MxCuBE for time-resolved SSX at T-REXX

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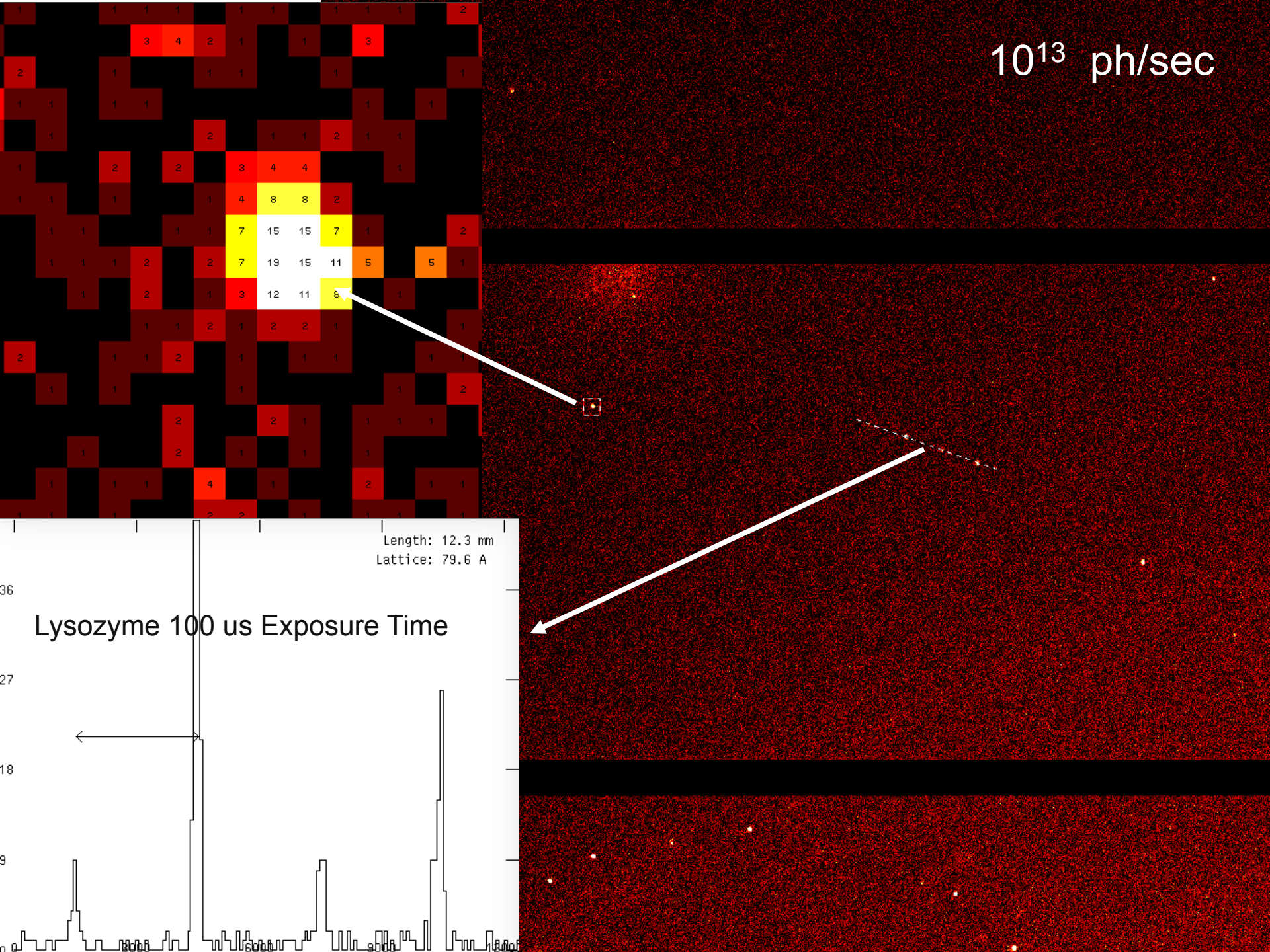
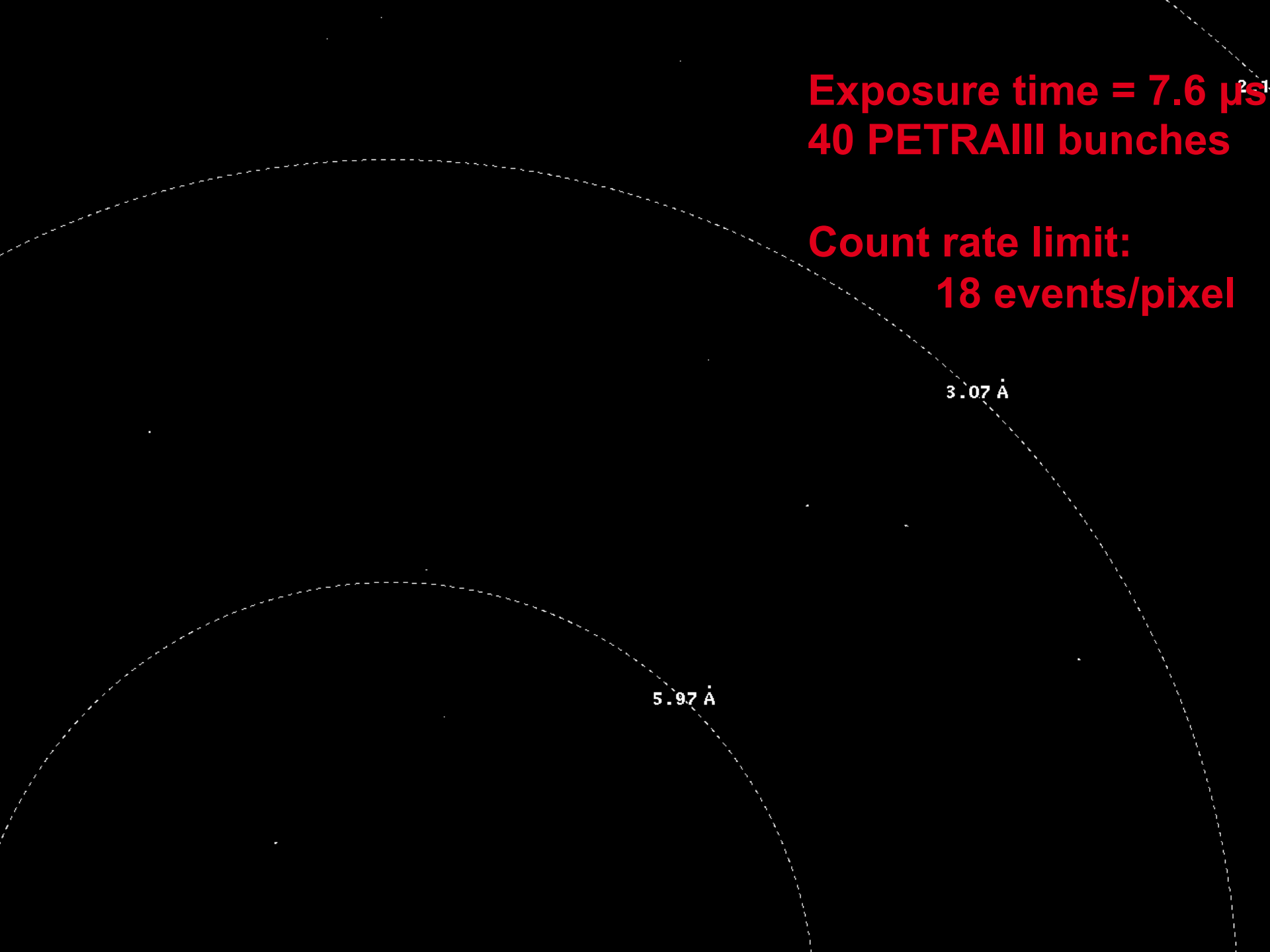
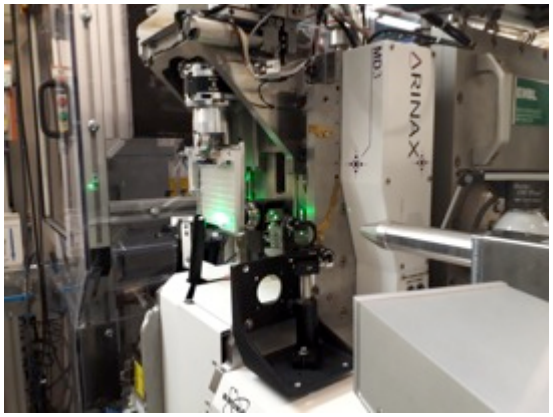
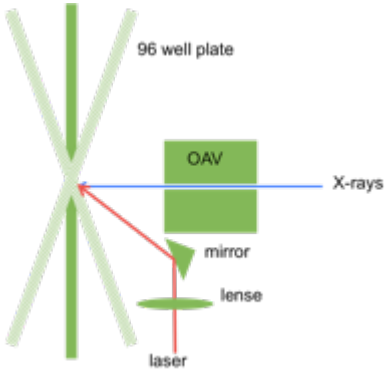

10^{13} ph/sec
Length: 12.3 mm
Lattice: 79.6 A
Lysozyme 100 us Exposure Time

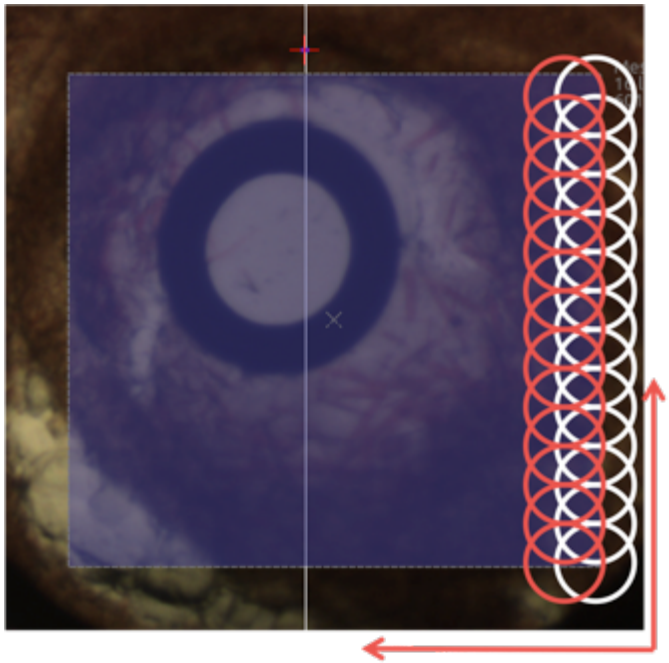

Exposure time = 7.6 µs
40 PETRAIII bunches
Count rate limit:
18 events/pixel
3.07 Å
5.97 Å

Time-resolved SSX by serial helical scans





Laser-flashes delivered at the sample in 96-well plate at a sub-harmonic of the detector framing frequency



- Laser beam ⦸ 50 µm
- Exposure time 1.3 ms / frame
- Ver. translation 1 µm/frame
- Laser flash at every 30th frame
- Hor. translation 30 µm / line

== 30 time points x 1.3 ms

10^6 frames in 3 hours wall clock
~30% hit rate

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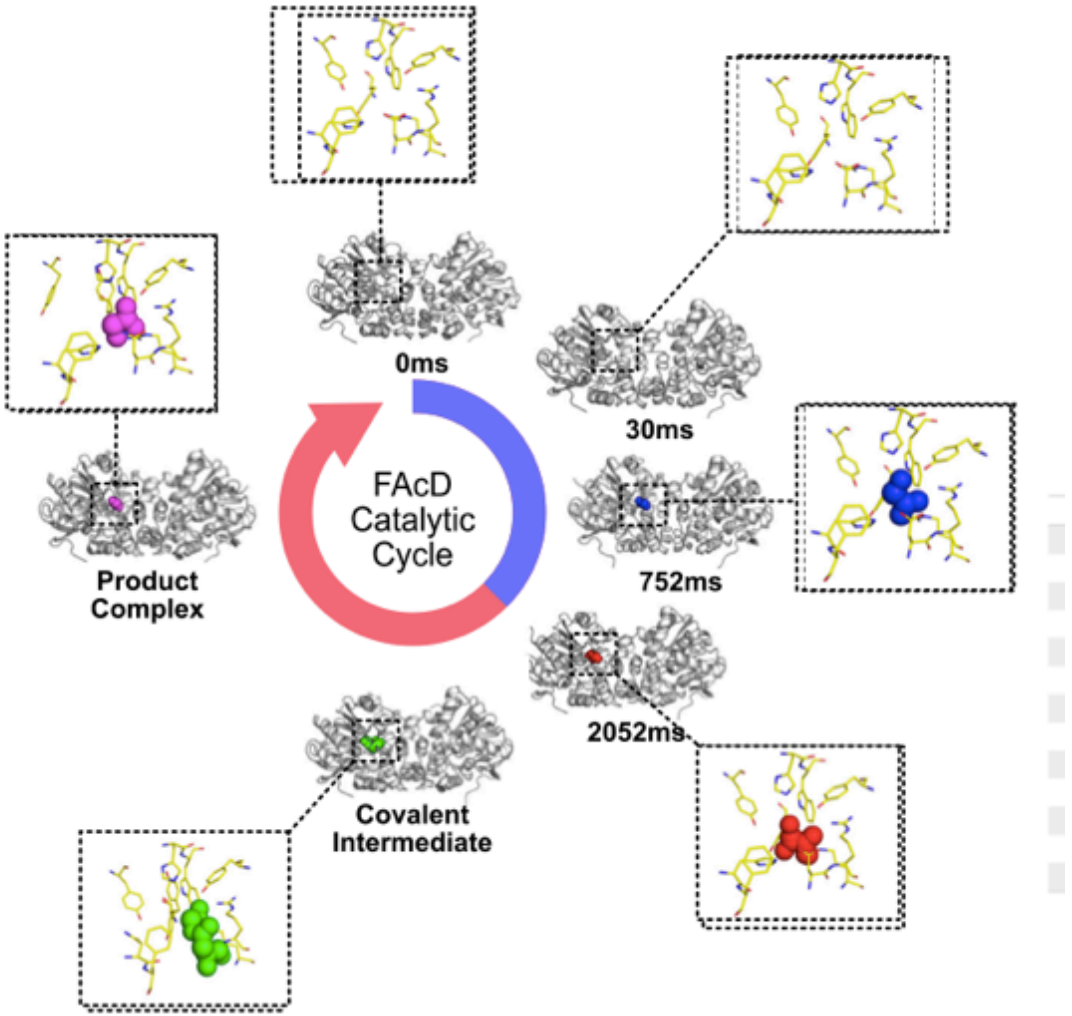
Time series: *linear vs logarithmic*



Defluorinase, Schulz, Mehrabi, Müller-Werkmeister et al. Nat. Methods *2018*

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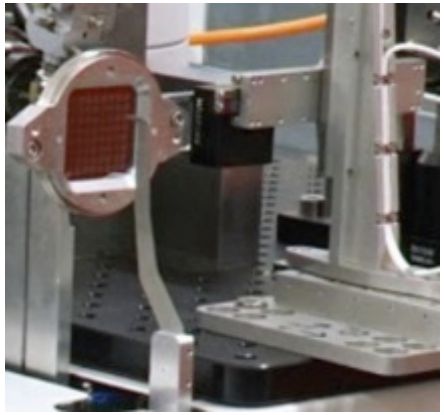
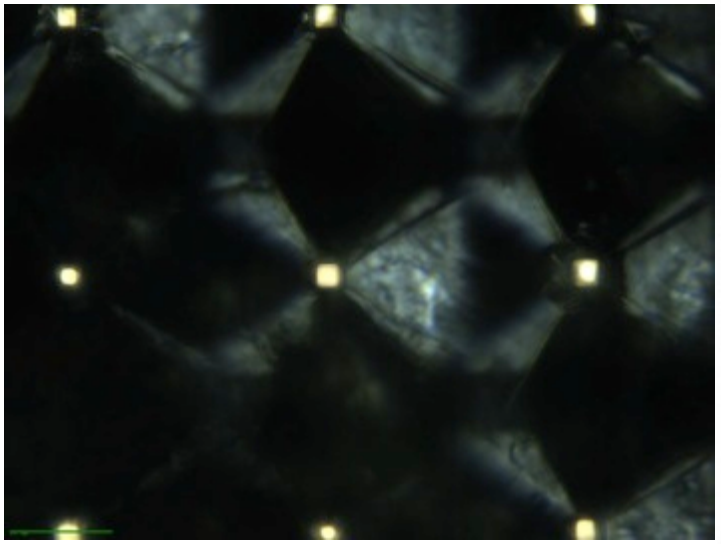
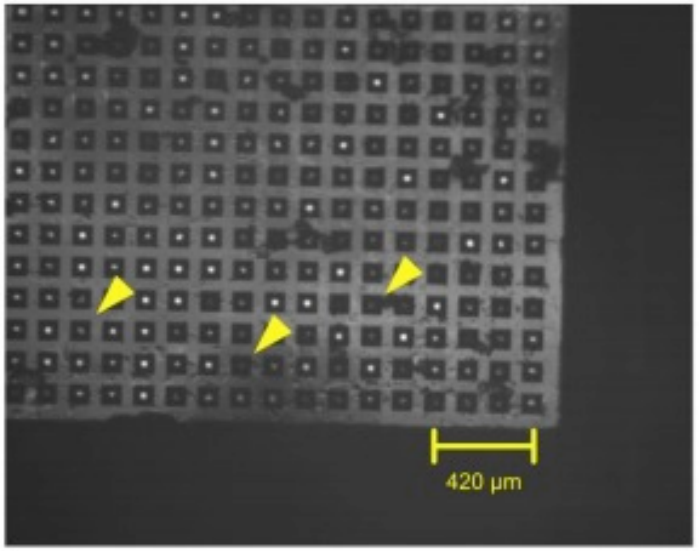
Si chips for sample delivery







Zarrine-Asfar et al. (2012) Acta Cryst. D
Sherrell et al. (2015) J Synch. Rad.

- 20000-25000 compartments
- 120-150 µm pitch
- 25 Hz re-positioning

Eike Schulz, Pedram Mehrabi, Rike Müller-Werkmeister, Dwayne Miller, MPISDM Hamburg

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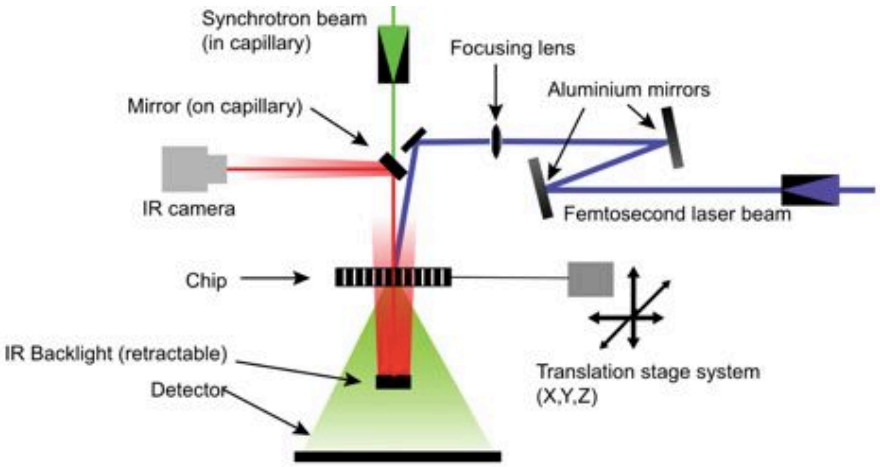
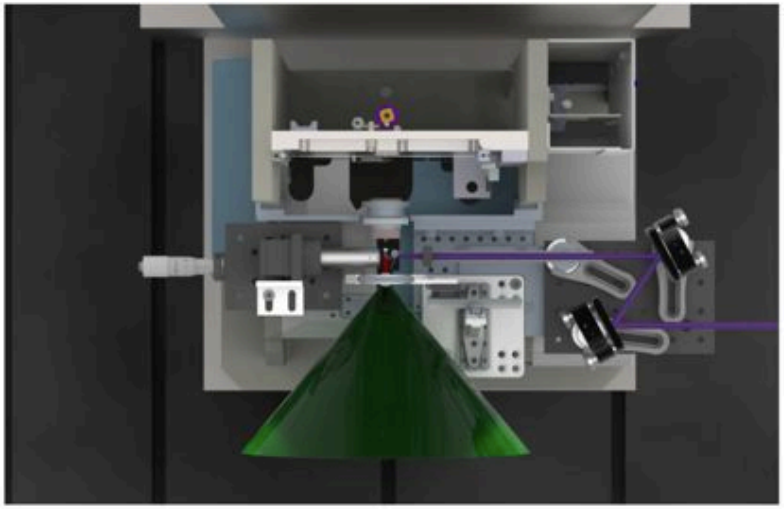
Un-caging experiments at P14.EH1





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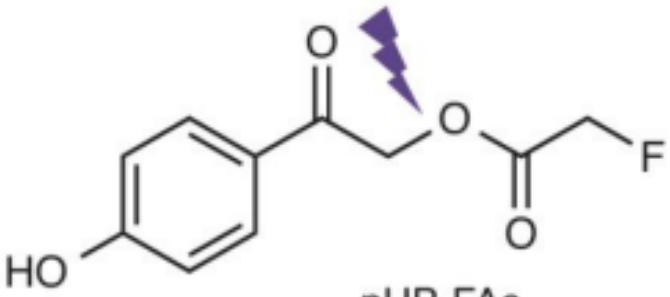
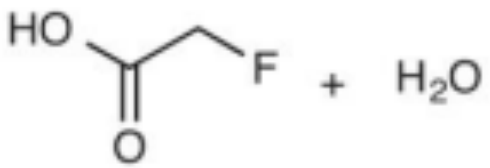
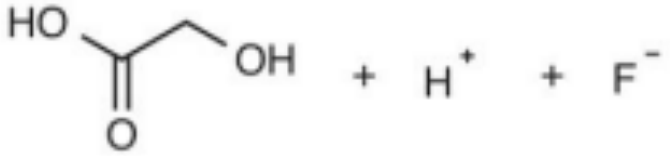
Fluoroacetate dehalogenase substrate un-caging

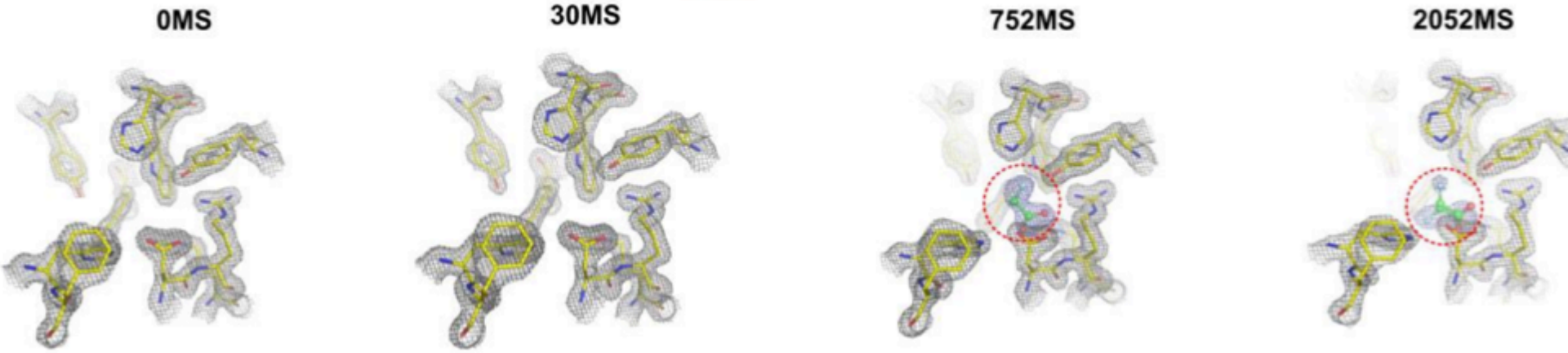


pHP-FAc

Pump: 340 nm 45 nJ / 100x100 um^2
4-15 ms X-ray exposures
20000 frames x 4 time delays in 1 hour
>3.5K diffraction images per time delay
Resolution 1.8 Å

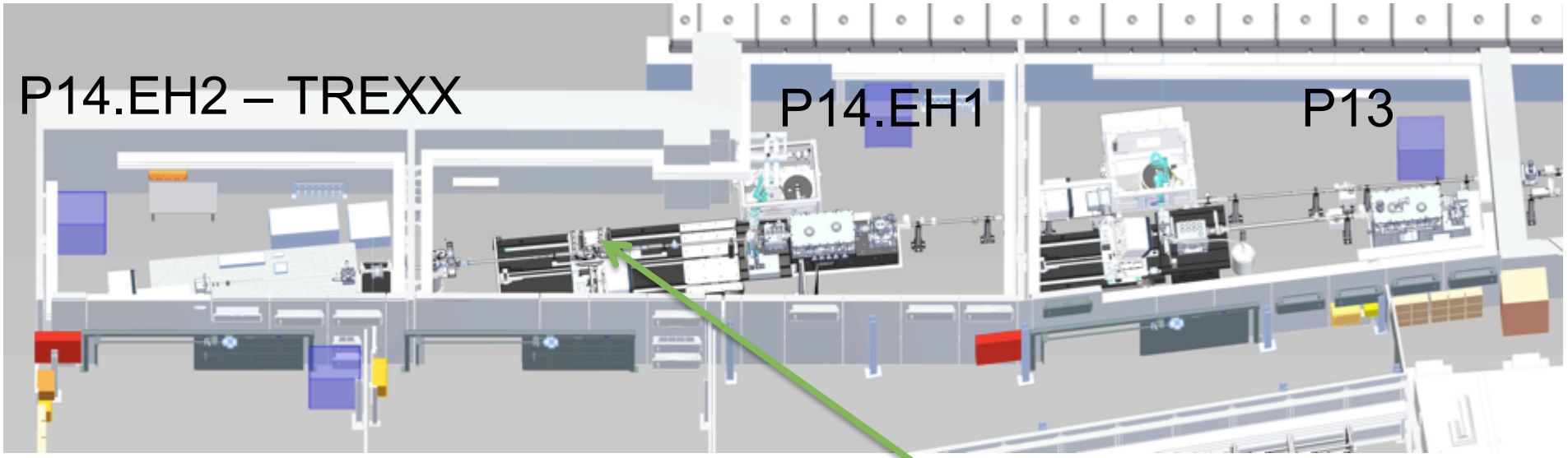






Schulz, Mehrabi, Müller-Werkmeister et al. Nat. Methods *2018*

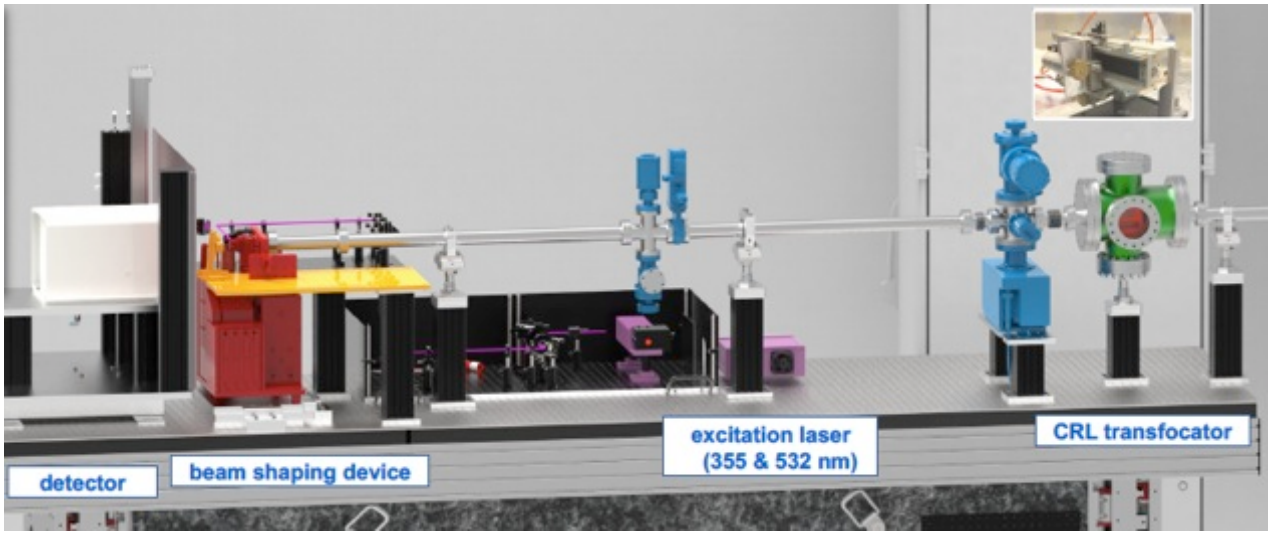
Dedicated P14 end station for time-resolved MX

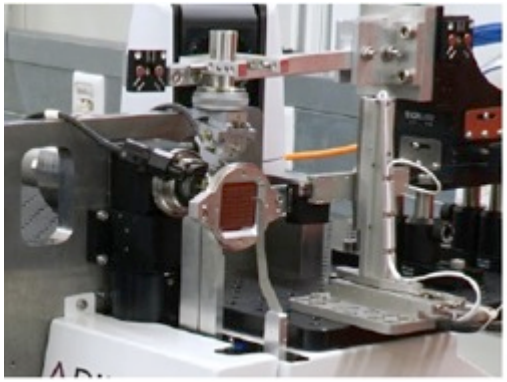


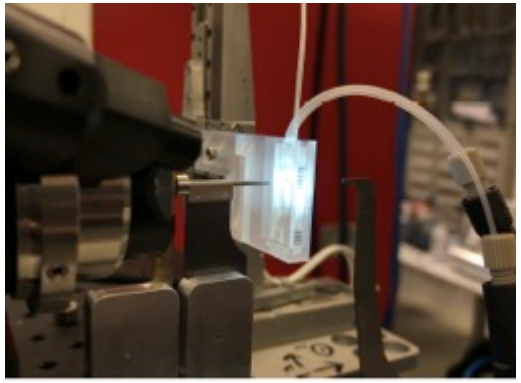
- In operation since 10/2018
- EH1/EH2 switch in 1 hour
- 66 shifts scheduled for 2019
- 1-day allocations

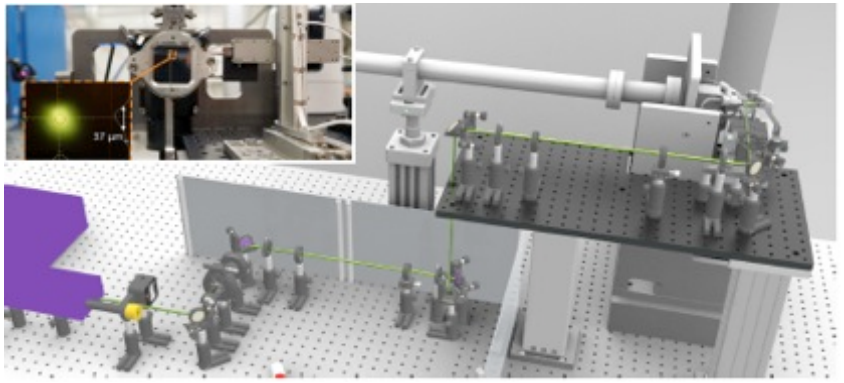
beam transport

TREXX Instrumentation

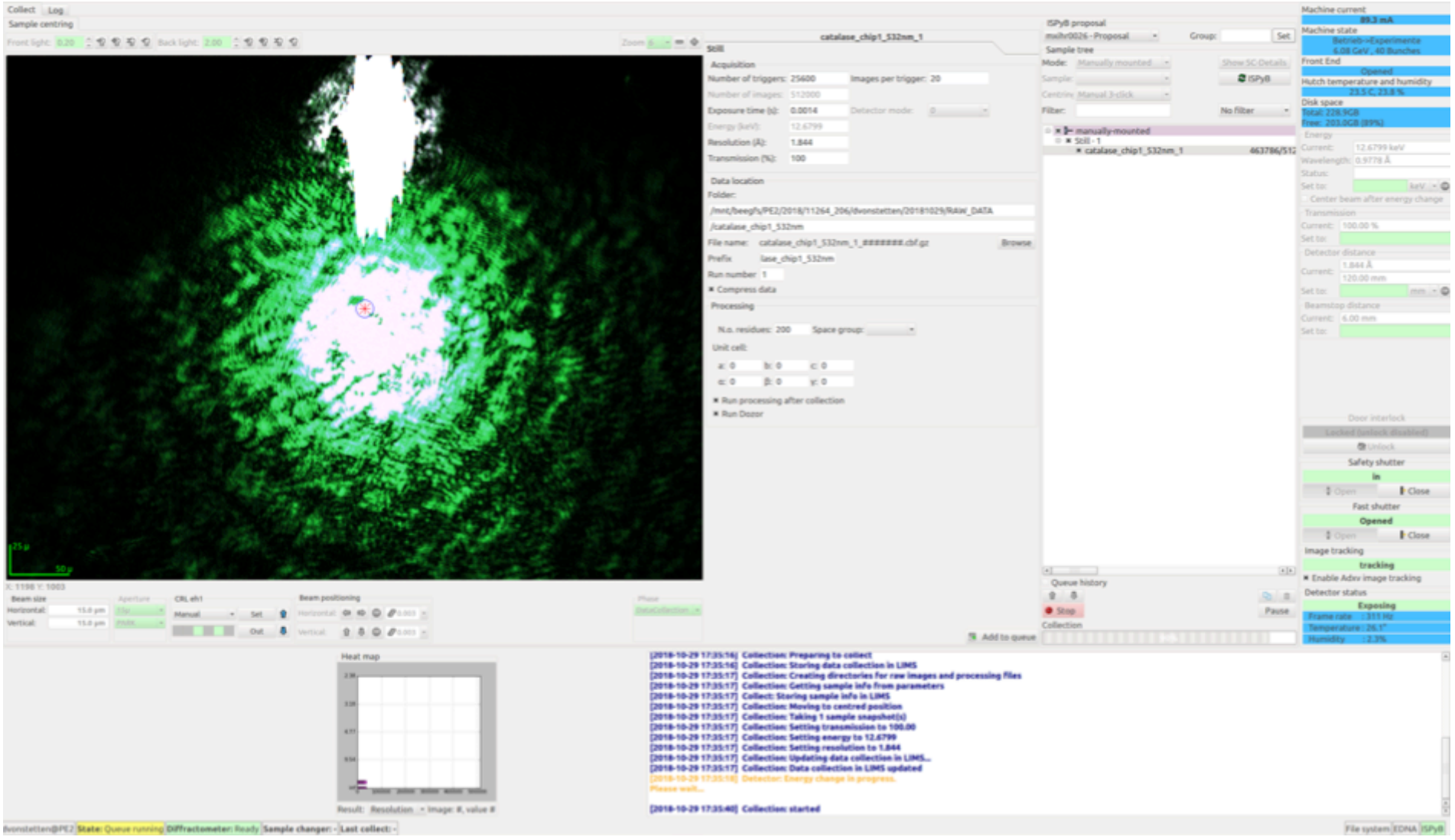




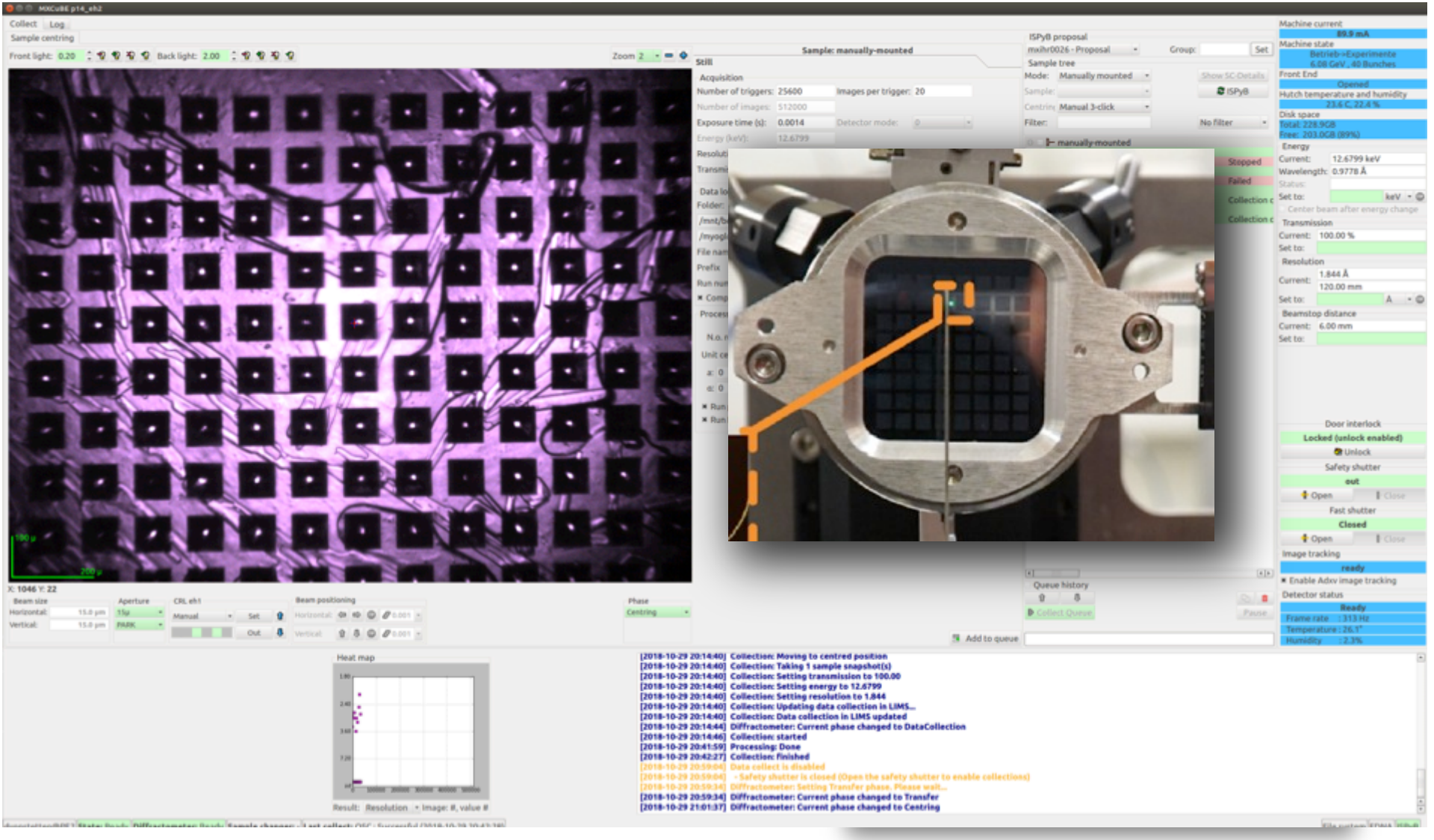




MXCuBE @ TREXX : data acquisition



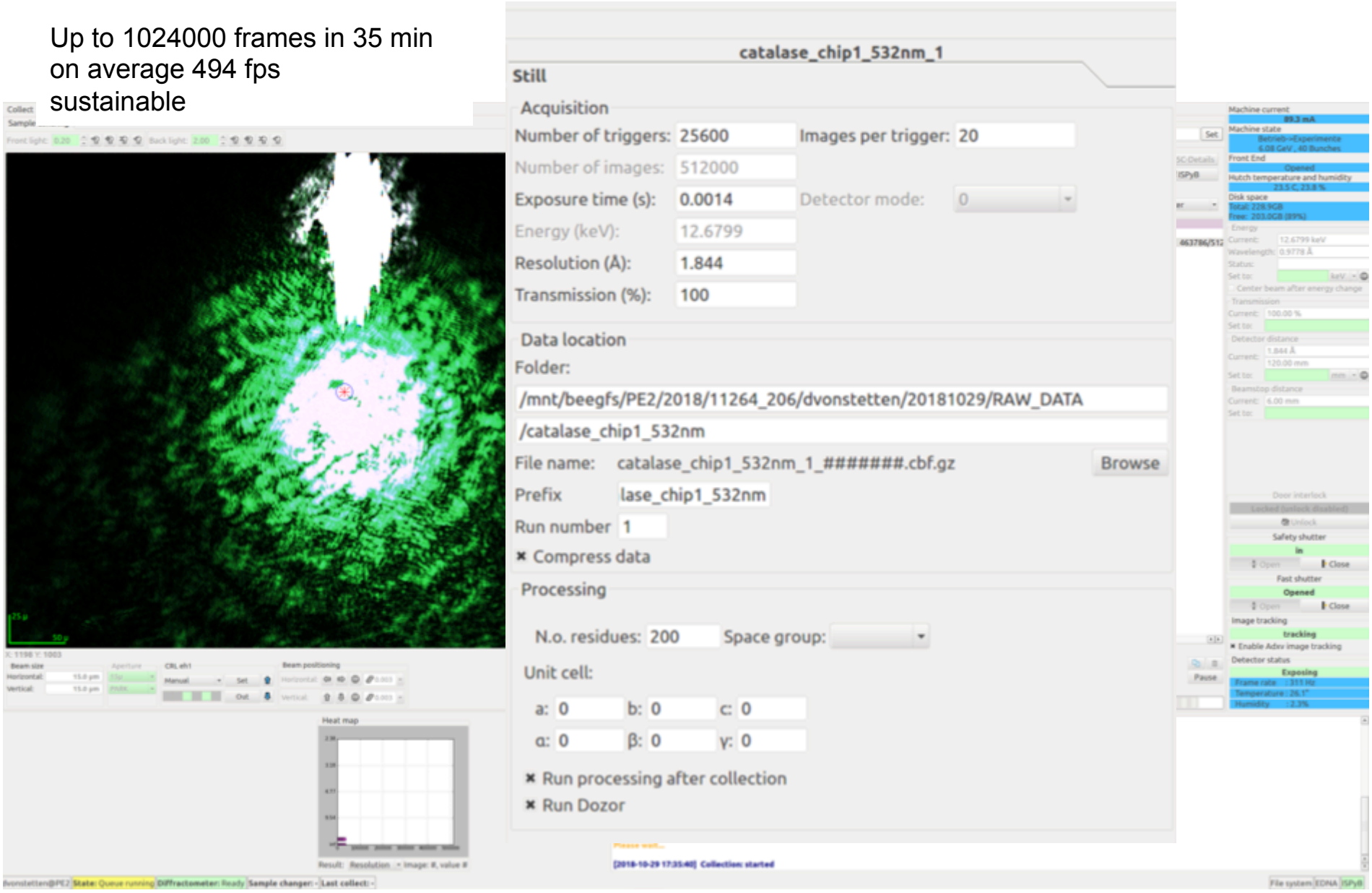
MXCuBE at TREXX : chip centering in IR light (Arinax OAV)



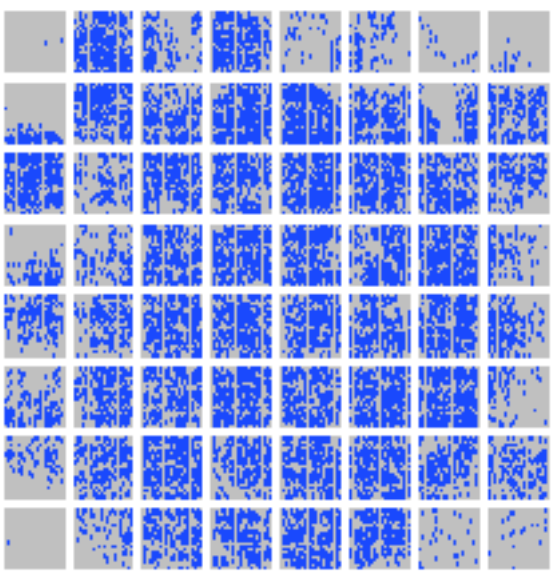
Currently not connected to the chip scanner motors

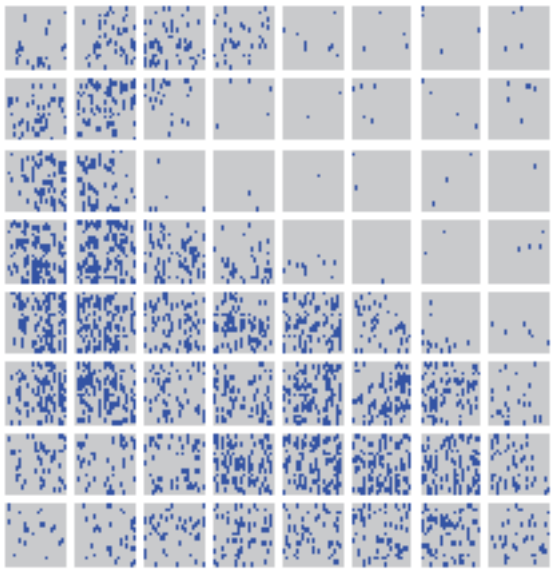
MXCuBE @ TREXX : data acquisition

Up to 1024000 frames in 35 min
on average 494 fps
sustainable

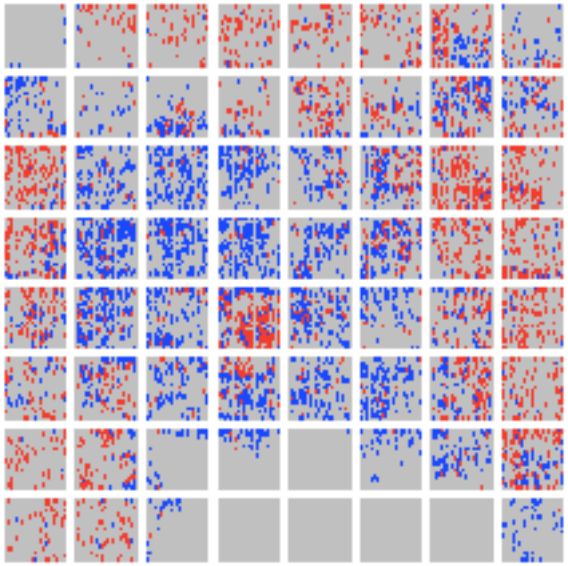


Hit maps





DOZOR
real time
chip coverage

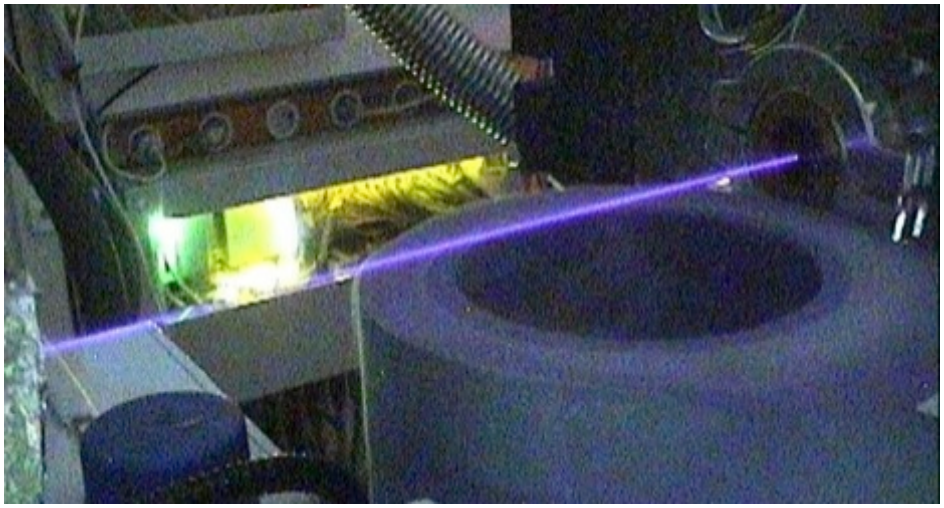


CRYSTFEL
post processing
different unit cells

On going

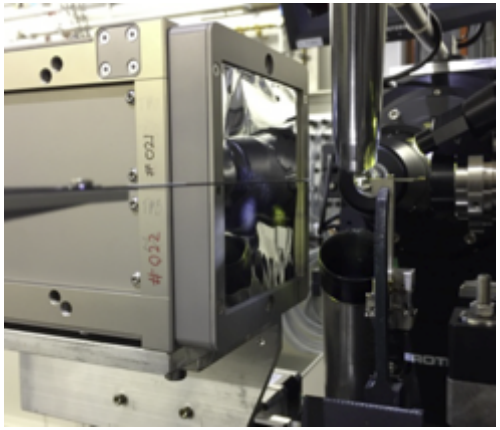
- Chip scanner device server
- Scan trajectory and triggers definition in MXCuBE
- On line auto-processing with
    - EDNA CRYSTFEL plugin
    - EDNA nXDS plugin

Future



Ionized air glow , $4x10^{14}$ photon/second $\Delta E/E=1.5\%$
with Double SiW multilayer @ P12/PETRAIII
S. Fiedler, EMBL-Hamburg Instrumentation group

- 100 fold increase in flux with broad energy bandwidth optics
- 150 ps single-bunch exposures will become feasible



JUNGFRAU Detector at SLS

- Integrating pixel-array detectors

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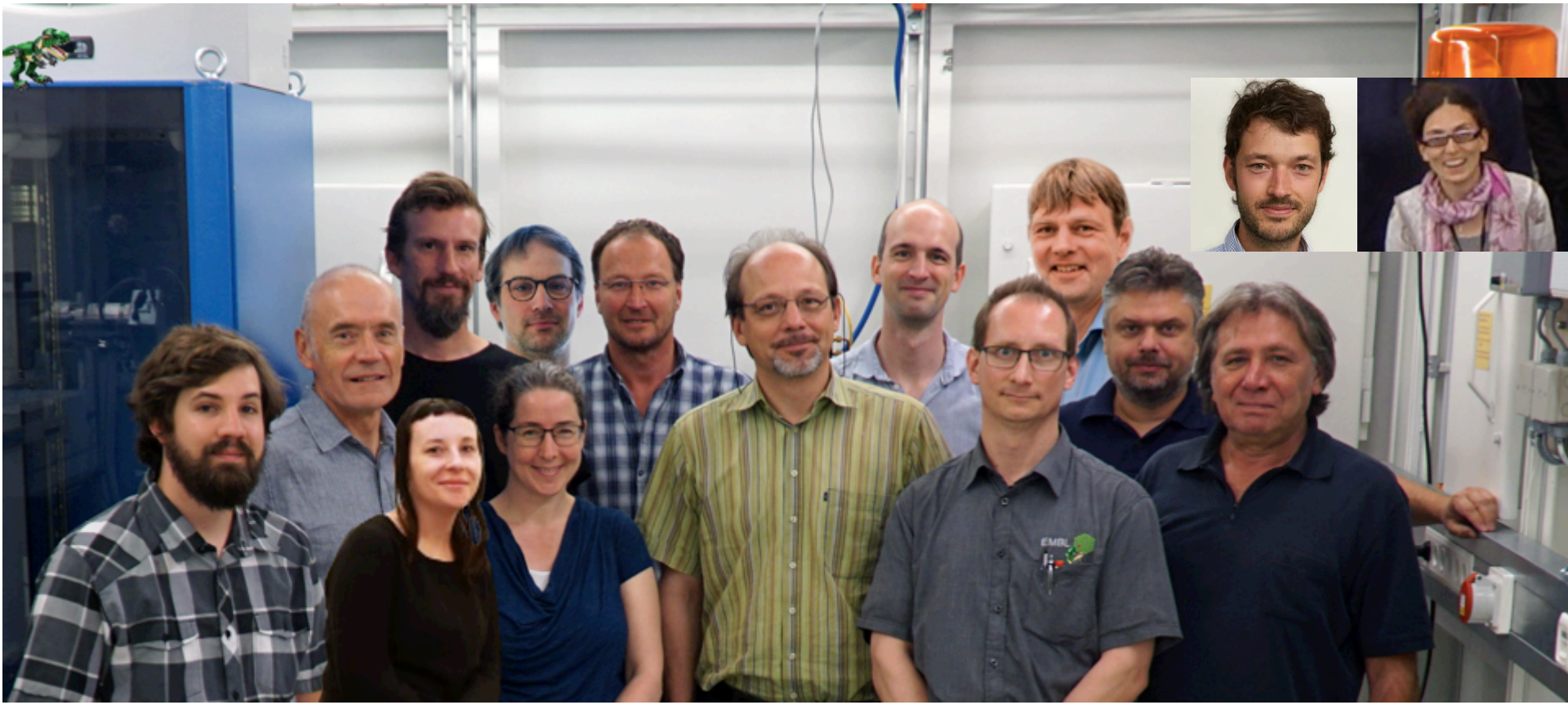
Acknowledgements



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