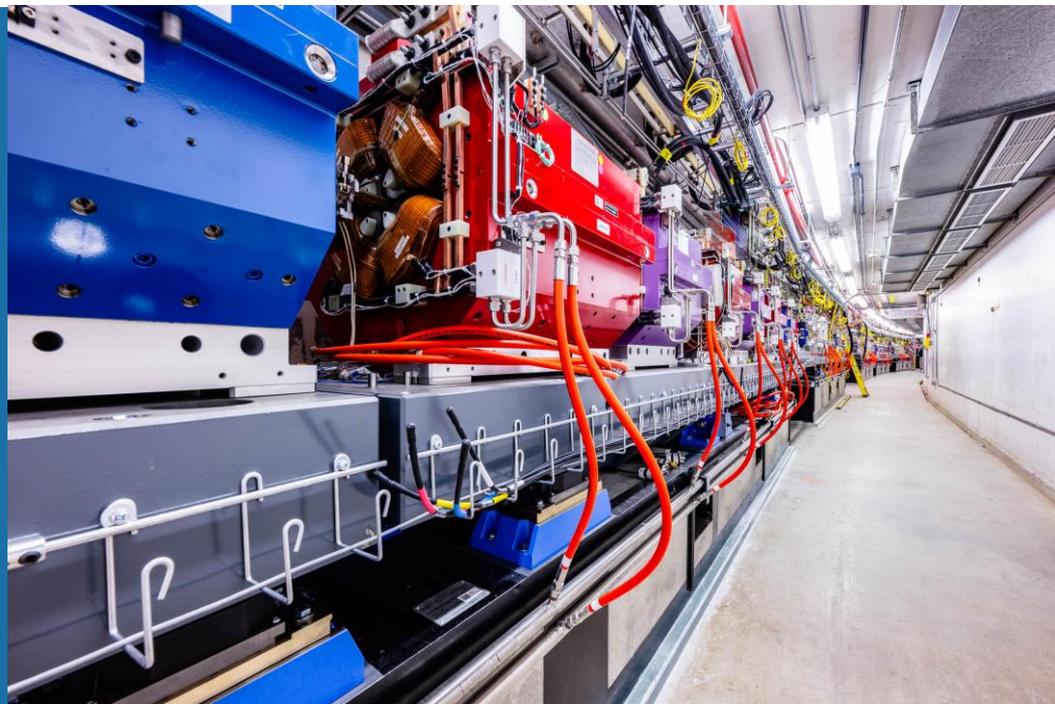


# APS Upgrade Q&A Session

December 6, 2023



# APS Upgrade Status

December 6, 2023

Jim Kerby  
Director, APS Upgrade Project

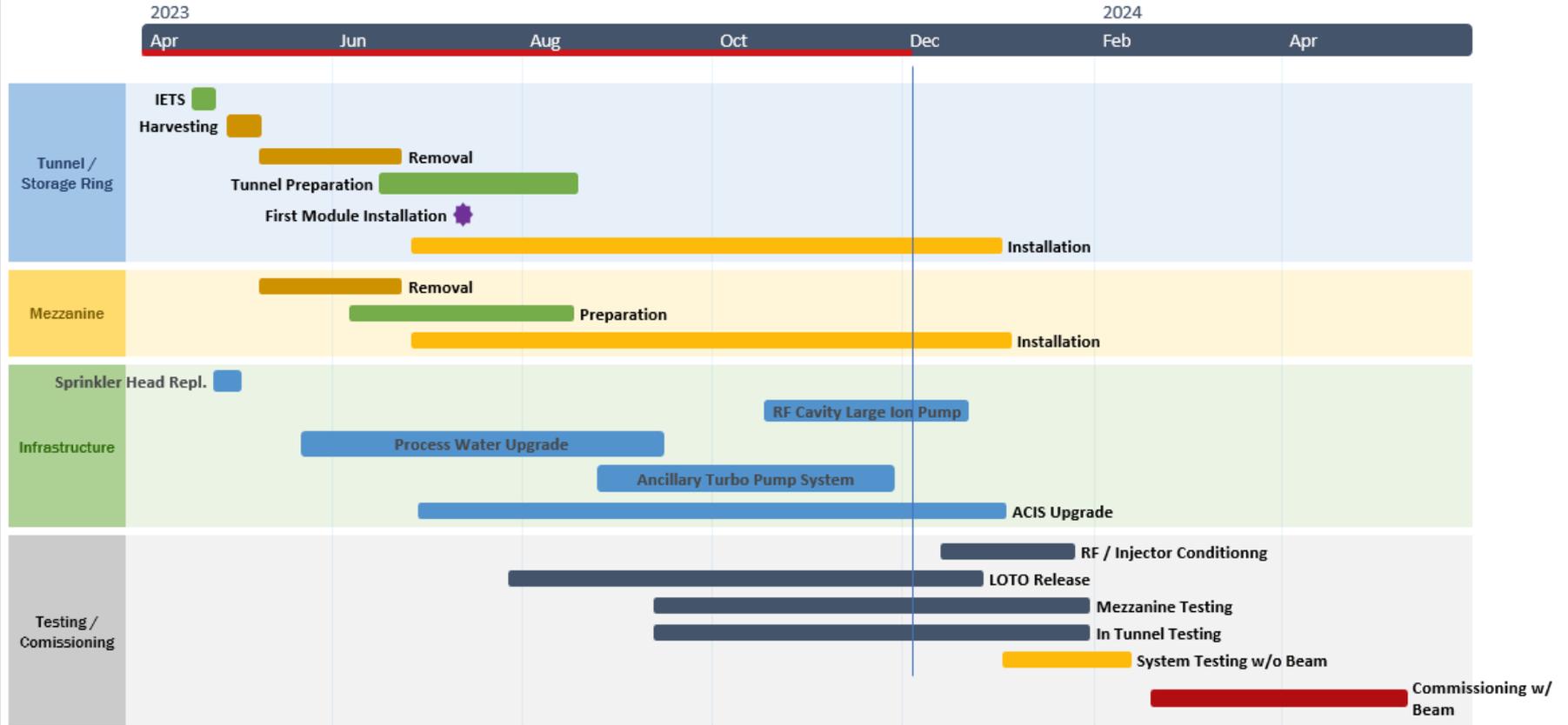


# BY THE NUMBERS

Storage Ring	Insertion Devices	Front Ends	Beamlines
1,321 Magnets	11 Phase Shifters/Supports	470 Tables/Supports	36 Enclosures
4,640 Vacuum Components	48 Canted Magnets/Supports	162 Shutters	55 Mirrors
2,245 Power Supplies	33 Corrector Magnets	108 BPMs	20 Instruments
400 Power Supply Controllers	800 Vacuum Components	162 Masks	19 Monochromators
560 RF BPM Electronics	68 Power Supplies	116 Collimators	9 Transports
200 Module Assemblies	57 Insertion Devices	35 High Heat Load and Canted Front Ends	21 Compound Refractive Lens

*Project is 89% complete by cost, 95% complete by obligation  
 \$815M TPC; \$794M EAC; \$752M Costed + Obligated; \$710M Costed*

# STORAGE RING INSTALLATION



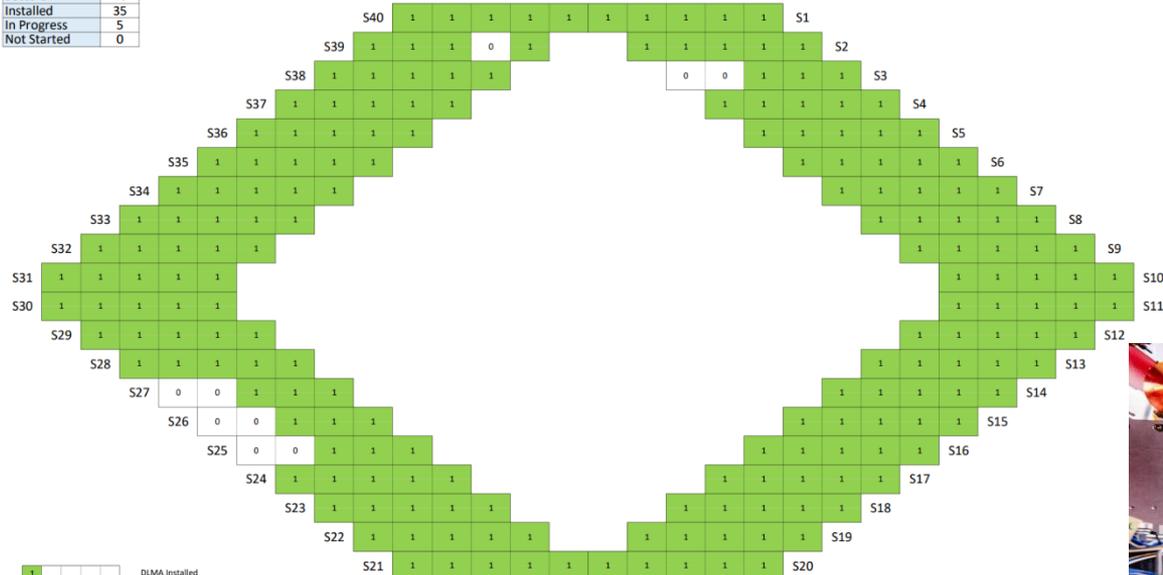
As of Dec 4

# STORAGE RING INSTALLATION

Installation Status - **Magnet Modules** [Per Sector; Per Type]

COB 12/1/2023

Sectors	40
Installed	35
In Progress	5
Not Started	0



1				
1	1			
		1		
			1	
				1

DLMA Installed  
QMQA Installed  
FOOD Installed  
QMQB Installed  
DLMB Installed

Disclaimer: Data used for the report comes from CDB Inventory Report

Dashboard by Alex Stankovik



# STORAGE RING STATUS

## ■ Installation Progress

- 54\*/54 Front Ends installed
  - 36 aligned
- 191/200 modules installed (5 modules in each of 40 sectors)
  - 8 sector bakeouts complete, 4 in progress
- 5 remaining IDVCs to install
  - 8 bakeouts complete, 2 in progress
- 10 IDs (2 revolvers) installed with cables landed
  - 1 device aligned with switches set

## ■ Test & Checkout

- Activity occurring in sector 23 up to sector 7
- Progress limited by bakeouts



# GENERAL UPDATES

- Assembly Work nearing completion
  - 200 modules completed (includes 3 spares)
    - 4 DLMAs remaining to be built for ring – this week and next.
  - 43/44 Insertion Devices (+IEX) ready for installation
- Remaining parts
  - 36 QMQB absorbers delivered and installed; 1 en route
    - Last 3 to be delivered via FMB Berlin or Argonne Central Shops (parallel paths)
  - All Beam Position Monitors are on site.
  - Septum testing to be complete by 12/15 for installation
  - Final Zone F chambers & absorbers delivered this month
- Schedule
  - Critical path through bakeouts and test and checkout
  - Storage Ring IRR (internal) planned for beginning of January
  - Estimating ARR week of February 12<sup>th</sup>

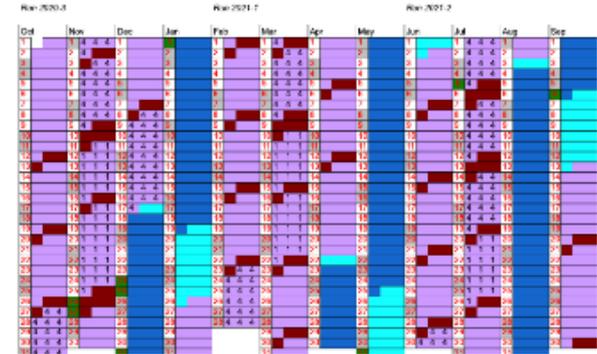
# EXPERIMENT FLOOR STATUS

- Shielded enclosure demolitions: 19 of 30
- Shielded enclosure installations/modifications: 20 of 32
- Primary mirrors installed: 16 of 22
- Monochromators installed: 4 of 16
- Major instrument systems installed: 8 of 24
- Beamline utility modifications: 32 of 54



# APS-U OPERATIONS SCHEDULE

- Feb. 2024 – Accelerator commissioning starts
  - 3-month plan -- includes schedule contingency
- May 2024 - Beamlines start receiving initial X-rays
  - There *may* be opportunities for early beamline checkout
- Expect similar run cycle schedule for initial X-ray operations
  - 3 months X-ray ops followed by 1 month maintenance
  - 5 to 6-day X-ray ops weeks with 1-2 machine studies in between
- Ramp up to full current operation to take ~1 year



Run	2024-1	2024-2	2024-3	2025-1	2025-2
Approx. Dates*	Jan.-Apr.	May-Aug.	Oct. – Dec.	Feb. – Apr.	May-Aug.
$I_{\max}$	0-25 mA	50 mA	100 mA	150 mA	200 mA
Anticipated Activities	Accel. Comm.	Shielding Verification Technical Comm. Some BL user ops.	Technical Comm. User ops.	Technical Comm. User ops.	User ops.
Bunch Pattern	324 bunch	324 bunch	324 bunch 48 bunch	324 bunch 48 bunch ( $I < 130$ mA)	324 bunch 48 bunch ( $I < 130$ mA)

# THE PATH AHEAD

The APS accelerator must be brought back online SAFELY, consistent with the Accelerator Readiness Review process. This reviews people, processes and equipment

- The Booster IRR is scheduled for week of December 18th
- The Storage Ring IRR is nominally scheduled for early January
- The Storage Ring ARR is nominally scheduled for early February
- We expect an incremental Storage Ring review will occur in ~May 2024, after initial commissioning is complete, before ramping to higher currents

Beamlines will be brought back online through their own IRR processes, after safety checks are complete.

We look forward to restoring the facility back to full User operations as quickly, and safely, as possible.

# Beamlines update

December 6, 2023

Jonathan Lang  
Director, X-ray Science Division



# RECENT BEAMLINE WORK



Exp. Station & multilayer mono at 11-ID



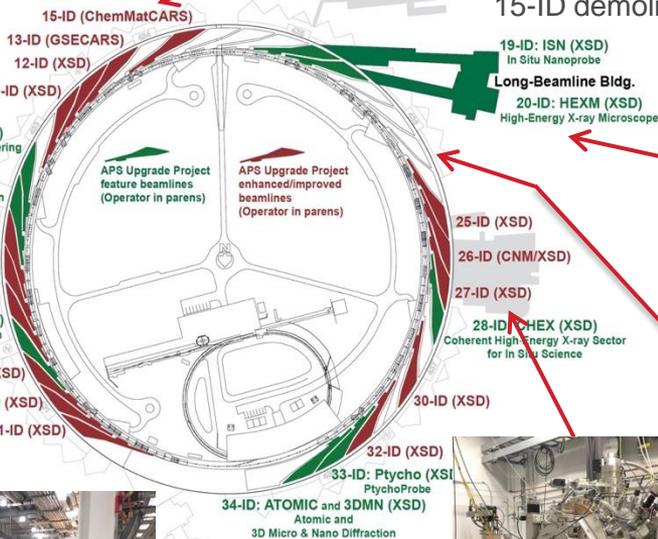
Grand Tube installation at 9-ID



Small Angle XPCS instrument at 8-ID



Demolition for POLAR at 4-ID



15-ID demolition for new enclosures (NSF)



20-ID-E HEXM enclosure



KB mirrors and CRLs at GMCA 23-ID (NIH)



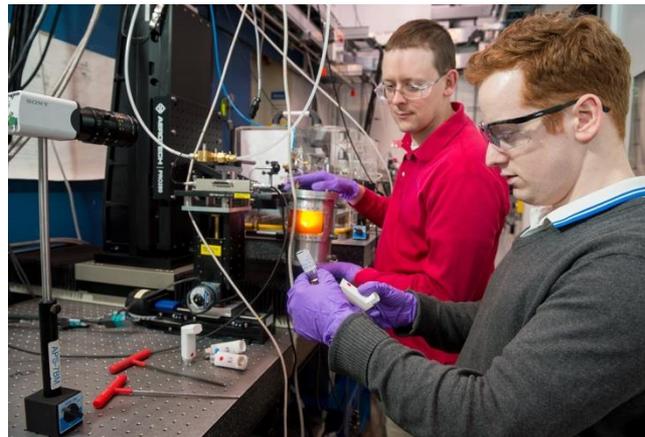
Repurposed DSC mono & mirrors at 27-ID (APS Ops)

All beamlines being touched significantly (APS-U, CAT, ...)

# RESTARTING GENERAL USER PROGRAM

Beamlines need to meet pre-beam requirements and undergo commissioning before returning to GU ops

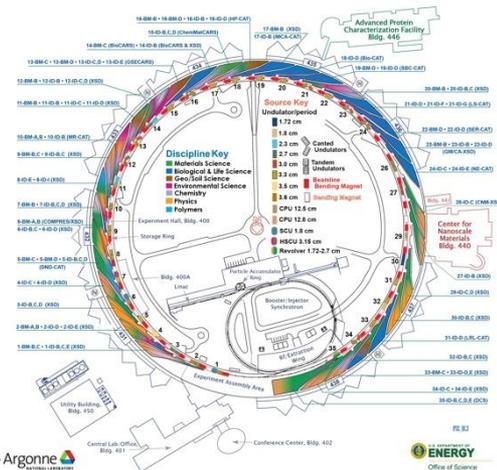
- **PDCRC Review** – Approval of final beamline design and ray tracings
- **Pre-beam check-out** – Testing of new equipment, systems without beam
- **Shielding Verification** – First beam and checkout. (~2.5 months to complete all beamlines)
- **Technical commissioning** – Testing of the beamline with beam. (~1 month existing BLs - ~3 months new BLs)
- **Scientific commissioning** and early experiments. (1-3 months)
- **General user program** can restart on beamline



# BEAMLINE RESTART

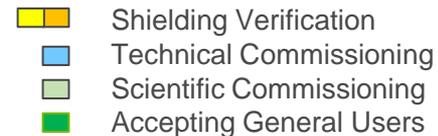
## Methodology considered in setting beamline restart order

- Beamlines separated into 4 different groups & cycled through each group. Balances startups between new/existing beamlines, between CAT and XSD, IDs/BMs, and techniques provided.
  - CAT MX beamlines (15 beamlines)
  - CAT non-MX beamlines (17 beamlines)
  - XSD: APS-U feature beamlines + Major enhancements (18 beamlines)
  - XSD: Remaining beamlines (22 beamlines)
- Factors in prioritizing order:
  - Readiness (most important)
    - Continuing supply chain issues affecting deliveries on several beamlines (enclosures, monochromators, mirrors, ...) that is making readiness an issue.
    - Quality of beamline diagnostics available on beamline.
  - Size of user community (individual beamline and multiple ports on canted)
  - Equity: Startups on CATs & XSD groups with multiple beamlines spread out by 2-3 weeks
  - Techniques offered (e.g. spread out multiple XAS, SAXS, XRD, ... beamlines)



# BEAMLINE STARTUP TIMELINE

## Time increments in weeks



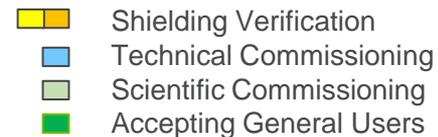
Known Delivery Issues

~10 weeks

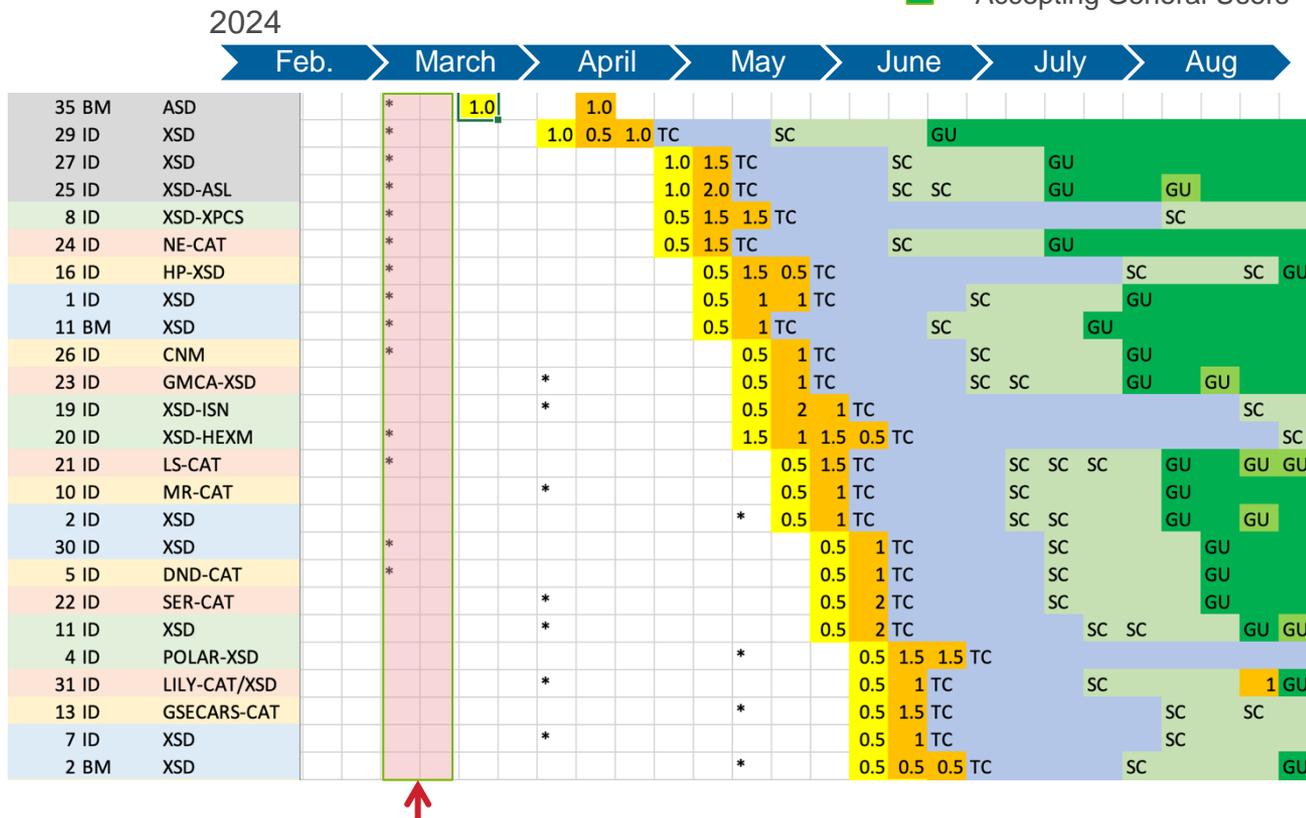
- Shielding verification is rate limiting step (serial with 2 Health Physics crews/day = ~10 weeks)

# BEAMLINE STARTUP TIMELINE

## Time increments in weeks



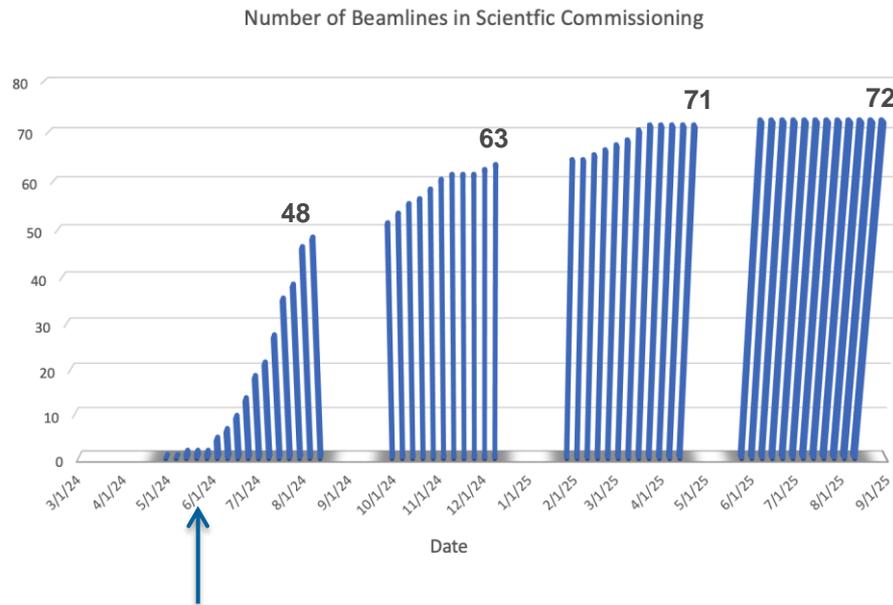
- 35-BM and 29-ID commissioned during accelerator commissioning
- Current forecast: start beamline commissioning early May
- 27-ID and 25-ID first at request of commissioning team due to “known” diagnostics.
- Shielding verification needed for 35-BM and 50 “user ports” (72 beamlines), lasting ~ 10 weeks
- Asterisk(\*) indicates current assessment of when everything in place for beamline to start commissioning
- Draft schedule.** Continuing to refine based on discussions with CAT and XSD staff (**consult beamline staff for latest est. start date**)



No access to beamlines for ~ 2 weeks when storage ring starts. Current forecast is early March. Accel comm. starts only after Accelerator Readiness Review (ARR) approval.

# BEAMLINES INTO SCIENTIFIC COMMISSIONING

- Majority (48) of beamlines will be transition to scientific commissioning during 2024-2 run. Most of rest will be in 2024-3
- Late construction feature beamlines (CHEX, 3DMN, Atomic, & Ptycho) will start scientific commissioning in 2025-1 cycle.
- Scientific commissioning user access:
  - APS-U feature beamlines:** “first experiments” proposal call coming in January
  - Remaining beamlines:** Regular GU proposal call (Feb. ‘24), score proposals, and beamline schedule from list based on commissioning progress.



- Earliest beamline could host a user experiment in late May/early June 24'

# FIRST EXPERIMENTS WORKSHOPS

- APS-U feature beamlines.
  - HEXM May 4, 2023 (APS user meeting)
  - POLAR June 28, 2023
  - XPCS July 18-19, 2023
  - CSSI Aug. 1-2, 2023
  - ISN/Ptycho Aug. 3-4, 2023
  - 3DMN Spring, 2024
  - ATOMIC Spring, 2024
  - CHEX Spring, 2024
- Follow on to Townhalls meetings in Fall '21 & Jan. '22
- First experiments call, January 2024 (~1 month away)
  - Goal to choose 2-3 experiments to run multiple times during scientific commissioning on feature beamlines.
- First GU experiments call for 2024-2 will be February 12, 2024
  - Proposals will be scored but not allocated.



Attendees of the XPCS 8-ID First Experiments Workshop

## POLAR First Experiments Workshop

### AGENDA:

9:00 Welcome: Dean Haeffner, Argonne National Laboratory

9:05-9:30 Introduction: Daniel Haskel, Argonne National Laboratory

**Theme 1:** Reciprocal and real space imaging of electronic texture with Dichroic CDI and Tomography (Chair: Joerg Stempffer)

**9:30-10:00** Dr. Claire Donnelly, Max Planck Institute for Chemical Physics of Solids, Dresden

**10:00-10:30** Dr. Danny Mannix, European Spallation Source, Lund

**10:30-11:00** Dr. Suzanne te Velthuis, Argonne National Laboratory

**11:00-11:30** Prof. Motohiro Suzuki, Kwansai Gakuin University, Japan

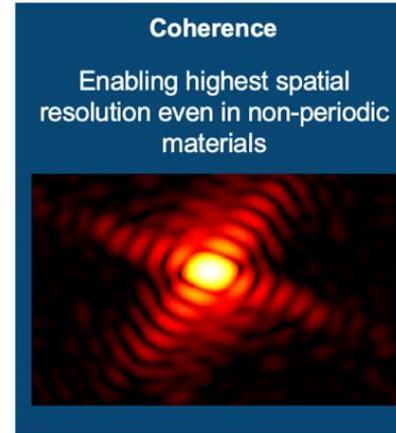
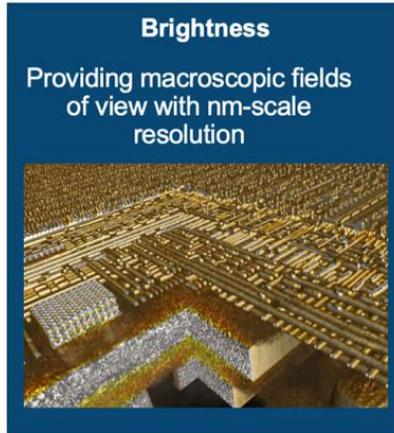
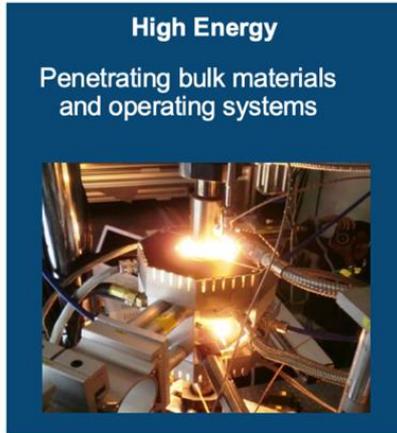
**11:30-11:45** Dr. Joerg Stempffer, Argonne National Laboratory

**11:45-12:00** Open floor discussion, (Moderator: Joerg Stempffer)

**12:00-13:00** Lunch Break

# SUMMARY

- All beamlines being impacted by APS-U and other upgrades and will need some time to “check out” and commission new systems to get them ready for users.
- Have set an order for beamline restarts.
  - Each CAT/XSD group will have at least one beamline in first half of commissioning period
  - Bi-weekly meetings looking at issues affecting beamline readiness & will adjust as needed.
- Goal is to start successful user experiments as soon as possible.



# QUESTIONS ON PROJECT SCHEDULE (ACCELERATOR)

- When will the beamlines expect full 200mA current aside from the two commissioning phases?
- When will the beam be ready for the beamlines even if at 25 mA?
- When the APS restarts, the plan is to increase storage ring current stepwise over time. What are the risks and mitigations for this? For example, is there a significant risk that we might be stuck at 50 mA (arbitrary number) for an extended time?

# QUESTIONS ON PROJECT SCHEDULE (BEAMLINES)

- When can we expect 20-ID to be online for general use?
- While it is no doubt that accelerator is the top priority, how soon can resources be made available to the beamlines else that will lag behind severely?
- When is LS-CAT going to be back and operational?
- When do you estimate we will begin user beamtime?
- Which beamlines are expected to come back first?
- Is the project on track or has there been any delays? When can we expect to resume data collection for MX?
- When can we expect to travel to APS for experiments again?
- When will the X-ray microtomography beamlines be available for use? What are the new capabilities/spatial resolutions of the microtomography beamlines?

# QUESTIONS ON SUBMITTING PROPOSALS

- When/where can I submit a proposal? How will a new proposal cycle be announced for those of us considered new users?
- When should we expect APS reopen to general users? When are general users will need to start to submit new proposals for the new cycle after the upgrading? A timeline (even an estimated one) will be helpful since it will allow users to have enough time to prepare new proposals. Thanks!
- What will be the process for "first experiments" proposals?
- I wonder If we can submit the beamtime proposal before the upgrade finishes.
- Will the review standard/regulation for beamtime proposals change after the upgrade?

# QUESTIONS

- With the restart of the APS occurring in late April, the run schedule will initially be out of sync with the normal APS run schedule. Will we return to the normal run schedule from before the shutdown and, if so, when?
- Can you give an update on the data infrastructure development? What type of communications and training will users receive regarding data workflow?
- How will the APS provide opportunities for beamlines to highlight new science & upgraded capabilities, other than a focus simply on the new "Feature beamlines"?

# QUESTIONS

- What is the plan for an "Argonne Guest House Upgrade" to complement APS-U? (Covid restrictions and lack of investment have made the Guest House less than competitive with local hotels. Yet, bringing young scientists and students on site will be key to building up the new APS-U science - as was the case originally for APS in the 1990's/2000's.)
- During the commissioning phase of the new APS facility is there possible to measure the XAS of some samples?
- Regarding the generation of circular polarization at APS-U, will the force-compensated X-undulator be commissioned soon after the restart or are phase plates / Apple II undulators planned to be used for a while?

# QUESTIONS

- For the various schemes, how fast will be possible to switch in between left and right circular polarization? Will users have access to polarimetry diagnostics over the full frequency range?
- Are you having fun yet?

# Questions?