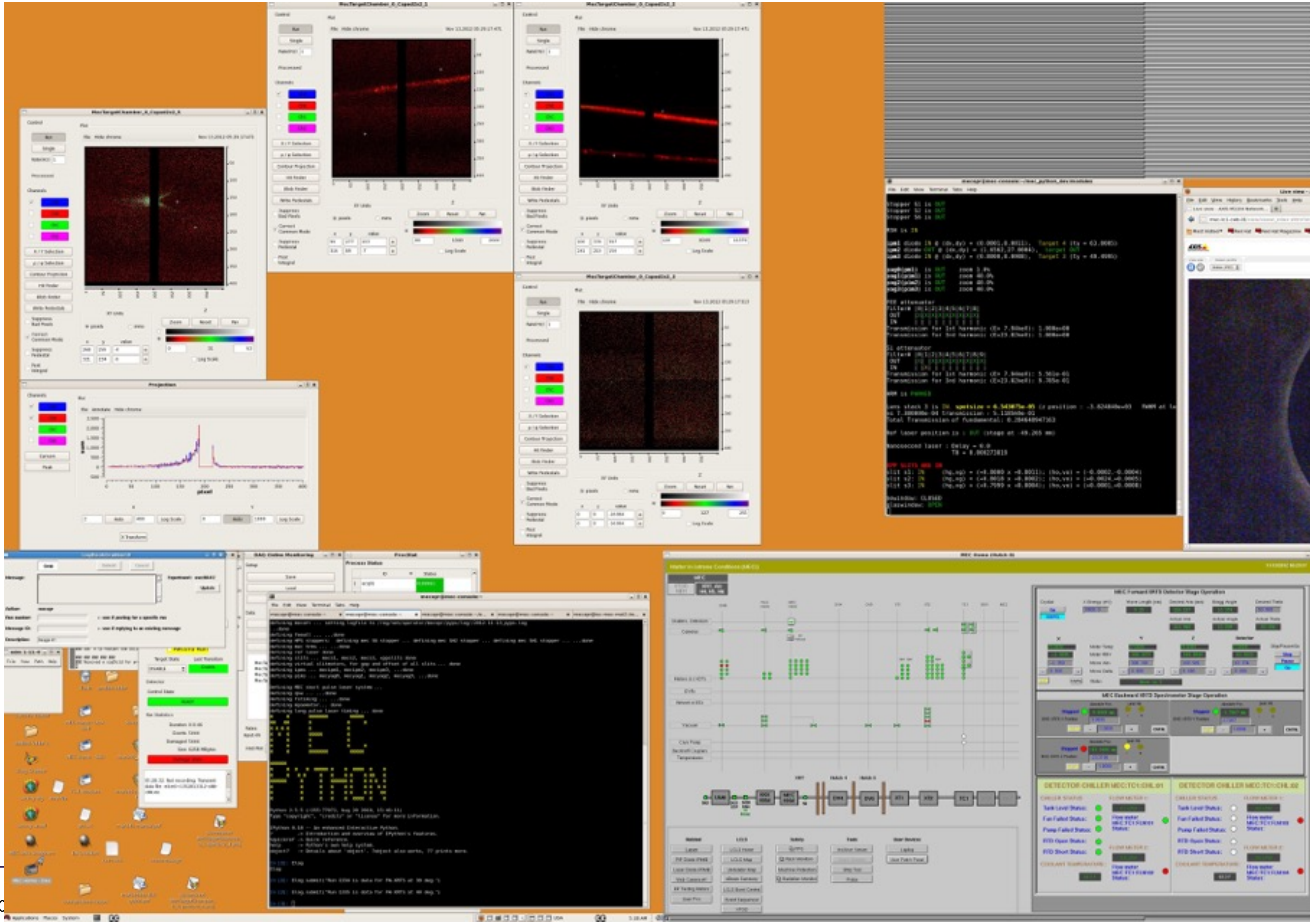
- Based on EPICS
- EDL for most control GUIs



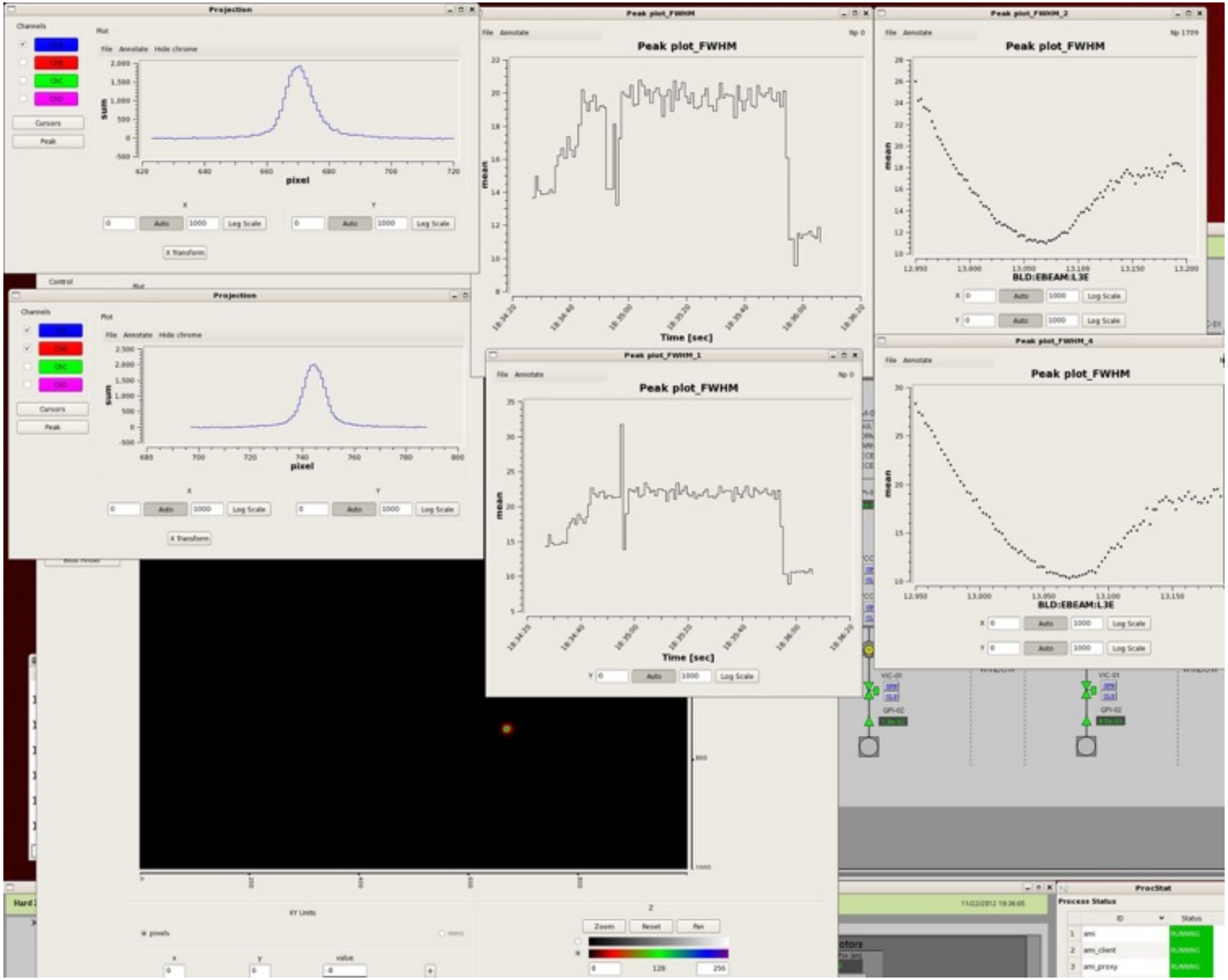
Full Epics motor interface



Python Controls Scripts



LCLS DAQ


Projection
Peak plot_FWHM
mean
Time [sec]
pixel
sum
BLD:EBEAM:L3E
ProcStat

LCLS analysis framework history

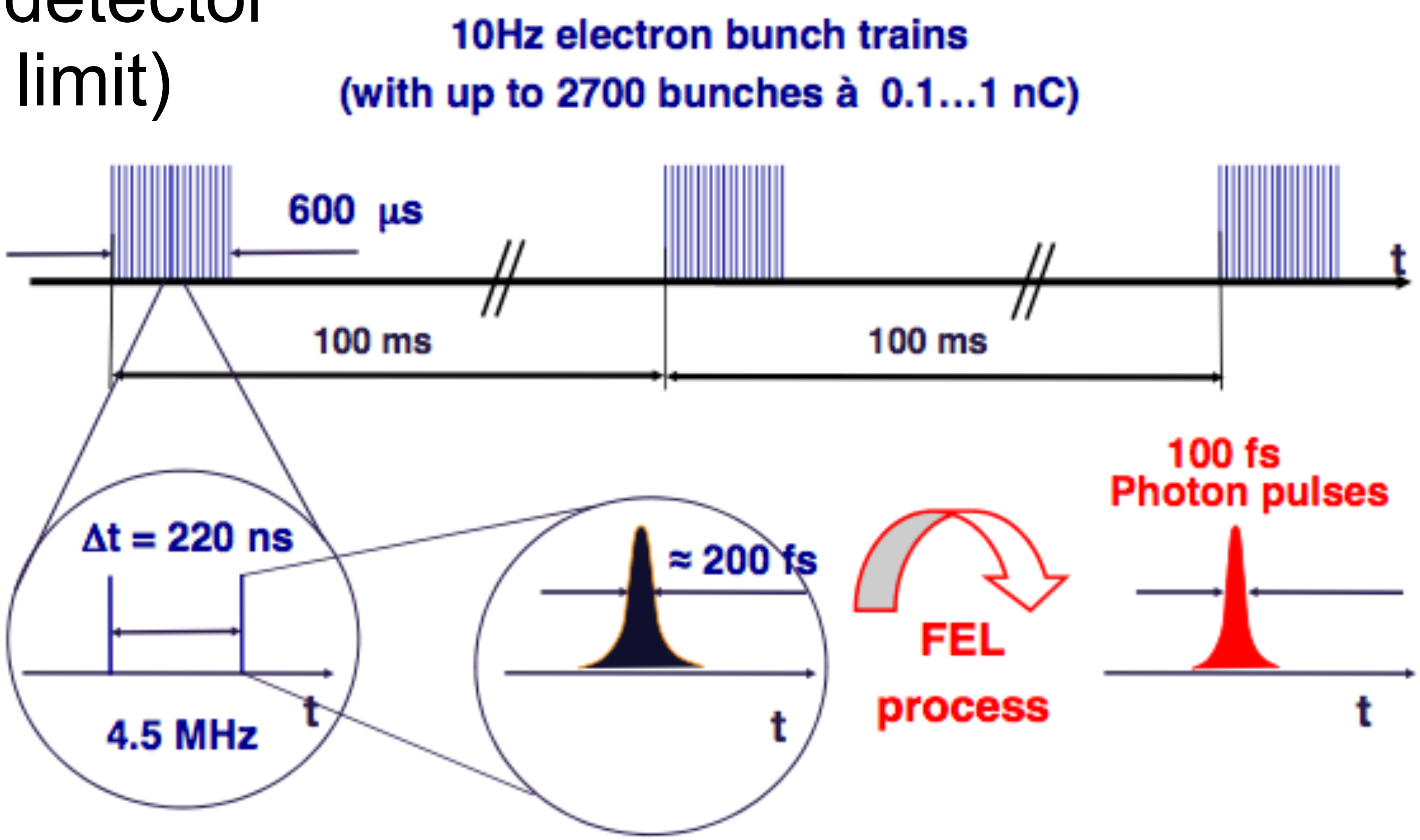
- middle of 2009: ???
  - no storage, DAQ not working, formats unclear
- Commissioning: myana (C monolit, one library for detector formats) 2009
  - EPICS and DAQ running, 200 TB collected
- psana (C++ framework, modular, configuration driven) 2010
  - first PB collected
- pyana (python with C++ bindings) 2011
- ipsana (interactive data analysis) 2014
- psana python (the analysis as a python module)

Special data tools

- xtc2hdf5 translator (easy data access: python, matlab)
- detector calibration management (geometry and intensity)
- timetool
- XTCAV
- time correlation analysis
- data visualisation
  - DAQ online monitor
  - PyQT for controls
  - pyana - interactive displays
  - interactive user displays
    - CASS-MPI, CCTBX-LBNL, ONDA-CFEL

Advantages of XFEL.EU to sample consumption

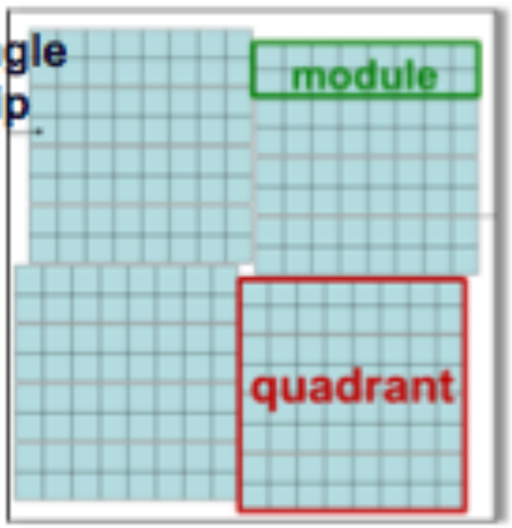
- Repetition rate
  - SACLA - 20 Hz
  - LCLS - 120 Hz
  - European XFEL at SPB - effectively 3500 Hz (given by detector limit–27 kHz beam limit)



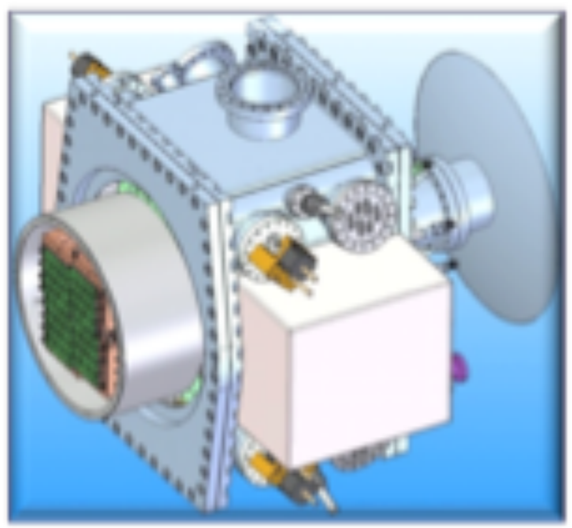
- ⇒ ≳30× data for the same sample consumption!
  - very useful for rare or valuable sample

Adaptive Gain Integrating Pixel Detector

High repetition rate (4.5 MHz) 1MPix imaging detector



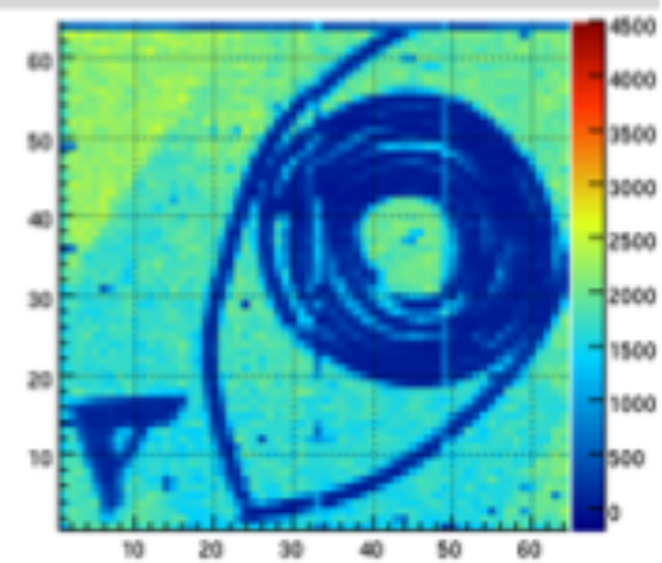
64x64 pixels/chip
2x8 chips/module
modules/quadrant
4 quadrants/detector



Parameter	AGIPD
Energy Range	3-16 keV
Dynamic Range	10^4 ph @12 keV
Single Photon Sens	Yes → Noise ~350e- rms
Storage cells/pixel	352 (analog)
Pixel size	200x200 μm^2 (squared)
Variable hole	Yes→ four independently movable quadrants
Veto capability	Yes

Status

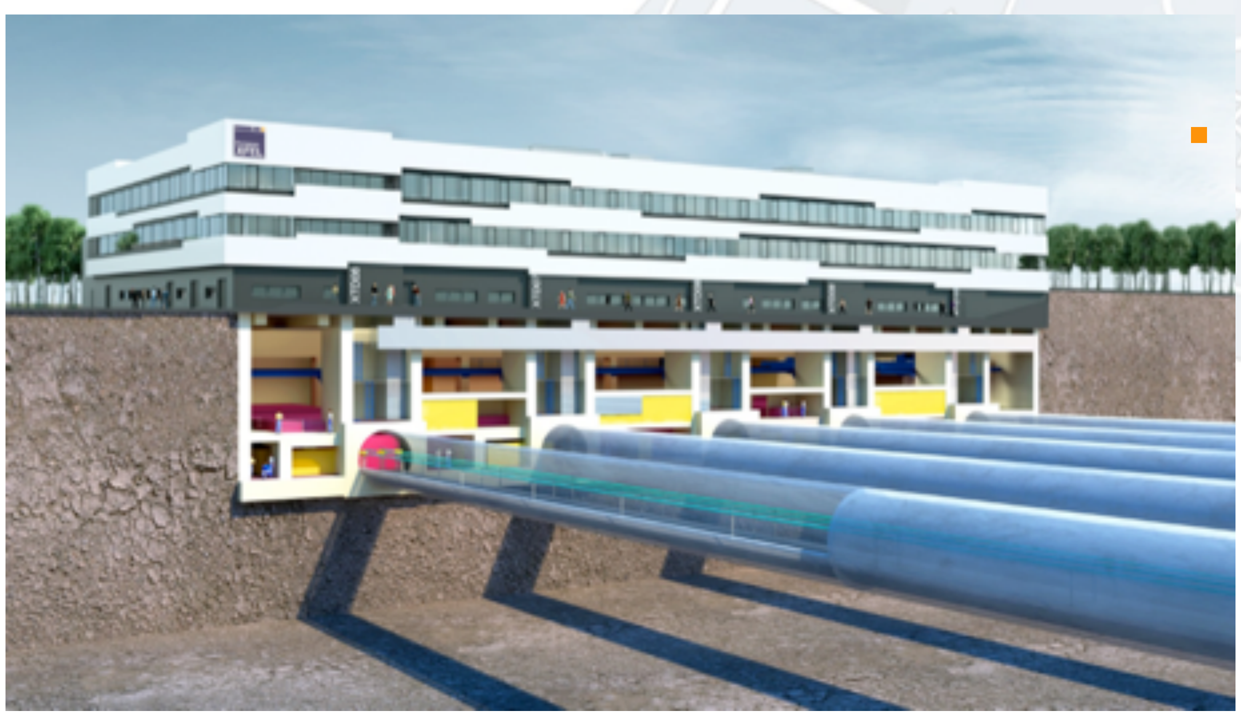
- The full scale chip **AGIPD1.0** exists
  - Fist test results show no major problems → very encouraging
  - Measured parameters within the specification
- **Mechanics** design for 1MPix detector in advanced state
  - Initial tests of movement system successful
- **Integration** of the detector in the XFEL beamlines in progress



Slide: J. Sztuk-Dambietz, XFEL
Image: AGIPD consortium

Karabo will be used at the photon beamlines

- **Why?**
  - One software framew
    programming interfac
  - Less learning, less te
    changes, less conver



- **Why else?**
  - Our requirements are different to those of classical synchrotron or high energy physics experiments
  - We invest a lot of money for better science, a small fraction is for better software

Data filtering using Karabo

- ideally on the fly
  - only pretty raw data available
  - full detector calibration expensive
- timing seems acceptable
  - 0.25s/100 frames
  - application of pixel mask
  - background subtraction
  - counting of pixels over threshold
- data distribution essential for DAQ

Data filtering statistics

- Lysozyme test data from LCLS/CS-Pad
- 0.06s per frame from file
  - needs large data blocks (>50 frames)
  - can generate average automatically
  - could allow per train correction w/o any external input
  - works on single tiles

Conclusions

- intentionally left blank