



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

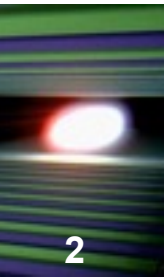


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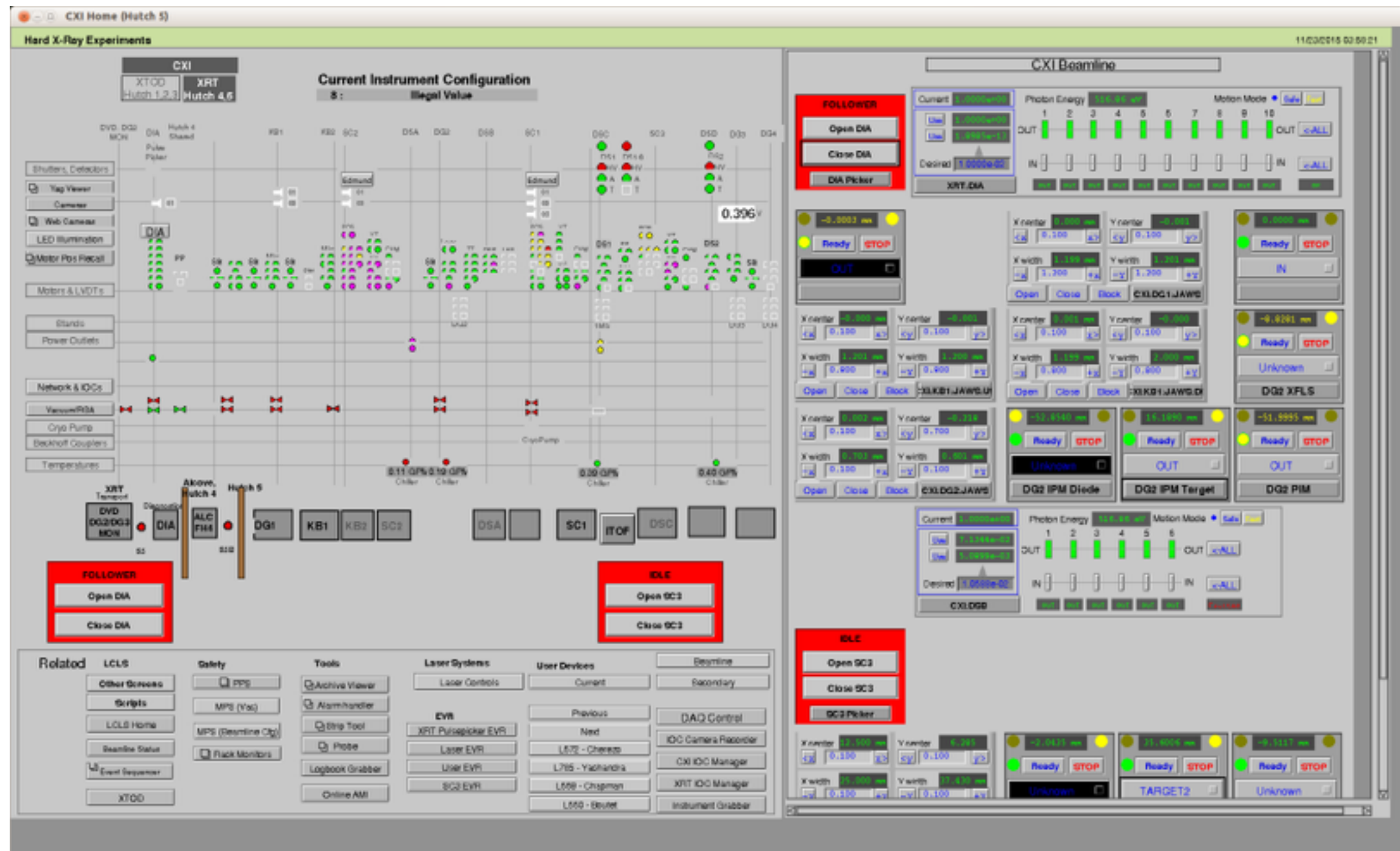
Overview



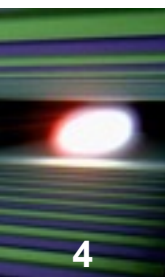
- LCLS controls
- LCLS DAQ
- A brief history of LCLS data analysis frameworks
- Data and Processing rates
- Summary

LCLS controls

- Based on EPICS
- EDL for most control GUIs



Full Epics motor interface



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IMS Motor Control -- Main

CXI:DG2:MMS:09 -- MDI3CRL23C7-EQ

Aux Settings Error Codes Re-Initialize Exit

Description: Y Stepper motor for targets Digi : Port: digi-cxi-05.2103

Log Messages:

- 07:17:42 Saving ...
- 07:17:42 Saved 17.1924 (dial: -17.1924, count: -7042)
- 05:57:32 Move to 16.1924 (DVAL: -16.1924), with ACCL & VELO
- 05:57:33 Desired 16.1924, reached 16.1914
- 05:57:34 Move to 17.189 (DVAL: -17.189), with ACCL & VELO
- 05:57:37 Desired 17.189, reached 16.189, missed due to HLS
- 05:58:38 Saving ...
- 05:58:38 Saved 16.189 (dial: -16.189, count: -5531)

Status At: 05:45:16 N Saved At: 05:58:38 N EGU / Res: mm 0.002441406

Run Current Max: 75 Saved P: -16.1890 MRES / ERES: 0.000097656 0.002441406

Run Current (%): 75 HC Max: 20 Encoder: Disable Enable

Dial Minimum: -200.0000 Dial Max: 200.0000 Mode: Normal Scan

User Minimum: -200.0000 User Max: 200.0000 Direction: Pos Neg

Base Speed: 0.0100 Base Velo: 0.0500 Offset: 0.0000 Variable Frozen

Max Speed: 1.0000 Max Velo: 5.0000 Position: Zero ALL Use Set

Speed (Rev/s): 0.3000 Velocity: 1.5000 Holding C: 20 Zero Restore

Acceleration: 0.0014

Status: -200.0000 200.0000 Dial

Position RBV: 16.1890 -16.1890

Move To: 16.1890 -16.1890

Move Delta: Y- 1.0000 Y+

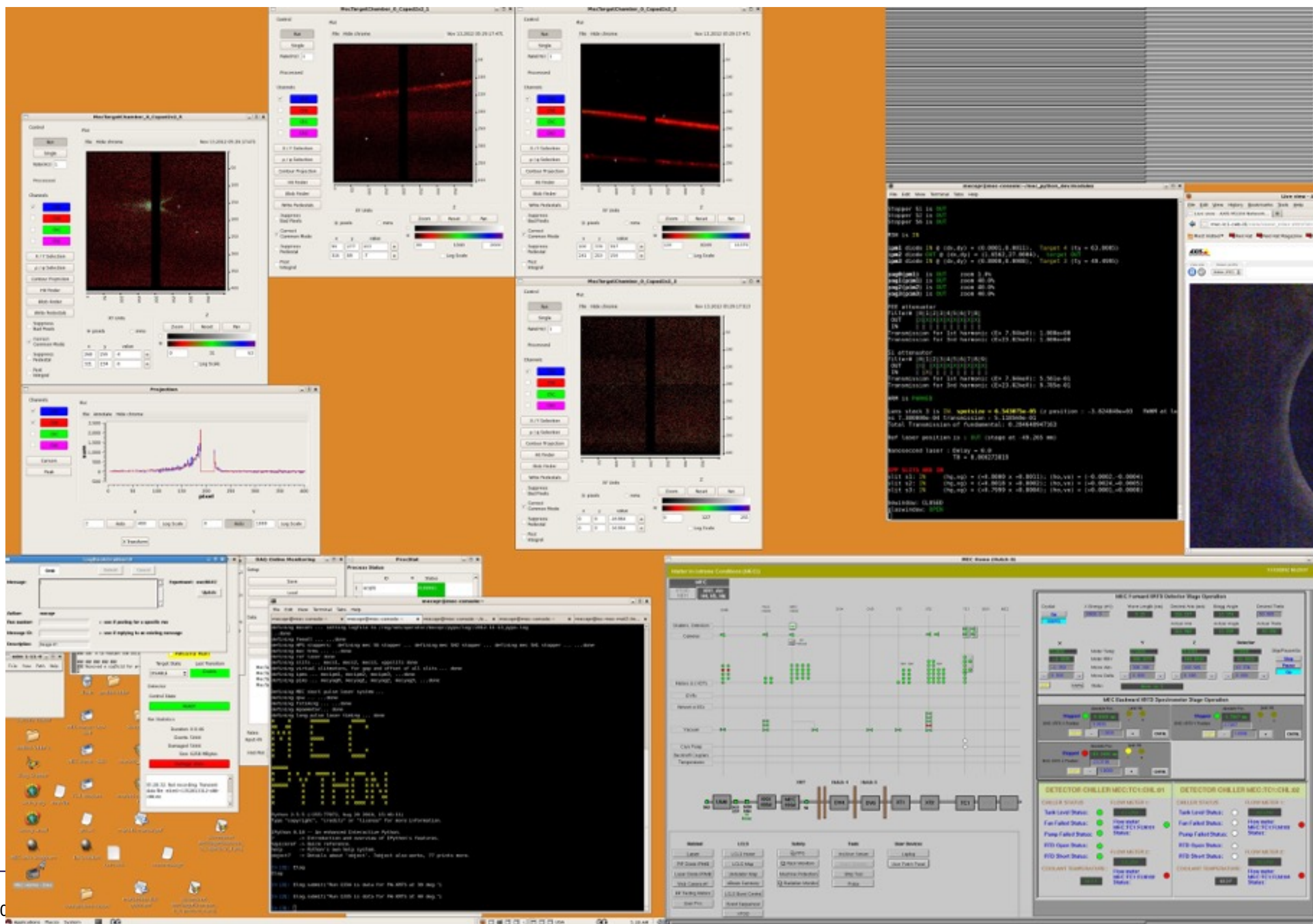
Jogging: << >>

Homing: >> E Mark << 0.0000

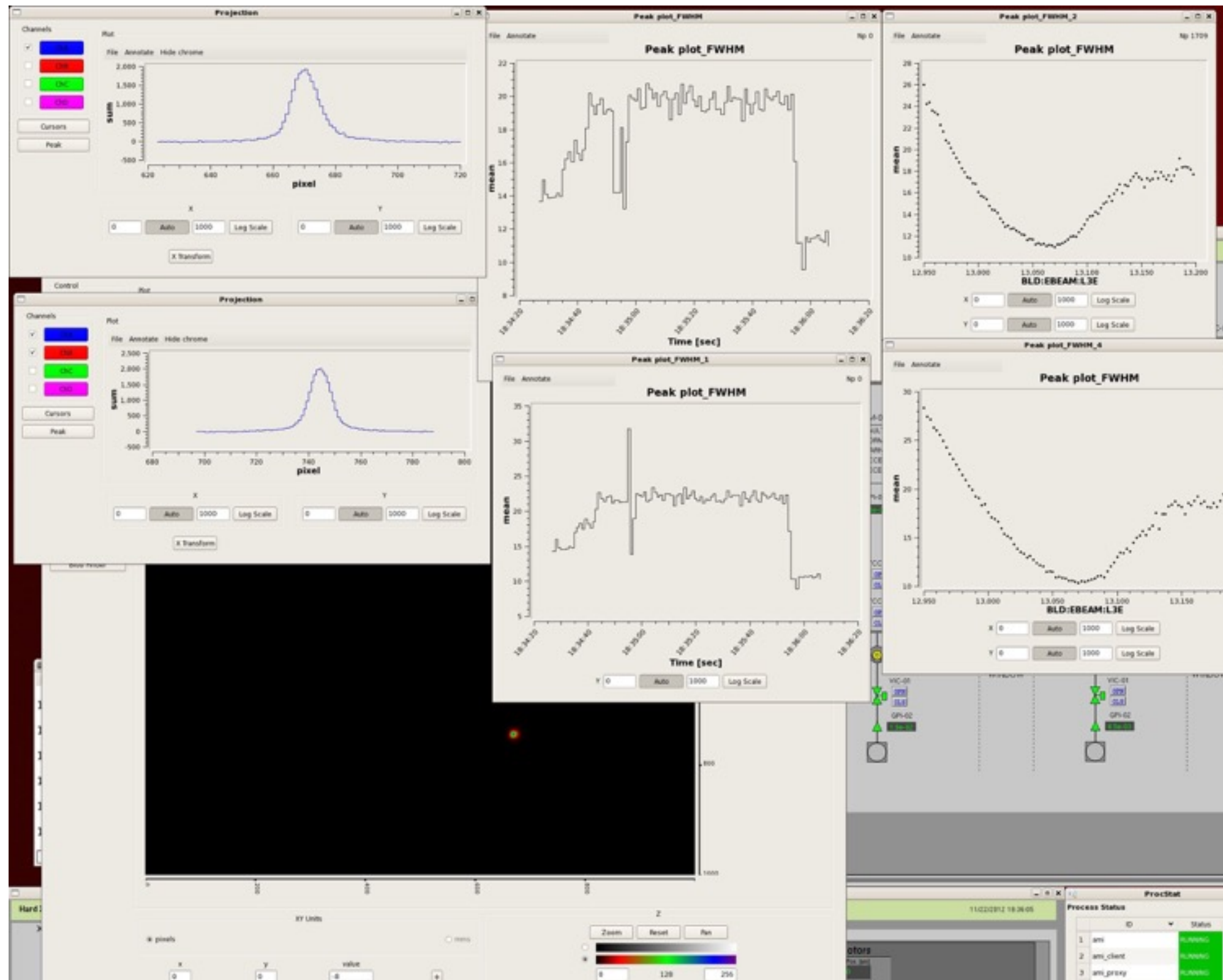
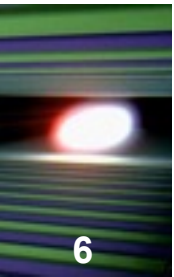
Stop Pause Go

Update Status Save Current State Emergency Stop

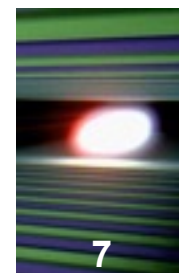
Python Controls Scripts



LCLS DAQ

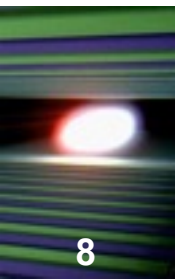


LCLS analysis framework history



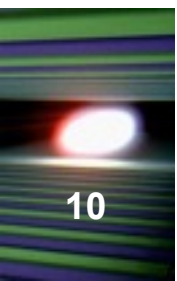
- middle of 2009: ???
 - no storage, DAQ not working, formats unclear
- Commissioning: myana (C monolit, one library for detector formats) 2009
 - EPICS and DAQ running, 200 TB collected
- psana (C++ framework, modular, configuration driven) 2010
 - first PB collected
- pyana (python with C++ bindings)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

Special data tools



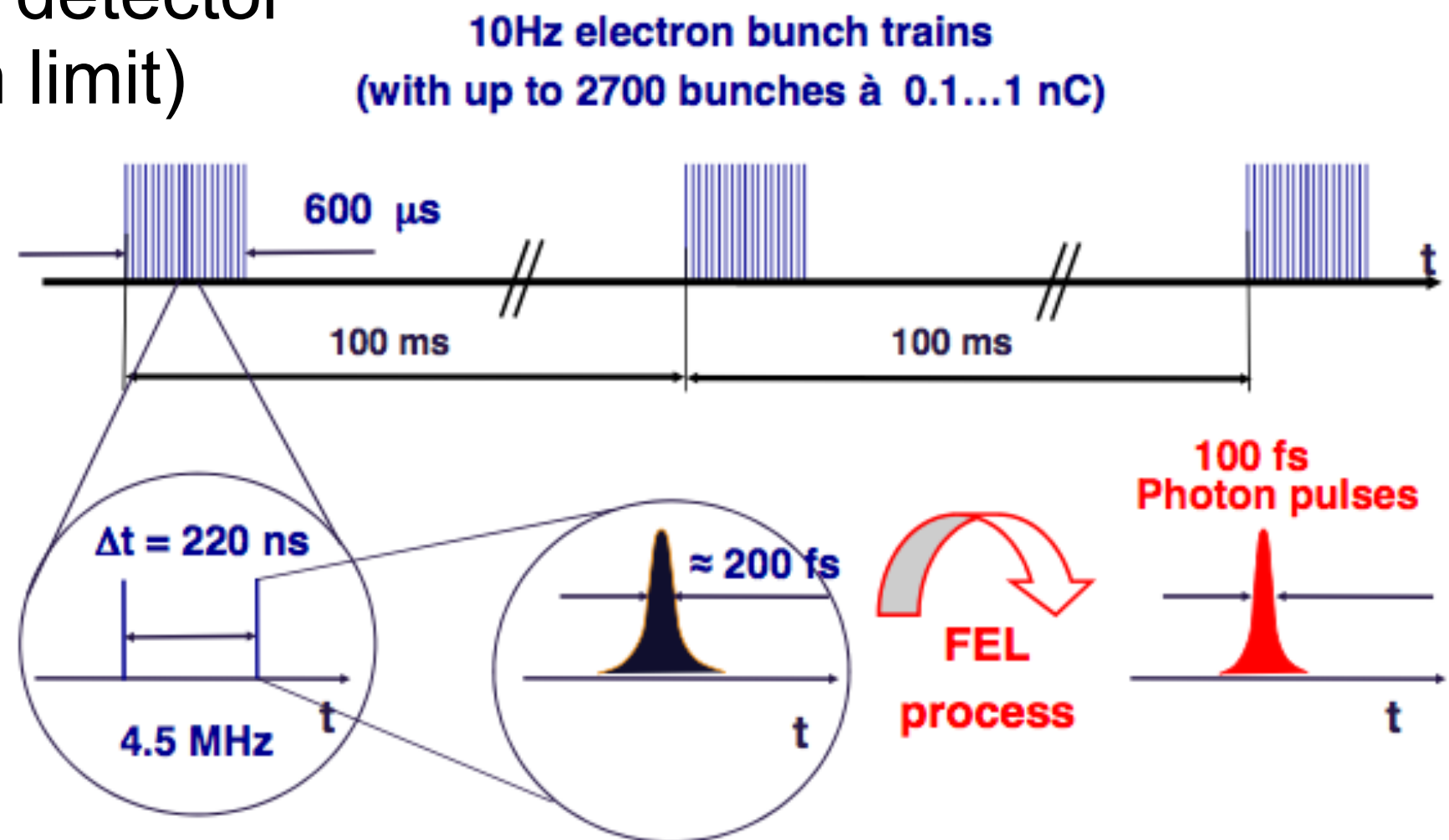
- xtc2hdf5 translator (easy data access: python, matlab)
- detector calibration management (geometry and intensity)
- timetool
- XTCAV
- time correlation analysis
- data visualisation
 - DAQ online monitor
 - PyQt for controls
 - pyana - interactive displays
 - interactive user displays
 - CASS-MPI,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

Advantages of XFEL.EU to sample consumption

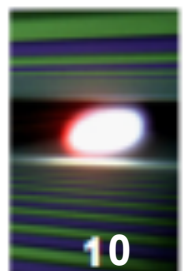


- Repetition rate
 - SACLA - 20 Hz
 - LCLS - 120 Hz
 - European XFEL at SPB - effectively 3500 Hz (given by detector limit–27 kHz beam limit)

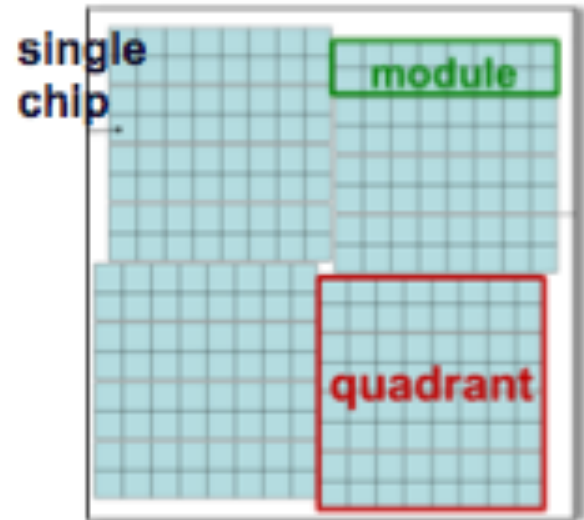
- $\Rightarrow \approx 30\times$ data for the same sample consumption!
- very useful for rare or valuable sample



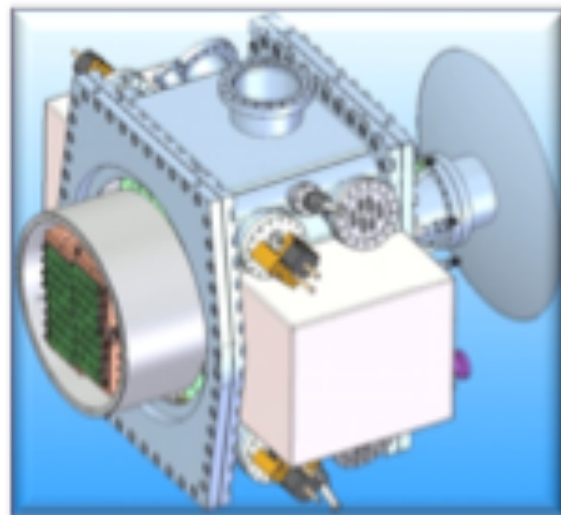
Adaptive Gain Integrating Pixel Detector



High repetition rate (4.5 MHz) 1MPix imaging detector



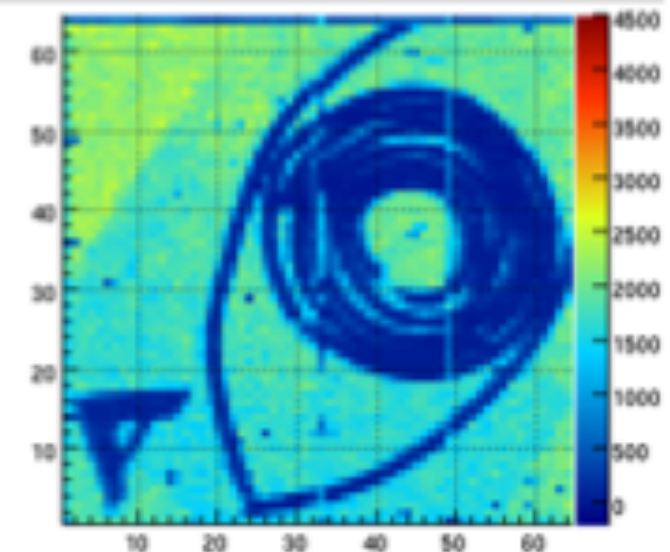
64x64 pixels/chip
2x8 chips/module
modules/quadrant
4 quadrants/detector



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

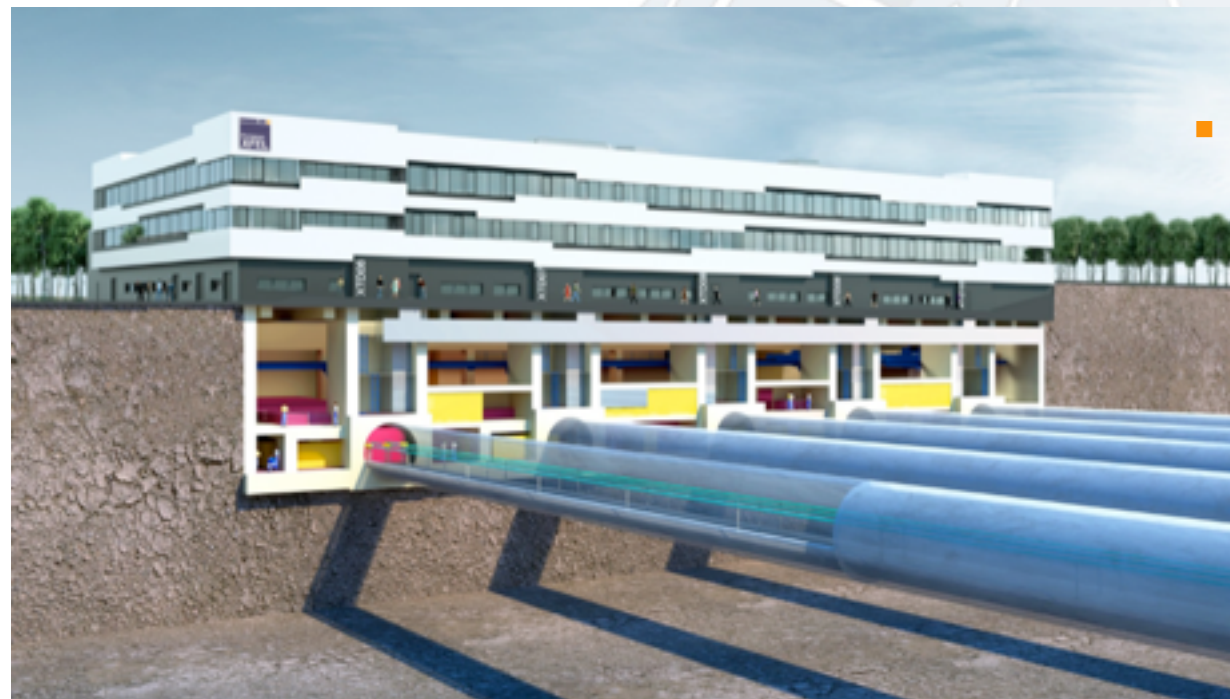
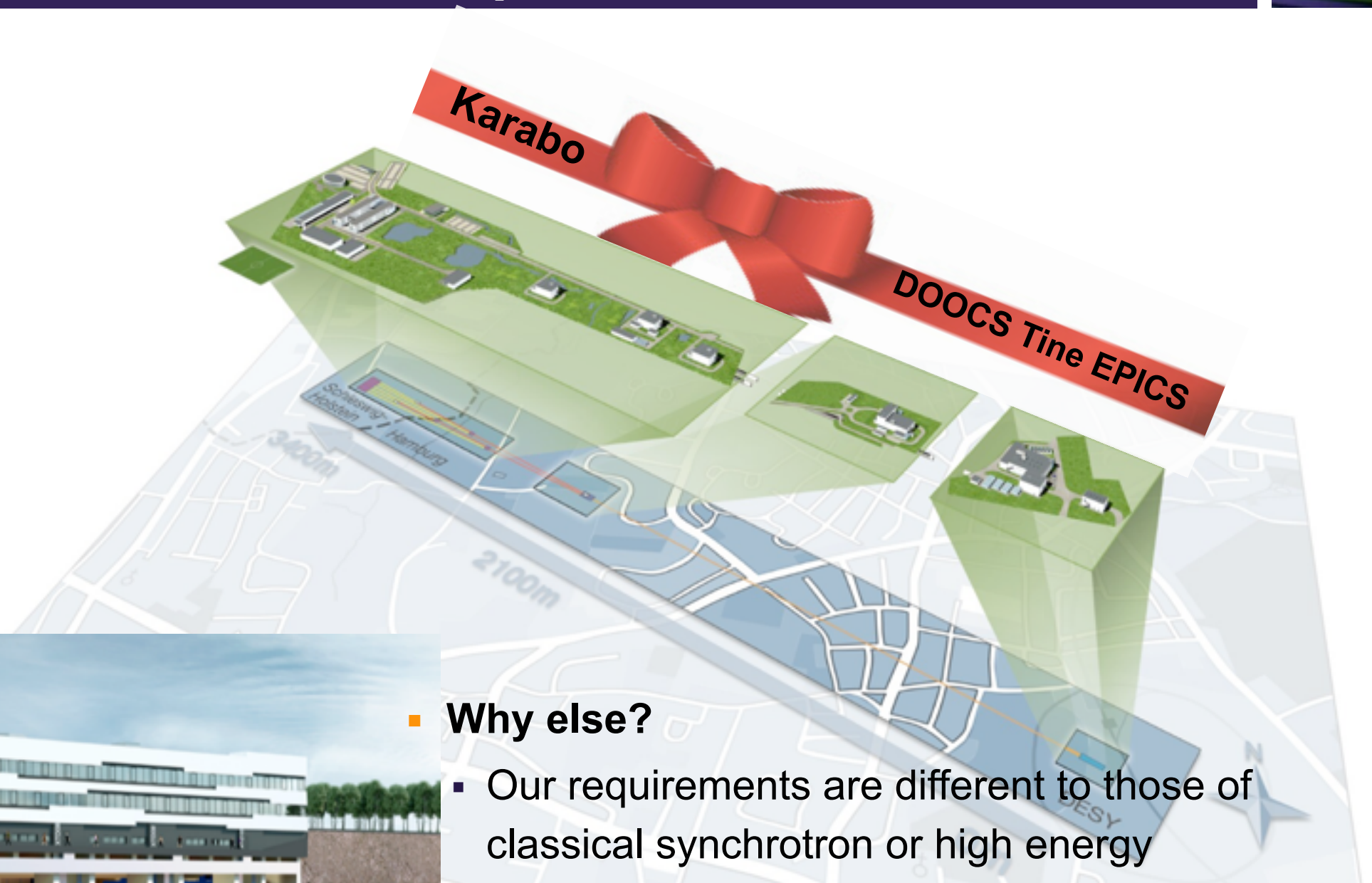


Karabo will be used at the photon beamlines

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■ Why?

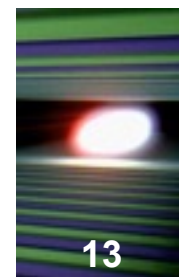
- One software framework programming interface
- Less learning, less technical changes, less conversion



■ Why else?

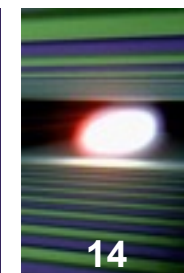
- Our requirements are different to those of classical synchrotron or high energy physics experiments
- We invest a lot of money for better science, a small fraction is for better software

Data filtering using Karabo



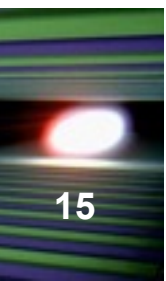
- ideally on the fly
 - only pretty raw data available
 - full detector calibration expensive
- timing seems acceptable
 - 0.25s/100 frames
 - application of pixel mask
 - background subtraction
 - counting of pixels over threshold
- data distribution essential for DAQ

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