

X-RAY SCIENCE DIVISION FY2022 PRIORITIES

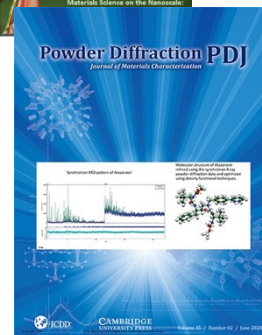
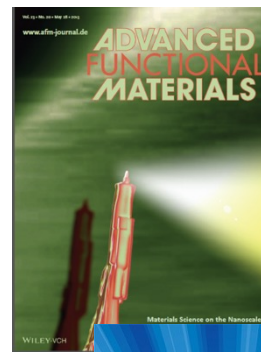
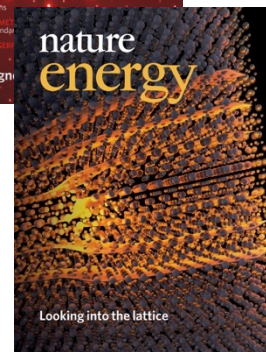
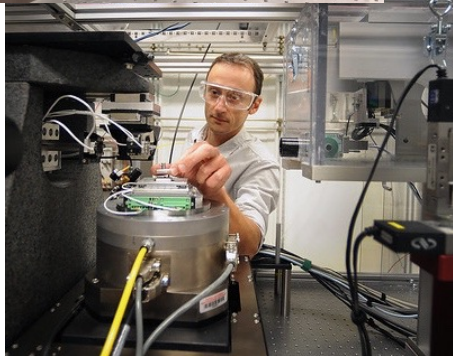
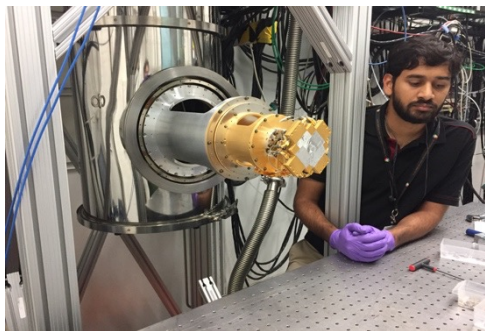


JONATHAN LANG
X-ray Science Division
Photon Sciences Directorate

APS All-Hands Meeting
July 28, 2021

X-RAY SCIENCE DIVISION - MISSION

Enable and conduct world-class research using x-rays by developing cutting-edge x-ray instrumentation and techniques.

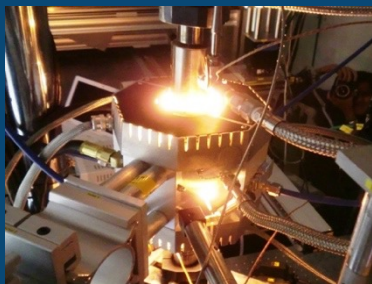


Operate 43 (35 + 8) of 67 beamlines & partner 26-ID beamline
APS CY20: **2118** (1256) publications ~40% IP>7; >4000 users

X-RAY SCIENCE DIVISION STRATEGY

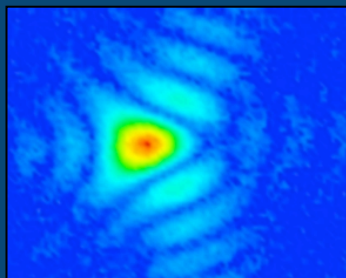
High Energy

Penetrating bulk materials
and operating systems



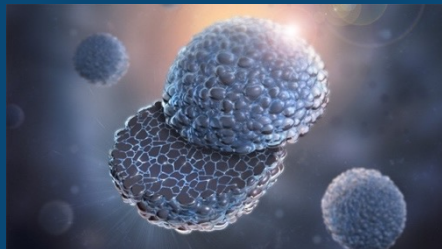
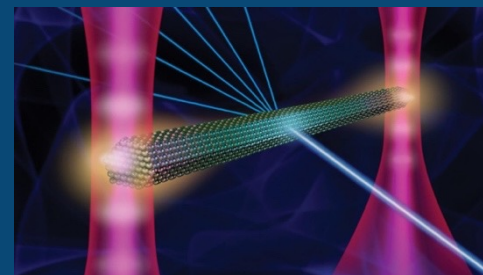
Brightness/Coherence

Highest possible spatial
resolution/dynamics



Time-Resolved Studies

Measurements from
~100ps to seconds



Argonne National Lab

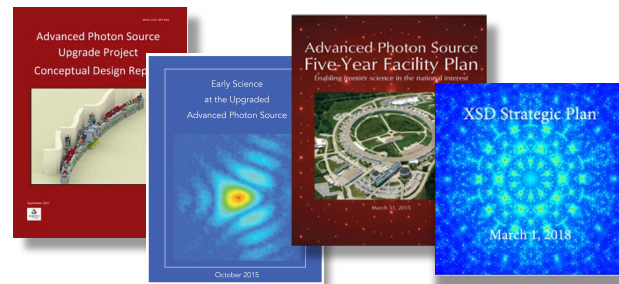
Leverage ANL core research programs &
advanced computing facilities to enhance
x-ray capabilities & scientific productivity



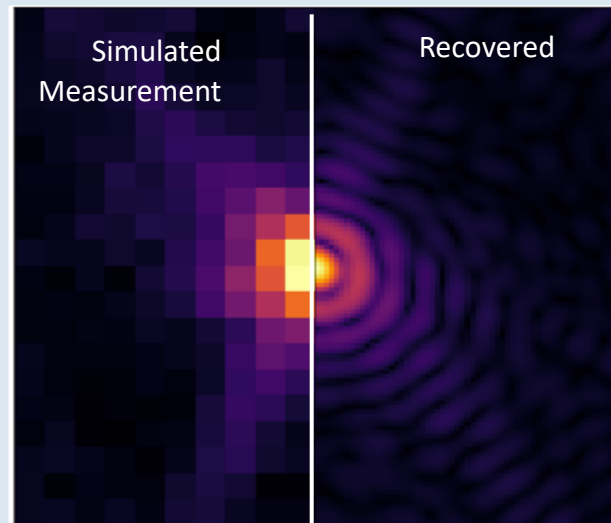
Make the APS will be the premier light-source for brilliance driven high-energy x-ray
measurements post-upgrade

X-RAY SCIENCE DIVISION STRATEGY

Leverage unique characteristics of APS & ANL.



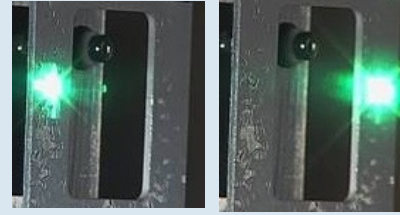
- Enhance and expand core capabilities related to APS-U
 - High-Energy, Nanofocusing, Coherence, Imaging, ...
- Develop optics, detectors, instruments, and data strategies relevant to APS-U
- Foster effective lab & external partnerships to improve APS capabilities & strengthen ANL research.
- APS-U/APS beamlines
 - APSU “feature” beamlines & beamline “enhancements”
 - Strategic investments to full APS beamline suite.
- Operate suite of world-class x-ray capabilities for the US scientific community.



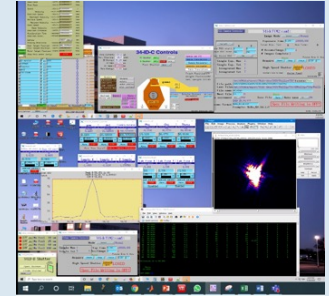
Coherent imaging at 54 keV. Left: coarse pattern due to compression of reciprocal space, Right: recovered pattern using oversampling method
S. Maddali et al., Sci Reports 8, 4959 (2018)

RECENT PROGRESS

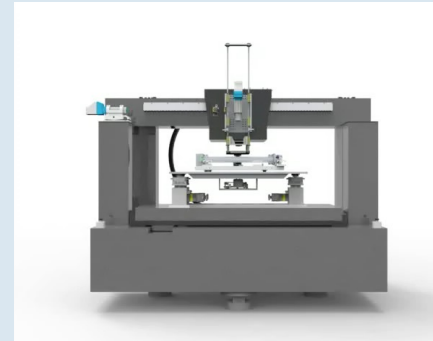
- Completed the canting project at 2-ID & restarted user program
- Enhanced remote operation and telepresence capabilities at XSD beamlines
- “Finished” upgrade of the metrology capabilities to be APS-U ready.
- Fabricated Zone Plates in-house that demonstrated <10nm resolution in transmission x-ray microscopy
- Number of projects initiated to apply AI/ML & HPC for spectroscopy, synthesis, CDI, ...



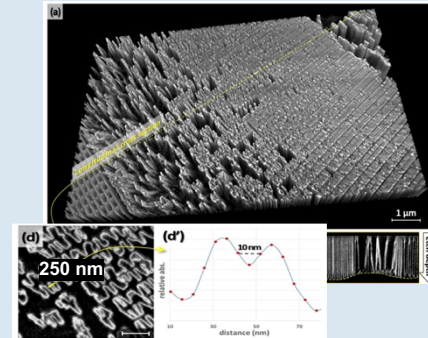
Inboard and outboard beams in 2-ID-A station



Remote operation of 34-ID-C



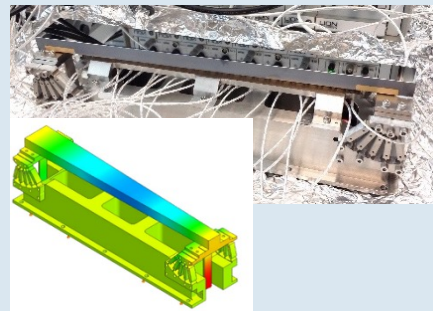
Long Trace Profiler upgrade



Zone Plate “selfie” showing 10nm resolution at 32-ID TXM

XSD FY21 BEAMLINE TECHNOLOGIES

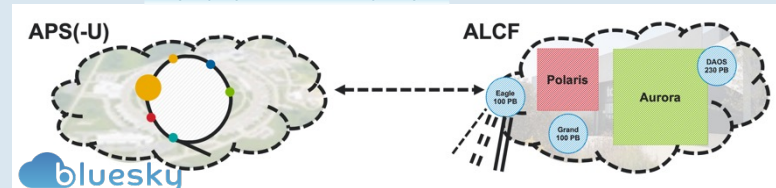
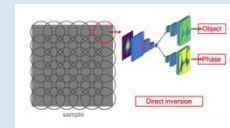
- Zoom optics development.
 - Applied ML for rapid optimization of mirror curvature
- Mixed Mode PAD Detector (APS/Cornell)
 - High dynamic range (10^8), high-speed ($>1\text{kHz}$), high-energy detector (CdTe sensors).
- Develop HPC tools for fast (real-time) analysis
 - Continue to strengthen ties with ASCR programs to develop analysis pipelines and on-demand queues
- Advanced experiment control
 - Enable additional remote access capabilities
 - Continued deployment of Bluesky (NSLS-II) on XSD beamlines



Flexure based mirror bender with capacitive sensor readback



MM-PAD v2 prototype

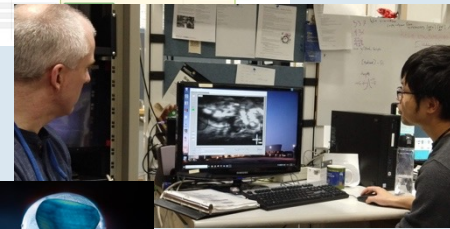
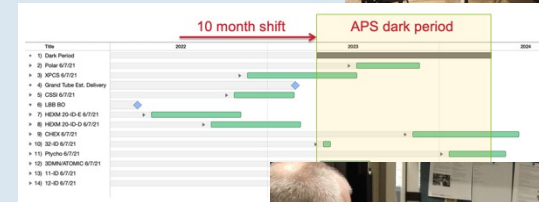
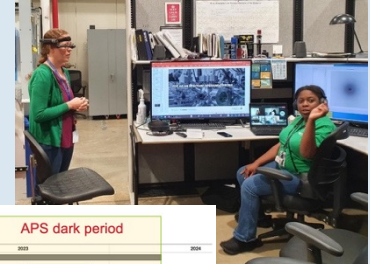


HPC data analysis

XSD FY22 BEAMLINE PROJECTS



- Continue to improve remote (hybrid) to enhance user operations on XSD beamlines
- Support APS-U beamline scope
 - Complete construction of IDEA (28-ID) & ASL (25-ID) beamlines
 - Prepare for construction of other feature beamlines & enhancements.
 - Finalize all APS-U instrument designs
- Deploy workflows, queues & data analysis pipelines on POLARIS to lay foundation for post-APS-U data processing
- Continue development Bluesky controls and AI/ML approaches for data analysis and rapid experimental feedback at the beamlines (CDI, XES, Materials synthesis, ...)



X-RAY SCIENCE DIVISION FY22 GOALS

- Develop innovative instrumentation that further advances beamline capabilities particularly for high-energy, coherence, nano-focusing,
- Ensure delivery of APS-U beamline scope
- Prepare for first post APS-U experiments
 - Lay foundation for enabling capabilities
 - Communications with the user community. Townhalls, Workshops,
- Continue improvements for automation and remote operations to reach underserved user communities
- Continue to attract, develop, and retain a diverse set of talented scientific and technical staff.
 - Adapt to new hybrid work environment.

