

P99: An optical beamline for offline technique development and systems integration for prototype beamline instrumentation

Aaron Parsons, Diamond Light Source

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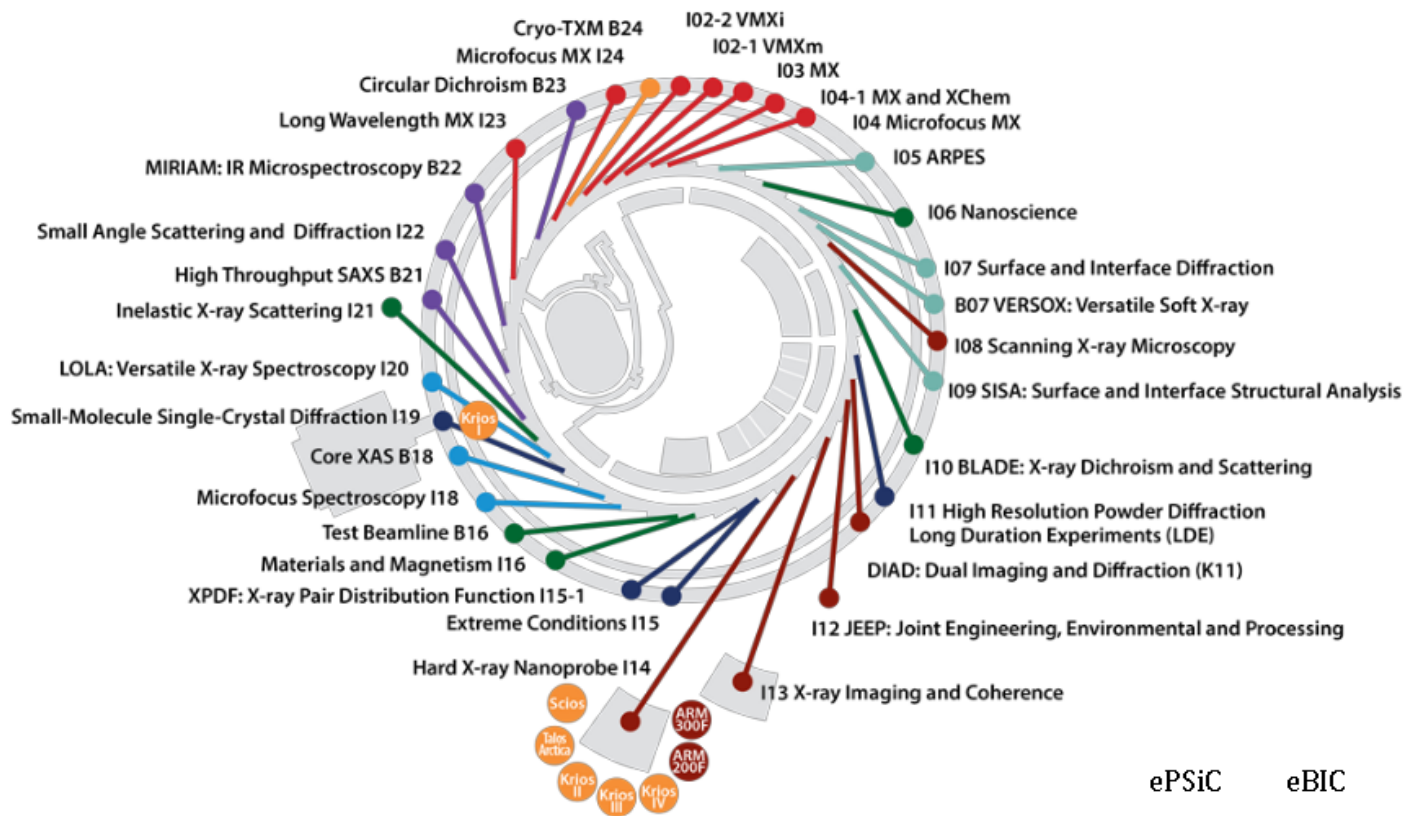
"Test what you fly, fly what you test"

NASA

Bucher, 2001

Diamond

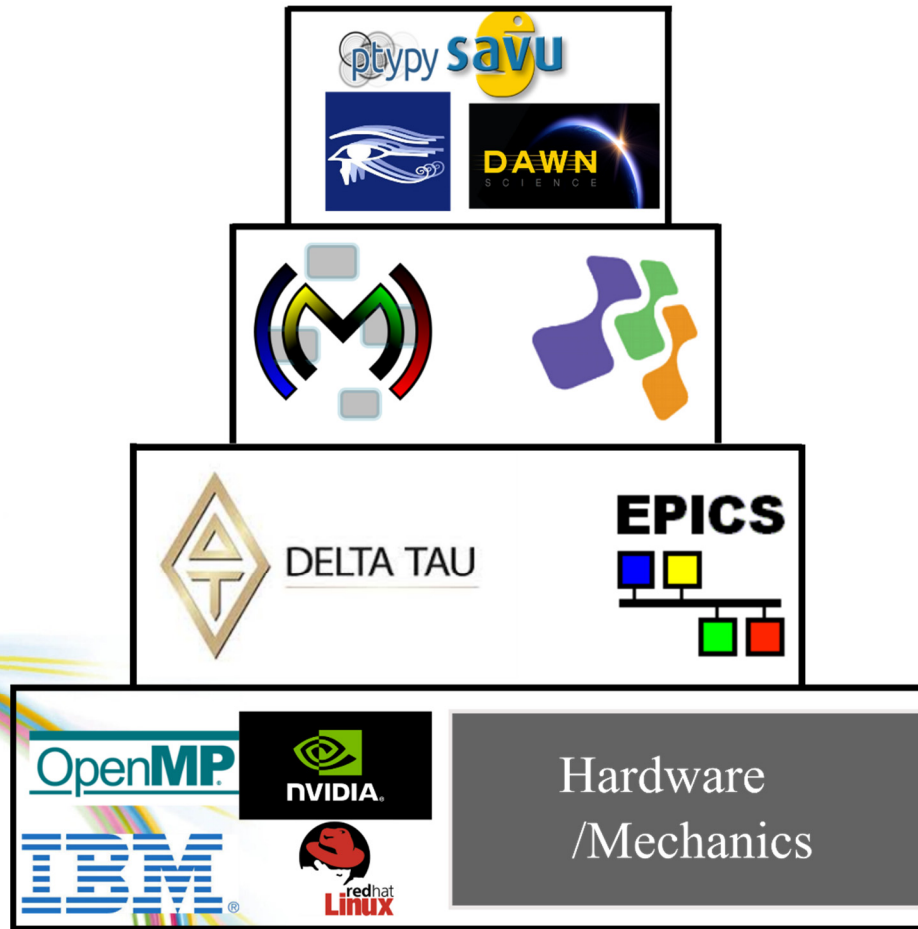
37 instruments



ePSiC

eBIC

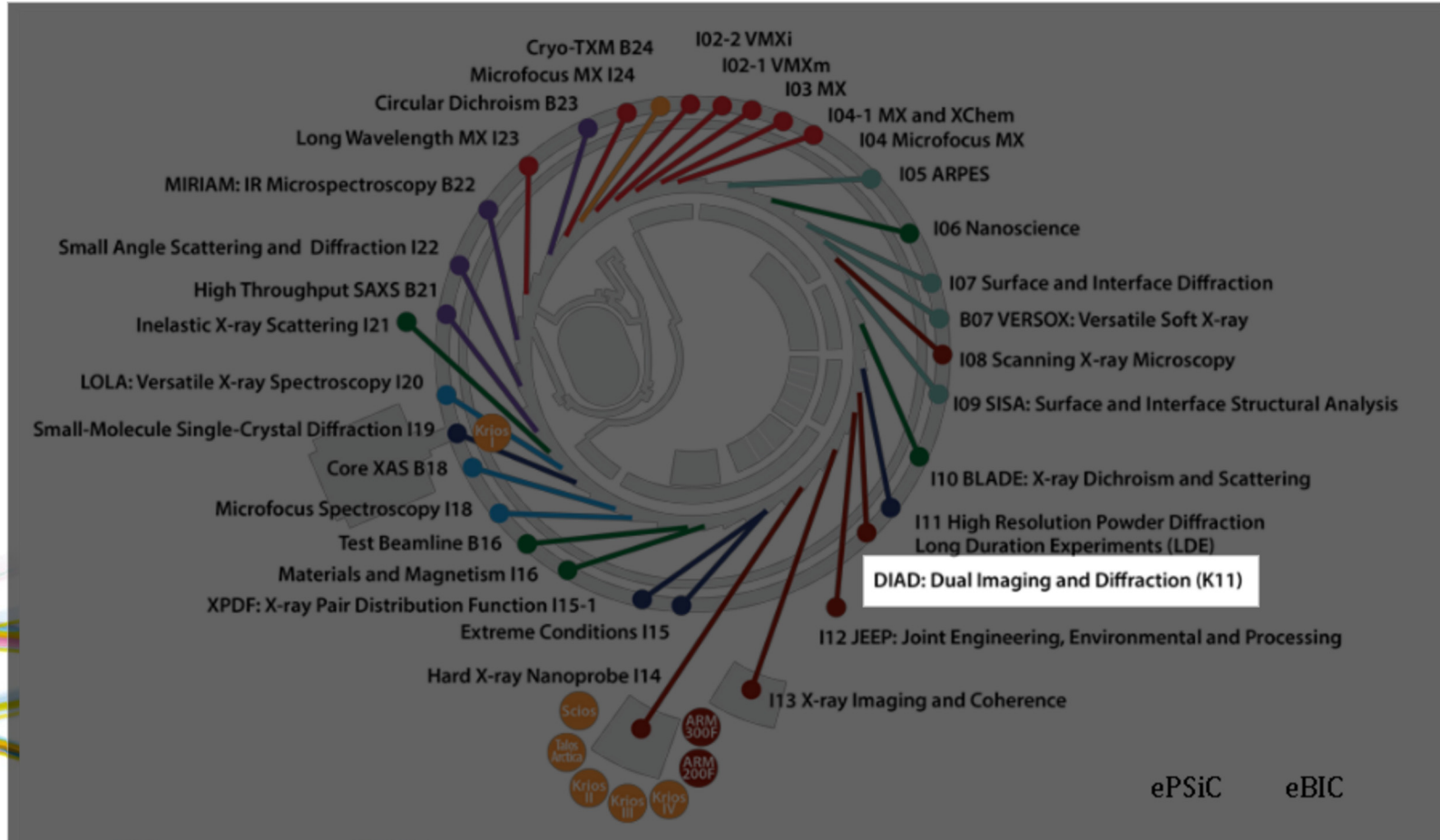
Software Stacks for Science



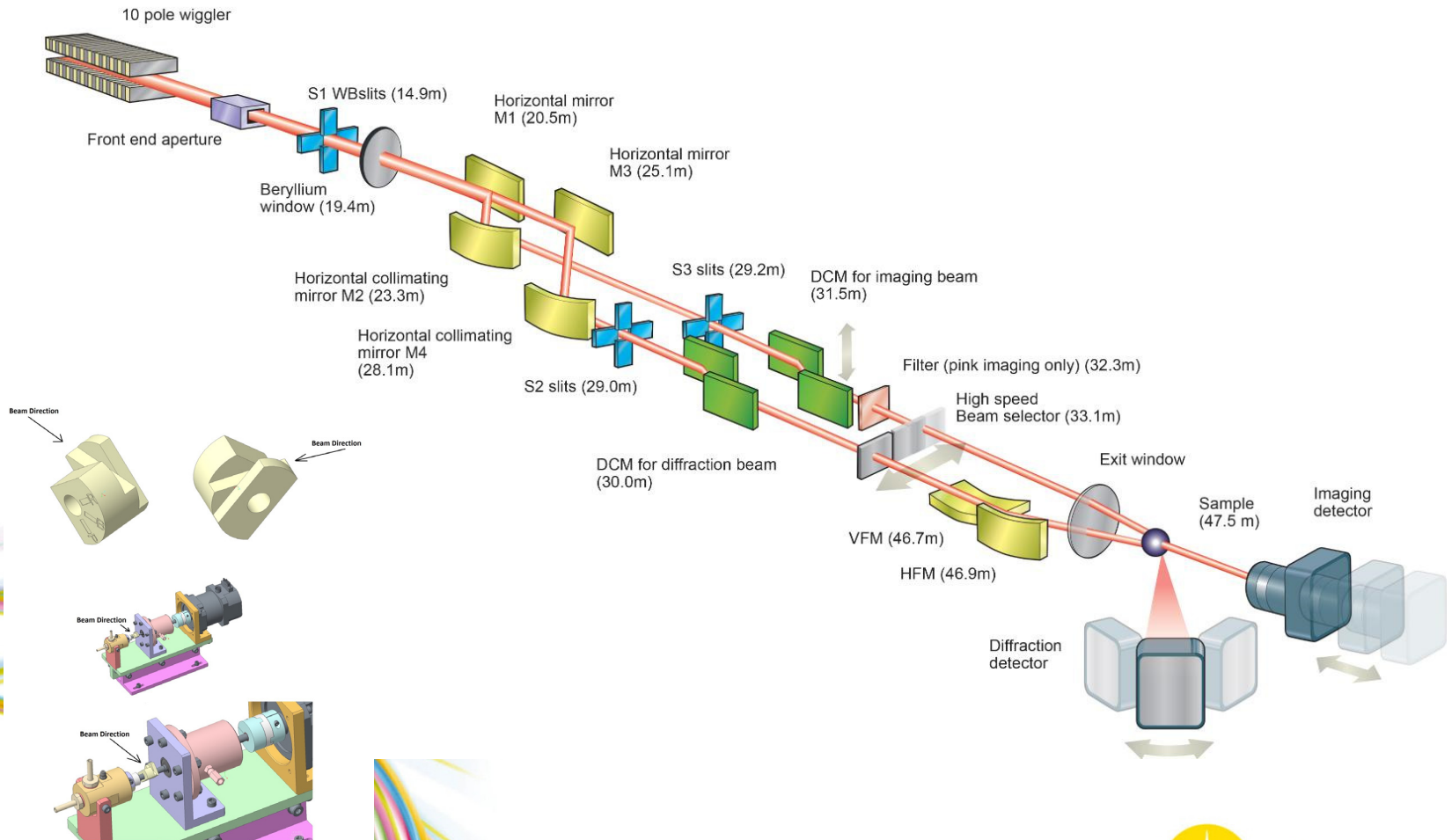
P99



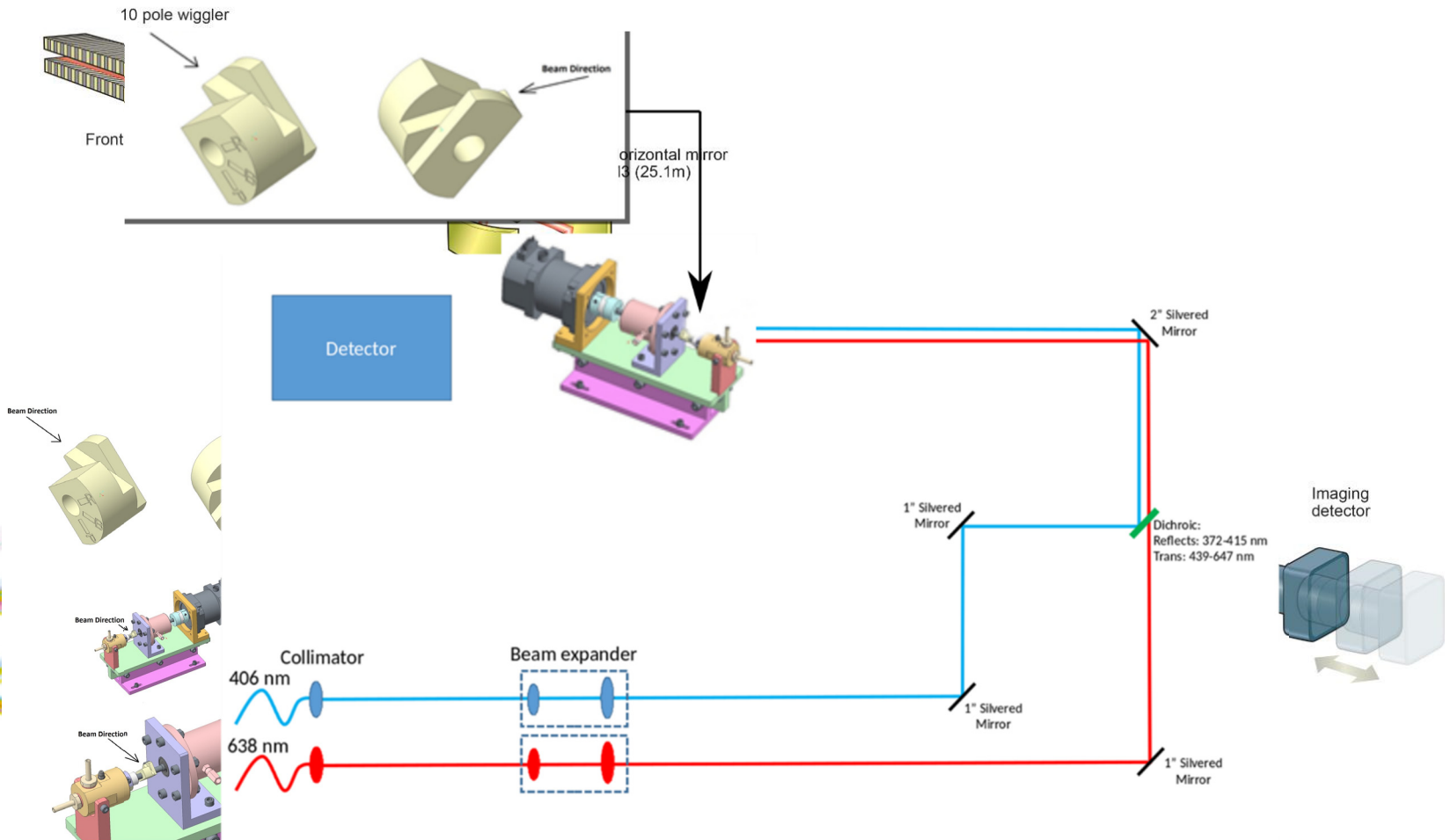
DIAD beam selector testing



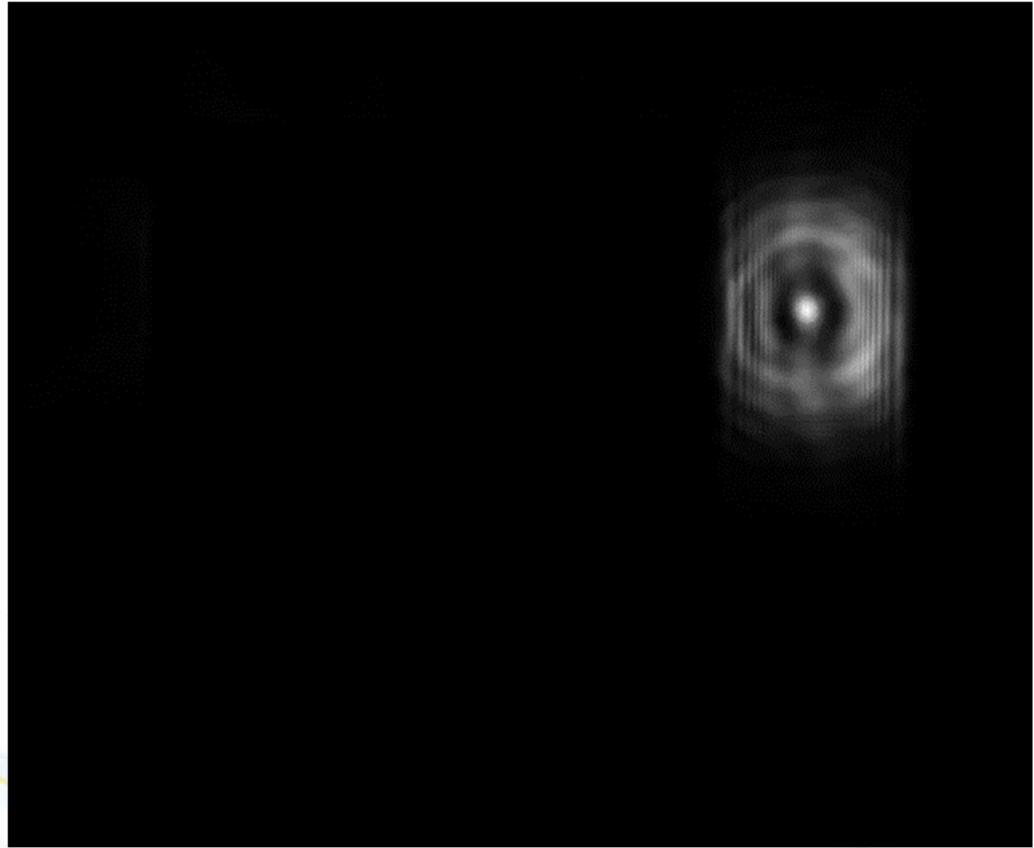
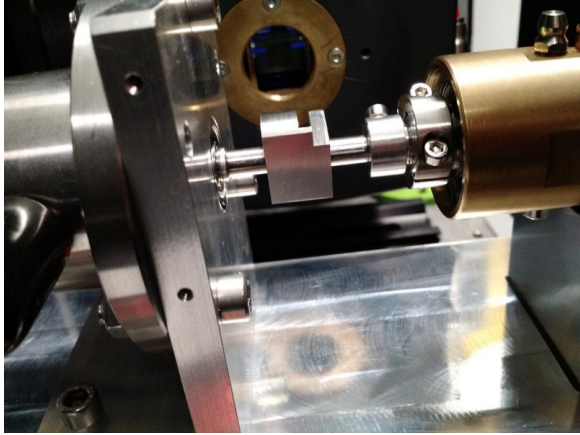
DIAD: Dual Imaging and Diffraction



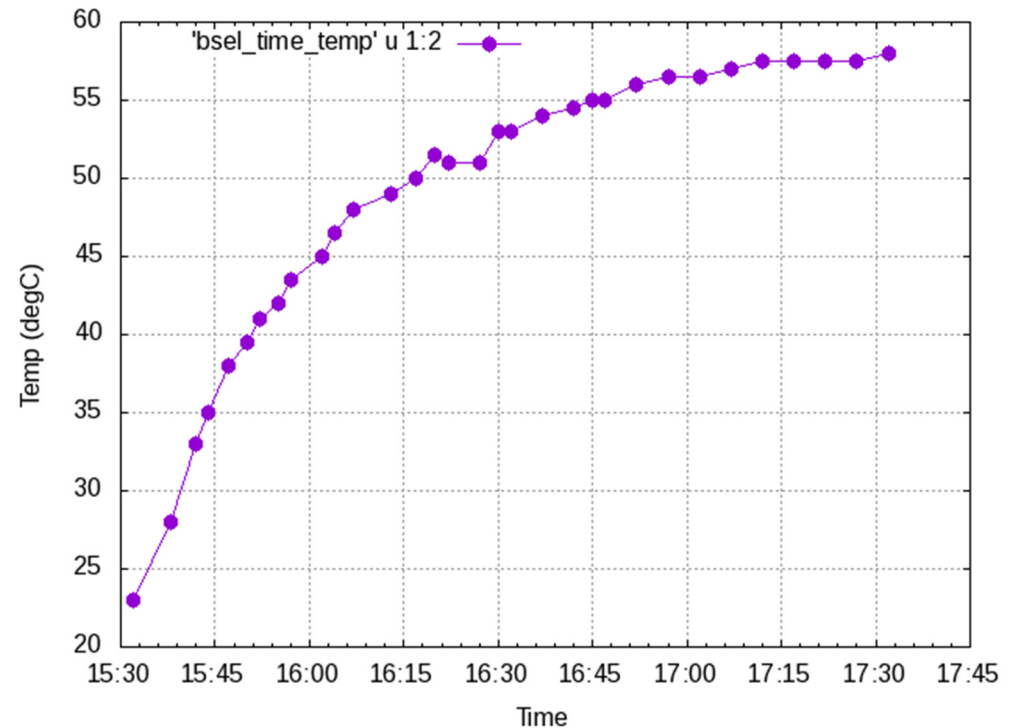
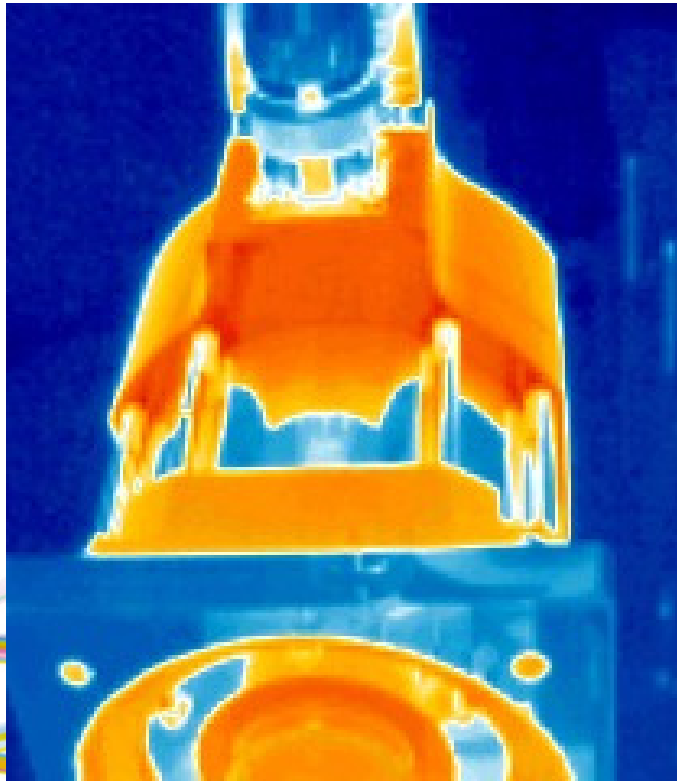
DIAD: Dual Imaging and Diffraction



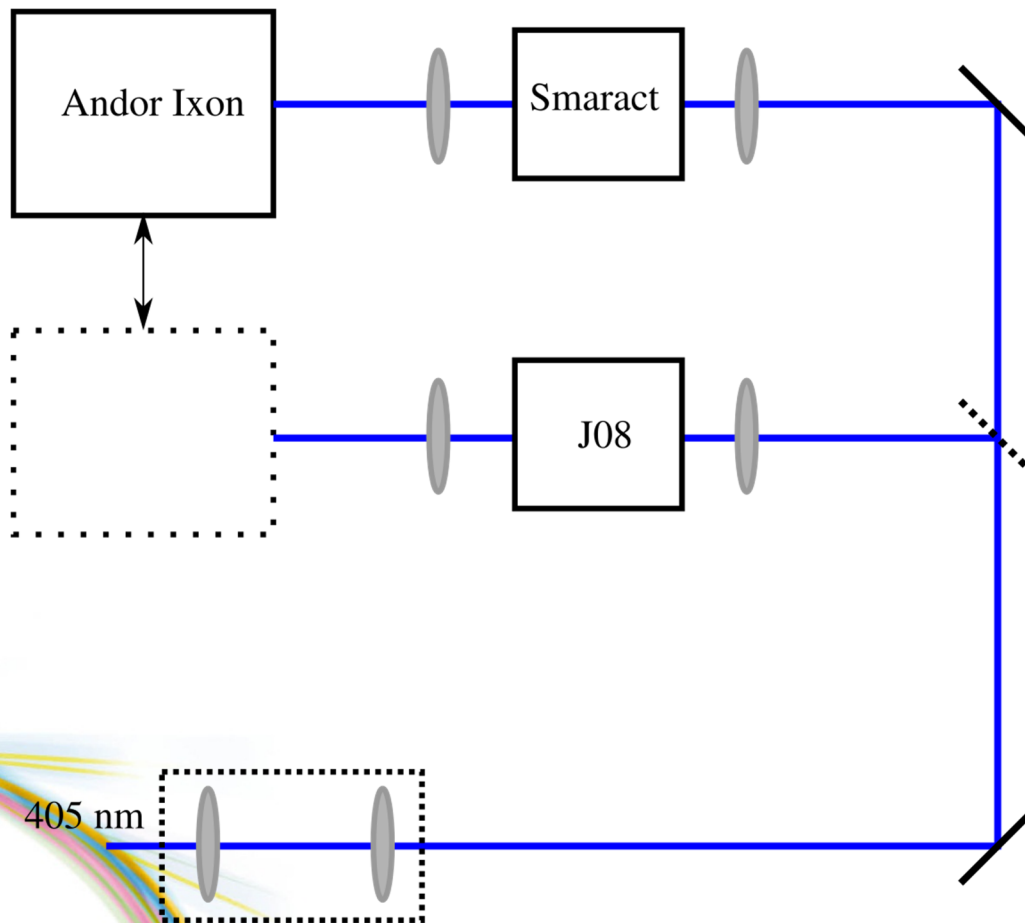
DIAD: Dual Imaging and Diffraction



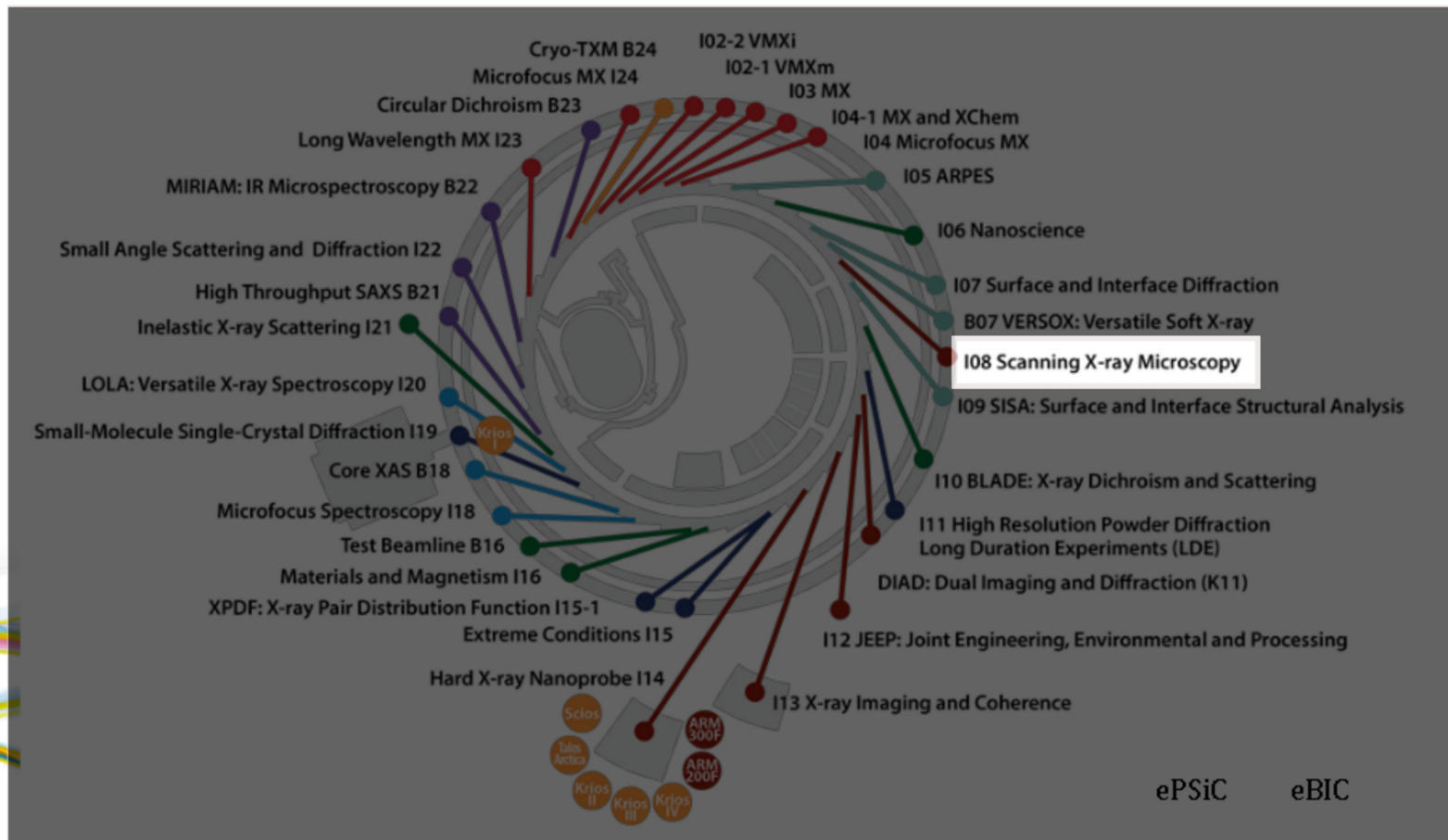
DIAD: Dual Imaging and Diffraction



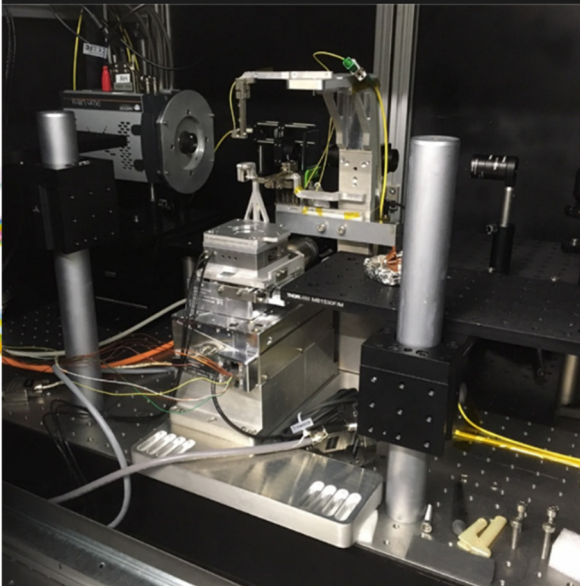
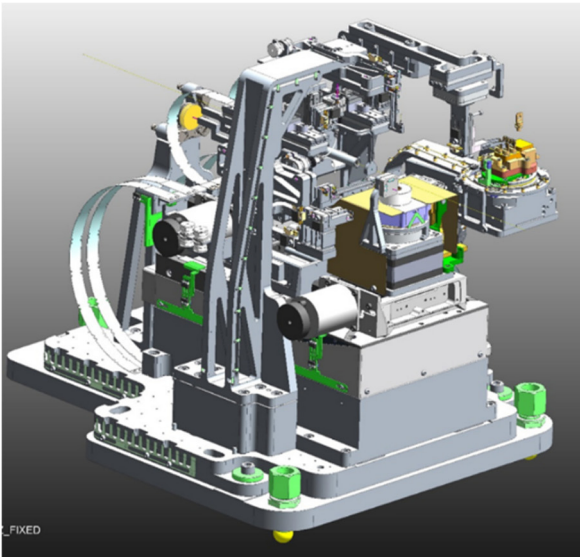
Optical Configuration



J08: Soft X-ray Ptychography

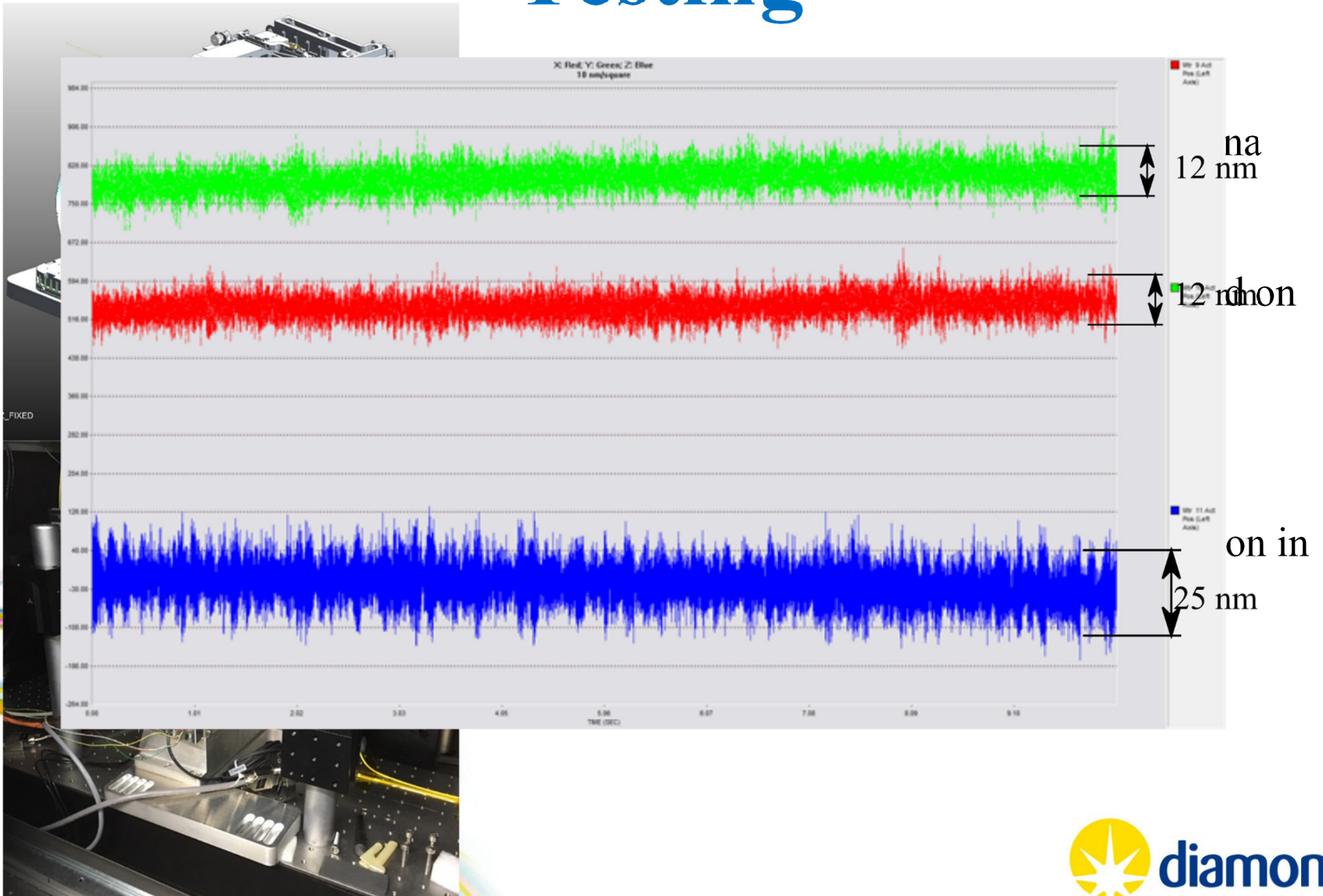


Testing

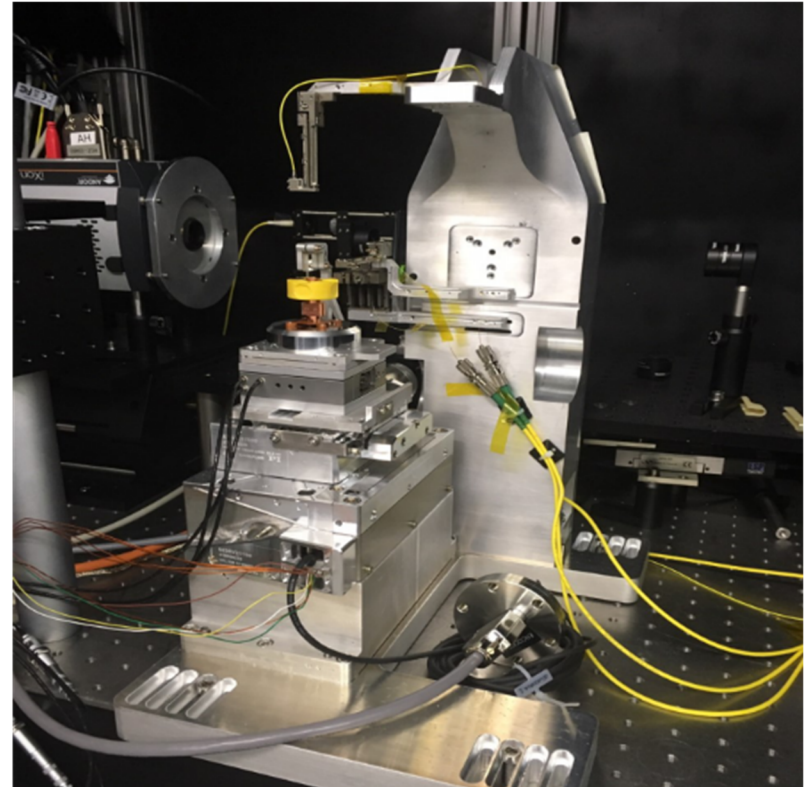
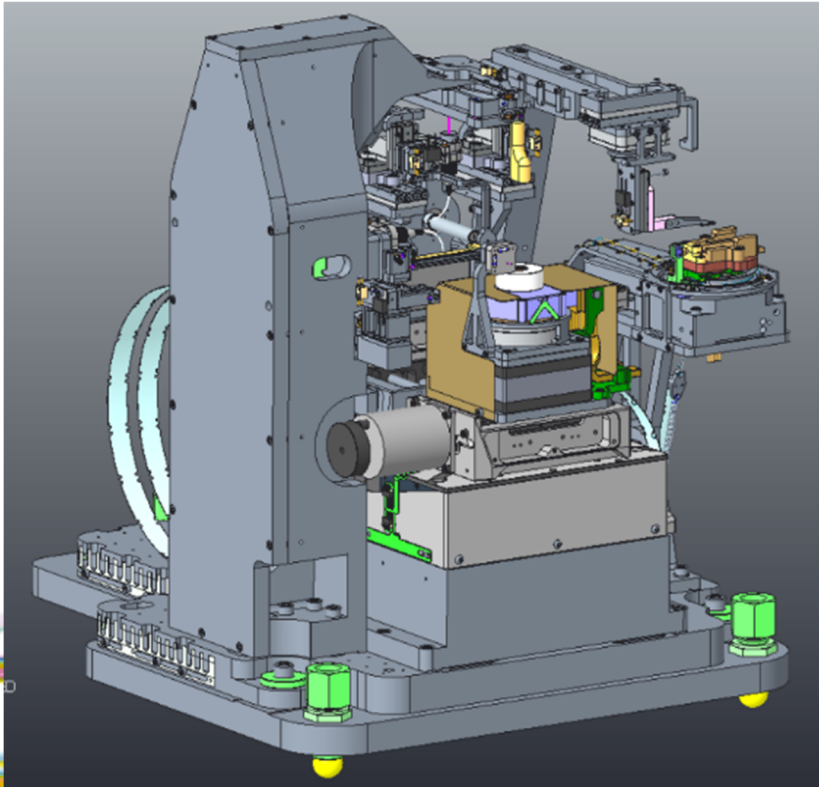


- Coarse XY stepper motor stack (PI-Micos) + fine flexure stage (Piezo Jena Tritor 101)
- Attocube IDS interferometer mounted on reference arm
- 5 nm resolution target
- Can trade off instability with relaxation in analysis, but expensive.

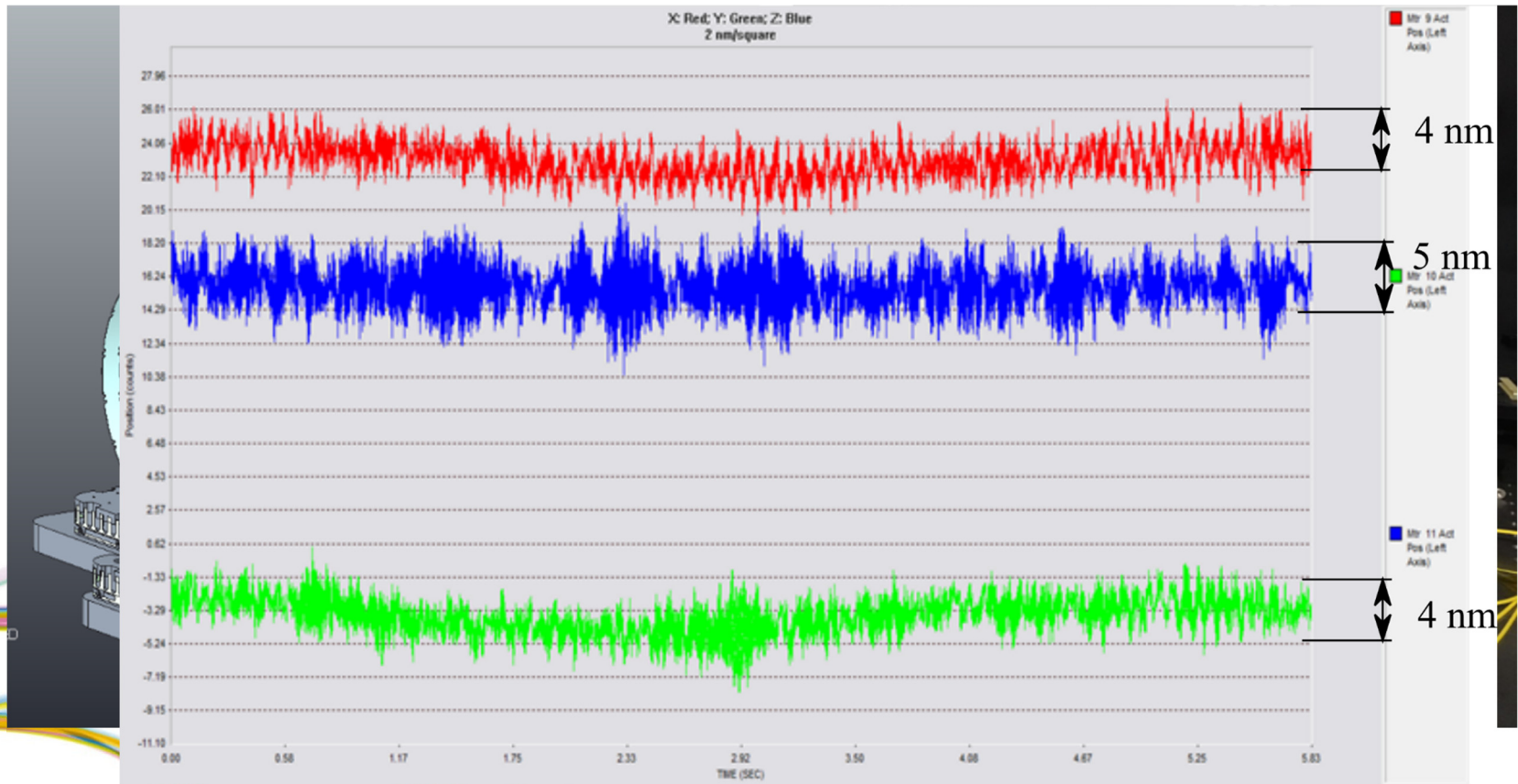
Testing



New design

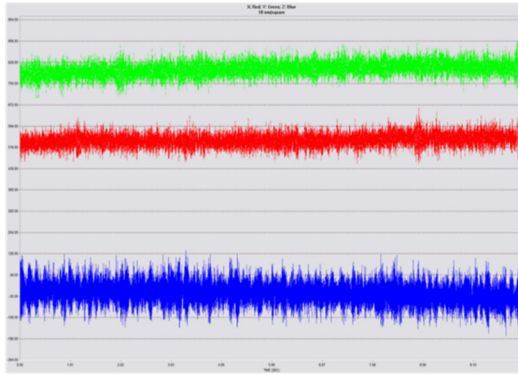


New design

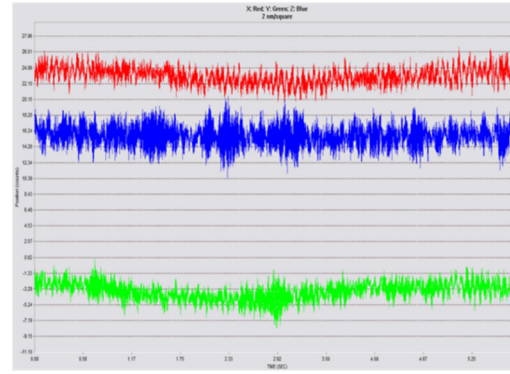


New design

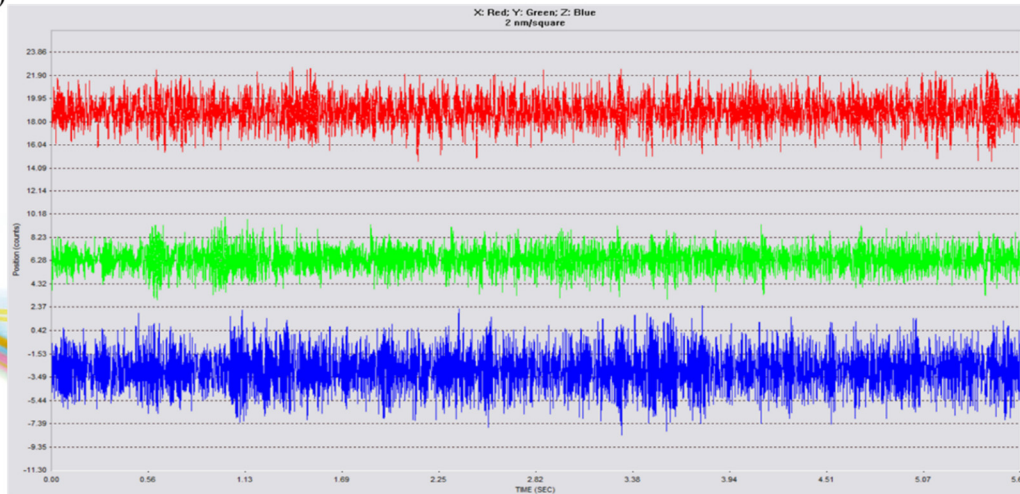
a)



b)

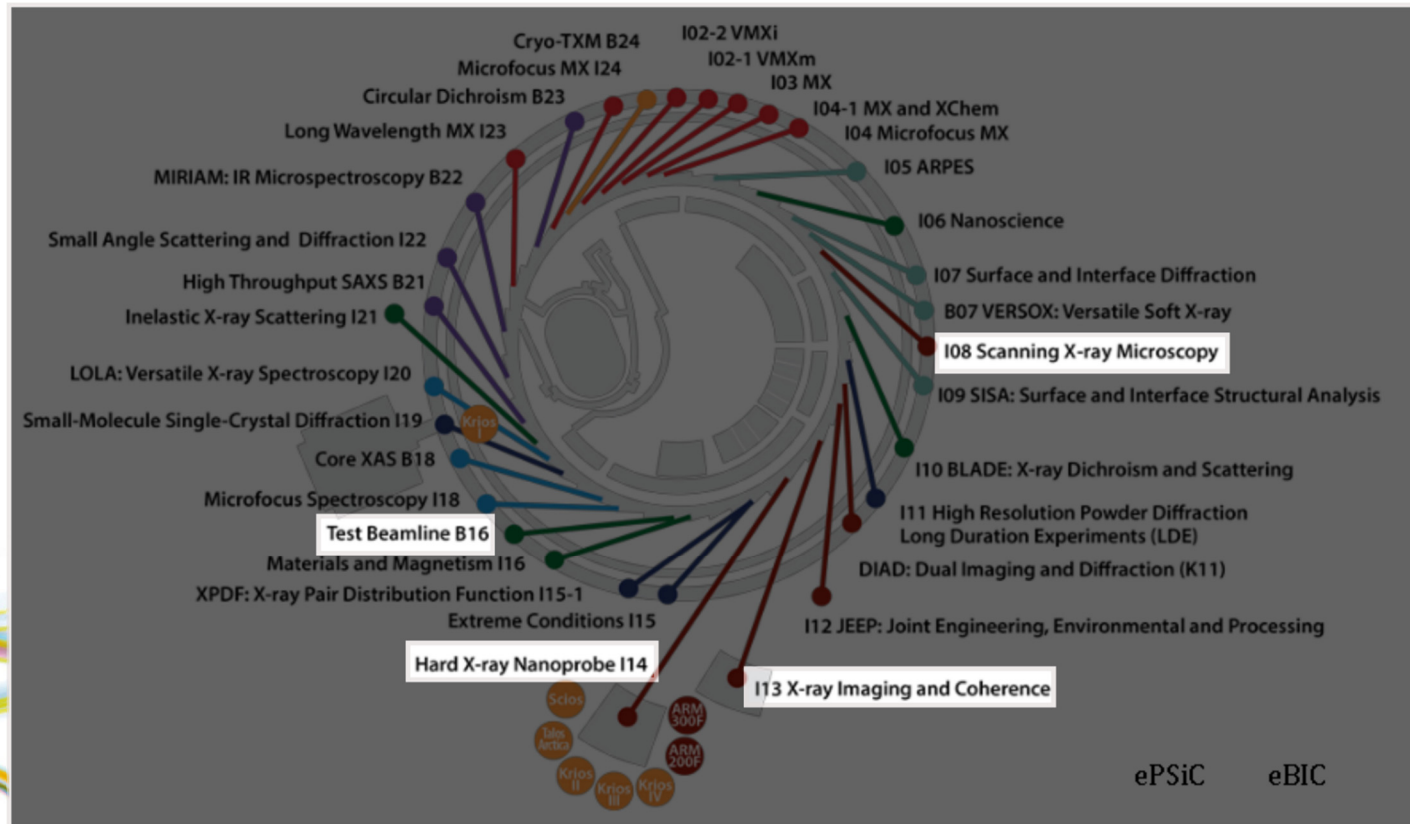


c)



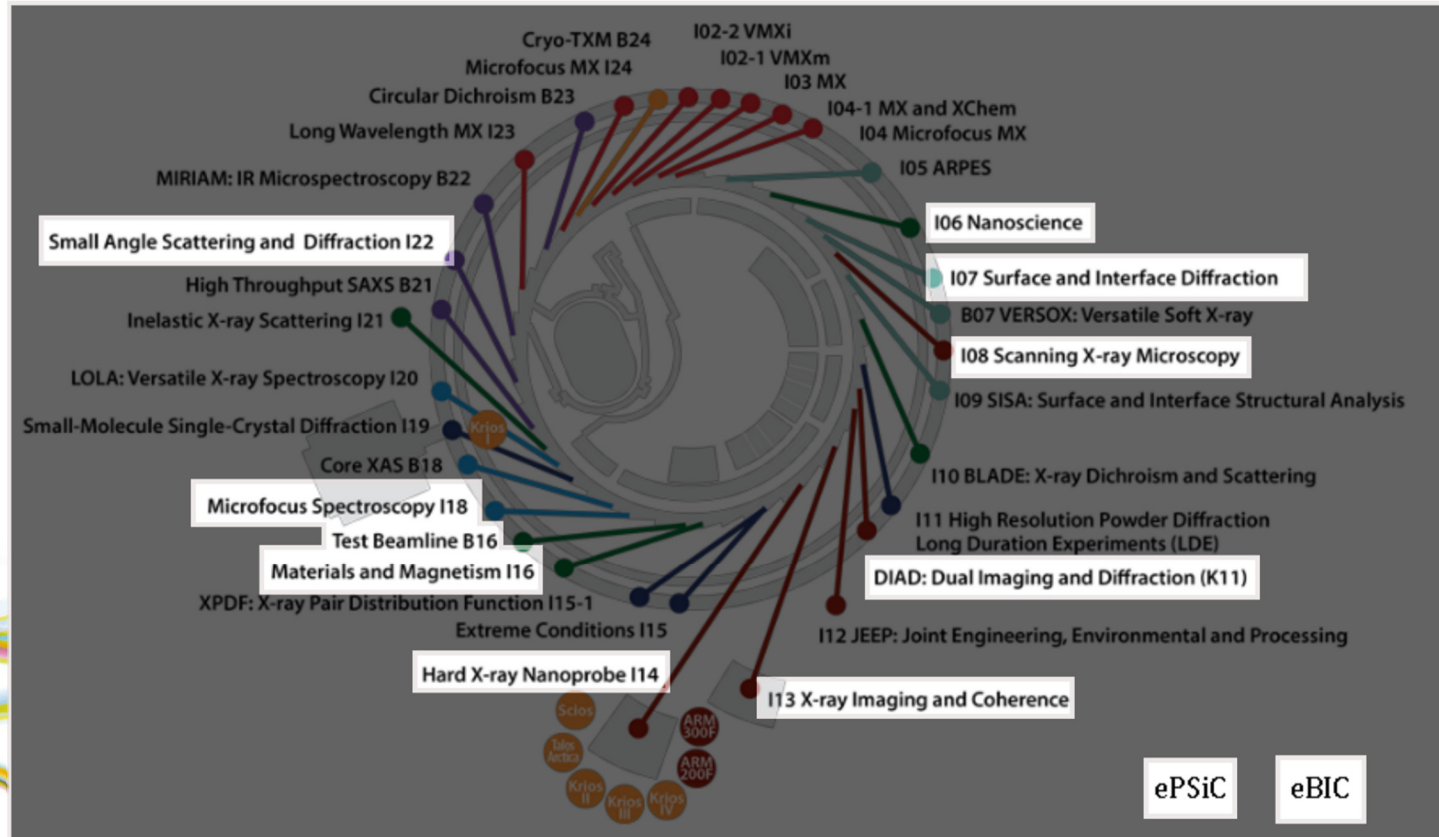
Current Ptychography Instruments

4 instruments



(Very near) Future Ptychography Instruments

12 instruments



The Mapping Project

The screenshot displays the 'Data Acquisition Client - Beamline I08 - 9.8.0' software interface. The main window is titled 'Data Acquisition Client - Beamline I08 - 9.8.0' and contains several panels:

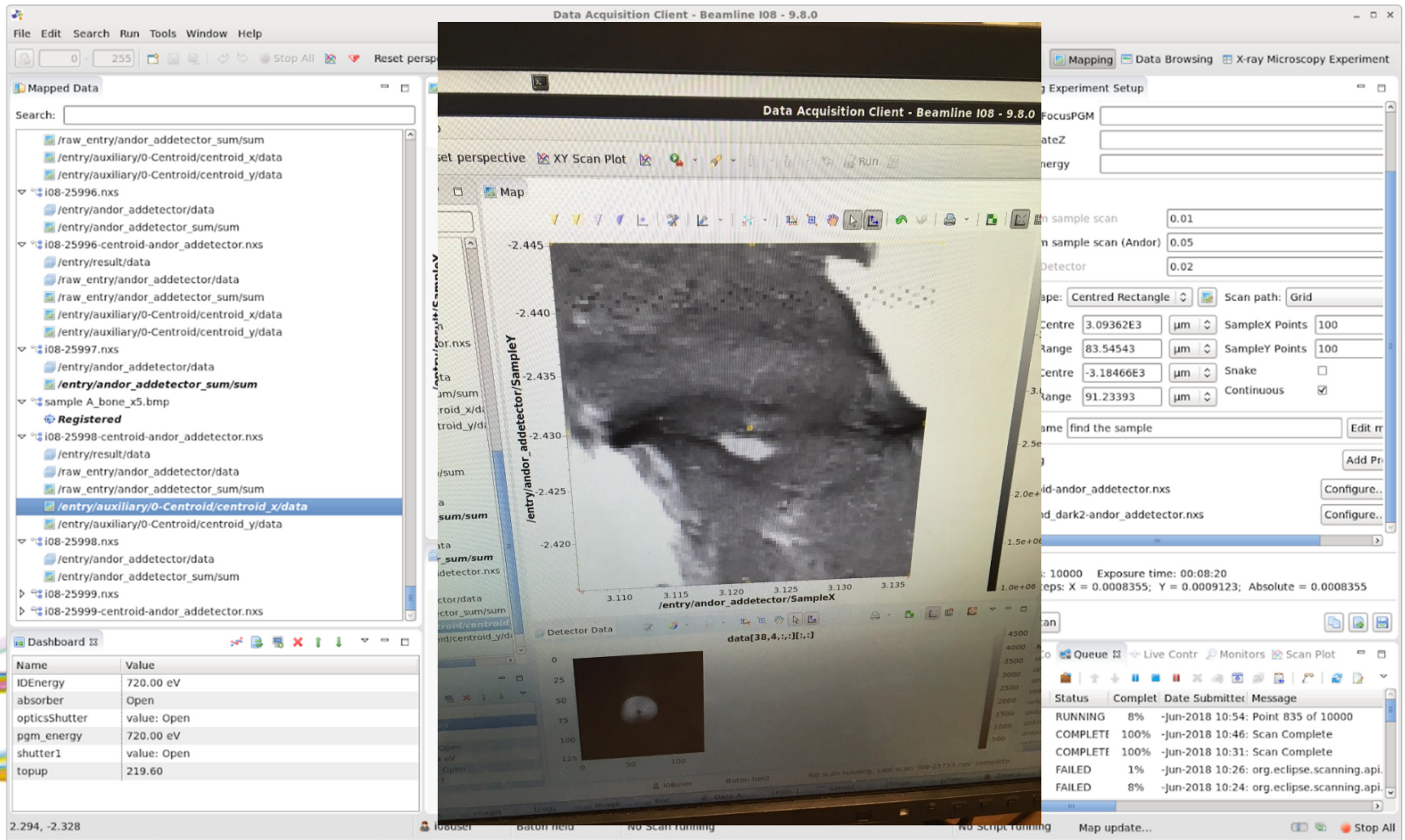
- Mapped Data:** A file tree on the left showing the directory structure of the experiment data, including folders for different sample scans and their associated data files.
- Map:** A central plot showing a 2D grid of detector data. The x-axis is labeled '/entry/result/SampleX' and the y-axis is labeled '/entry/result/SampleY'. The plot shows a grid of orange and black squares, with a white grid overlaid on top.
- Mapping Experiment Setup:** A panel on the right containing various configuration options for the mapping experiment, such as 'energyFocusPGM', 'ZonePlateZ', 'pgm_energy', and 'Detectors'. It also includes fields for 'SampleX Centre', 'SampleX Range', 'SampleY Centre', and 'SampleY Range'.
- Detector Data:** A panel at the bottom center showing a zoomed-in view of a single data point, labeled '/entry/result/data[25,87,:][::]'. The plot shows a single bright spot on a dark background.
- Queue Scan:** A panel at the bottom right showing a list of scan jobs with their status and completion times. The table below shows the data from this panel:

Status	Comple	Date	Submitter	Message
1	RUNNING	8%	-Jun-2018 10:54:	Point 835 of 10000
1	COMPLETE	100%	-Jun-2018 10:46:	Scan Complete
1	COMPLETE	100%	-Jun-2018 10:31:	Scan Complete
1	FAILED	1%	-Jun-2018 10:26:	org.eclipse.scanning.api.
1	FAILED	8%	-Jun-2018 10:24:	org.eclipse.scanning.api.

Mark Basham, Jacob Filik, et al, Synch. Rad. News, 31:5, 21-26 2018



The Mapping Project



Mark Basham, Jacob Filik, et al, Synch. Rad. News, 31:5, 21-26 2018



Ptychography Project Aims

1. Bring close-to-real-time ptychography measurements to 5 state-of-the-art imaging instruments (I08, J08, I14, I13, ePSiC)
2. **Measurement** rather than an **experiment**
3. Upgrading of core controls and analysis capabilities
4. Controls software developed to achieve movements and frame-rates synchronized to 10 kHz
5. Automatic analysis, displayed back to the user interface as quickly as possible (GPU acceleration, Zocalo pipelines [WEMPR001, Markus Gerstel, Wednesday]).

So far...

- pyMalcolm upgrade - **done**
- OS update across Diamonds infrastructure from Redhat (el6 to el7) - **done**
- Bug shooting Andor Technology SDK's - **done**
- Paused and rewind of scans (allowing pausing for machine top-up) - **done**
- Towards true position compare \rightarrow 10 kHz – **in progress**
- Zocalo pipeline for auto processing from NXcxi_ptycho application definition – **nearly complete**
- Implementation of DAWN (Data Analysis Workbench) and the Ptypy frameworks to handle the data processing - **complete**
- GPGPU (General Purpose Graphics Processing Unit) upgrade – **in progress**

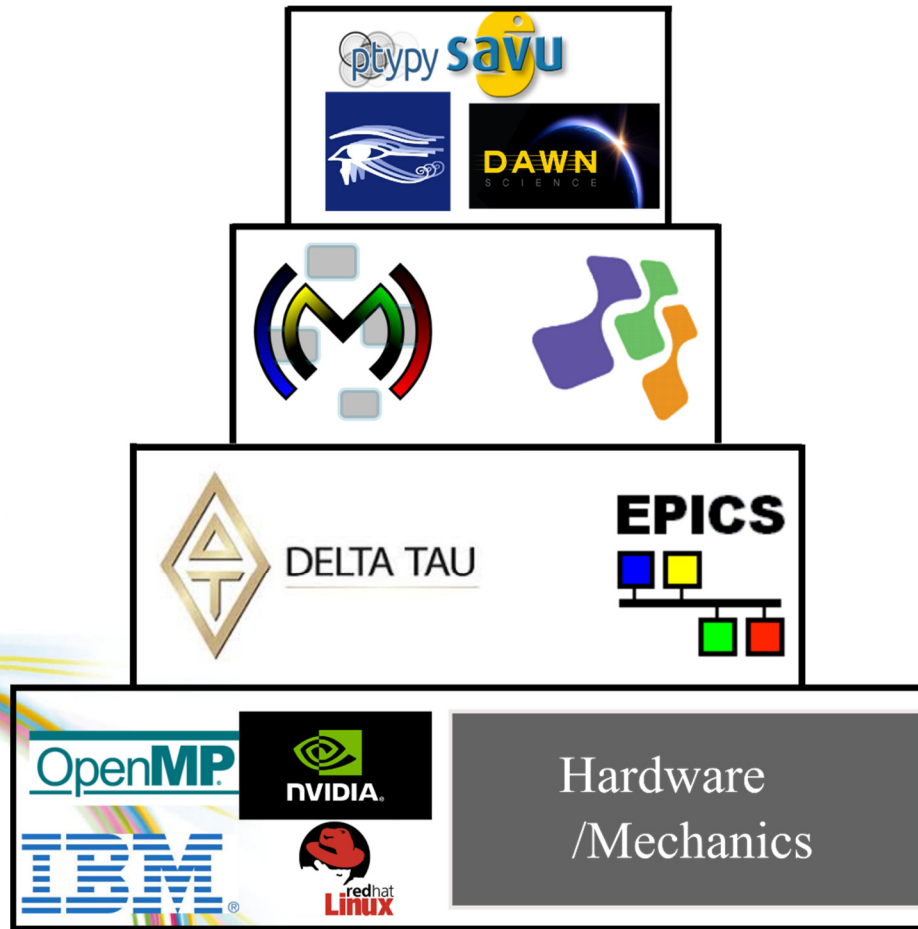
M. Basham, *et al.*, “Data analysis workbench (DAWN)”, *J. Synchrotron Rad.*, vol. 22, pp. 853-858, 2015,

doi:10.1107/S1600577515002283

B. Enders and P. Thibault P., “A computational framework for ptychographic reconstructions”, vol. 472, *Proc. R. Soc. A*, 2016, doi: 10.1098/rspa.2016.0640



What's up next?



Acknowledgements

Scientific Software

A. D. Parsons

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Beamline Controls

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M. Taylor

A. Wilson

N. Dougan

J. Shannon

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X. Tran

L. Hudson

B. Nutter

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D. Bond

F. Ferner

P. Joyce

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D. Winter

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K. Ralphs

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M. Burt

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P. Quinn

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