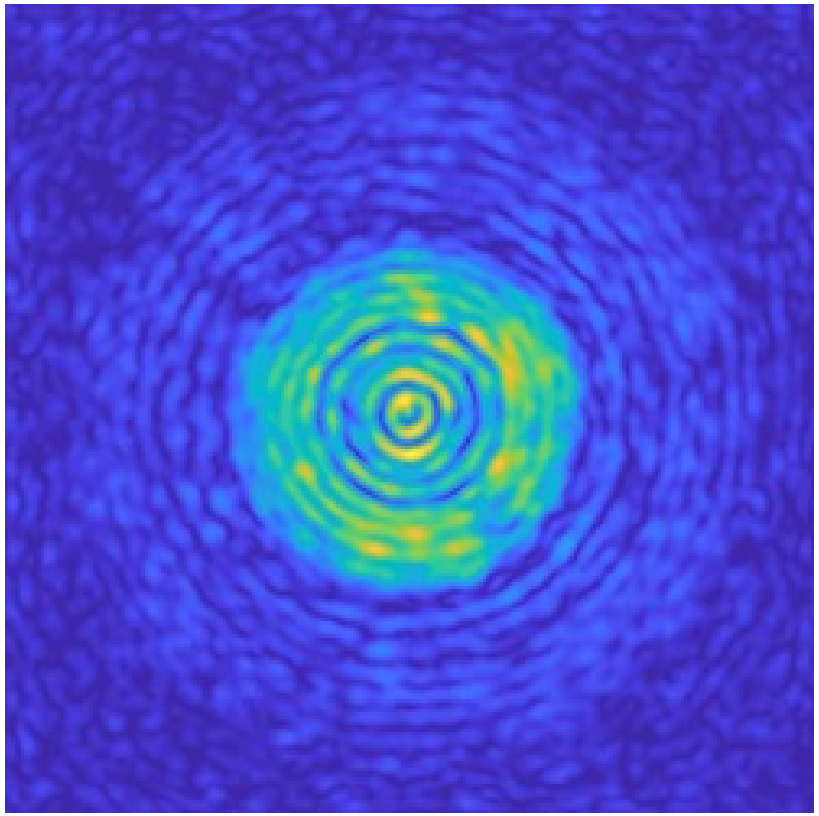
PSC ALL-HANDS MEETING
MAY 1, 2019

STEPHEN STREIFFER
Director, Advanced Photon Source
Associate Laboratory Director, Photon Sciences

AGENDA

- PSC Update – Stephen Streiffer
  - Safety
  - Organizational Changes
  - Budget
  - Highlights
  - Awards
  - Upcoming Events

- APS Upgrade Update – Bob Hettel



Reconstructed focus from ptychography scan, of a zone plate engineered to produce a flat-top focus

Team: Michael Wojcik (XSD-OPT), Junjing Deng (XSD-MIC), Christian Roehrig (XSD-MIC), Jeffery Klug (XSD-MIC), Curt Preissner (XSD-BI)

SAFETY: WHAT NEEDS TO GO RIGHT?

- We'll continue to safely operate the user program and safely maintain the facility
- PSC will be procuring, receiving, and installing a ***large*** amount of heavy equipment over the next several years
  - ➢Plan the work, work the plan
  - ➢Material moves, rigging, hoisting, lifting
  - ➢Ergonomics
  - ➢Electrical safety
  - ➢Deal with stress and fatigue

Jefferson Lab

SAFETY FLASH

EVENT: JLAB EMPLOYEE RECEIVES AN ELECTRICAL SHOCK

DATE/TIME OF EVENT: APRIL 26, 2019; 3:00 P.M.

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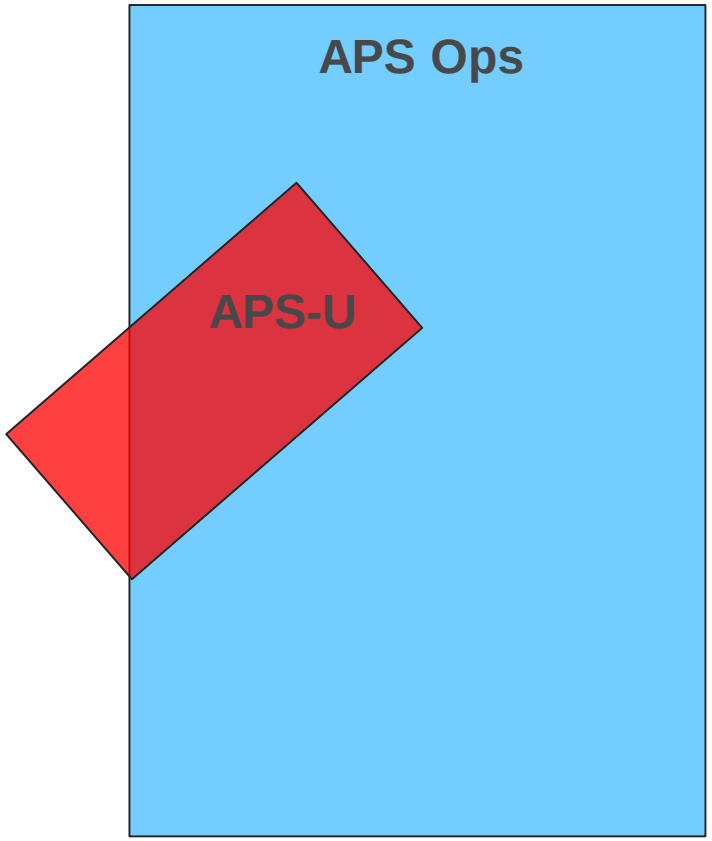
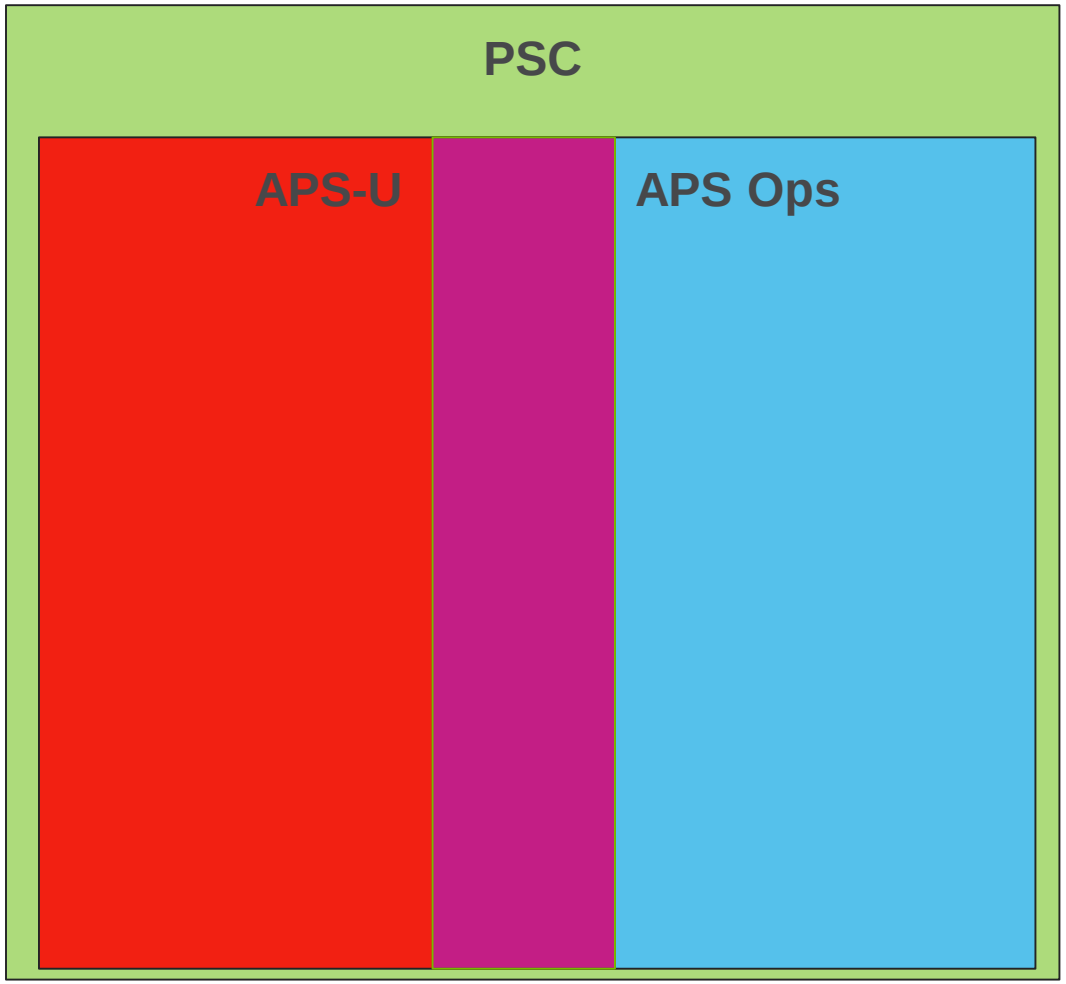
FY16
APS Ops: $130M
APS-U: $20M



FY19
APS Ops: $136M
APS-U: $130M

APS 2025 INTEGRATION UPDATE: ONE PLAN FOR PSC



Integrated spend over the next 5 years is ~$1.1B

- John Connolly leading integrated staffing planning
  - PSC available resources compiled for all groups, all three divisions, integrated with APS-U P6 demand
    - Yields picture of where APS-U demand swells and then rolls off
- Julie Cross, Chris Churchill, and George Srajer have been meeting with Interface Portfolio stakeholders, with recent focus on accelerator systems (by WBS element)
- Integration of design and safety reviews on-track
- On track for completion prior to June CD-3 review

PERSONNEL CHANGES

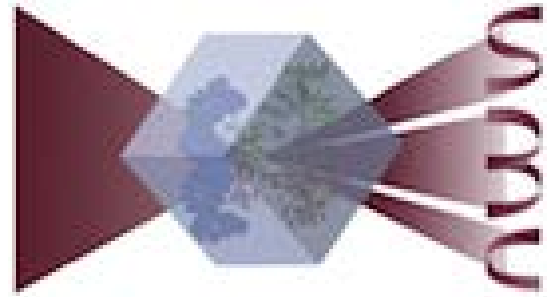
- **George Srajer** to assume new role as Deputy ALD for Planning and Integration
- **John Connolly** to assume new role as Deputy ALD for Operations, with dual hat as AES division director

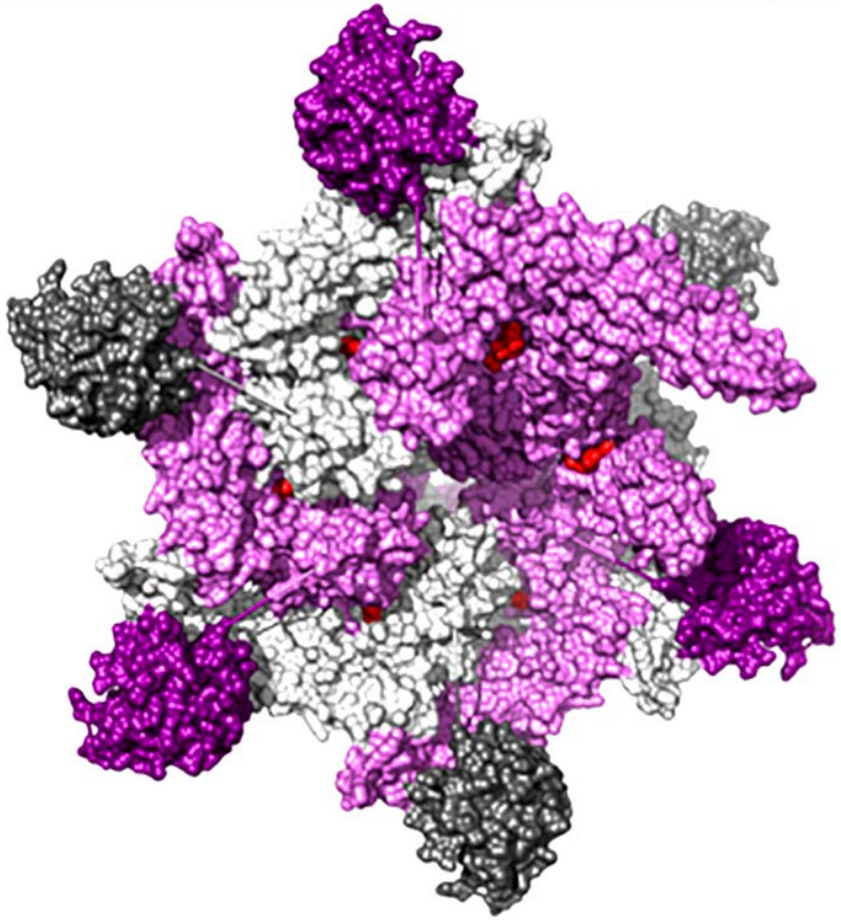
- **Alec Sandy** selected as the new XSD Associate Division Director for Beamline Technologies
- **Dean Haeffner** appointed as XSD Associate Division Director for Beamline Development
- Position posted for an additional XSD Beamline Associate Division Director

- **Nena Moonier** selected as Group Leader, EFOG
- **Maddury Somayazulu** (aka Zulu) selected as HP-CAT Group Leader

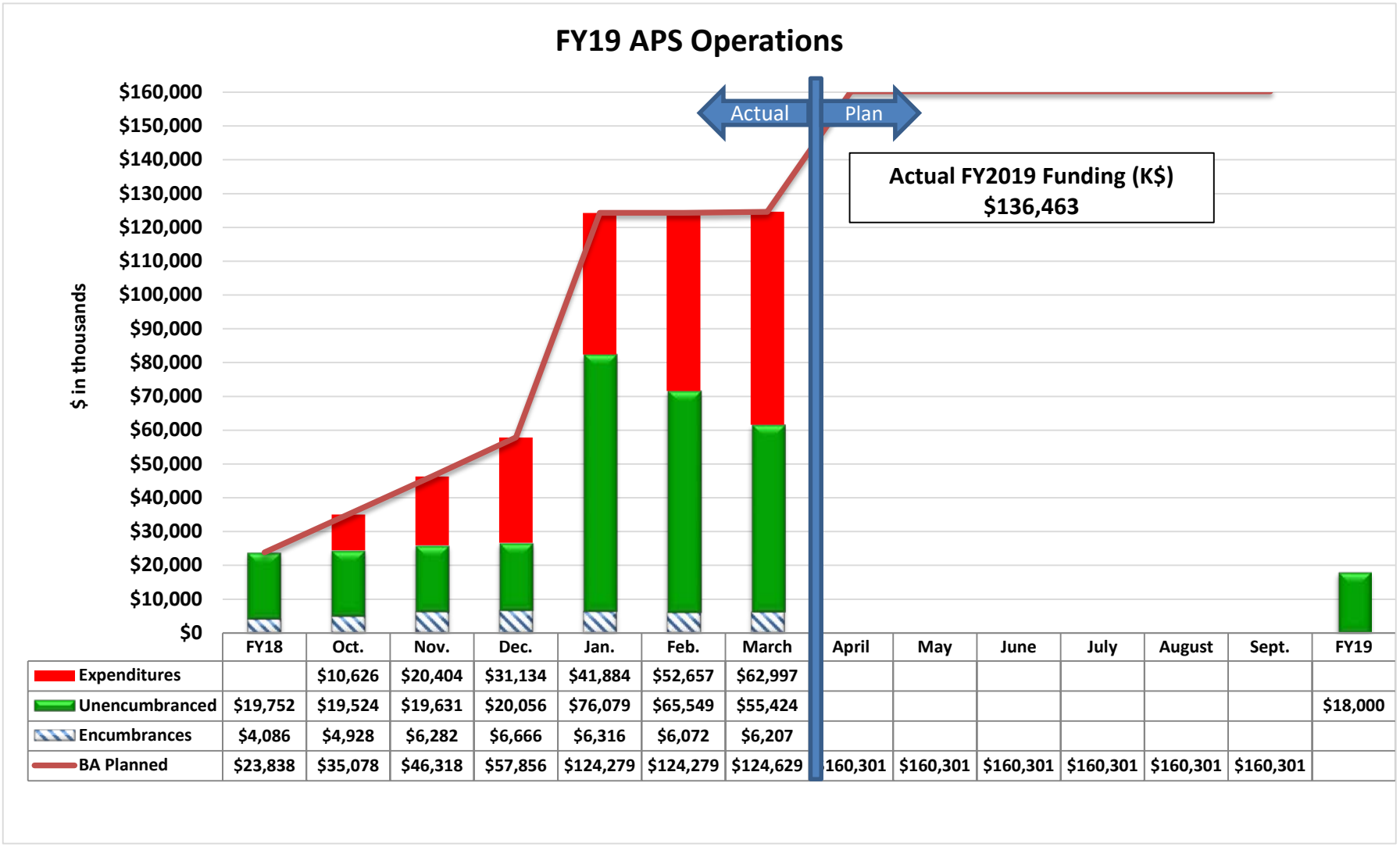
SBC TO JOIN XSD

- The Structural Biology Center Collaborative Access Team (SBC-CAT) macromolecular x-ray (MX) crystallography research facility at Sector 19 of the Advanced Photon Source (APS) will become part of the APS X-ray Science Division
- Andrzej Joachimiak, the founder of SBC-CAT, will continue as Group Leader
- As of April 12, 2019, researchers using the SBC-CAT bending magnet and insertion device beamlines have deposited 5469 biological protein structures in the Protein Databank, more than any other MX sector at the APS





APS OPERATIONS – FY19 BUDGET



	FY18	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sept.	FY19
Expenditures		$10,626	$20,404	$31,134	$41,884	$52,657	$62,997							
Unencumbranced	$19,752	$19,524	$19,631	$20,056	$76,079	$65,549	$55,424							$18,000
Encumbrances	$4,086	$4,928	$6,282	$6,666	$6,316	$6,072	$6,207							
BA Planned	$23,838	$35,078	$46,318	$57,856	$124,279	$124,279	$124,629	$160,301	$160,301	$160,301	$160,301	$160,301	$160,301	

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FY20 BUDGET UPDATE

President's budget request was released later than typical

- APS-U: $150M (ALS-U, LCLS-II-HE, PPU all down)
- APS OPS: $129M, down $8M or -5.7% relative to FY19

The Congressional process is now underway!

HIGHLIGHTS

ACCELERATOR STATUS FOR RUN 2019-1

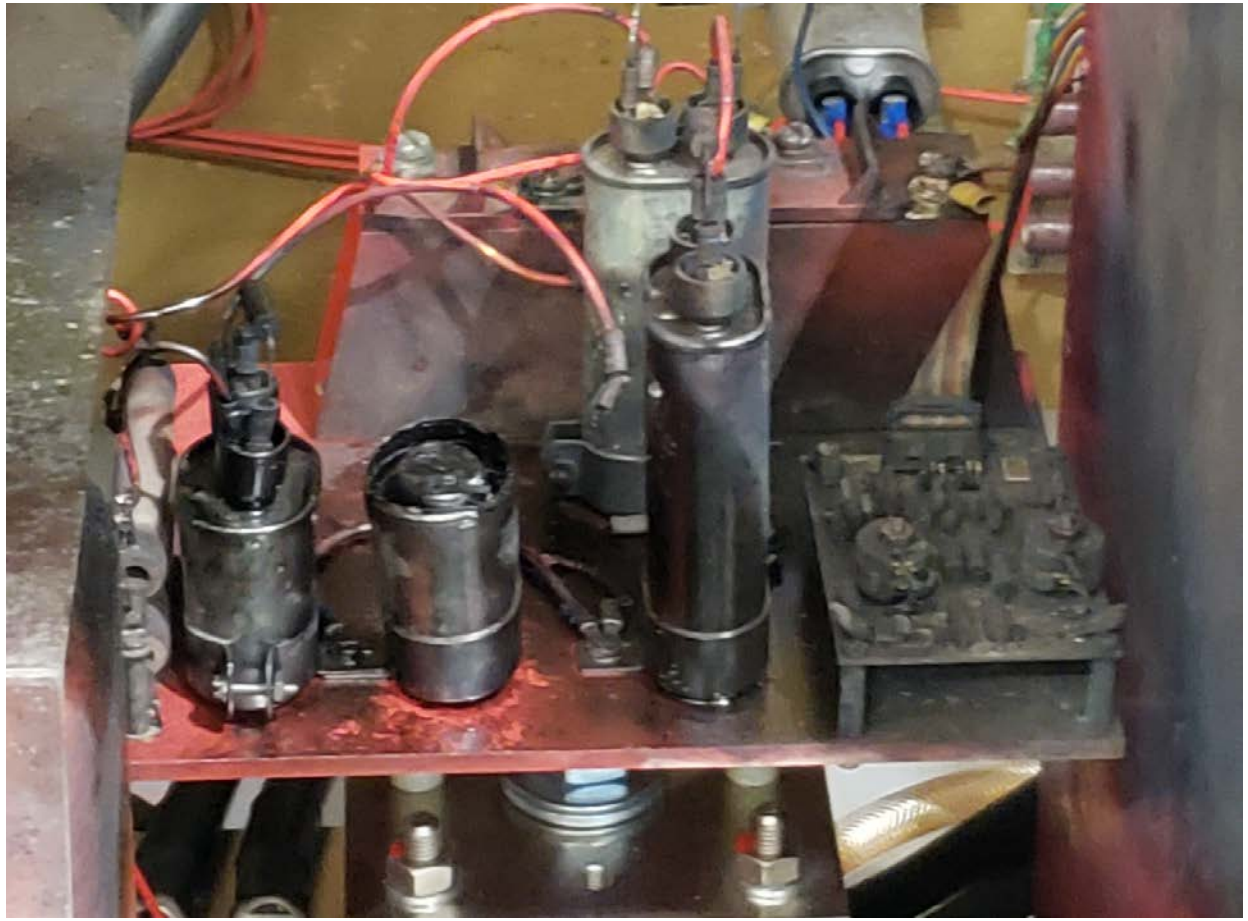
- 2019-1 User Run started on January 29, 08:00; ended on April 22, 24:00

Total Amount of User Time	1719 Hours
Delivered Beam	1691 Hours
Percentage of Scheduled Time	98.4%
Mean Time Between Faults (MTBF)	89.0 Hours
Downtime During Period	28.0 Hours
Mean Fill Duration in Period	84.6 Hours
Faults per Day of Delivered Beam	0.27
Total Number of Faults	19

- Three trips contributed to the lion's share (12.9 hours) of downtime:
  - Quadrupole and horizontal corrector power supplies
  - RF4 crowbar for storage ring
  - RF5 silicon controlled rectifier (SCR) failures and associated water pump trip

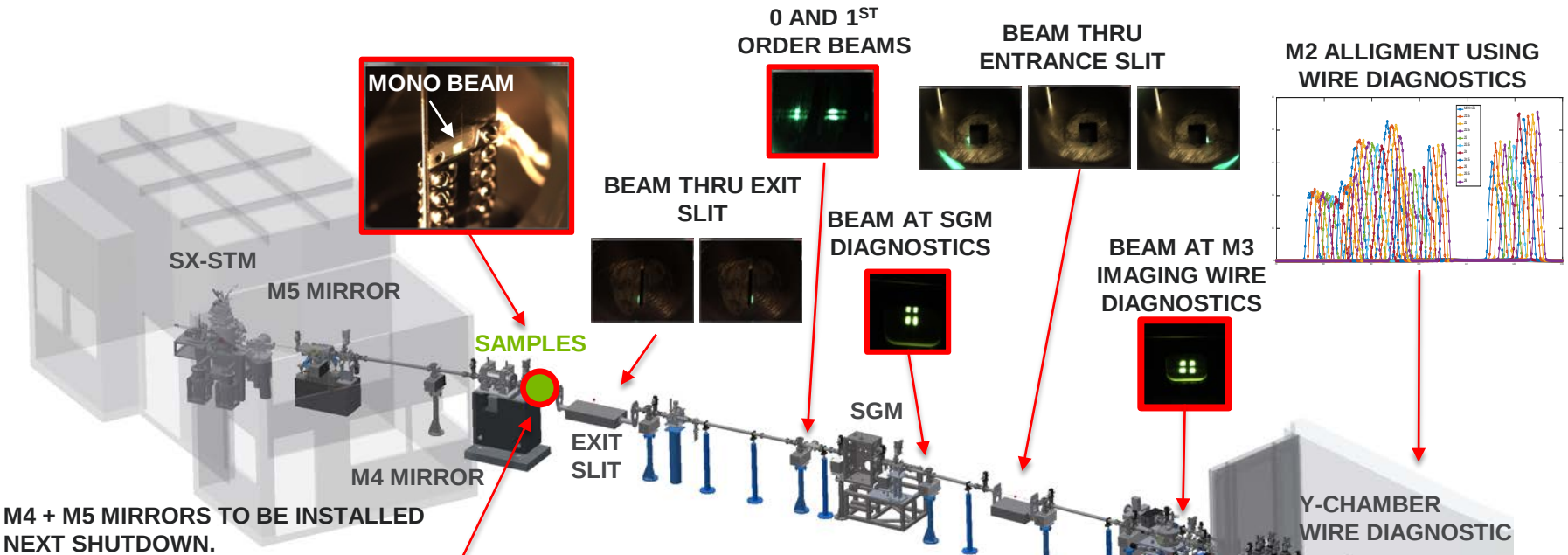
RF SILICON CONTROLLED RECTIFIER FAILURE

- On April 7 at 15:17 (Sunday, of course) SR RF3 and Booster RF5 tripped off due the smoke detection system in the high voltage power supply crowbar cabinets
- The Booster RF System's SCR cabinet was determined to be the source of the smoke
  - 1400 V Phases A and C had "burnt out."
- A waveguide switch was performed to have the SR RF3 provide power for the Booster
- Downtime: 5.1 hours
- Additional 1.8 hours lost due to water fault while restoring beam
- Everything worked as it should; users happy about quick recovery, given the nature of the failure



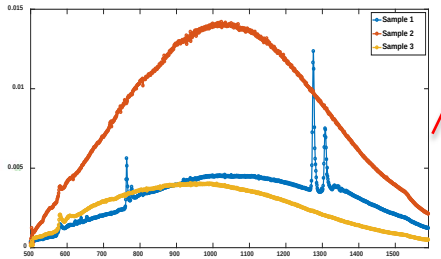
X-TIP BEAMLINE AT 4-ID: STATUS UPDATE

COMMISIONING UP THROUGH EXIT SLIT ACCOMPLISHED DURING 2019-1 RUN

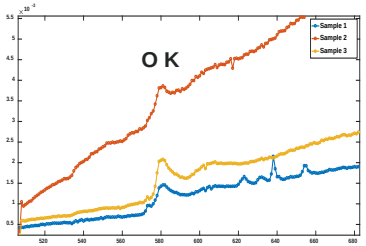


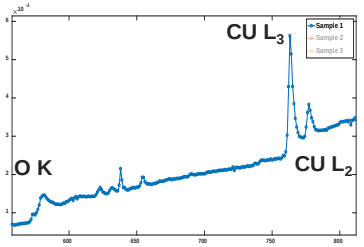
- M4 + M5 MIRRORS TO BE INSTALLED NEXT SHUTDOWN.

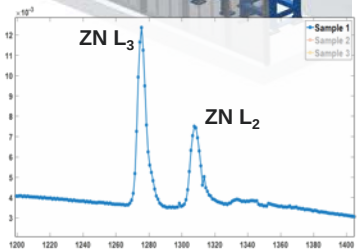
EXPERIMANTAL RESULTS:



EFFICIENCY OF 600-LINES GRATING MEASURED ON 3 TARGETS







- MONO BEAM ON SAMPLES AFTER EXIT SLIT.
- SPECTROSCOPY TO BE USED FOR MONO CALIBRATION.

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XTIP beamline

DETECTOR UPDATE: HARD X-RAY TRANSITION EDGE SENSORS

First prototype TES fabrication run completed and characterized

- Multiple TESs and collimator chips fabricated

Demonstrated enhanced XRF capabilities

- Discriminating K_α and K_β line overlaps in Co/Ni/Cu thin film
- Unresolvable with commercial silicon detector

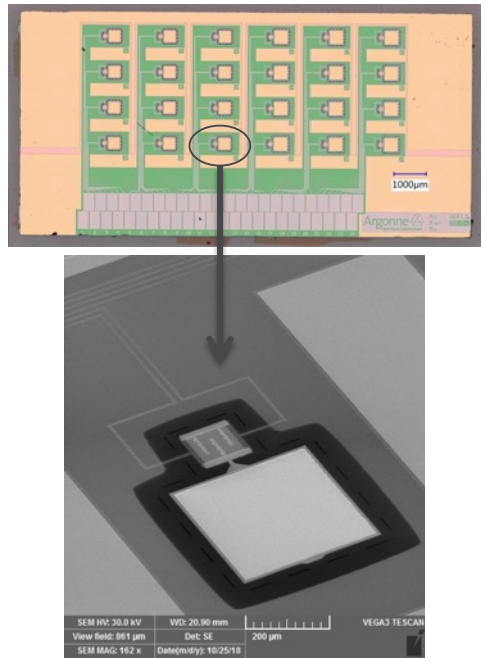
New TES detector design finalized and new fabrication run ongoing

New cryostat completely wired and active

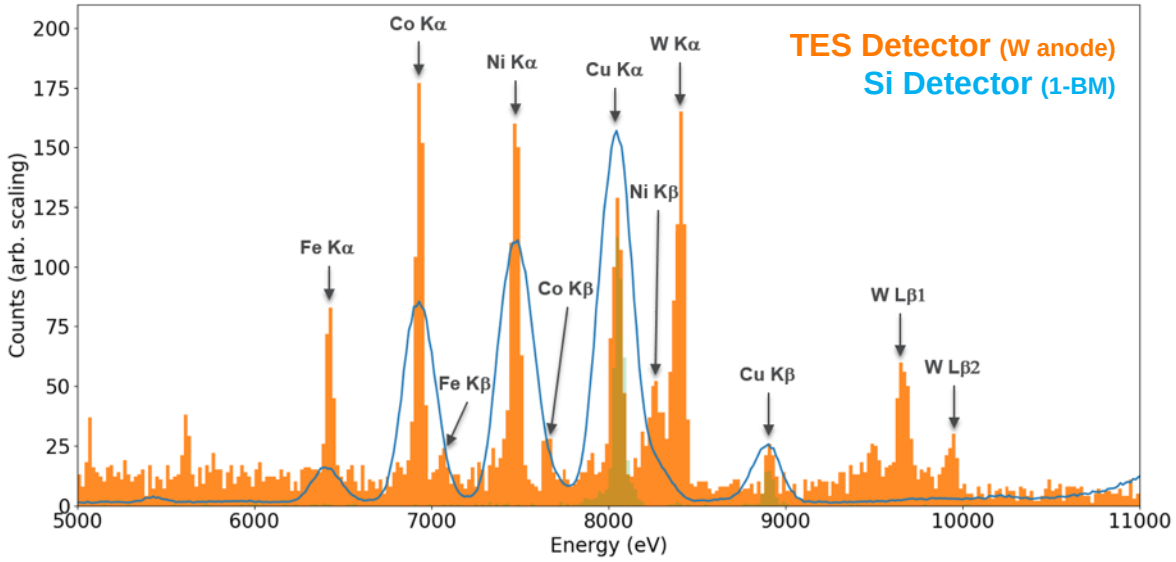
- Detector snout designed, currently being assembled

Planning deployment of the detector at 1-BM-C in summer 2019

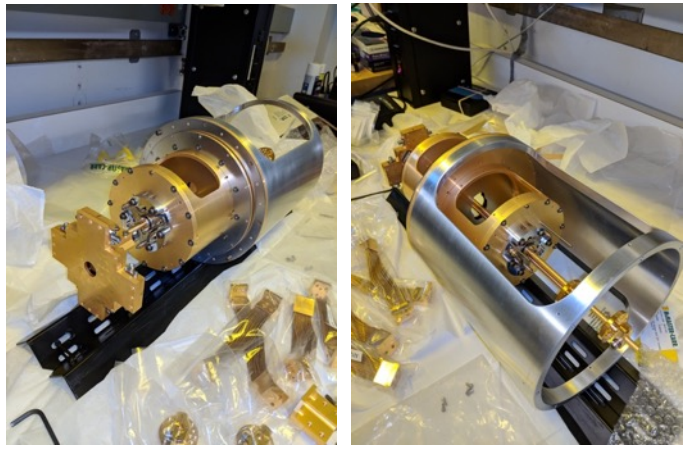
24-pixel TES array fabricated by XSD/DET



Enhanced XRF with APS TES Detector



Detector snout mechanical assembly

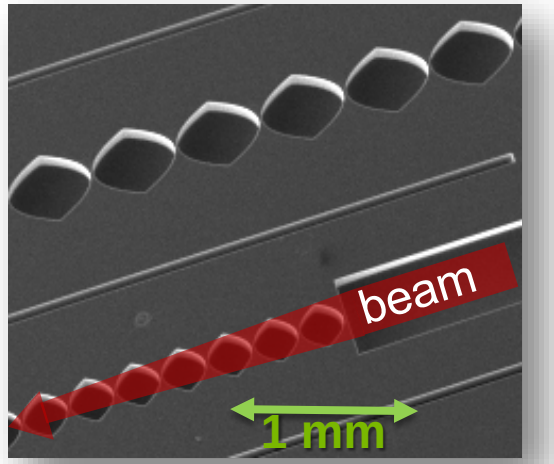


1D FOCUSING OF HIGH-ENERGY X-RAYS

Lens structures etched in Silicon wafer

Challenge: Efficient focusing of high-energy X-rays (> 30 keV)

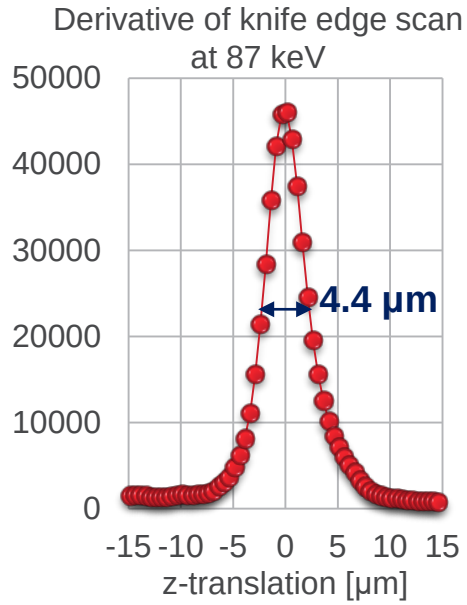
- Micro-focusing → ~ up to 400 compound refractive lenses (CRL)
- Deep etched parabolic lenses into Si-wafer is an efficient approach, but commercially not available and not well developed for high-energy X-rays
- Structures for various photon energies and focal distances on one wafer → cost effective and easy handling
- First prototype produced in CNM and tested at 11-ID-B: focal size < 5 µm and gain of factor >25 at 59 keV and 87 keV



Parabolic lenses etched 400 µm deep into Si wafer

Next 6 month milestones: Focusing in 11-ID-B and 6-ID-D

- Optimizing process for straight etching of up to 700 µm depth
- Testing various lens radii for best efficiency
- Longer structures for >100 keV



Next 12 month milestones: Development of standard procedure

- Recipes for lenses matching individual demands
- Production of lenses for other high-energy X-ray beamlines

Doug Robinson (MM), Lisa Gades (DET), Orlando Quaranta (DET),
Suzanne Miller (NST), Kevin Beyer (SRS), Olaf Borkiewicz (SRS), Uta Ruett (SRS)

TOWARD A UNIVERSAL THERAPY AGAINST EBOLA VIRUS

Scientific Achievement

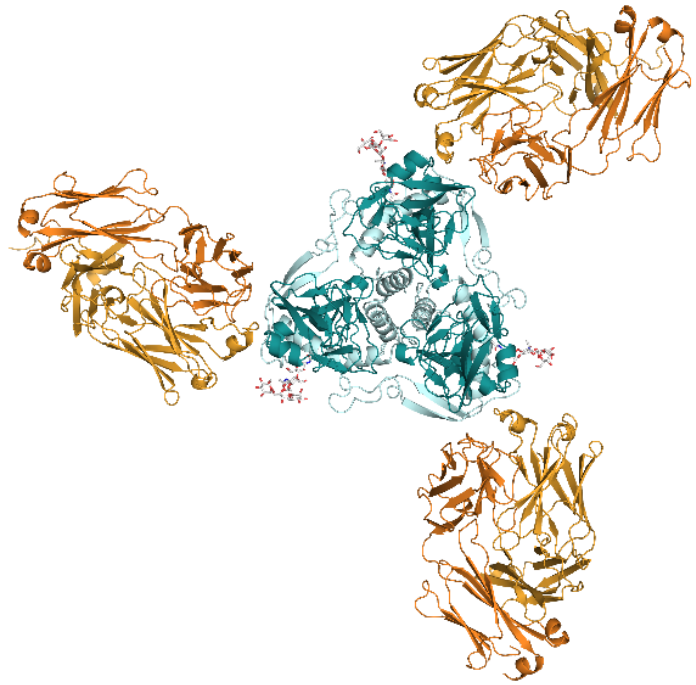
Using x-ray crystallography, a research team collected diffraction data in order to examine the three-dimensional molecular interaction between an antibody and its target, the *Ebolavirus* glycoprotein (GP).

Significance and Impact

Understanding the molecular interactions between broadly neutralizing antibodies and the *Ebolavirus* GP is crucial to the design of next-generation immuno-therapeutic cocktails; the results of this study will instruct vaccine design aimed at eliciting a broadly neutralizing humoral immune response against ebolaviruses.

Research Detail

- The researchers investigated how one broadly neutralizing antibody, ADI-15946, interacts with the viral glycoprotein.
- They evaluated a 3-D molecular model of the structure of the viral GP epitope (the part the antibody binds to) and the antibody's paratope (the part that binds to the epitope) in complex with the viral GP cellular receptor.



Three antigen-binding fragments of ADI-15946 (orange) are shown bound to the surface glycoprotein of Ebola virus (teal).

B.R. West, C.L. Moyer, L.B. King, M.L. Fusco, J.C. Milligan, S. Hui, E. Ollmann Saphire, "Structural Basis of Pan-Ebolavirus Neutralization by a Human Antibody against a Conserved, Yet Cryptic Epitope," mBio **9**(5), e01674-18 (September/October 2018). DOI: 10.1128/mBio.01674-18.

Contact: erica@scripps.edu

Work performed at Argonne National Laboratory

The Scripps Research Institute

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OPTICAL “TWEEZERS” AND X-RAYS ENABLE ANALYSIS OF CRYSTALS IN LIQUIDS

Scientific Achievement

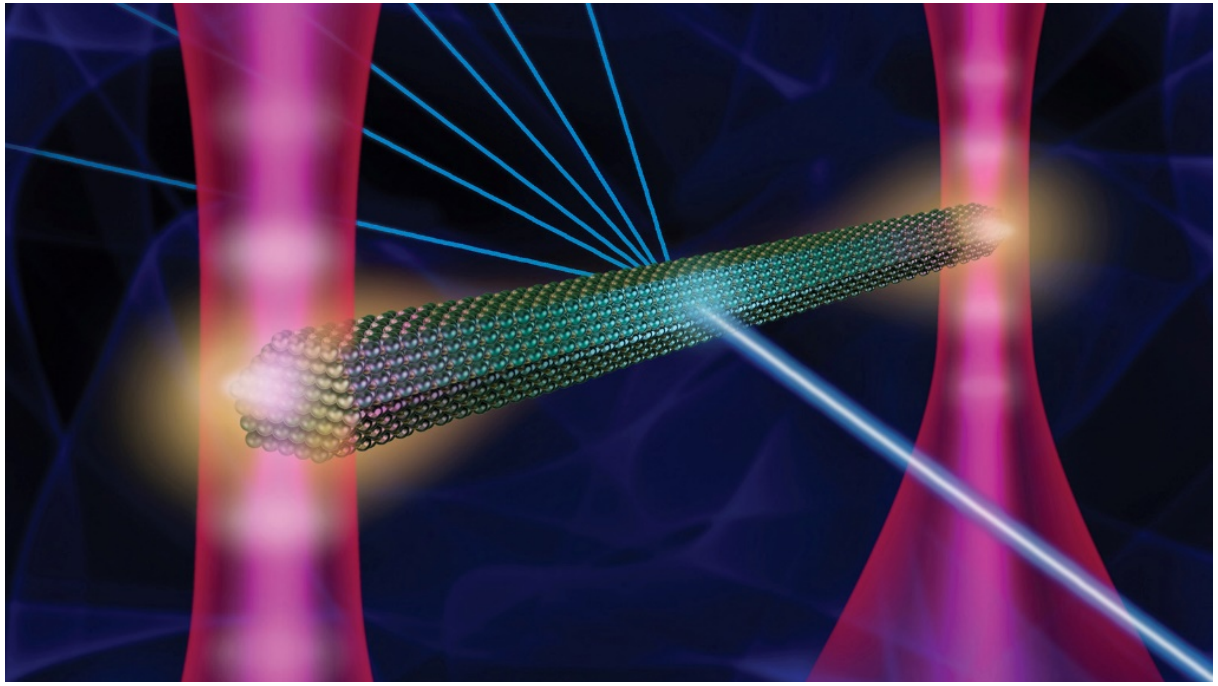
A new technique combines the power of nanoscale “tractor beams” with high-powered x-rays.

Significance and Impact

Researchers can position and manipulate tiny crystals in solution that are not in contact with substrates without adhering or gluing the crystal to a surface, which strains the crystal, thus altering its structure and potentially affecting reactivity.

Research Detail

- Holographic optical tweezers use lasers modified with a spatial light modulator reflected off a mirror to create an interference pattern of “hotspots” that have rapidly reconfigurable locations.
- The electric field gradient of these hotspots attracts the micron-sized polarizable crystal and holds it in place.
- This creates an ”optical goniometer,” allowing coherent x-ray diffractive imaging of the particle in solution.



Scientists have found a way to use “optical tweezers” employing lasers, a mirror and a light modulator to anchor a crystal in solution. The “tweezers” have made it possible to conduct X-ray diffraction measurements of a crystal suspended in solution.

Y. Gao, R. Harder, S.H. Southworth, J.R. Guest, X. Huang, Z. Yan, L.E. Ocola, Y. Yifat, N. Sule, P.J. Ho, M. Pelton, N.F. Scherer, L. Young, “Three-dimensional optical trapping and orientation of microparticles for coherent X-ray diffraction imaging,” Proc. Natl. Acad. Sci USA **16**(10), 4018 (March 5, 2019). DOI: 10.1073/pnas.1720785116

Contact: young@anl.gov

Work performed at Argonne National Laboratory


AWARDS &
HONORS

AWARDS & HONORS

- **Christine Dunham** (Emory University) was awarded the "2018 Cozzarelli Prize" for best Biological paper published in PNAS in 2018. Commentary by JF Atkins. "Culmination of a half-century quest reveals insight into mutant tRNA-mediated frameshifting after tRNA departure from the decoding site". **Christine Dunham** was also named a 2018 American Society of Biochemistry and Molecular Biology (ASBMB) Young Investigator

- **Bi-Cheng Wang** (University of Georgia) was awarded the iHuman "Structure of Life Award" which is presented to worldwide scientists who have made outstanding contributions to structural biology community in 2018

- **Mikhail Solovyev** (Rutgers University) earned a DOE Science Graduate Student Research award to work at APS on first-of-its-kind materials analysis

AWARDS & HONORS

- **William Guszczo, Joseph Vanis, and Anthony Puttkammer (ASD/PSG)**
  - Pacesetter Award for extraordinary effort and diligent work to prepare for and to carry out the task of installing the power supply for the Booster defocusing magnets in four days during the shutdown. Their mistake-free work ensured a smooth power supply commissioning. The new power supply is operational after the shutdown and will improve the Booster operation and provide opportunities for machine studies.

- **Theodore Grodecki (ASD/AOP), Robert Vargas, and Byron Jordan (ASD/PSG)**
  - Pacesetter Award for extraordinary effort and persistent work. To extend the lifetime of the power converters, the ASD Power Systems Group decided to replace the power modules with a new design. Rob Byron, and Ted were given the task to implement the new design. Between two shutdowns and weekly intervention time, they worked extraordinarily for six months and replaced the power modules in all 400 power converters. With the new power modules, we expect to extend the lifetime of the power converters and maintain the operation reliability.

AWARDS & HONORS

- **Sunil Bean (XSD/BI), Ahmet Alatas, Ayman Said, Emily Aran (XSD/IXN), and Russell Woods (XSD/DET)**
  - Pacesetter Award for extraordinary and tireless collaborative effort to research, design, procure, implement and test a special in-vacuum area-detector, capable of reliably recording ultra-low countrate, inelastic signals from multiple spherical crystal analyzers on the HERIX spectrometer in sector 30. This detector replaces a set of outdated, ailing point detectors, which, had they failed totally, would have compromised user operation on this important, work-horse instrument.

- **Jennifer Zhang, Xuli Wu, Arvind Ramanathan (AES/IS) and Arista Thurman III (AES/IT)**
  - Pacesetter Award for extraordinary effort in implementing a complex system upgrade that affected over 20 critical APS business systems. This was performed successfully and within schedule. The upgrade required detailed planning to coordinate the many aspects of the project and ensure good communication to stake holders. The system upgrade was the first complex change to go through our new change management process. It will be used as a model of how to plan and perform complex changes in future.

AWARDS & HONORS

- **Scott Benes, Anthony Pietryla, Thomas Fors, Steven Shoaf, and Sharon Farrell (AES/Controls)**
  - Pacesetter Award for extraordinary effort and innovation in documenting the Accelerator Timing System. Over 2500 interconnections documented on over 140 pages of spreadsheets were validated in the field, drawn out on a system diagram, and imported into a convenient search/sort/browse tool. This will allow for improved maintenance and will facilitate necessary enhancements of the system for the APS-U.

- **Jeffrey Toeller (AES/TSS), Glenn Moonier, Michael Bracken (AES/MOM) John Vacca (HSE/HP), Brian Talsma, Ryan Roberts (FAC), and Marlene Nowotarski (OCF)**
  - Pacesetter Award for extraordinary effort in achievement of storage space reduction and consolidation for the APS buildings in the 300-area, that reduces the directorate recurring storage costs and provides space for the APS Upgrade project.

AWARDS & HONORS

- **John TerHAAR, Joseph Gagliano III, Eric McCarthy, John Grimmer (ASD/MD), and Martin Smith (AES/CTRLS)**
  - Pacesetter Award for their extraordinary effort in completing the checkup, replacement, and lockout of all 160 plus insertion device motor cable connectors.

- **Evan Maxey (XSD/MIC)**
  - Pacesetter Award for extraordinary effort in recovering and updating Beamline 8-BM in a thorough and efficient manner.

- **Alireza Nassiri, Douglas Horan, Gian Trento, Bruce Epperson, Mark Moser (ASD/RF) and Michael Bracken (AES/MOM)**
  - Pacesetter Award for their extraordinary effort in the procurement, refurbishing and the operating of the Los Alamos klystrons, resulting in over $5M in savings for APS Operations.

AWARDS & HONORS

25+ YEARS SERVICE AWARDS

Congratulations to the following individuals for 25 & 30 years of dedicated service to Argonne National Laboratory (first quarter 2019):

25 years	30 years
Mark Erdmann	Greg Wiemerslage
David Wallis	Bradley Micklich
Kurt Goetze	
John Burke	
Joseph Sullivan	
Robert Vargas	
Isaac Vasserman	

UPCOMING EVENTS

- May 6 - 9, 2019: APS/CNM User Meeting
- May 19 – 24, 2019: International Particle Accelerator Conference, Melbourne, Australia
- June 16 – 29, 2019: NX School, ORNL and ANL
- June 18-20, 2019: APS-U CD-3 Review
- August 5 – 9: Denver X-Ray Conference and 25th International Congress on X-ray Optics and Microanalysis (ICXOM-25), Lombard, IL
- September 1 – 6, 2019: 2019 North American Particle Accelerator Conference (NAPAC2019), Lansing, MI
- September 24 – 25, 2019: Catalysis Research, X-rays, and the APS Upgrade
- October 19, 2019: ICALEPCS, New York, NY
- Summer 2020: MEDSI, Chicago, IL

2019 APS/CNM USERS MEETING

May 6, 2019—May 10, 2019

Advanced Photon Source | Center for Nanoscale Materials

Argonne National Laboratory

THE INTERNATIONAL YEAR OF THE PERIODIC TABLE OF CHEMICAL ELEMENTS