

# APS Upgrade-Proposed Beamlines

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# APS-U Beamline Process

- Gather Input
  - Midterm beamline proposals (Feb. 2008)
  - Science Team Cases (from Lisle workshop)
  - LOIs/Scientific Proposals for new beamlines
- Distill Input
  - Beamline Renewal Working Groups

<u>Category</u>	<u>APS Leader</u>	<u>Outside Co-Leader(s)</u>
Imaging/Coherence	Barry Lai	C. Jacobson & Mark Sutton
Extreme Conditions	Malcolm Guthrie/ Wolfgang Sturhahn	Mark Rivers
Ultrafast Dynamics	Eric Dufresne	Paul Evans
Interfaces	Paul Zschack	John Budai & Dillon Fong
Spectroscopy	Steve Heald	Clem Burns
Proteins to Organisms	Stefan Vogt	J. Penner-Hahn & Malcolm Capel
Other (AA)	Dean Haeffner	



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- Distill Input
  - Beamline Renewal Working Groups
  - Presentation presented at last PUC/APSUO meeting
  - Community Input Talks
  - Presentations to APS SAC
  
- Refine/Prioritize Requests
  - APS Management in discussion with DOE
  
- Develop “Strawman” Scenario
  - Dean Haeffner, Denny Mills, George Srajer, Mark Beno
  - Help from APS-U Steering Committee
  - Input from many APS/XOR staff



# APS Upgrade Steering Committee

- Denny Mills (Chair)
- Rod Gerig
- George Srajer
- John Maclean
- Michael Borland
- Tom Irving (APS PUC Chair) (formerly Denis Keane)
- Paul Fuoss (APSUO Rep)
- Bob Fischetti (Life Sciences Council Chair)
- Dan Neumann (SAC Member)



# Flagship Beamline Programs

- From DOE Scope 2
  - Wide Field Imaging (AXI-WF) (200 m beamline)
  - Coherent Diffraction Imaging (AXI-CDI)
  - Surfaces and Interfaces (XIS)
  - High Magnetic Field Diffraction (In-field Diffraction)
  - High Energy X-rays for Mechanical Behavior
  - Advance Spectroscopy (LERIX/XAFS)
  - High Energy Tomography
  - Bionanoprobe
  - Short Pulse X-ray Beamline (SPX)
  - Enhance X-ray Photon Correlation Spectroscopy (XPCS)
  - Enhance Ultrafast Imaging
  - Enhance SAXS
  - Split MERIX/HERIX, combine MERIX programs
  - Nuclear Resonant Scattering upgrade
  - Catalysis Center Beamline
  - High Pressure Microbeam Upgrade
  - Upgrade 100 ps time resolved program
  
  - Beamline upgrades for higher storage ring currents
    - As needed to all APS beamlines



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“Key” Beamlines  
In Murray’s DOE  
presentation

**Bionanoprobe** singled  
out as opportunity for  
funding from bio sources



# APS Factors Affecting the APS-U Upgrade

A highly over constrained problem.

- Three open ports for ID beamlines
  - 12 ID beamlines proposed
  - Hold one current open port for new outside proposal (probably DC-CAT or NRR-CAT)
- Long straight sections have symmetry constraints for acceptable accelerator performance
  - CD0 proposes 8 LSS
- \$350 million upper limit
  - 35% contingency
  - 10% project management related costs
  - R&D costs
  - Adjustments for inflation (“Escalation”)
  - Not as much as it sounds (~\$88M)
- Strong desire to have LSS for crab cavities
  - 7-ID picked for main SPX beamline due to existing program
- Long (e.g., 200 m) beamlines work best at Sectors 18, 19, or 20



# Long Straights

- Reasons:
  - Effectively increases undulator length (best for fixed energy beamlines)
  - Can have different undulator periods for different energies
    - Multiple devices can provide complete spectral coverage
  - Less compromise on undulators for canted beamlines
- Several geometrical options
  - Favorites: 1 X 8, 2 X 4
  - Other possibilities
    - 3 X 4, 2 X 5
- Need to fix the starting point
- RHB and LSS incompatible
  - AXI-WF cannot go to LSS sector
- Proposed LsL x 4 symmetry
  - Anchored around 7-ID



# Proposed Roadmap

- Red indicates a proposed change in scope for that BL, NOT A PRIORITY LIST!
- Gray indicates no major change in scope on that BL, but that DOES NOT MEAN INVESTMENTS IN THAT BL WILL NOT BE MADE!

Beam line	Owner	Current	Long str.	Cant.	Long BL	Proposed Map
1-ID	XOR	HE Stress Strain Texture HE Diff. Microscope / $\mu$ PDF	x	x		D: HE Stress Strain Texture E: HE Diff. Microscope
2-ID	XOR	B: CDI / $\mu$ Fluorescence D: $\mu$ Diffraction / $\mu$ Fluorescence E: $\mu$ Fluorescence		x		B: CDI / $\mu$ Fluorescence D: $\mu$ Fluorescence E: $\mu$ Fluorescence
3-ID	XOR	NRS/HERIX				NRS/HERIX
4-ID	XOR	C: LE Magnetic Spectroscopy D: HE Mag. Spect / Mag Diffrac.		x		C: LE Mag. Spectroscopy D: HE Mag. Spectroscopy
5-ID	DND-CAT					DND-CAT
6-ID	XOR	B: Magnetic Diff./General Diff. C: Surface/Liquid Scattering D: HE Scattering	x			Time-resolved EXAFS (program from 11-ID and 20-ID)
7-ID	XOR	Time-resolved		M		Time-resolved/SPX
8-ID	XOR	XPCS & Coherent SAXS	x		M	XPCS & Coherent SAXS
9-ID	XOR	MERIX/Liquid Scattering				MERIX
10-ID	MR-CAT					MR-CAT
11-ID	XOR	B: PDF C: PDF/HEX D: TR-XAFS	x	x	M	B: PDF C: PDF/HEX D: In-field diffraction (mag scat.)
12-ID	XOR	SAXS/surface diffraction		*		SAXS/surface diffraction
13-ID	GSECARS	GSECARS	M	*		GSECARS
14-ID	BioCARS	PX/Ultrafast				PX/Ultrafast
15-ID	ChemMatCARS	Single Crystal/Liquid Scattering/USAXS		x		Single Crystal /USAXS / Liquid Scattering (5-ID & 6-ID pgms)
16-ID	HP-CAT	HP	M	*		HP CAT
17-ID	IMCA-CAT	PX				PX
18-ID	BIO-CAT	BIO-CAT				BIO-CAT
19-ID	SBC-CAT	PX				PX
20-ID	XOR/PNC	XAFS/TR-EXAFS/Surf./LERIX			x	Wide Field & Single Shot Imaging (AXI proposal)
21-ID	LS-CAT	PX		*		PX
22-ID	SER-CAT	PX				PX
23-ID	GM/CA-CAT	PX		*		PX
24-ID	NE-CAT	PX		*		PX
25-ID				x		EXAFS/LERIX
26-ID	CNM/XOR	Nanoprobe				Nanoprobe
27-ID					x	New Proposal (Dyn. Comp. or Nuclear & Rad. Research)
28-ID			x	x	x	X-ray Interface Science (XIS)
29-ID	XOR/IEK	LE Spectroscopy				LE Spectroscopy
30-ID	XOR	HERIX/MERIX				HERIX
31-ID	LRL-CAT	PX		x		PX
32-ID	XOR	Single Shot Imaging/TXM Wide Field Imaging		x		Single Shot Imaging/TXM Bragg Coh.Diff. Imaging
33-ID	XOR	Interfaces/Diffraction	x			Interfaces/Diffraction
34-ID	XOR	C: Bragg Coh. Diff. Imaging E: 3D X-ray diffraction		*		$\mu$ Diffraction (from 2-ID) 3D X-ray diffraction

	LSS location
x	LSS installed
M	LSS installed Maybe

*	Existing Canted FE
x	New Canted FE
M	Maybe

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# Roadmap Highlights

- 20-ID program moved to make room for long beamline (AXI-WF)
  - Upgraded LERIX/XAFS canted beamline at 25-ID
  - AXI-WF on 20-ID with single shot imaging station upstream
- Crap cavities initially downstream on 6-ID and upstream on 8-ID
  - Could move one upstream on 6-ID for second SPX sector
- 6-ID programs moved to various locations, ultrafast programs from 11-ID-D and 20-ID moved to 6-ID
- Bragg CDI moved to 32-ID, 32-ID canted
  - CDI on one branch
  - TXM, Single shot imaging on other
  - Wide field to AXI-WF
- 2-ID microdiffraction moved to 34-ID
  - 2-ID canted: CDI/microfluorescence
- Liquid scattering consolidated at 15-ID
  - Negotiations need to be carried out with CARS
- New XIS beamline
  - 6-ID, 20-ID chambers incorporated into XIS or 33-ID



# Roadmap Highlights

- MERIX moved to 9-ID
  - HERIX program expanded on 30-ID
- 1-ID canted
  - One line: Stress/Strain/Texture focus on processing
  - 2<sup>nd</sup> line: HEDM, high-energy diffraction
- In-field diffraction (with possible big magnet) to 11-ID-D
- Initial LSS
  - 1, 6, 8, 11, 13 (M), 16 (M), 28, 33

# Options

- Keep the current Sector 20 program where it is, move SBC to Sector 25 and the long beamline (Wide Field & Single Shot Imaging) on Sector 19.
- Keep the current Sector 20 program where it is, move BioCAT to Sector 25 (or another location) and the long beamline (Wide Field & Single Shot Imaging) on Sector 18.
- Keep the TR-EXAFS program at 11-ID-D and dedicate Sector 6 to the in-field diffraction (magnet scattering) program.
- Swap programs in Sectors 25 and 28.
- Consolidation of PX programs to liberate a beamline/sector through canting a currently un-canted sector.
- Partnerships between XOR with CAT programs to build out un-utilized hutches or develop beamlines on canted FEs.

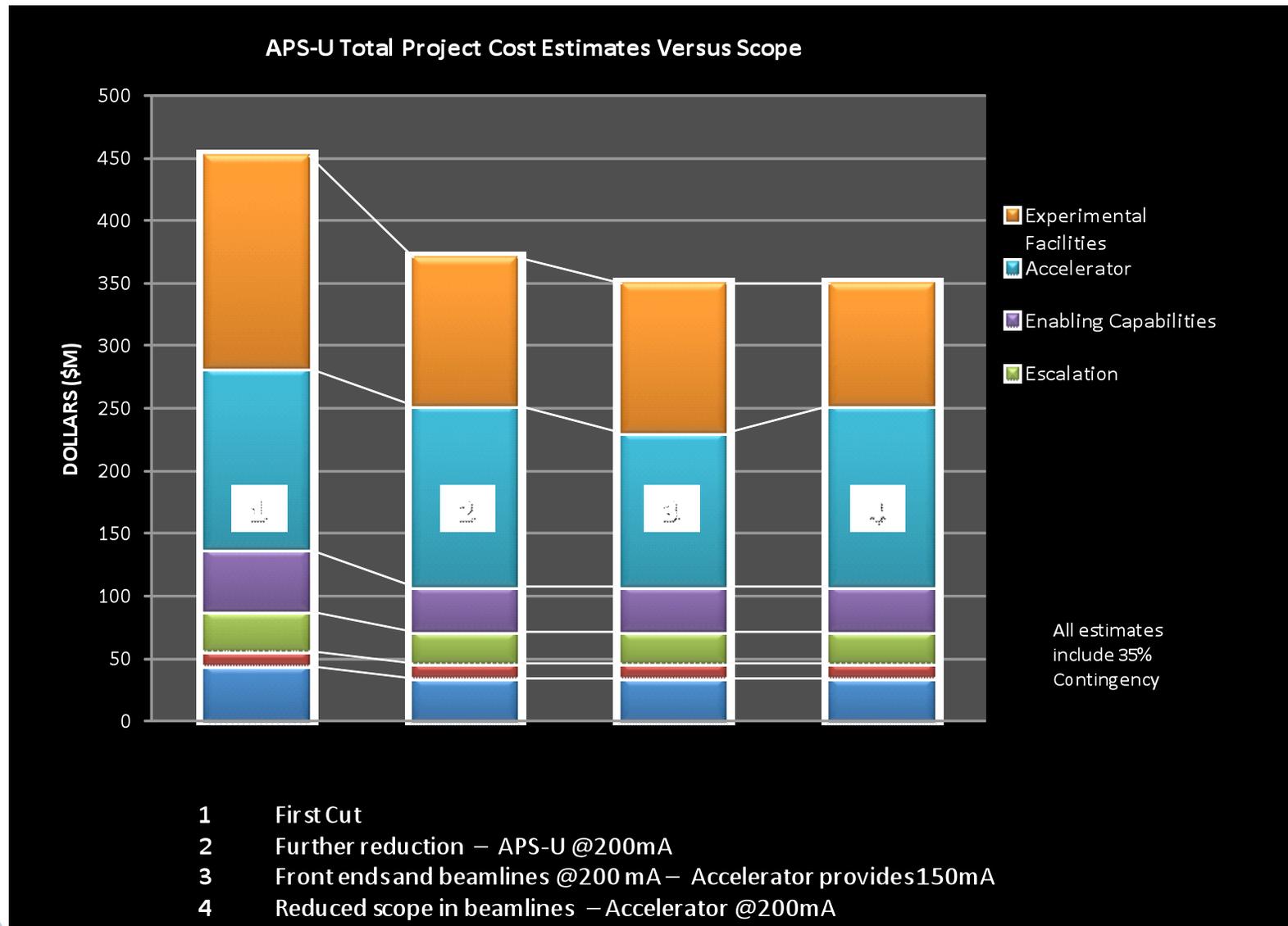


# Summary

- This is a strawman proposal!
- In details, several logistics problems
  - Any show stoppers?
- Possible better solutions with CAT interaction
  - Anyone want to move?
- Need to look again at LSS symmetry to make sure best option is being picked
  - Possible to expand LSS implementation when funds are available
- Bending magnet beamlines not discussed
  - Several open spots
  - High-energy tomography
  - Like convert 1-BM to high-energy diffraction



# Upgrade Scenarios - Presented to DOE October 2009



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# Experimental Facilities - Scope 2 or Scope 3 option

New & Upgraded Beamlines/Support Capabilities	Type	Cost (\$M)
New long beamline for Wide field Imaging (Advanced X-ray Imaging)	New	22.1
New ID beamline for study of surface and Interfaces (phase 1)	New	15.0
New High Energy X-ray beamline for studying mechanical behavior of materials	New	6.5
New advanced spectroscopy beamline ( 2 <sup>nd</sup> branch of relocated sector 20)	New	8.8
Dedicated beamline for High Energy Tomography	New	1.6
<b>Upgrade all beamlines for higher current operation</b>	Upgrade	12.0
Short Pulse x-ray beamline for Pico-second experiments	Upgrade	15.9
Upgrade beamline for Coherent Diffraction Imaging	Upgrade	5.3
Upgrade x-ray high magnetic field beam line	Upgrade	5.0
Enhance X-ray Photon Correlation Spectroscopy beamline	Upgrade	3.2
Relocate sector 20 and install canted beamline with addition of LERIX-2 spectrometer	Upgrade	2.2
Enhance existing ultrafast Imaging beamline	Upgrade	1.1
Enhance SAXS beamline	Upgrade	2.2
Relocate MERIX from 30 ID to 9 ID and enhance 9 ID beamline	Upgrade	3.4
Enhance nuclear resonant scattering program at 3 ID	Upgrade	2.3
Establish a catalyst center and 9 BM and other beamlines	Upgrade	1.6
Upgrade existing ID beamline (HP-CAT) to facilitate high pressure diffraction studies	Upgrade	1.6
Enhance the fast laser system and a new laser laboratory	Support	5.0
Infrastructure development of Pixel Array Detector use at MX beamlines	Support	0.8
Cryo sample preparation facility of high pressure freezing of samples	Support	2.8
<b>Scope 2 or Scope 3</b>		<b>118.4*</b>

Note that details of this list may not be exactly the same as the strawman BL configuration map.

\* Includes 35% contingency

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