Operation Discussions

Diling Zhu, on behalf of LCLS

8th Hard X-ray FEL Collaboration Meeting, 2016





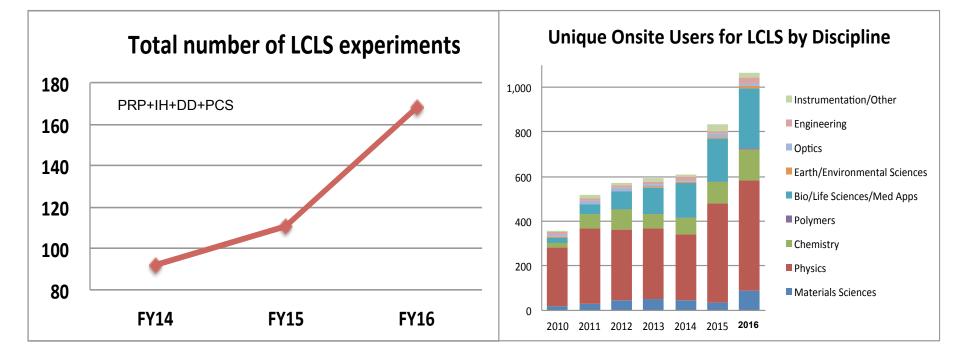


Implement standard configuration

SLAC

Opportunities for automation

Increase user access to LCLS (FY16)

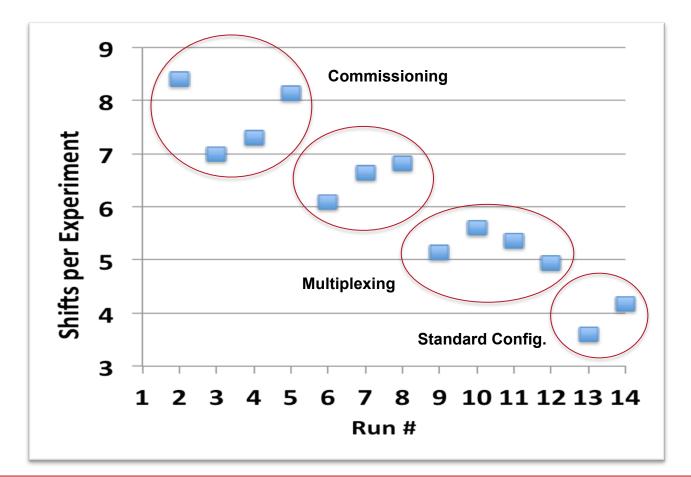


50% increase in user experiments

27% increase in onsite users

Average duration of LCLS user experiments

SLAC



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

Before Multiplexing (2011.11 – 2012.05)

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

After Multiplexing (2016.08 – 2016.12)

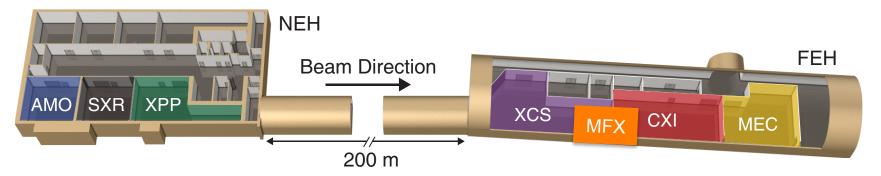
LCLS Run 14 Schedule Ver 1: 5/2/16	First XCS 'mono' Multiplexing Shifts
Mon Tue Wed Thu Fri Sat Sun Mon Tue Wed Thu Fri Sat Sun Mon Tue Wed Thu Fri Sat S LO35 X114 SPI	21 22 23 24 25 26 27 28 29 30 31 n Mon Tue Wed Thu Fri Sat Sun Mon Tue Wed 38 Kong LO63 Staub LN34 Westenhoff LO47 Pollack /3 PCS PCS PCS PCS PCS PCS LO08 Watk. LO68 LO08 Watkins
9/1/2016 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 2 Thu Fri Sat Sun Mon Tue Wed Tue Wed	21 22 23 24 25 26 27 28 29 30 /ed Thu Fri Sat Sun Mon Tue Wed Thu Fri LO30 Henighan X118 LN45 Reis LM33 Grvil, IH-Sci Hunter LO14 McBr. LO14 McB. PCS PCS PCS
10/1/2016 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 2 Sat Sun Mon Tue Wed Thu Fri Sat Sun Mon Tue Wed	
11/1/2016 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 2 Tue Wed Thu Fri Sat Sun Mon LN74 Mara X132 LN74 Mara X124 X125 X14 X14 X15 X14 X14 X14 X14 X14 X14 X	21 22 23 24 25 26 27 28 29 30 Ion Tue Wed Thu Fri Sat Sun Mon Tue Wed LN94 Zast. L039 Porer X126 PCS X111 LN94 LN53 Pardini LN53 Pardini Ked Ked
	21 22 23 24 25 26 27 28 29 30 31 led Thu Fri Sat Sun Mon Tue Wed Thu Fri Sat
AMO SXR XPP XCS MFX CX Day 9 am - 9 pm Night 9 pm - 9 am	KI MEC

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

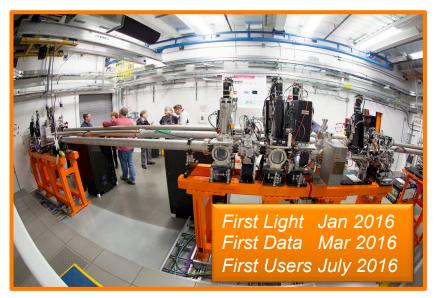
New instrument area: "MFX" in hutch "4.5"



Macromolecular Femtosecond Xtallography





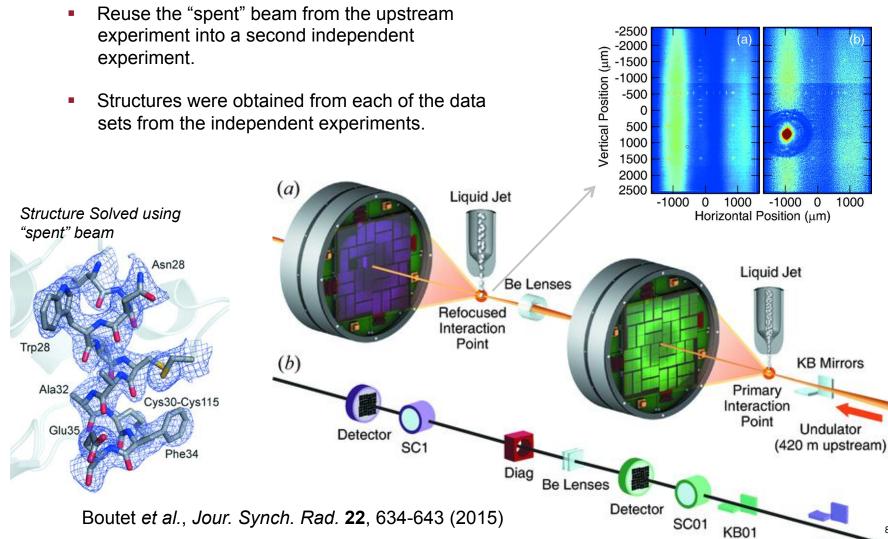


7

Serial Serial Femtosecond Crystallography

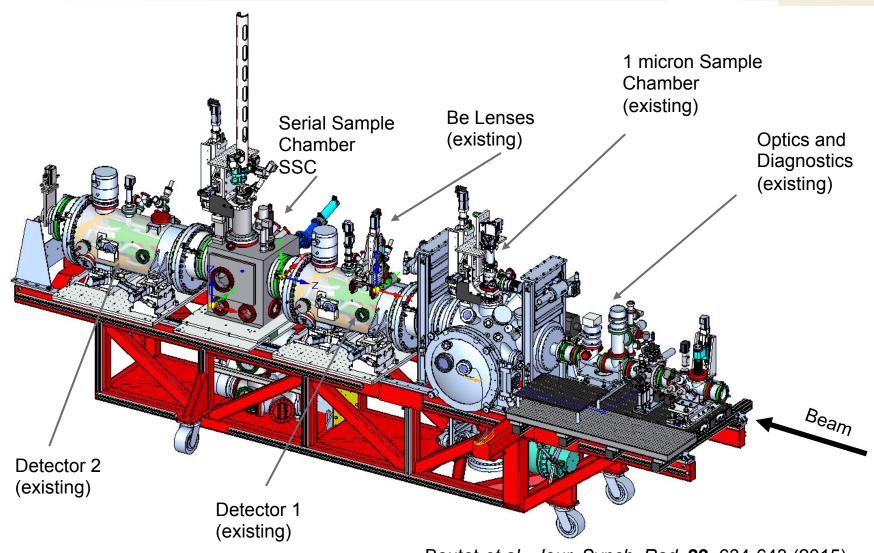


KB1



Beam without Lenses Beam After Lenses

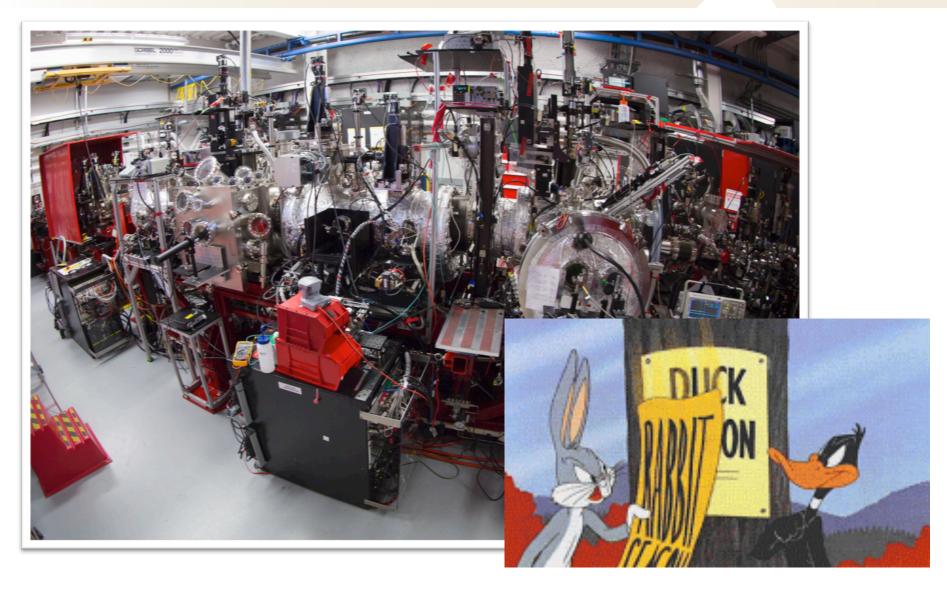
CXI Serial Sample Chamber – Installed June 2015



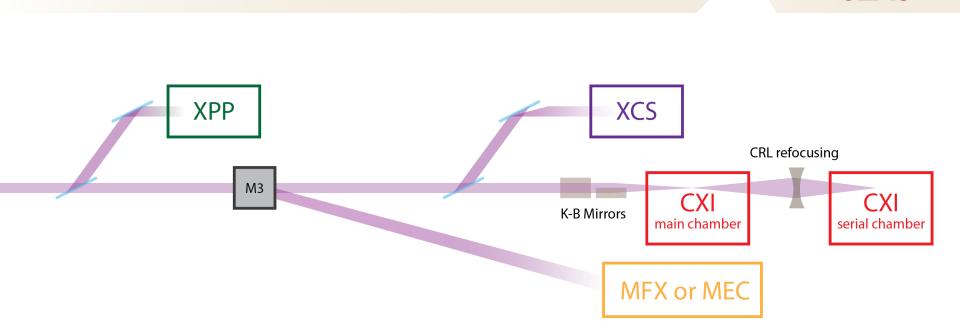
Boutet et al., Jour. Synch. Rad. 22, 634-643 (2015)

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.

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	Ν
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	Ν
LN47	SAX	3	Mono, 9.5 keV	540 nm, 580 nm	Rayonix	Capillary Ver. 1	Python	Ν
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

LAS:FS3:VIT

+ 0.000

TTAME

0V MIN 5V MAX

4457.341335

Current Correction Ins Zero Re-Center IPM

LASER TIME SETTING

-

TIMETOOL DRIFT CONTROL

NOISE ANTI-ELIMINATOR

TIMING SYSTEM STATUS

high level

control interface

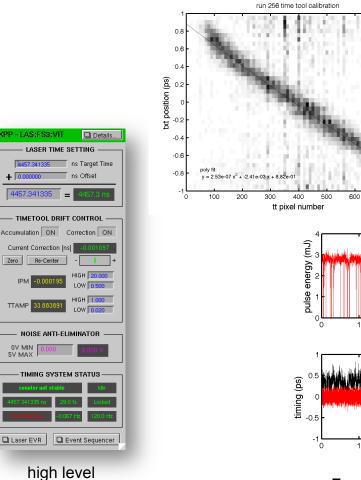
ns Offset

LOW 0.020

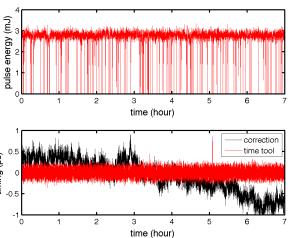
SLAC



Standard hardware



Automatic calibration routine



700

800

Feedback implementation to enable robust maintenance free operation

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.