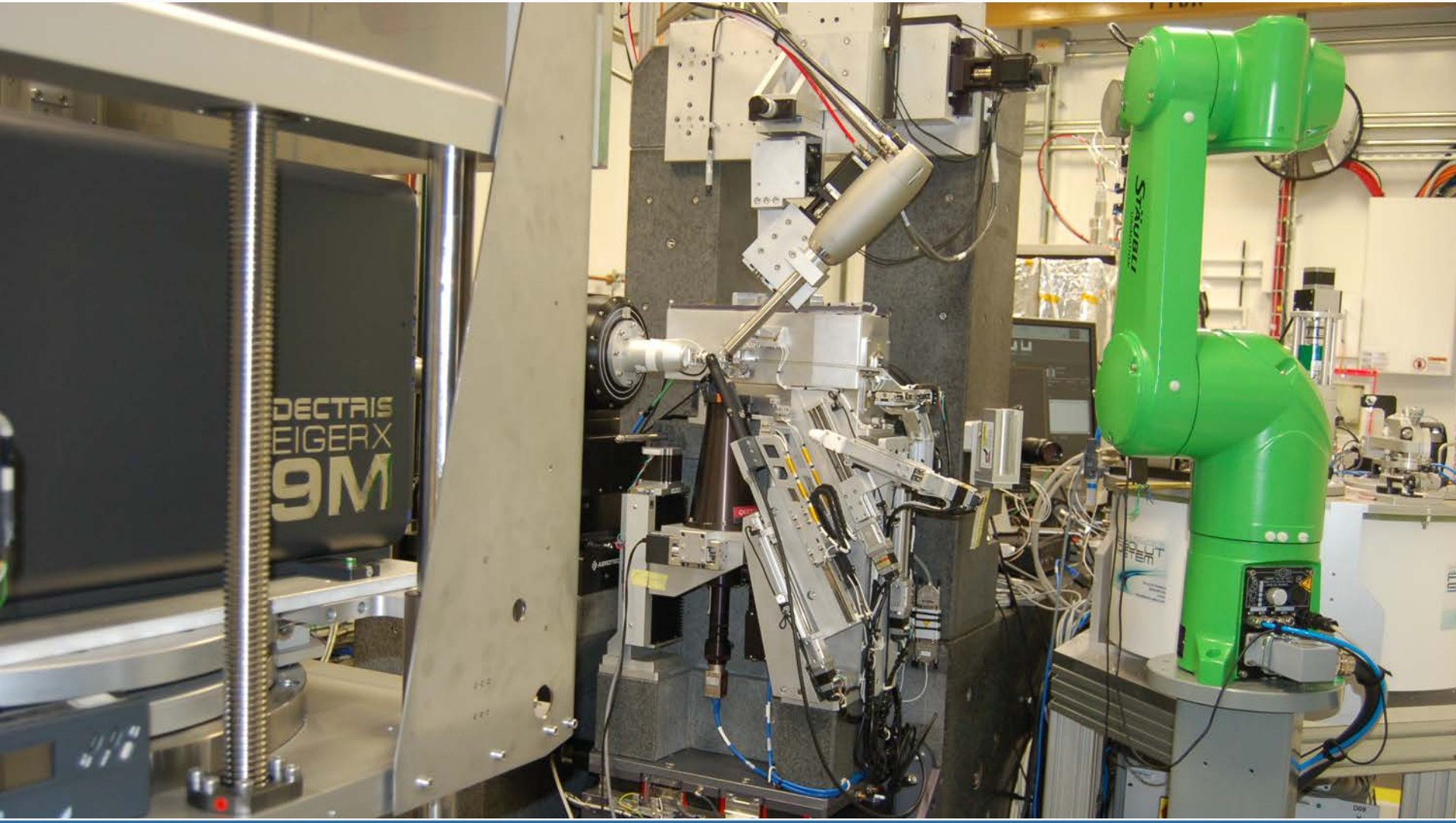
AMX one year since first light

Dieter Schneider

LSBR Advisory Committee Meeting, March 28, 2017

AMX April 17 2016: first focused beam

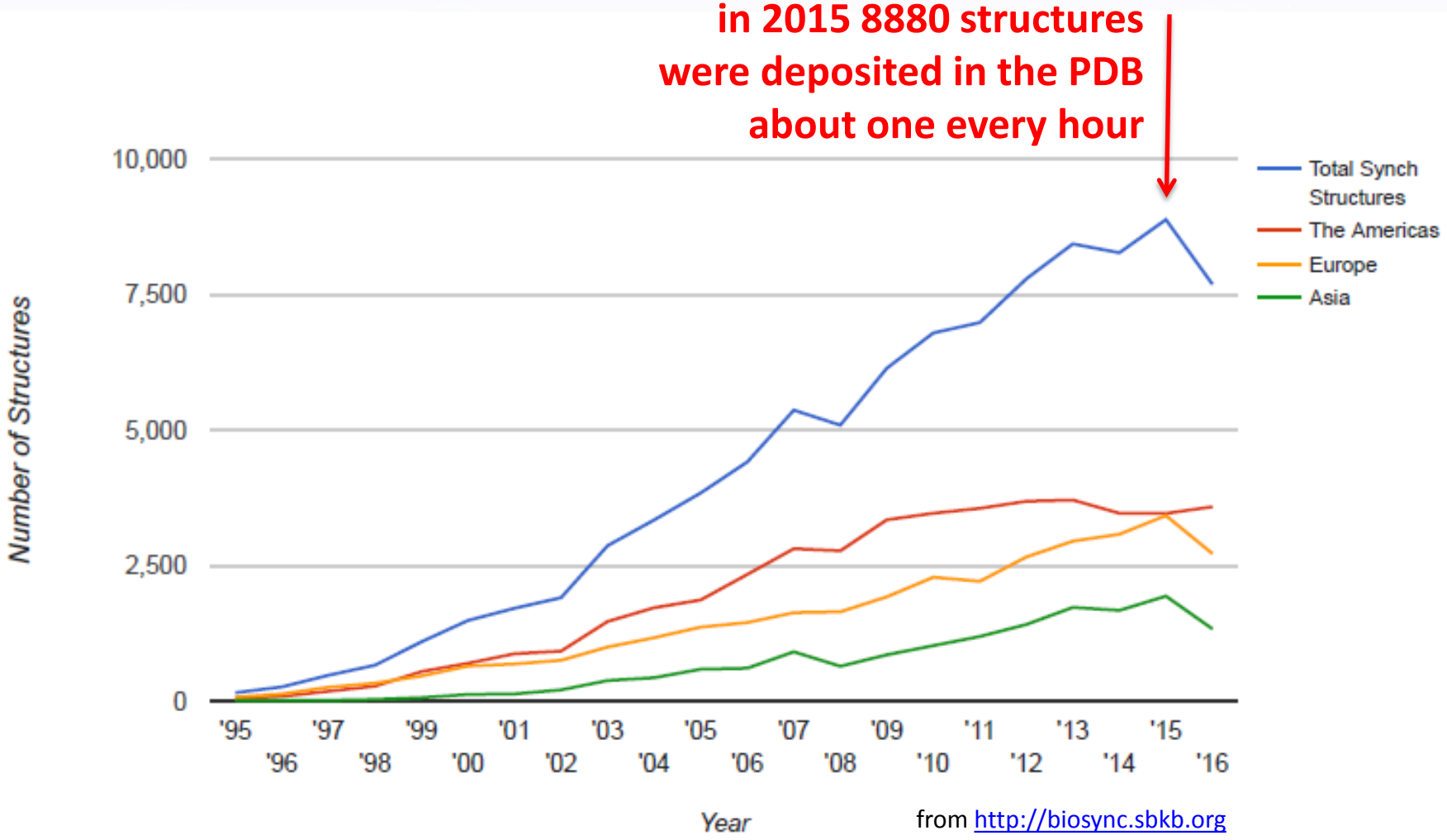
AMX February 17 2017: GU program launched



AMX build up in past year

- Detector cradle received and installed, April 2016
- AMX DCM realigned, April 2016
- AMX KB vertically focusing mirror inverted, May 2016
- Liquid nitrogen distribution system through phase separators installed ,June 2016
- Experimental station installed in stages, ongoing since June 2016
- Visitor and staff working area and stations installed, June 2016
- **Beamline hot commissioning carried out, Nov 2016**
- Control systems hardened and expanded with efficient utilities, ongoing
- Beamline computing and networking upgraded, Jan 2017
- **Eiger X 9M commissioned, Jan 2017**
- Automounter Dewar and robot installed, Jan 2017
- Data collection methods implemented, ongoing
- **User-assisted scientific commissioning performed through Feb 2017**

Do structural biologists need AMX and FMX?

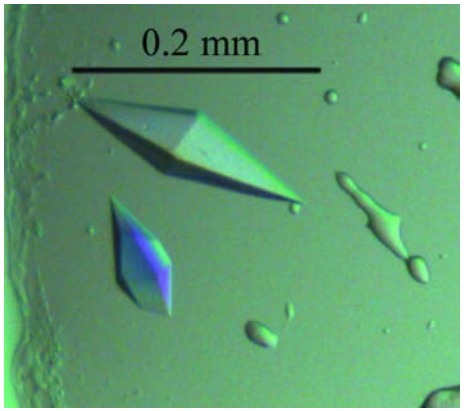


from http://biosync.sbkb.org

Leading MX beamlines in the US

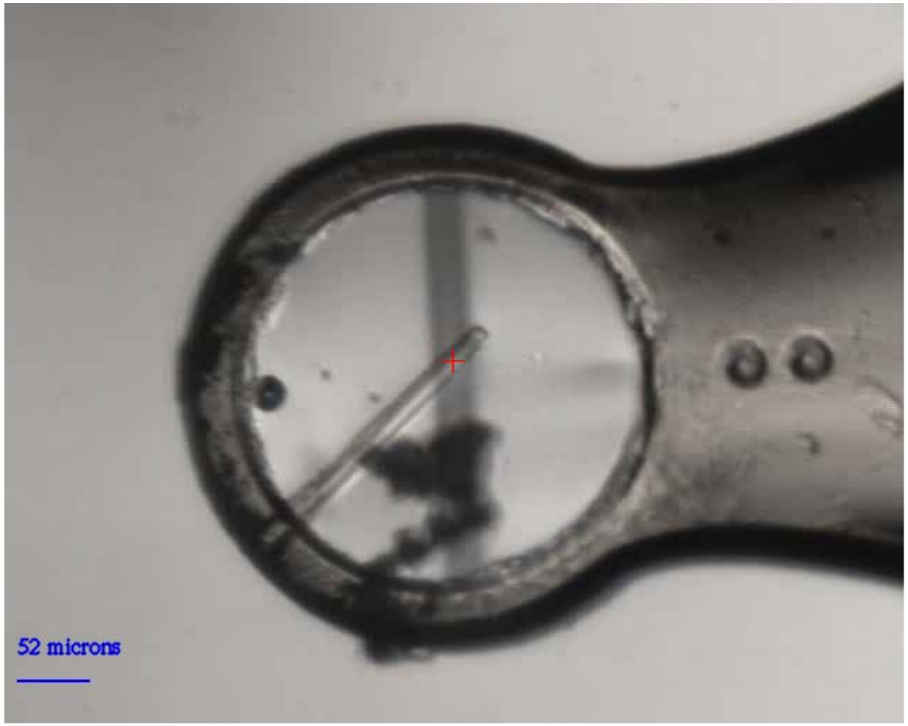
	Beamline		*Flux [ph/s]*	*Native Focus*
APS	GM/CA	23-ID-D	1×10^{13}	75 x 25
	NE-CAT	24-ID-C	3×10^{12}	60 x 40
	SER-CAT	22-ID	7×10^{12}	80 x 40
	LS-CAT	22-ID-D	5×10^{12}	50 x 50
	SBC-CAT	19-ID		100 x 20
ALS	UCSF	8.3.1	1×10^{12}	80 x 60
	BCSB	5.0.2	1×10^{12}	150 x 50
SSRL	BL12-2		4×10^{12}	100 x 200
Cornell	MacCHESS	F1	3×10^{11}	200 x 200

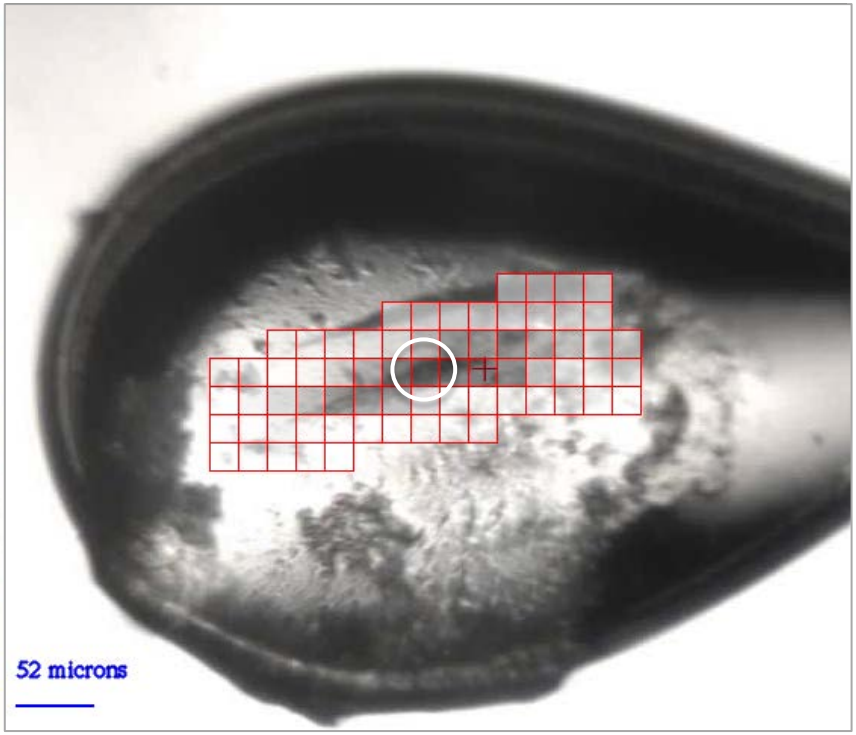
from http://biosync.sbkb.org



But ... these premiere beamlines were built when xtals were large

Crystals brought to AMX are typically small





Challenge: Match beam size to xtal size and find xtal

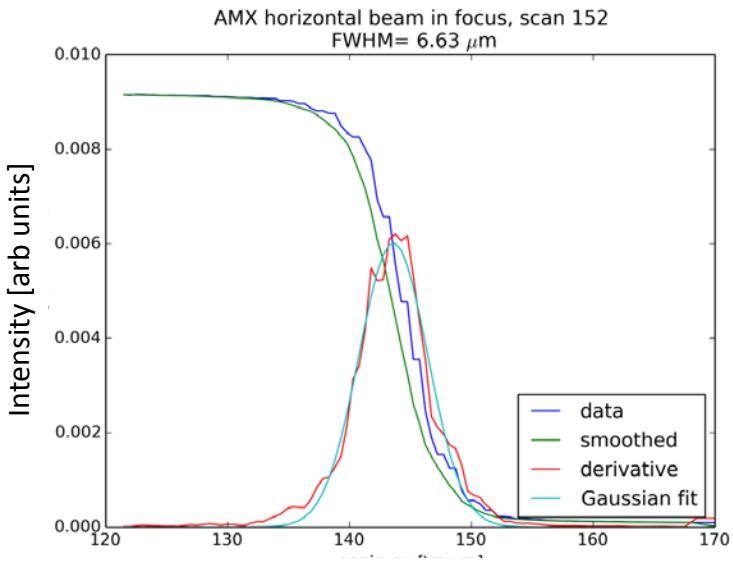
Thus, micro-focusing beamlines are required

Beamline		*Flux [10^{13} ph/s]*	*Native Focus [hxv μm^2]*	*Target*
NSLS-II	**AMX**	**1.0**	**6.6 x 4.8**	**5 x 4**
	FMX	**0.8**	**1.4 x 1.1**	**1 x 1**
SPring8	**BL32XU**	**0.006**	**1 x 1**	
SLS	**X06SA**	**0.2**	**5 x 5**	
MAX-IV	**BioMAX**	**3.0**	**20 x 5**	
Soleil	**Proxima2**	**0.1**	**10 x 5**	
Alba	**Xaloc**	**0.2**	**50 x 6**	
Diamond	**I24**	**0.1**	**8 x 8**	
AUS	**MX2**	**0.1**	**20 x 10**	
ESRF	**Massif2**	**1.5**	**15 x 15**	

Data from http://biosync.sbkb.org except for AMX, FMX

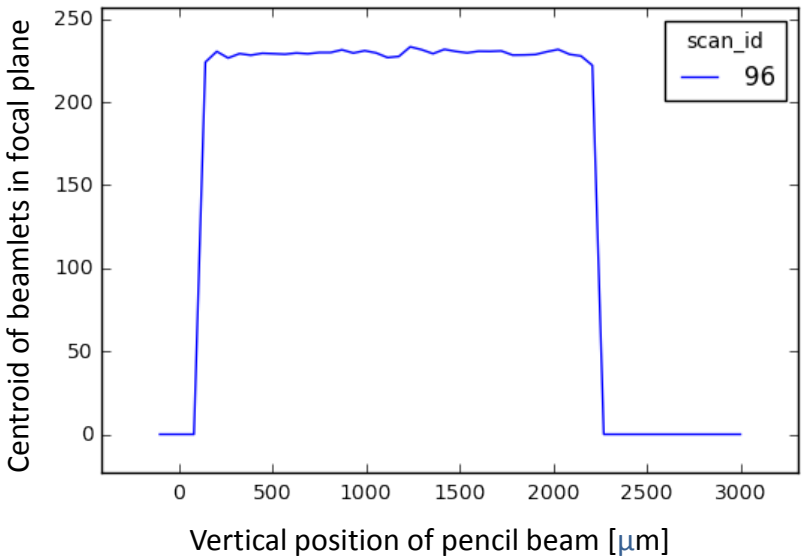
AMX hot commissioning results of Nov 2016

Horizontal knife edge scan



with Andreas Biermanns-Foeth (RI)

Pencil beam scan across incident beam reveals accurate focusing by KB mirror



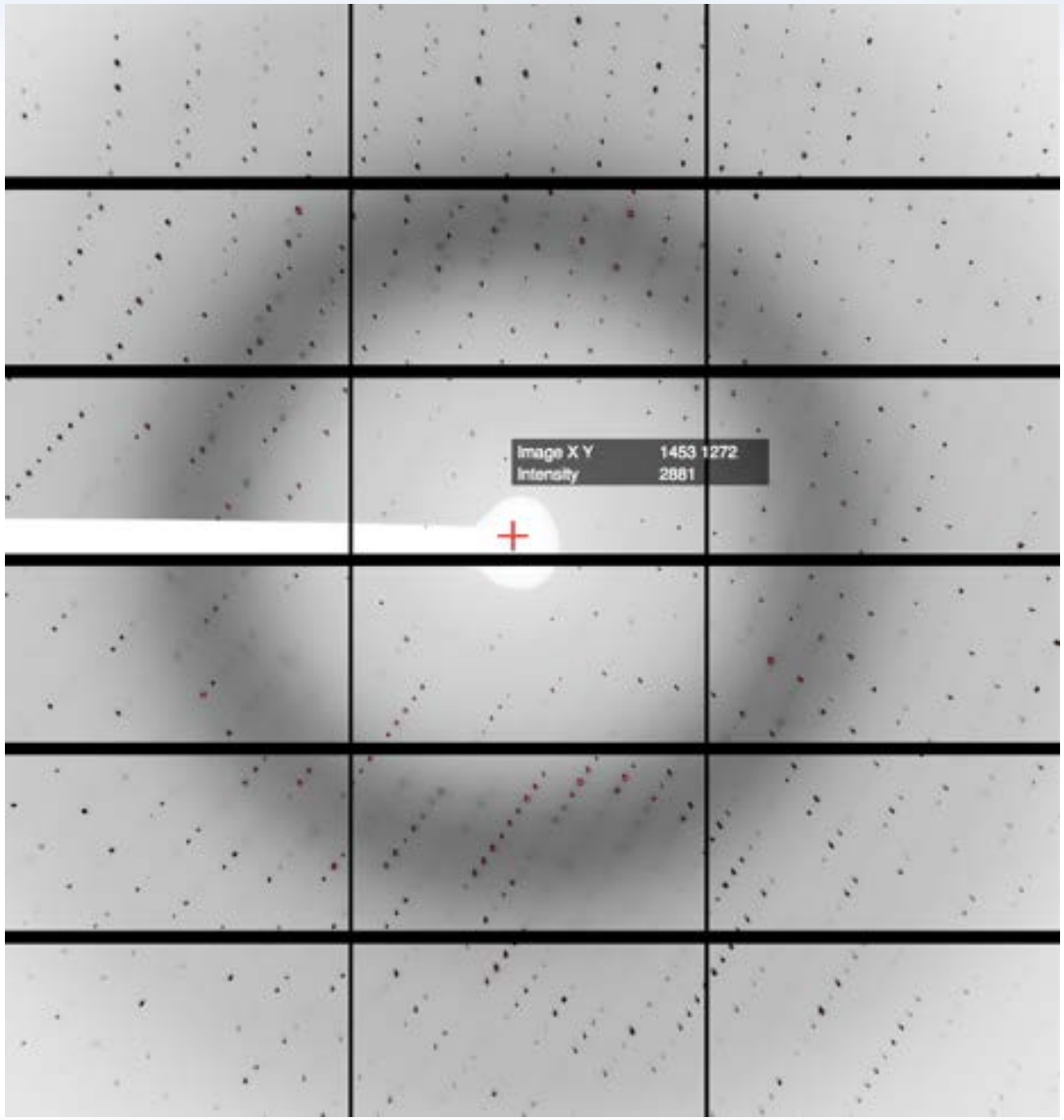
with Mourad Idir and Lei Huang

At 250 mA ring current and with all slits fully open

Native focal spots size (final emittance model: 5 x 4 μm^2) **6.6 μm x 4.8 μm**

Flux in focal spot (final emittance model: 10^{13} ph/s) **4.8 x 10^{12} ph/s**

Eiger X 9M commissioned in Jan 2017

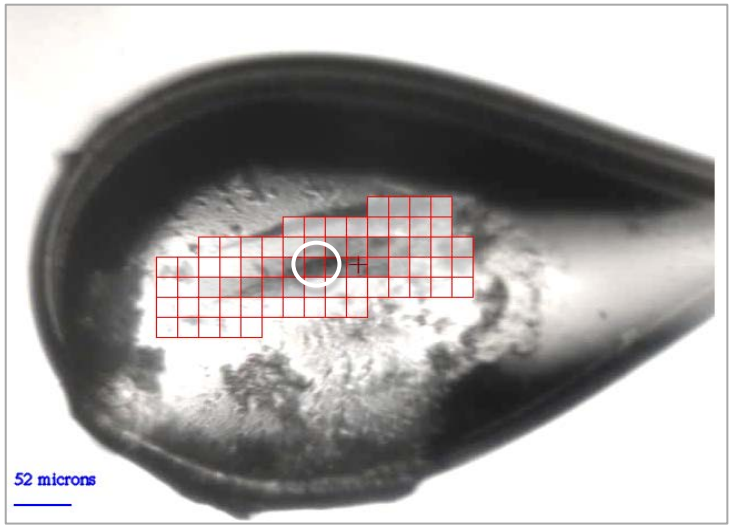


Pixel size	75 x 75 um^2
Area	233 x 245 mm^2
Pixels	3110 x 3269

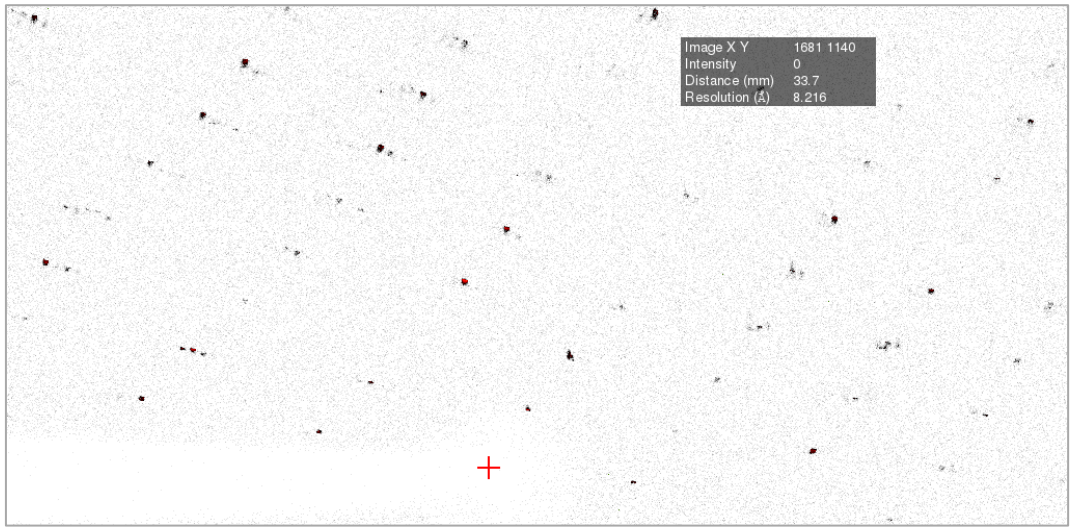
Frame rate	238 Hz
in 4M ROI	750 Hz
Image buffer	>15,000
Networked at	40 Gb/s

Fast framing Eiger 9M replaced slow Pilatus 6M now allows data collection at full flux

Mini beam raster scanning: powerful and fast



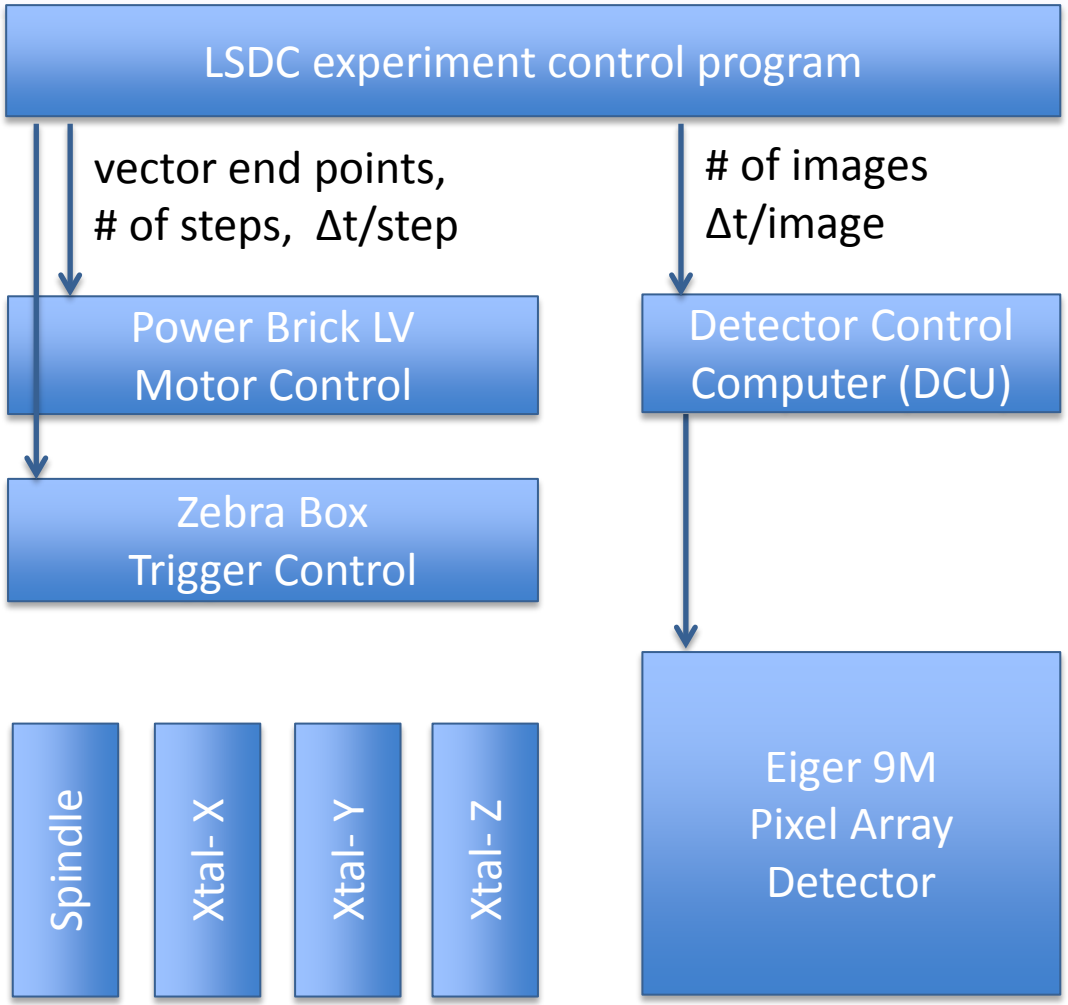
Screening images of 5 ms taken with
10 x attenuated beam at 71 nodes
Scan to results in ~ 10 s



Diffraction of a protein complex (70 x 70 x 340 Å^3)
recorded on Eiger 9M (1 module shown)
in 5 ms over 0.2° oscillation

Raster screening, rastered data collection (serial crystallography)
Vector and helical scan data collections all
require fast xtal positioning and accurately synchronized with data collections
The requisite hardware triggering of motions and detector were developed by
Bruno Martins, Stu Myers, John Skinner, and Jean Jakoncic

Advanced raster scanning deployed



Arm systems

Use raster or vector defined in LSDC GUI

Initiate scan

Open shutter
Backup motors
Accelerate to speed

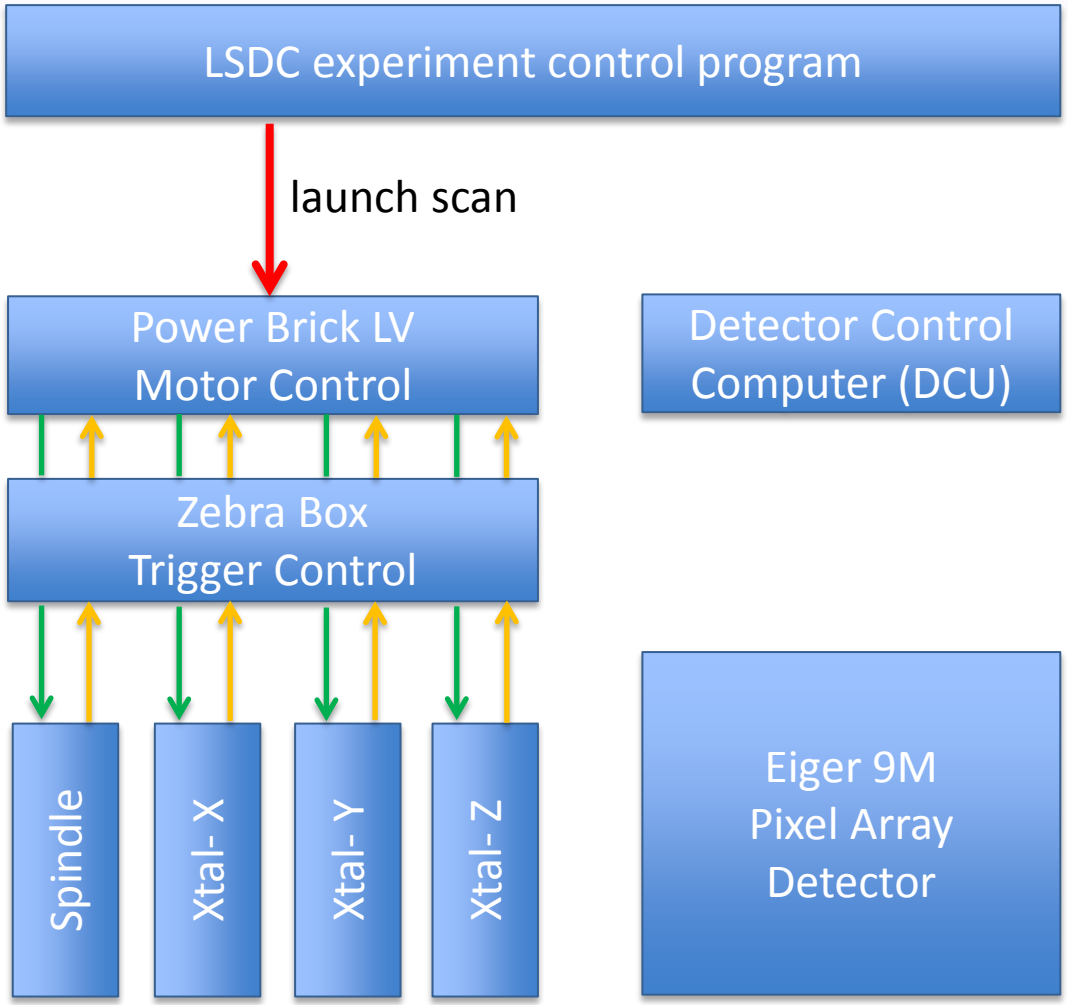
Execute scan

Read encoders
When at target trigger 9M

Finish scan

Transfer data
Launch Spotfinder
Display results
Close shutter
Stop motors

Advanced raster scanning deployed



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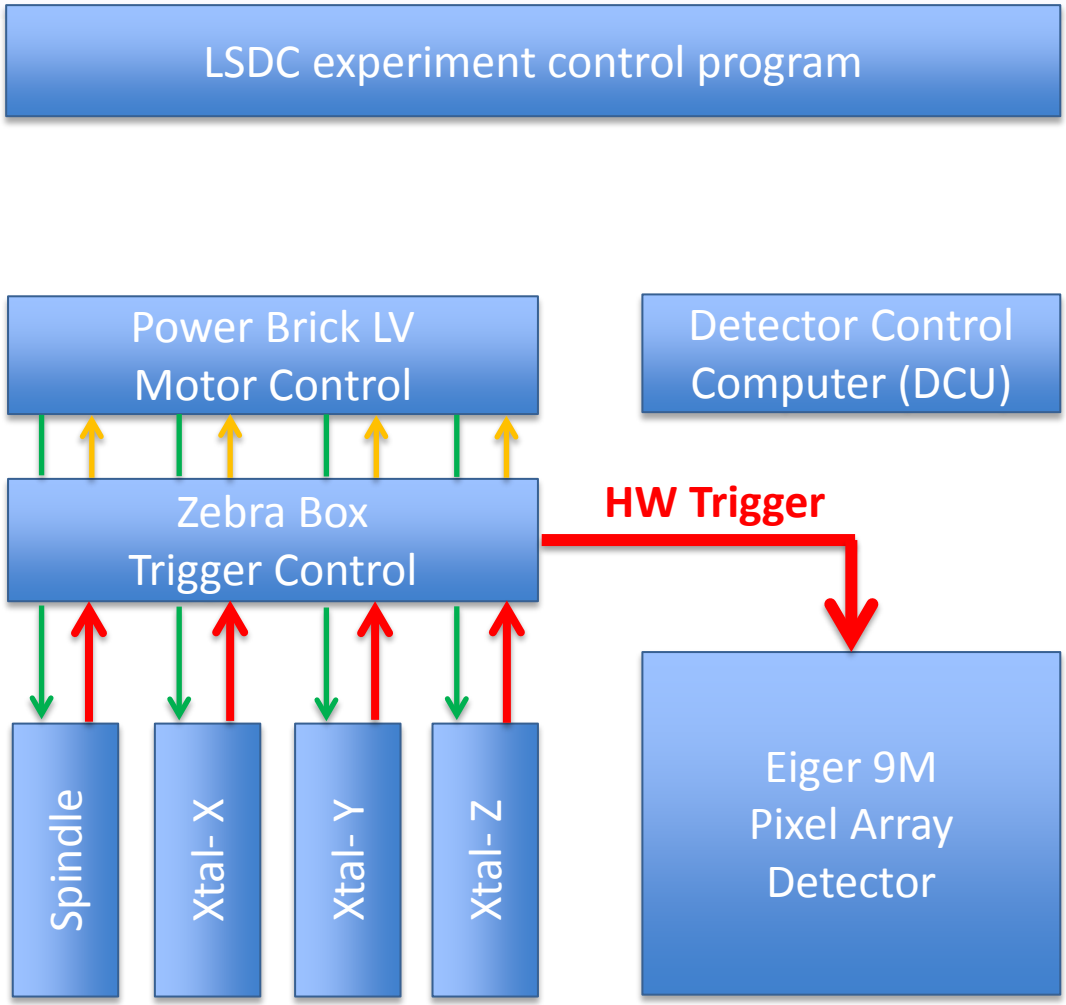

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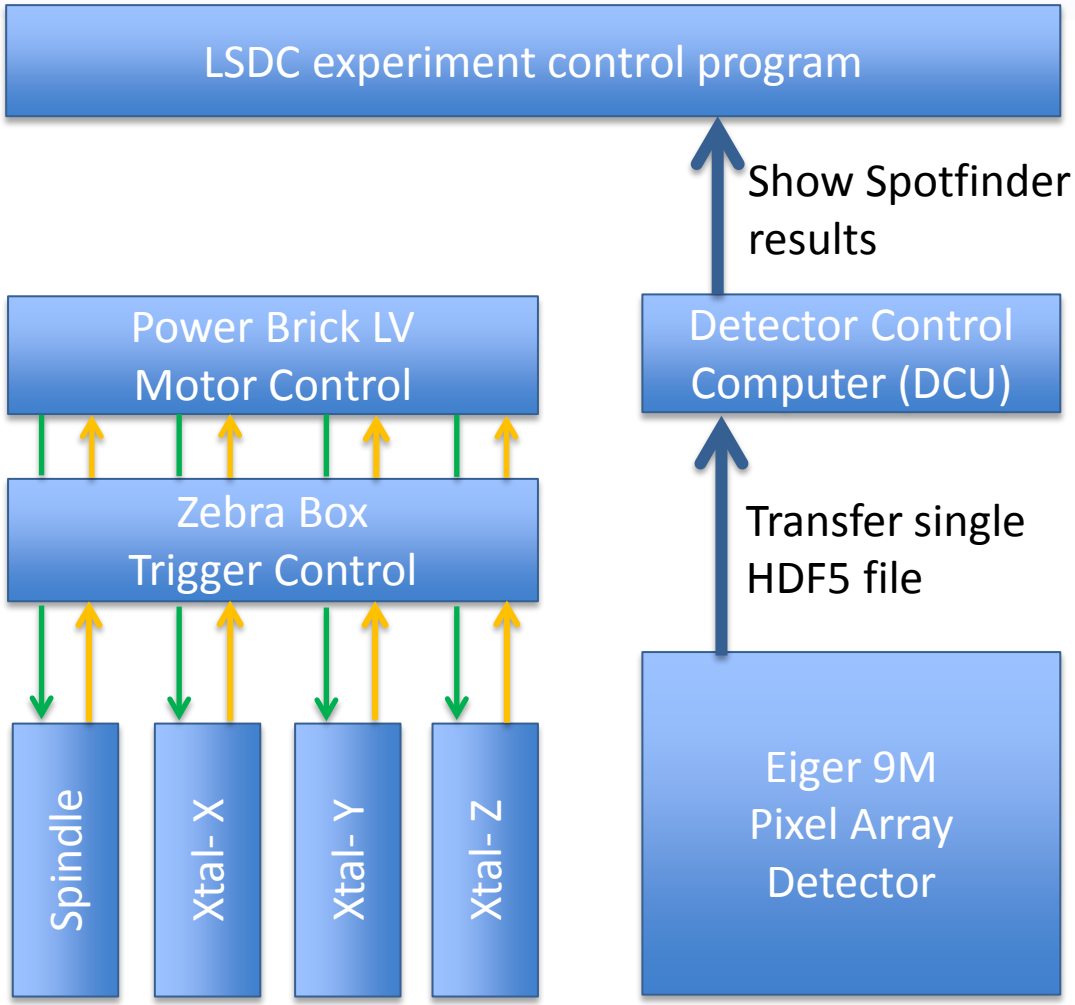

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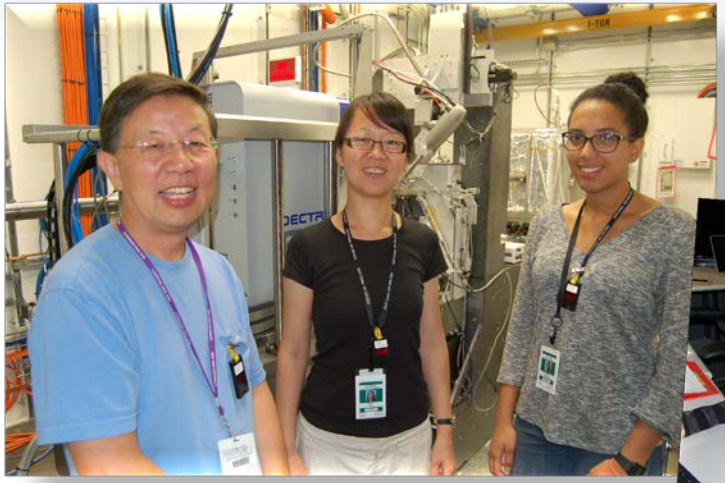
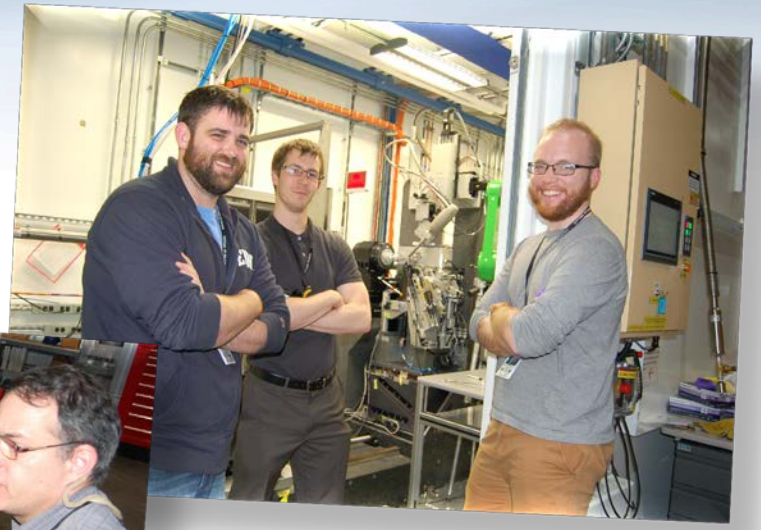
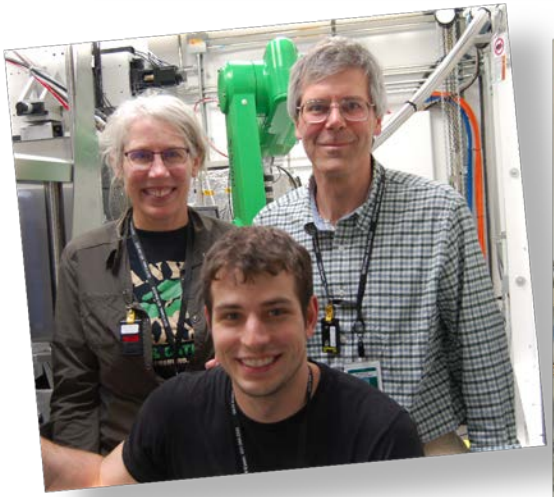
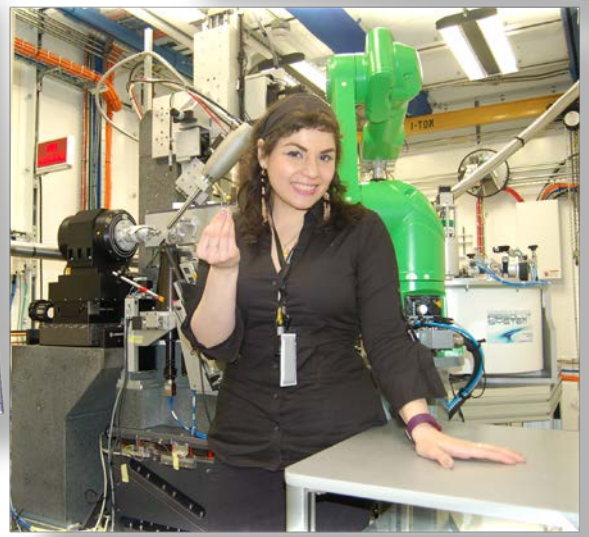
Some of the first visitors









What are the priorities for challenges ahead?

At the beamline:

Get automounter into operation
Control beam stability
Refine ease of operation
Further automate workflow
- Loop alignment
- Crystal finding
- Automatic rastering

Develop simple standard routines
Implement remote access

LSBR team lead by Sean McSweeney

Level of support :

Standardized simple collections
Sophisticated methods

Programmatically:

Initiate one or a few collaborations with investigators who will take full advantage of the unique opportunities AMX affords