Operation Discussions

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8th Hard X-ray FEL Collaboration Meeting, 2016

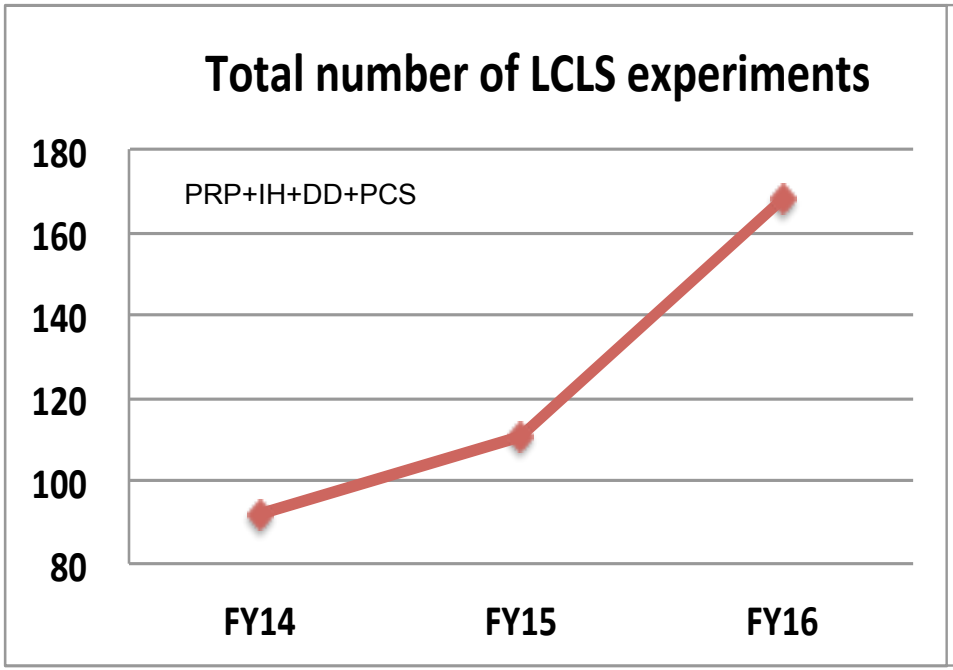
U.S. DEPARTMENT OF ENERGY
Office of Science

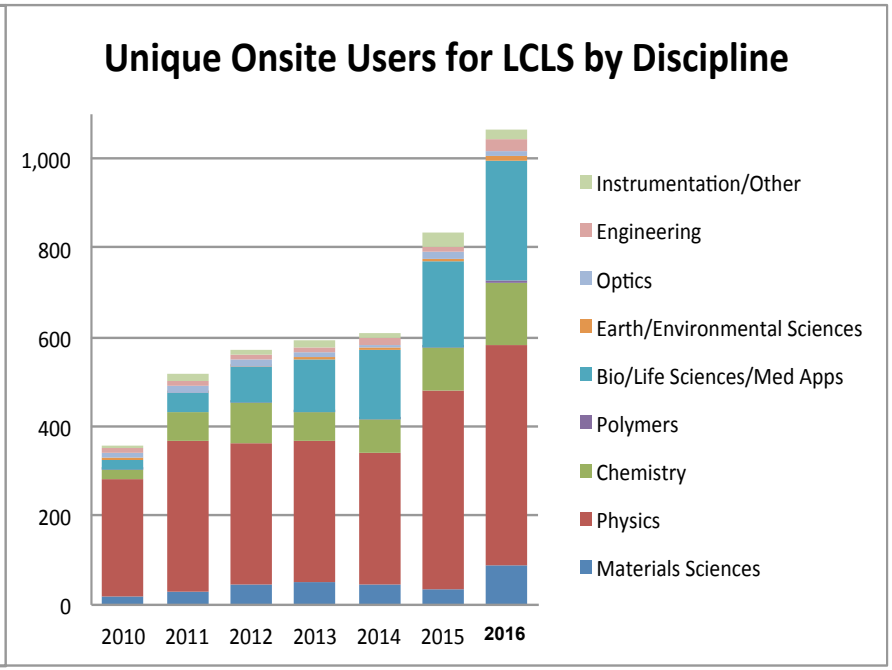
SLAC NATIONAL ACCELERATOR LABORATORY

Three Topics, Three Steps

- Increase multiplexing flexibility
- Implement standard configuration
- Opportunities for automation

Increase user access to LCLS (FY16)

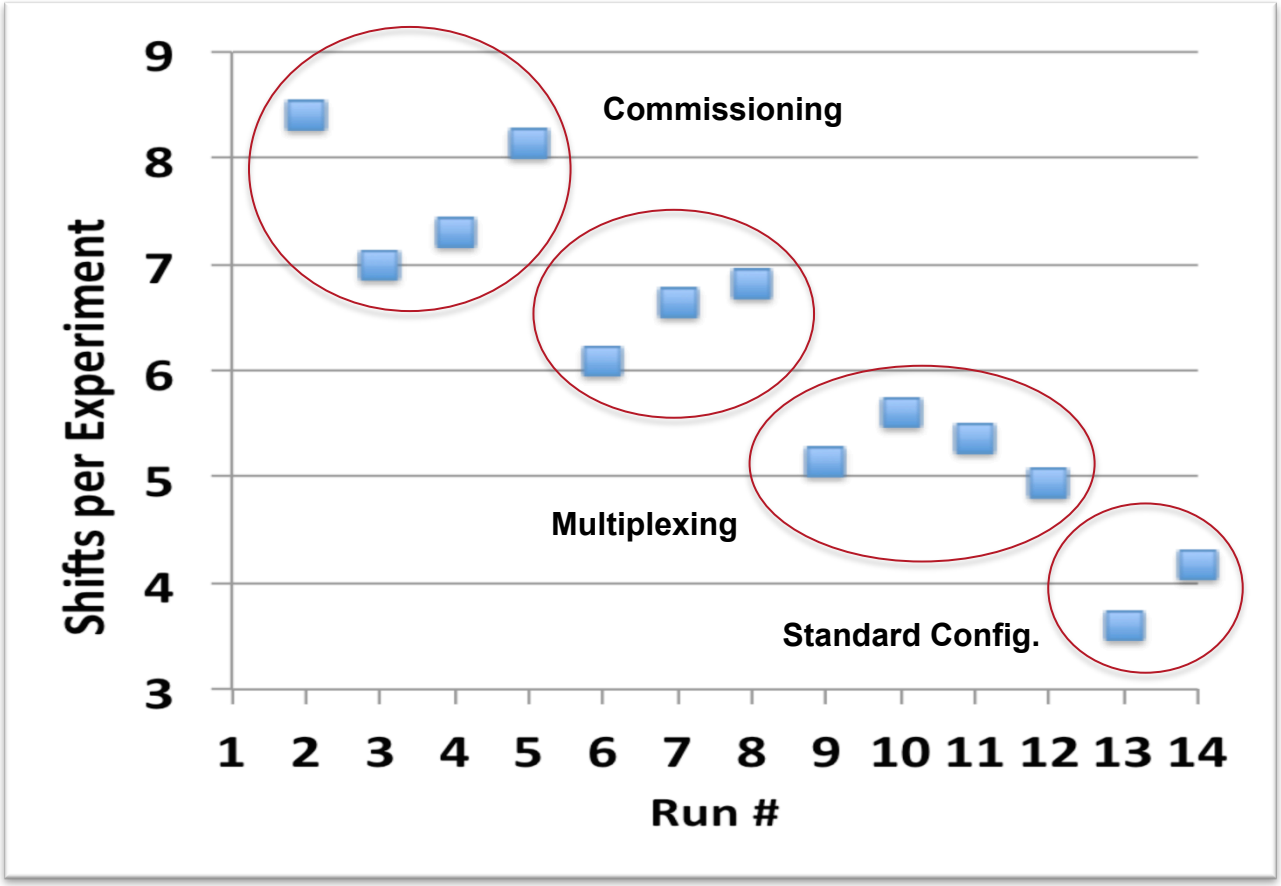




50% increase in user experiments

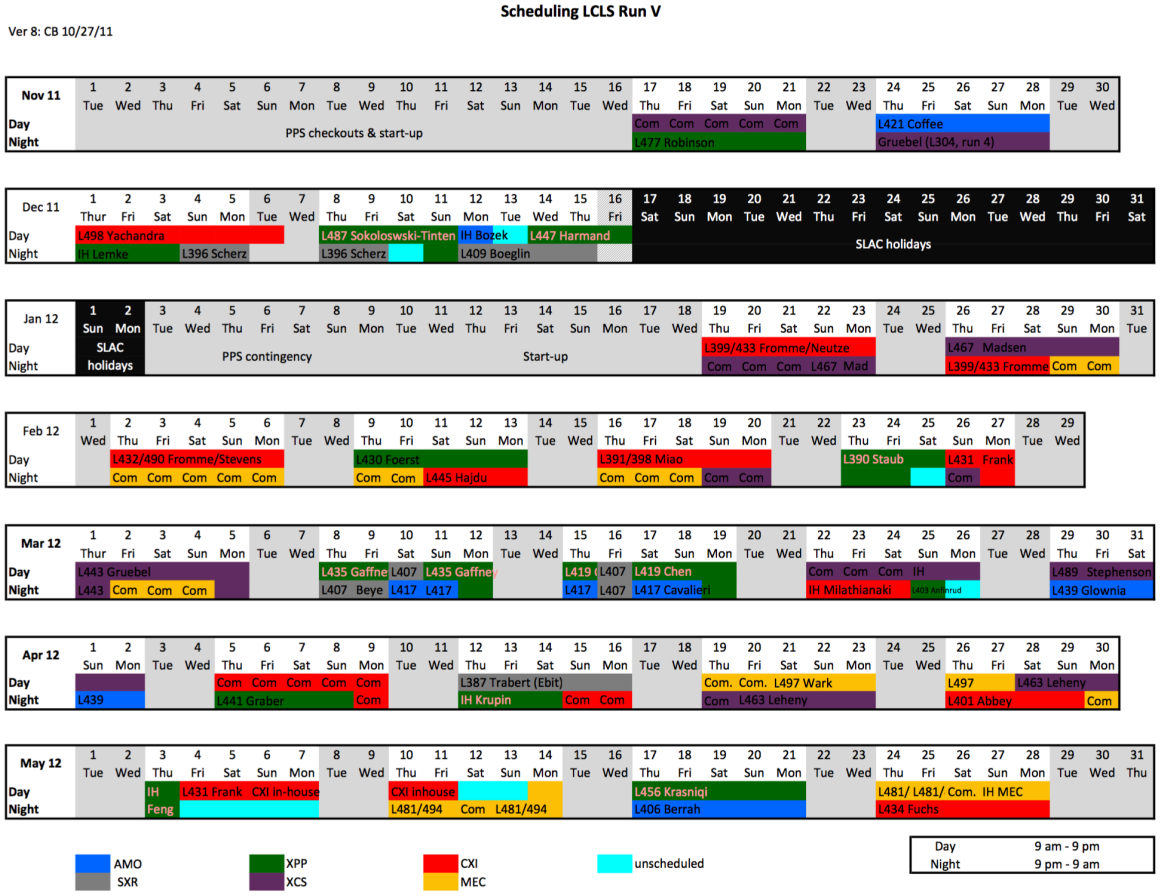
27% increase in onsite users

Average duration of LCLS user experiments



*Implementation of "**standard configurations**" has been well received by the user community, representing ~30% of all proposals*

Before Multiplexing (2011.11 – 2012.05)

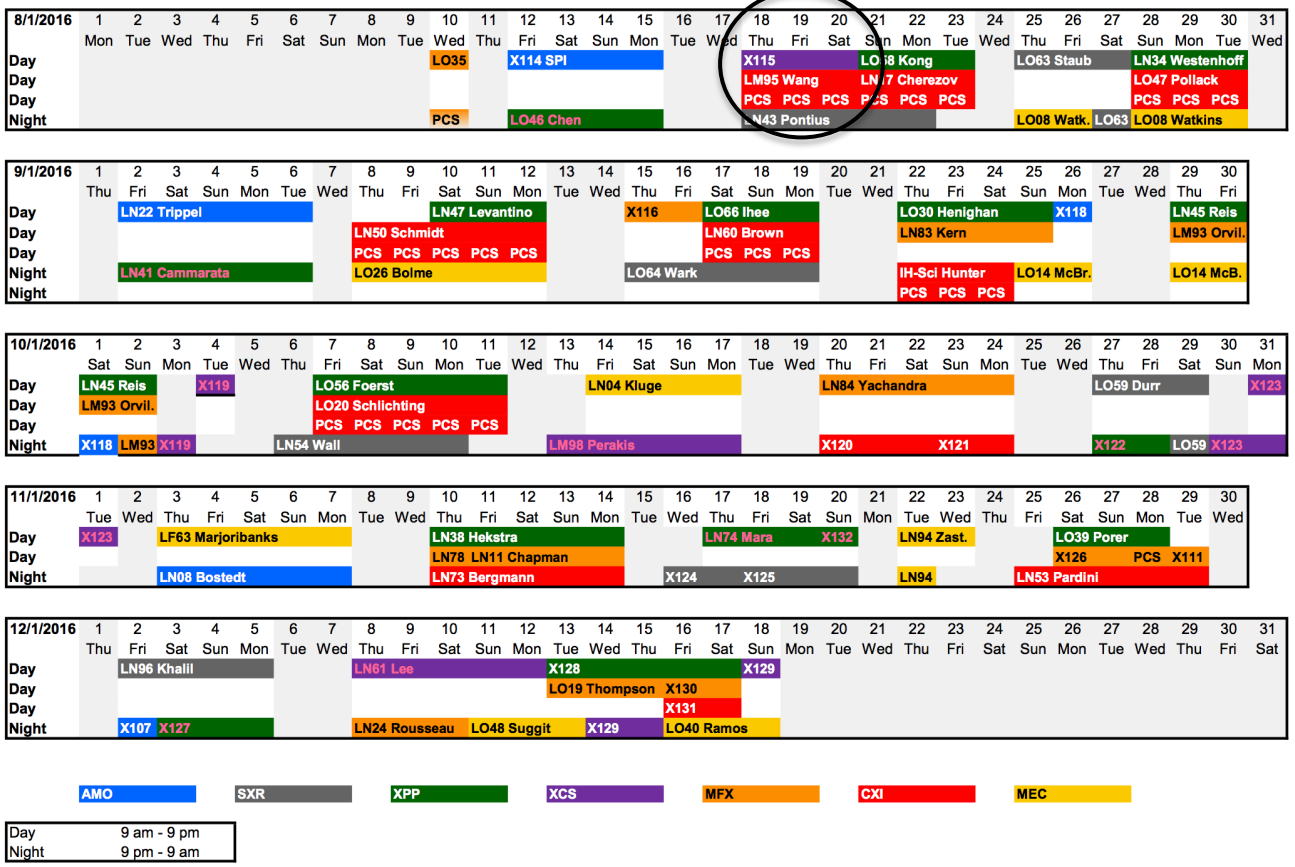


12 hour shift structure: Day/Night split between two instruments

After Multiplexing (2016.08 – 2016.12)

LCLS Run 14 Schedule
Ver 1: 5/2/16

First XCS ‘mono’ Multiplexing Shifts



From 2 rows to 4 rows: A fairly significant increase in number of shifts.

New instrument area: “MFX” in hutch “4.5”

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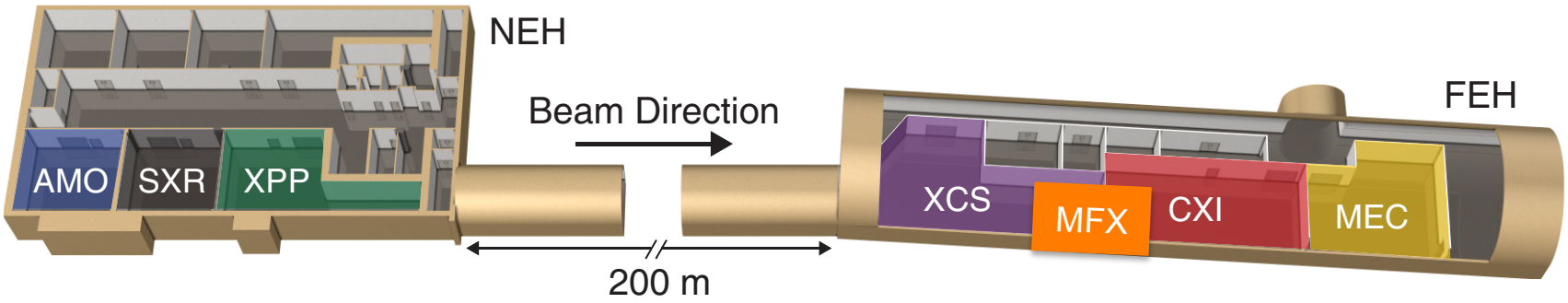
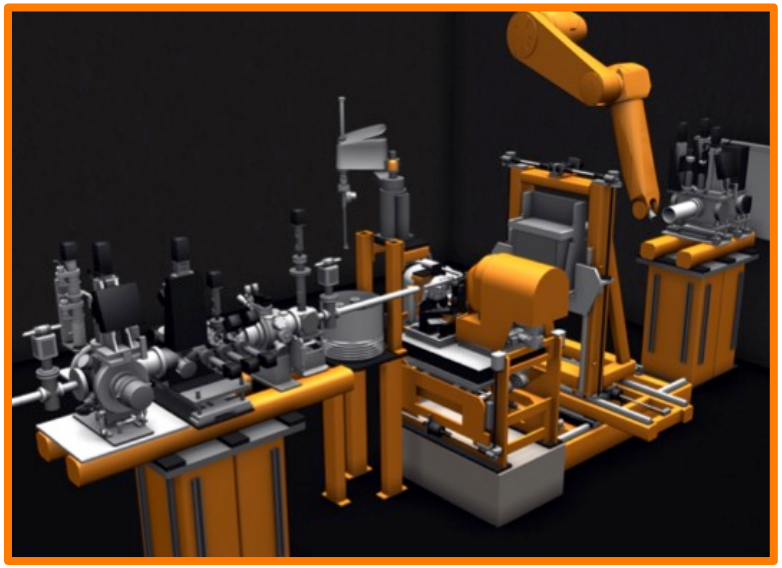
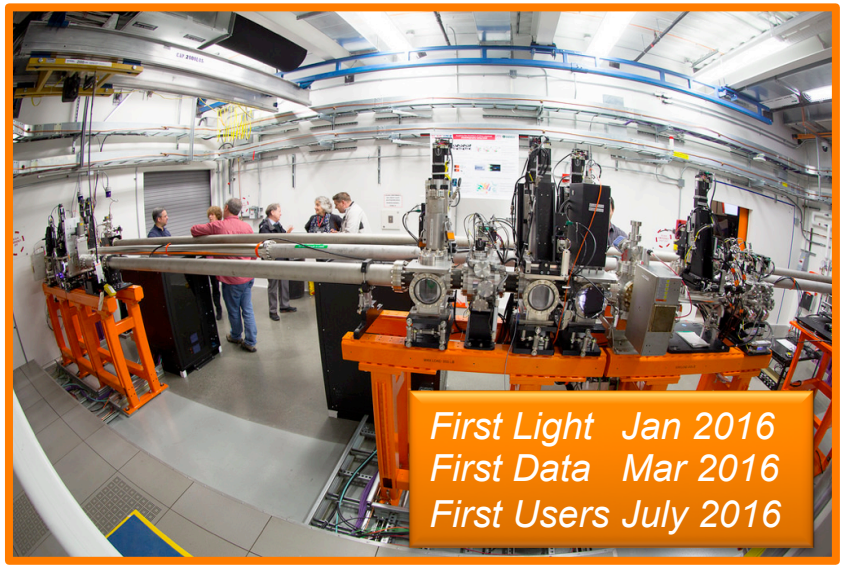
Macromolecular **F**emtosecond **X**tallography



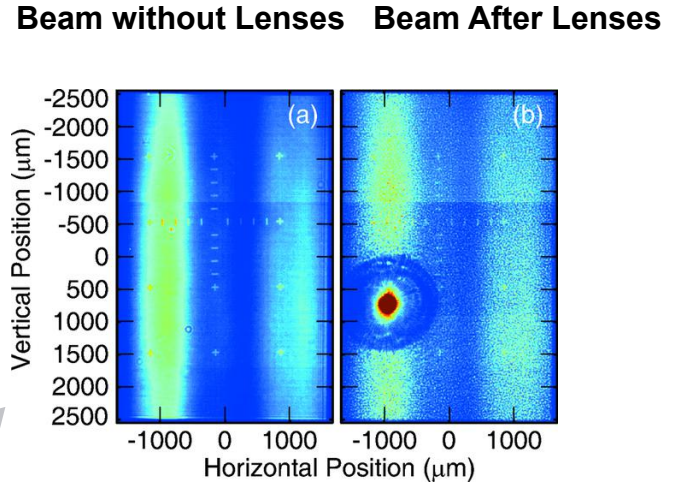




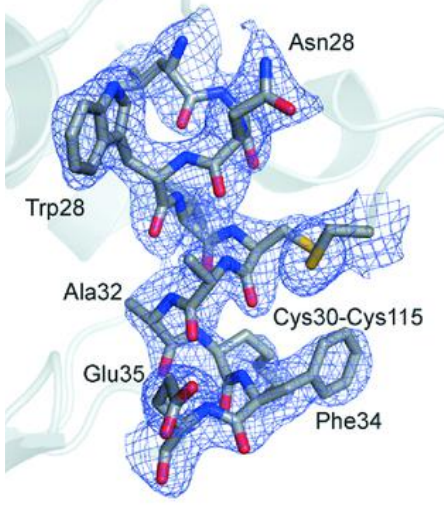
Courtesy: S. Boutet

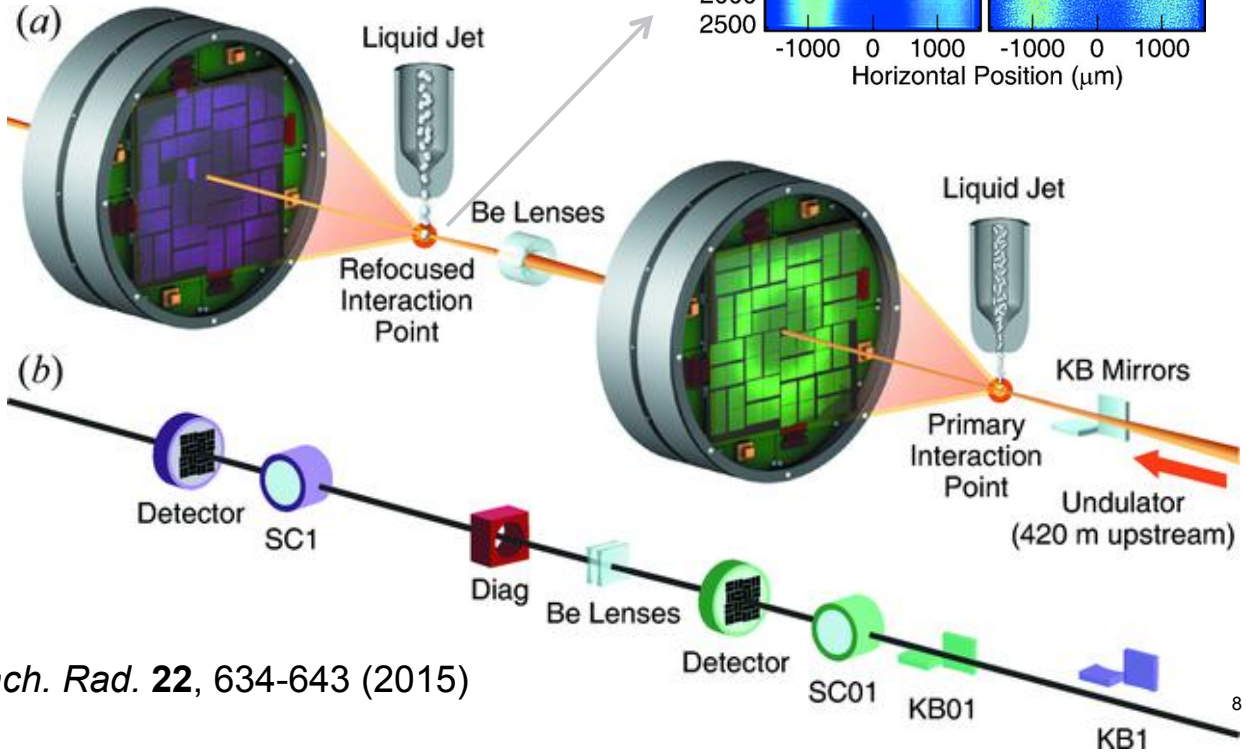
Serial Serial Femtosecond Crystallography

- Reuse the “spent” beam from the upstream experiment into a second independent experiment.
- Structures were obtained from each of the data sets from the independent experiments.



Structure Solved using “spent” beam





Boutet *et al.*, *Jour. Synch. Rad.* **22**, 634-643 (2015)

CXI Serial Sample Chamber – Installed June 2015

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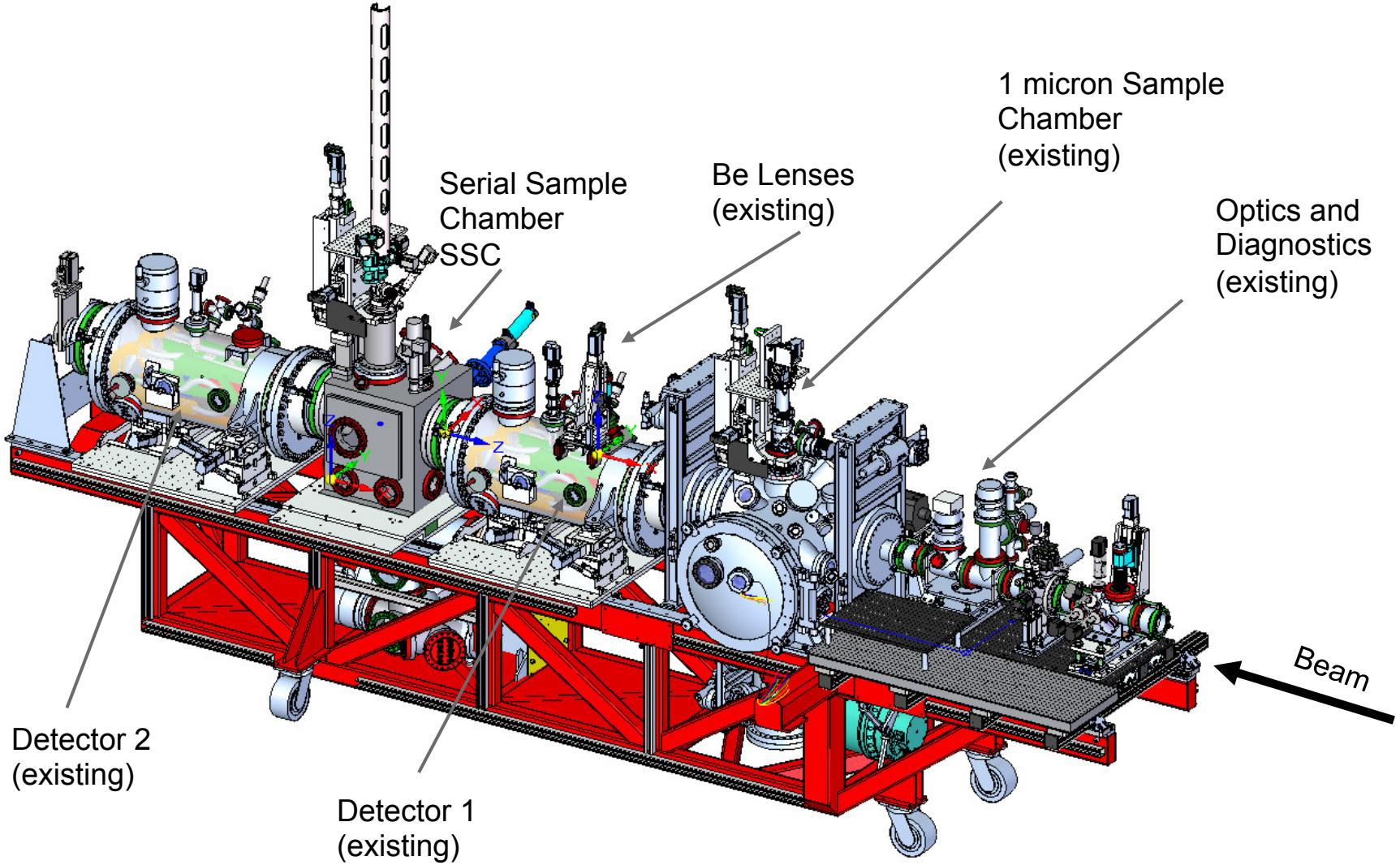

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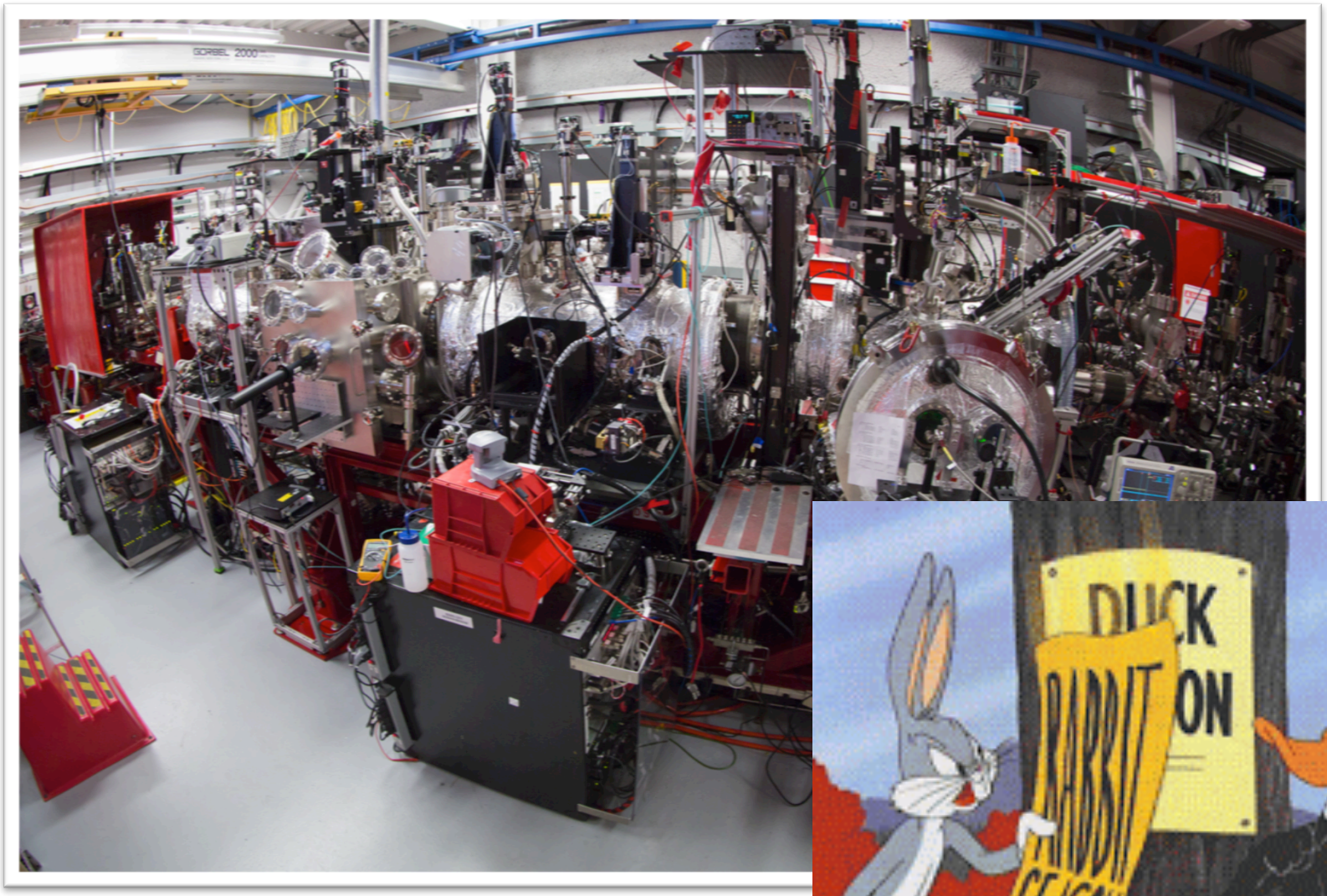
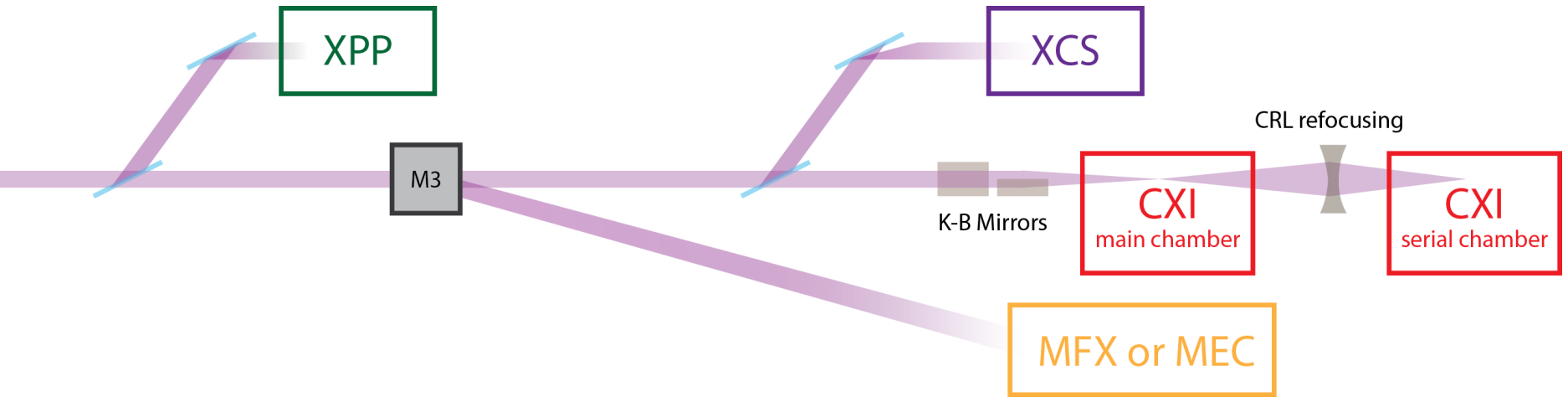
Challenges of SSC Operation



5-Way Multiplexing



- Modification to M3 mirror now serves both MFX and MEC.
- 60 um diamond commissioned for XCS Large Offset Mono.
- Serial Sample Chamber commissioned at CXI.

Standard Configurations

AMO: gas phase molecular dynamics with LAMP. VMI, eTOF, iTOF detectors.
SXR: Resonant soft x-ray scattering endstation. Liquid jet endstation.
XPP: Time-resolved in-air diffraction of solid samples, low T with cryostream.
XCS: Time-resolved solution scattering and emission spectroscopy.
CXI: 1 um KB, SFX and scattering, various injectors to choose from.
MEC: X-ray diffraction and Thomson scattering on shocked material by ns laser.

PCS at **CXI** & **MFX**: Protein screening time, SFX.

Quote from Call for Proposal

" Selected areas will operate ~25% of Run 15 (possibly more if user demand is high) in a contiguous block of time during which the instrument will be in a Standard Configuration."

Further Standardize Standard Configurations

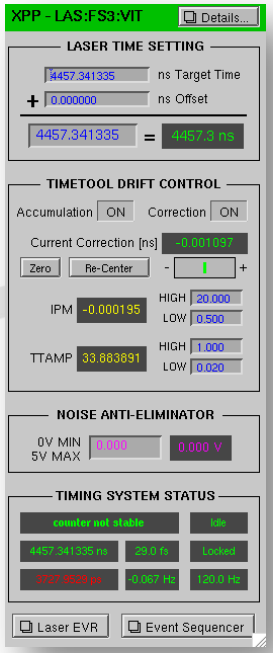
Example: 6 experiments in 5 weeks for the liquid scattering and spectroscopy standard configuration. How similar are they?

	Primary technique	No. of Shifts	X-ray photon energy	Laser wavelength	detector	Sample delivery	Analysis	New group
LO46	XAS	4	Pink, 7.1 keV	520 nm	CSPAD	Liquid jet	Matlab	N
LO58	WAX	3	Mono, 9.5 keV	400 nm	CSPAD	Liquid jet	Matlab, Igor	Y
LN34	WAX	3	Mono, 9.5 keV	266 nm	CSPAD	Liquid jet	Python	Y
LN41	XAS	5	Pink, 7.1 keV	540 nm	CSPAD	Liquid jet	Python	N
LN47	SAX	3	Mono, 9.5 keV	540 nm, 580 nm	Rayonix	Capillary Ver. 1	Python	N
LO66	SAX	3	Mono, 9.5 keV	530 nm	CSPAD	Capillary Ver. 2	C++	Y

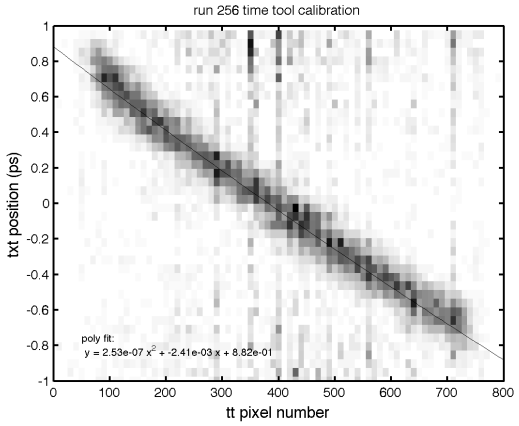
***Need new setup**: fixed experimental procedure based on well established hardware is the starting point for the implementation of automation.*

Automation Example: Timing Diagnostics & Feedback

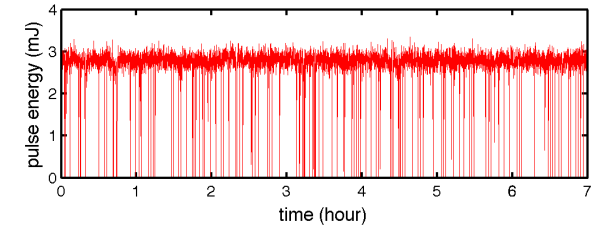
Standard **hardware**

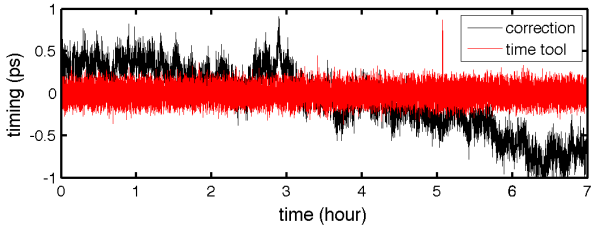


high level
control interface



Automatic **calibration** routine





Feedback implementation to enable
robust maintenance free operation

Potential Areas of Collaboration

Standard Configuration

- Discuss/Collaborate on the designs and implementation of standard configurations to make life easier for users who performs similar experiments at different facilities.
- Common intermediate data format, common data analysis routines.

Operation Automation

- Identify best implementation of in-situ diagnostics for beam pointing stabilization.
- K-B alignment, need to develop diagnostic implementation and optimization routines for the 10s of K-B systems across all facilities.
- Automatic sample injection monitoring and tracking via advanced image recognition algorithms.