

# X-RAY SCIENCE DIVISION FY2020 PRIORITIES

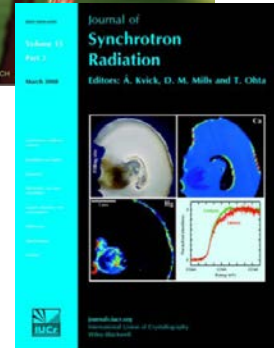
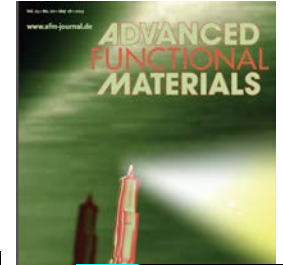
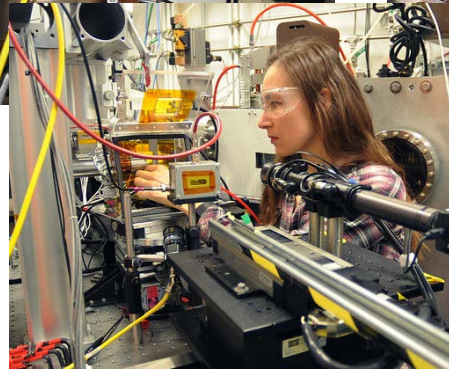
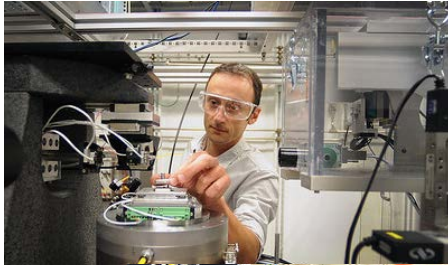


**JONATHAN LANG**  
X-ray Science Division  
Photon Sciences Directorate

**APS All-Hands Meeting**  
July 24, 2019

# X-RAY SCIENCE DIVISION - MISSION

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



Operate 35 (+9) of 68 beamlines; partner in 2 additional beamlines

APS CY18: **2016** (1089) **publications** ~18% high impact; > 5700 users

# X-RAY SCIENCE DIVISION STRATEGY

Take advantage of unique characteristics of APS.

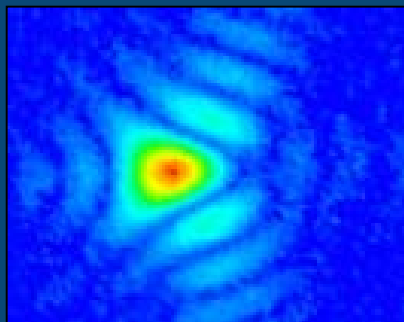
## High Energy

Penetrating bulk materials and operating systems



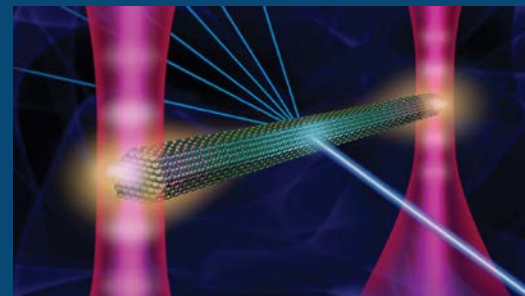
## Brightness/Coherence

Highest possible spatial resolution/dynamics



## Time-Resolved Studies

Measurements from ~100 ps to seconds



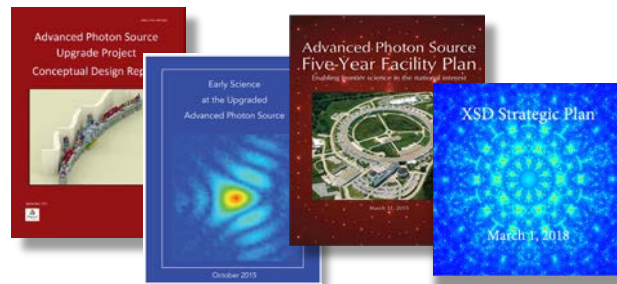
## Argonne National Lab

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

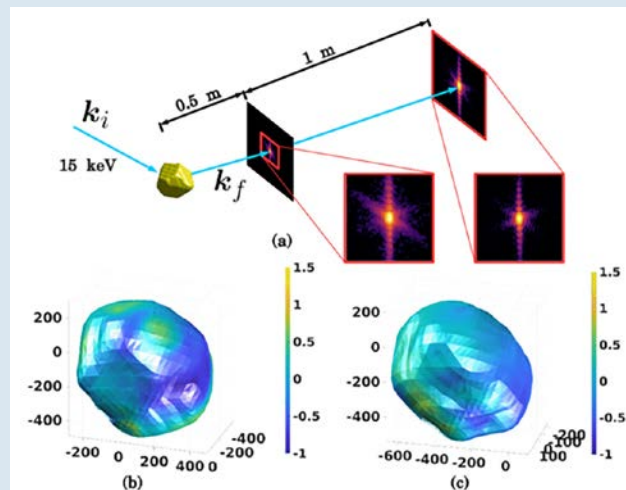


# X-RAY SCIENCE DIVISION STRATEGY

Take advantage of unique characteristics of APS.



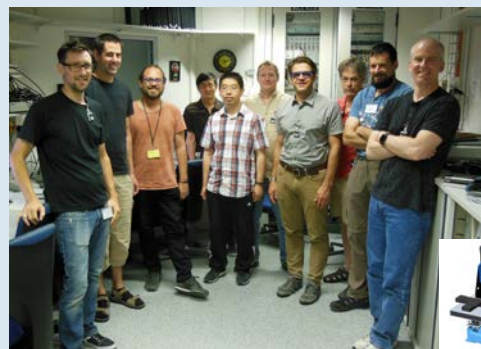
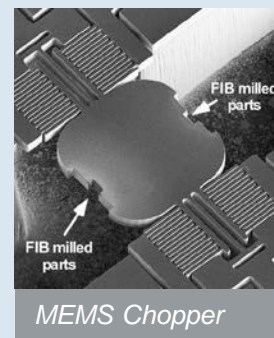
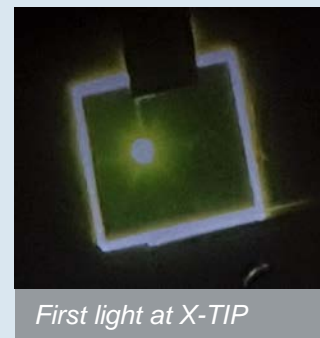
- Enhance and expand core capabilities related to APS-U
  - High-Energy, Nanofocusing, Coherence, Imaging, ...
- Develop optics, detectors, instruments, and data strategies relevant to APS-U
- Foster effective lab & external partnerships to improve APS capabilities & strengthen ANL research.
- APS-U/APS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



Bragg coherent diffraction imaging phase retrieval of high-energy X-rays scattered by a gold nanoparticle

# RECENT PROGRESS

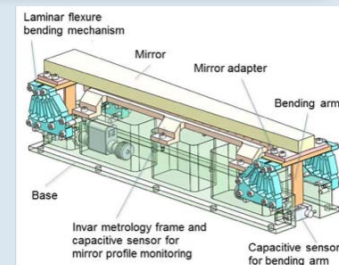
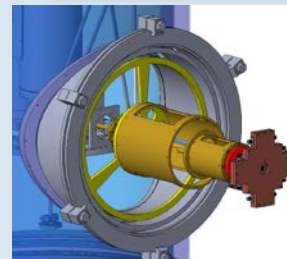
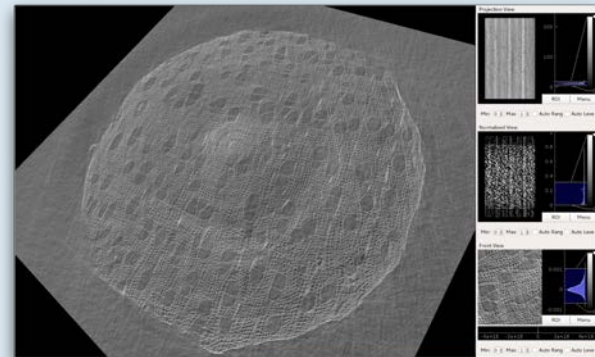
- Early Career Research Program  
Haidan Wen (2016) Zhang Jiang (2018)  
(Timing/Coherence)
- Completed X-TIP beamline at 4-ID (Lab Partnership CNM / XSD – MIC & MM)
- High-Throughput HEDM instrument at 6-ID-D (NSF; Carnegie Mellon; XSD – MPE & MM)
- Achieved sub-300 ps synchronization of MEMS based optics (CNM / XSD – TRR)
- Acceptance test of RAVEN ptychographic laminography instrument at SLS ( iARPA / XSD-MIC)



# XSD FY20 BEAMLINTE TECHNOLOGIES

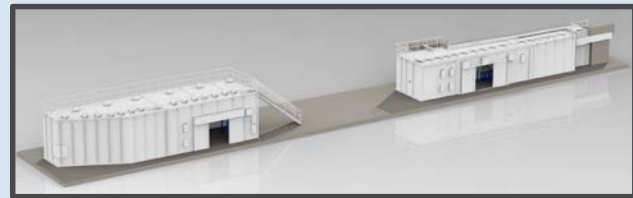
Consider beamline, sample environments, scanning systems, detectors, data pipe-lines & analysis as a complete integrated system

- Advanced experiment control and execution software
  - Bluesky (NSLS-II), MONA
- Develop HPC tools for fast (real-time) analysis
  - Forge ties with ASCR programs to develop analysis pipelines and on-demand queues, in-order to effectively utilize leadership computing facilities (DOE-BES/ASCR cross facility pilot)
- Transition Edge Sensors ( APS/NIST/SLAC )
  - Deploy high energy resolution (10-20 eV) spectroscopy detector on the beamline.
- Develop Zoom Optics to provide controllable beam size at the sample position.
- Upgrade APS metrology capabilities to be APS-U ready.



# XSD FY20 BEAMLINER PROJECTS

- Work with APS-U on buildout of IDEA beamline at 28-ID. Implement R&D program for optics and concepts for next-generation beamlines
- Install RAVEN instrument for ptychographic imaging of integrated circuits
- Cant 2-ID beamline to rationalize spectromicroscopy capabilities and prepare for APS-U
- Work with APS-U on construction of ASL at 25-ID and relocation 20-ID ( & portions 11-ID-D & 7-ID programs)
- Develop AI and ML approaches for data analysis and rapid experimental feedback at the beamlines (CDI, XES, Materials synthesis, ...)



# X-RAY SCIENCE DIVISION FY20 GOALS

- Maintain active and productive user programs on all XSD operated beamlines
- Develop innovative instrumentation that further advances beamline capabilities particularly for high-energy, coherence, nano-focusing, ....
- Complete current beamline development plans
  - APS-U IDEA beamline (28-ID); RAVEN instrument
  - Start ASL construction at 25-ID
  - Cant 2-ID to rationalize spectro-microscopy
- Work with APS-U on future beamlines and implementation of enhancements to broader beamline suite.
- Ensure safety is of primary concern in achieving this work.
- Continue to attract, develop, and retain a diverse set of talented scientific and technical staff.

