Obsolescence and Maintenance of XSD Beamlines

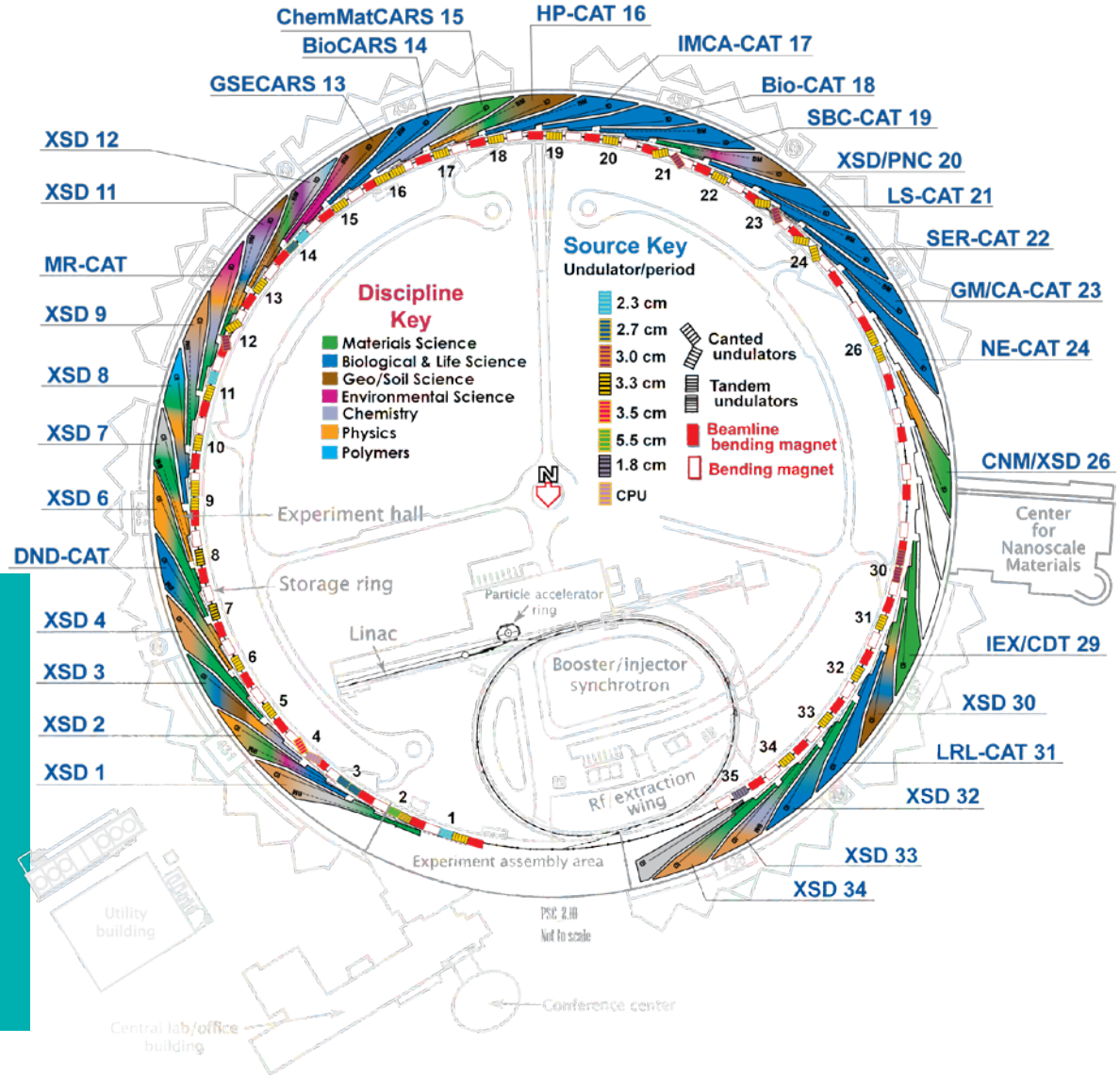
"Starving the future to feed the present is a mistake
- it leads to obsolescence and stagnation. Sometimes it is hard to make this understood."

Burton Richter

APS – 2014 snapshot

7 GeV, 100 mA, 3 nm-rad
Dedicated 1996

- 66 simultaneously operating beamlines
  - 45 ID, 21 BM
- 60% physical science
- 40% biological science
- ~5400 unique users/year



XSD Beamline responsibilities

33 *XSD beamlines*

1 *as major partner with EERE*

4 *as minor partners with CNM, ChemMat-CARS, LS-CAT, Bio-CARS*

3 GMCA *"CAT" beamlines funded by NIH*

Where are we today?

XSD%20Equipment

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	A	B	C	D
1				
2	**Beamline**	**Component**	**Make/Model**	**Qty**
3				
4				
5	1-BM	Neo CCD	Andor	1
6	1-BM	StepPacs-power supply & plugins	ACS	3 racks
7	1-BM	Stepper Motors	Slo-Syn	20
8	1-BM	Ion Chamber-100mm wide	Custom	1
9	1-BM	Ion Chamber-standard		3
10	1-BM	PC computers-desktops & laptops	Various	5
11	1-BM	NIM Bin & plugins	V-to-F's, Hi V's, SCA's	3 bins
12	1-BM	Current preamps for ion chambers	Stanford(SRS)	4
13	1-BM	VME crate & plugins	Various	3
14	1-BM	Thermocouple readouts on PSL DCM	Omega	3
15	1-BM	Mono slits	JJ-x-ray	1
16	1-BM	MLL/FZP testing unit	APS custom/Deming Shu design	1
17				
18	**Beamline**	**Component**	**Make/Model**	**Qty**
19				
20	2-BM	Detectors	PCO/Edge	1
21	2-BM	Detectors	PCO/Dimax	1
22	2-BM	Detectors	Cool Snap K4	1
23	2-BM	Detectors	Cool Snap FX	1
24	2-BM	Stage	Aerotech/ABRS 250MP airbearing & controller	1
25	2-BM	Stage	Aerotech/ABL 1500 linear airbearing	1

Large-Scale Instrument | Operational Components | EPS Systems | Monochromators | Mirrors | D

Google Docs Table Entries for:

- Large-Scale Instruments
- Operational Components

Subdivided into

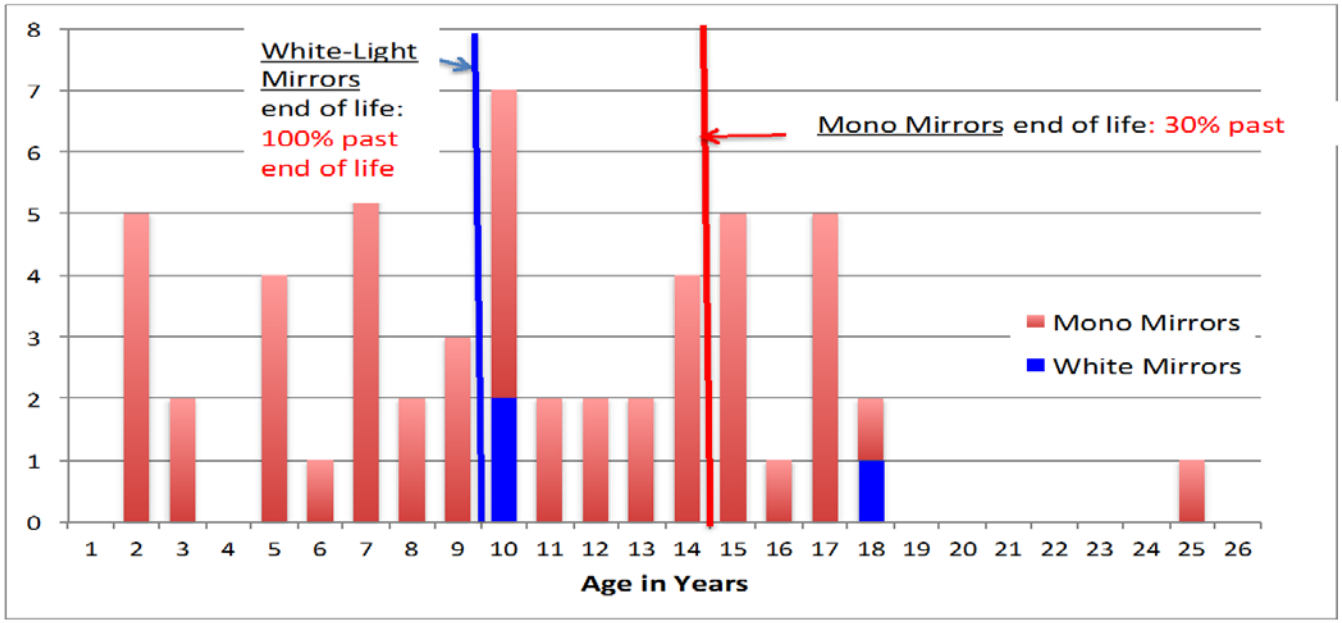
Photon Delivery Systems

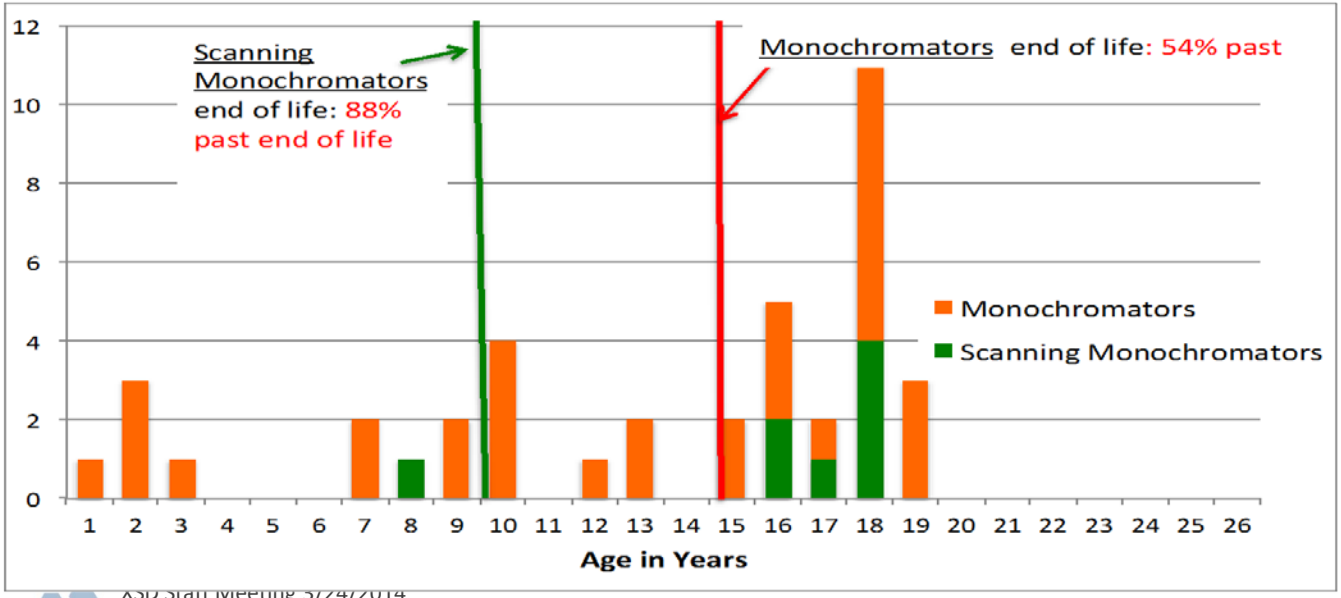
- Monochromators
- Mirrors,
- Nitrogen pumps
- Vacuum Systems
- etc.

Endstation Instrumentation

- Detectors,
- Diffractometers
- etc.

Photon Delivery System





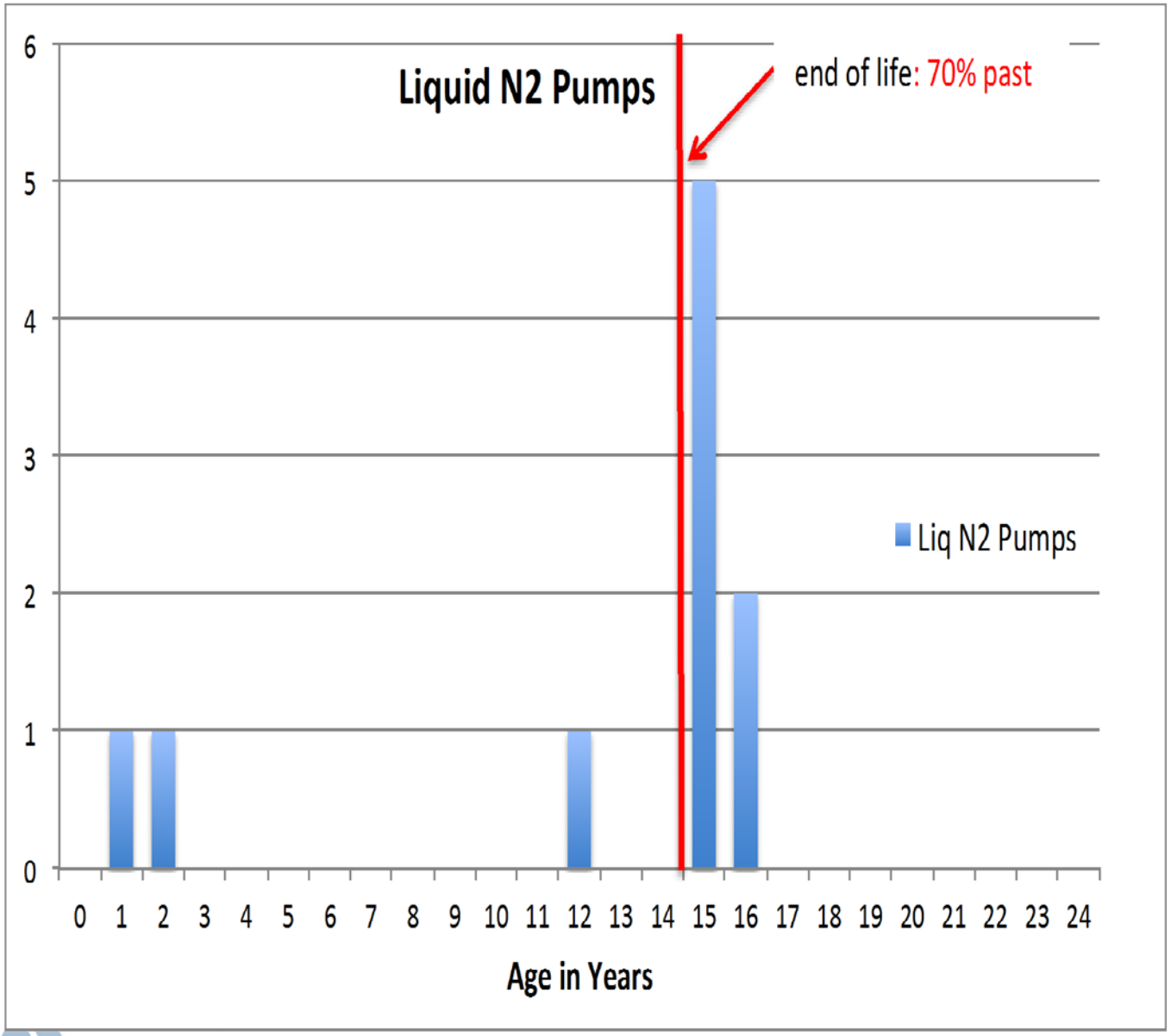
Issues for mirrors

- Carbon deposition
- Radiation damage
- Increasing surface roughness
- Higher rad dose results in shorter lifetime for white light mirrors

Issues for Monos

- Mechanical wear (primary issue for Scanning Monos)
- Radiation damage of wiring
- Aging / Rad Damage of Ferro-fluid seals
- Mono stability
- Obsolete/unavailable parts

Photon Delivery System



Issues

Two newest pumps are replacements for units that had multiple failures.

Pumps are Oxford Models B (1), C(8) and D++(2)

Models B and C are hand-made so cryo-lines and controllers are not in general interchangeable between units.

Photon Delivery System

1	**Motor Control**				
2	**Beamline**	**Types**	**Axes**	**Control Chain**	**Age**
3					
4	1-BM	Step-PAC	32	OMS 58-8	~15-20 yrs
5	1-ID	Step-PAC	124	OMS 58-8	~10-20 yrs
6		Kohzu (Oriental)	111	OMS 58-8	~10-20 yrs
7		Oriental RDK	24	OMS 58-8	~10-20 yrs
8		Phytron (Sincos)	24	OMS 58-8	~5-10 yrs
9	2-BM	Kohzu (Oriental)	24	OMS 58-8	~15-20 yrs
10		Step-PAC	80	OMS 58-8	~15-20 yrs
11	2-ID	Kohzu (Oriental)	10	OMS 58-8	~15-20 yrs
12		Step-PAC	120	OMS 58-8	~15-20 yrs
13	3-ID	Kohzu (Oriental)	8	OMS 58-8	~15-20 yrs
14		Phytron (Sincos)	268	OMS 58-8	~5-10 yrs
15	4-ID	Step-PAC	160	OMS 58-8	~15-20 yrs
16		Kohzu (Oriental)	30	OMS 58-8	~15-20 yrs
17	6-ID	Step-PAC	160	OMS 58-8	~15-20 yrs
18		Kohzu (Oriental)	16	OMS 58-8	~15-20 yrs
19	7-BM	Step-PAC	48	OMS MAXv	~5-10 yrs
20		Phytron (Sincos)	16	OMS MAXv	~5-10 yrs
21	7-ID	Step-PAC	80	OMS 58-8	~10-15 yrs
22		Phytron (Sincos)	40	OMS 58-8	~10 yrs
23	8-BM	Step-PAC	75	OMS 58-8	~5-10 yrs
24	8-ID	Step-PAC	116	OMS 58-8 / MAXv	~10-15 yrs
25	9-BM	Step-PAC	24	OMS 58-8	~10-15 yrs
26	9-ID	Kohzu (Oriental)	8	OMS 58-8	~15-20 yrs
27		Phytron (Sincos)	80	OMS 58-8	~5-10 yrs
45	32-ID	Kohzu (Oriental)	32	OMS 58-8 / MAXv	~10-15 yrs
46		Step-PAC	48	OMS 58-8 / MAXv	~10-15 yrs
47	33-BM	Step-PAC	52	OMS 58-8	~15-20 yrs
48	33-ID	Step-PAC	80	OMS 58-8	~15-20 yrs
49		Newport	16	Custom Vendor	~5-10 yrs
50	34-ID	Step-PAC	88	OMS 58-8	~10-15 yrs
51		Newport	16	Custom Vendor	~5-10 yrs
52					
53					
54					
55		Total Axes:	2869		
56					
57		Step-Pac	1887		
58		Phytron (Sincos)	604		

Issues

- Many kinds of motor controllers
- Need information of failure rate to get an estimate for end of life (EOL)
- Need to standardize across beamlines for future purchases.
  - e.g.. NSLS-II is using only DELTA TAU units
  - Perhaps we should plan to use 2 types at APS?
- If we have a 20 year EOL and decide to replace 200 per year to "catch up" @ $500 /motor controller yearly replacement cost would be ~ $ 100 K
- Replacements create spares

Obsolescence and Maintenance Plan

Establish yearly costs for obsolescence and beamline component maintenance

Example (My first pass)

Photon Delivery System

Mirrors	1 New Mirror system (est. from NEXT costs)		$800 K
	2 mirrors repolished and recoated		$100 K
Monochromators	1 new mono (est. from NEXT costs)	$900 K	
	1 monochromator rebuild		$200 K
Nitrogen Pump	1 / year		$150 K
Ion Pumps & Controllers	10 / year		$100 K
Motor Controllers	200 / year		$100 K

End-Station Instrumentation

Diffractometers	1 new diffractometer / 2 years (NEXT costs)		$500K
Detectors	10% of point & solid-state detectors /year	$200K	
	10% of linear detectors		$50K
	10% of area detectors		$900K
Electronics	10% of current amps, VME, NIM		$200K

Total **$4.2 M**