APS / CNM 2022 Users Meeting

May 2-6, 2022 and May 9-13, 2022

The 2022 APS/CNM Users Meeting will gather scientists and engineers from diverse fields of research from around the globe to discuss cutting-edge, mission-driven research. The event will feature plenary sessions, workshops, poster sessions, and a vendor expo.

The entire program will be offered virtually.

ORGANIZING COMMITTEE

Jean-Luc Ayitou (Chair), University of Illinois Chicago, CNM Users Executive Committee

Anthony Chappaz (Chair), Central Michigan University, APS User Organization Steering Committee

Lynnean Celmer, CPA, Event Planner

Jacki Flood, APS, Beam Time Access System Administrator

Michelle Mejia (Vice-Chair), Dow, APS User Organization Steering Committee

Badri Narayanan (Vice-Chair), Mechanical Engineering, University of Louisville, CNM Users Executive Committee

Connie Pfeiffer CNM, User Program Manager

Kathryn Tietz, CNM User Office

Kim Toerpe, APS, User Office Administrator

Constance Vanni, APS, Assistant User Program Manager

APS/CNM Users Meeting Agenda

MONDAY, MAY 2

APS WK#1: Multi-modal X-ray Imaging Using Multiple APS Beamlines – Current Status and Future Upgrades

CNM WK#3: CO_2 Capture and Conversion into Value Added Products

Joint APS/CNM WK#4: Machine Learning at the Edge for Real-time Analysis and Experimental Steering at Synchrotron Light Sources and Nanoscale Centers

TUESDAY, MAY 3

APS WK#1: Multi-modal X-ray Imaging Using Multiple APS Beamlines – Current Status and Future Upgrades

CNM WK#3: CO_2 Capture and Conversion into Value Added Products

Joint APS/CNM WK#4: Machine Learning at the Edge for Real-time Analysis and Experimental Steering at Synchrotron Light Sources and Nanoscale Centers

WEDNESDAY, MAY 4

CNM WK#2: Current Trends and Opportunities in Nanobiointerface Materials

APS WK #5: Dark Field X-ray Microscopy for Mesoscale Phenomena in Ordered Materials at APS-U

APS WK#8: Materials for Neuromorphic Computing: *Operando* Studies to Optimize Performance

THURSDAY, MAY 5

APS WK #5: Dark Field X-ray Microscopy for Mesoscale Phenomena in Ordered Materials at APS-U

APS WK #10: Impact of Bright Sources on EXAFS Measurements and Analysis

FRIDAY, MAY 6

Special Session: DEI Workshop: Allyship at Work

Special Session: Steve Heald Retirement Celebration

MONDAY, MAY 9

Combined APS/CNM Plenary

APS Facility Plenary

TUESDAY, MAY 10

CNM Facility Plenary

Special Session: APS Upgrade Q&A

Poster Session

WEDNESDAY, MAY 11

APS WK #6: X-ray Scattering of Emergent Quantum Phenomenon in 2-D Layered Materials

CNM WK #7: Ultrawide Bandgap Materials for Microelectronics

THURSDAY, MAY 12

APS WK #9: Accelerated Advances in Energy Storage Systems Enabled by APS and APS-U

FRIDAY, MAY 13

APS WK #11: Advanced Spectroscopy and LERIX (ASL) Workshop

APS Workshop 1: Multi-modal X-ray Imaging Using Multiple APS Beamlines: Current Status and Future Upgrades

Organizers: Olga Antipova, Yanqi (Grace) Luo, and Jorg Maser

Biological, chemical, geological, archeological, cultural heritage, and material science samples come with heterogeneous composition and characteristics that are impossible to evaluate using only one x-ray imaging tool. Combination of modalities enables comprehensive sample analysis and unveils deep scientific questions. The APS, and soon the APS Upgrade (APS-U), offers a variety of x-ray imaging instruments, such as x-ray fluorescence microscopy, x-ray diffraction imaging, Bragg coherent diffractive imaging, ptychography, laminography, small-angle x-ray scattering, and differential phase contrast imaging. Beamlines that operate in the hard x-ray regime often enable *in situ* and *operando* studies in areas ranging from energy harvesting materials (photovoltaic absorbers) to energy storage applications (batteries and fuel cells). In conjunction with flexible sample environment and advanced x-ray focusing optics, integrating more than one technique specific detectors at a given beamline or transferring sample between beamlines is possible to allow multimodal characterization in micro- or nano- scale. Generally speaking, conducting high-resolution multimodal characterization and/or micro- to nano- scale correlation analysis is often challenging, due to variation between beamlines, signal contrast (signal-to-noise ratio), and sample geometry/thickness constraints for various x-ray microscopy techniques. In many cases, proper sample preparation, selection of micro- and nanoscopic features, and efficient use of beamtime for variety of samples, such as tissue sections, cathode or catalysis material, solar cells, and soil aggregates require wider range and options than a single beamline may be able to offer. Fortunately, sequential measurement at two or three beamlines, such as 8-BM, 11-ID, 20-ID, 13-ID, 2-ID-D/E, 9-ID-B, 34-ID-C, and 26-ID with increasing resolution, expanded modalities, and possible sample modification, allows for integrated sample measurement, more comprehensive identification and characterization of micro features within large samples, and highly improves efficiency of measurements.

This workshop will demonstrate ongoing progress in multi-modal x-ray imaging research, including data collection, sample handling and guided modification, and developments in sample holders design and visualization software. In addition, we will reveal new instruments, capabilities, and improvements, which are enabled by the APS-U.

Monday, May 2, Morning

8:30 – 8:40 Organizers Olga Antipova, Yanqi Luo, and Jorg Maser (Argonne National Laboratory)
Welcome

8:40 – 8:55 Olga Antipova (Argonne National Laboratory)
Overview of Multimodal X-ray Imaging at APS

8:55 – 9:20 Stuart Stock (Northwestern University)
Multimode Synchrotron X-ray Studies of Shark Vertebrae

9:20 – 9:50 Yanqi Luo (Argonne National Laboratory)
A Reliable Workflow for Improving Nanoscale X-ray Fluorescence Tomographic Analysis on Nanoparticle Treated HeLa Cells

9:50 – 10:20 Sarah Wieghold (Argonne National Laboratory)
Investigating the Effect of Electric Fields and Illumination on the Stability of Lead Halide Perovskites

10:20 – 10:40 Break

10:40 – 11:05 Feng Lin (Virginia Tech)
The Electrochemical Interface as a Reactive Environment to Resynthesize Electrode Surface Chemistry Using the Dissolution-redeposition Dynamics

11:05 – 11:30 Hao Zheng (Argonne National Laboratory)
Hierarchical Quantum Matter: A Glimpse with Bragg's Microscope

11:30 – 11:55 Burak Guzelturk (Argonne National Laboratory)
Visualizing the Evolution of Polaronic Lattice Deformations in Semiconductors

12:00 Adjourn Session 1

Tuesday, May 3, Morning

8:55 – 9:00 Yanqi Luo (Argonne National Laboratory)
Welcome

9:00 – 9:20 Michael Stuckelberger (Deutsches Elektronen-Synchrotron DESY)
(Issues with) Data Stitching and Feature Recognition for the In Situ *Synthesis of Nanoparticles in Scanning X-ray Nanoscopes*

9:20 – 9:40 Xiaojing Huang (National Synchrotron Light Source II, Brookhaven National Laboratory)
Multi-modal Microscopy on Functional Materials at Nanoscale

9:40 – 10:00 Julia Parker (Diamond Light Source)
In Situ *Studies at Diamond's Hard X-ray Nanoprobe: Multi-modal Mapping of Structural and Chemical Changes*

10:00 – 10:15 Break

10:15 – 10:45 Matt Newville (GSECARS, University of Chicago)
Enabling Micro-scale XRF, XAS, and XRD at GSECARS X-ray Microprobe, 13-ID-E

10:45 – 11:15 Ross Harder (Argonne National Laboratory)
Opportunities for Multi-modal Experiments with Coherent Diffraction Imaging

11:15 – 11:45 Jorg Maser (Argonne National Laboratory)
The In Situ *Nanoprobe for the APS Upgrade*

11:45 – 12:00 Wrap-up/Discussion (Jorg Maser)

12:00 Adjourn

CNM Workshop 3: CO_2 Capture and Conversion into Value Added Products

Organizers: Elena Shevchenko and Elena Rozhkova

Capturing CO_2 from dilute sources using advanced sorbents and its further conversion into carbon-based chemicals and fuels is recognized as a necessary step in addressing the continuous increase of CO_2 release into the atmosphere. Nanomaterials show a great promise in design of structures capable of efficient capturing and conversion of CO_2 into value-added products. Functionalized nanoporous structures can selectively concentrate CO_2 from dilute sources while nanoparticles serve as active catalysts in thermal reduction processes, as well as electro- and photocatalysts for transforming CO_2 into CO, carbohydrates, and hydrocarbons. The materials science and electrochemistry communities are focusing their efforts on thermal, electrocatalytic, and photocatalytic conversion of CO_2, paying special attention to various aspects of catalytically active materials, such as their chemical composition, structure, surface termination, faceting, etc.

The workshop will focus on discussion of design principles of nanoarchitectures capable of CO_2 capturing from dilute sources and its efficient and selective conversion into value-added products via electrochemical, thermal, and photochemical routes.

Monday, May 2, Morning

9:00 – 9:05 Welcome

9:05 – 9:35 Ted Sargent (Northwestern University)
CO_2 Electroreduction to Fuels and Chemicals

9:35 – 10:05 Ah-Hyung Alissa Park (Columbia University)
Structure and Transport Behaviors of Liquid-like Nanoparticle Organic Hybrid Materials Designed for Combined CO_2 Capture and Conversion

10:05 – 10:35 Di-Jia Liu (Argonne National Laboratory)
Challenges and Design Principle for Electrocatalytic Conversion of CO_2 to C_2+ Chemicals

10:35 – 10:45 Questions and Break

10:45 – 11:15 Alan Hatton (Massachusetts Institute of Technology)
Electrochemical Control of CO_2 Separation Processes

11:15 – 11:45 Matteo Cargnello (Stanford University)
Nanocrystal-based Catalysts for CO_2 Hydrogenation to Fuels and Chemicals

11:45 – 12:15 Francesca Toma (Lawrence Berkeley National Laboratory)
(Photo)electrocatalysis at Work

12:15 – 12:30 Questions and Closing Remarks

Tuesday, May 3, Morning

9:00 – 9:05 Welcome

9:05 – 9:35 Akihiko Kudo (Tokyo University of Science)
Photocatalytic CO_2 Fixation Using Water as an Electron Donor

9:35 – 10:05 Andrew Bocarsly (Princeton University)
Electrocatalytic Formation of Useful Organics and Fuels from CO_2 Using Binary Alloys

10:05 – 10:35 Maria Chan (Argonne National Laboratory)
Modeling and Characterization of Cu2O Surfaces

10:35 – 10:45 Questions and Break

10:45 – 11:15 Yimin Wu (University of Waterloo)
Semiconductor Assisted Photocatalysis for CO_2 Reduction to Liquid Solar Fuels

11:15 – 11:45 Karen Mulfort (Argonne National Laboratory)
Outer Coordination Sphere Effects on CO_2 Capture and Conversion by Molecular Co(II) Complexes

11:45 – 12:15 Nikolai Gaponik (Technische Universitaet Dresden)
Nanocrystal Aerogels as Emerging Self-supporting Catalysts for CO_2 Photoconversion

12:15 – 12:30 Questions and Closing Remarks

Joint Workshop 4: Machine Learning at the Edge for Real-time Analysis and Experimental Steering at Synchrotron Light Sources and Nanoscale Centers

Organizers: Mathew Cherukara, Subramanian Sankaranarayanan, Nicholas Schwarz, and Chengjun Sun

Microelectronics is an emerging area of interest to DOE and there is a focus group established at Argonne to build collaboration with outside academic and industry collaborators to exchange ideas, foster collaborations with user facilities at Argonne, and embark upon new challenges in the areas of microelectronics.

Monday, May 2, Afternoon

1:20 – 1:30	Mathew Cherukara, Chengjun Sun, Nicholas Schwarz, and Subramanian Sankaranarayanan (Argonne National Laboratory) *Welcome Day 1*
Session 1	**Edge Hardware (Chair: Mathew Cherukara)**
1:30 – 2:00	Geetika Gupta (NVIDIA) *NVIDIA HPC+AI Platform for Edge to Datacenter*
2:00 – 2:30	Pete Beckman (Argonne National Laboratory) *AI@Edge for Scientific Instruments in the Digital Continuum*
2:30 – 3:00	Anakha Babu (Argonne National Laboratory) *Machine Learning at the Edge for Real-time Ptychography Data Analysis*
3:00 – 3:30	Break
Session 2	**Fast Training (Chair: Chengjun Sun)**
3:30 – 4:00	Venkatram Vishwanath (Argonne National Laboratory) *Facilitating Real-time Analysis and AI for Experiments at the Argonne Leadership Computing Facility (ALCF)*
4:00 – 4:30	Zhengchun Liu (Argonne National Laboratory) *Deep Learning Accelerated Real-time X-ray Diffraction Data Analysis at Edge*
4:30 – 4:45	Closing Discussion Day 1

Tuesday, May 3, Afternoon

1:20 – 1:30	Mathew Cherukara, Chengjun Sun, Nicholas Schwarz, and Subramanian Sankaranarayanan (Argonne National Laboratory) *Welcome Day 2*
Session 3	**Scientific Applications (Chair: Subramanian Sankaranarayanan)**
1:30 – 2:00	Apurva Mehta (SLAC National Accelerator Laboratory) *Leveraging Proximal Continuity to Estimate Background and Noise in Connected Datasets*
2:00 – 2:30	Christopher Tassone (Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory) *SMASH-ML: Automating the Synthetic Discovery of Nanomaterials*
2:30 – 3:00	Maxim Ziatdinov (Oak Ridge National Laboratory) *Bayesian Active Learning for Scanning Probe and Electron Microscopies*
3:00 – 3:30	Break
Session 4	**Workflows and Techniques (Chair: Nicholas Schwarz)**
3:30 – 4:00	Phillip Maffetone (Brookhaven National Laboratory) *Remote and On-the-fly: Artificial Intelligence-driven Science at User Facilities*
4:00 – 4:30	Anthony Avarca (Argonne National Laboratory) *Intelligent Nanoscience Data Infrastructure: A Data Platform for Materials Research*
4:30 – 4:45	Closing Discussion Day 2

CNM Workshop 2: Current Trends and Opportunities in Nanobiointerface Materials

Organizers: H. Christopher Fry and Elena Rozhkova

Nanoscale phenomena in biology demonstrate some of the most carefully orchestrated energetic processes. At the Center for Nanoscale Materials (CNM), we are inspired by these natural systems and employ them in hierarchically assembled materials to either exploit natural function or generate new functions altogether. The Department of Energy (DOE) has expressed great interest in several topics where scientists have called upon biomolecular systems to address the demands. In particular, investigations in quantum phenomena, microelectronics, and artificial intelligence (AI) are high on the radar. In this workshop, we plan to highlight all that nature has to offer when investigating these topics. Whether studying natural systems, interfacing materials with biology, or designing biomolecular materials, nanoscale properties emerge that provide exciting avenues to explore in each of these topical areas. Quantum phenomena are observed in arrays of materials, and their properties are investigated using advanced spectroscopies and methodologies. Development of novel materials and devices represents an area that focuses on optimizing material performance and interface capabilities for optimal sensing performance. Flexible electronics have shown exceptional promise in wireless medical sensing and diagnostics. Exploring the development of highly efficient flexible organic materials is essential for the advancement of the field. And finally, employing AI in sequence identification of novel biomolecular assemblies marks the future of molecular design. Essential to AI development are modernizing laboratories with automation and the production of standardized and searchable biomaterials databases. The goal of this workshop is to inform the user community of trends, as well as determine avenues in which the DOE-funded Scientific User Facilities can assist the broader scientific community in achieving their nanobiointerface goals.

Wednesday, May 4

9:00 – 9:20 Introduction

9:20 – 10:00 Darrin Pochan (University of Delaware)
Biomolecules for Non-biological Things: Polymer Construction through Peptide 'Bundlemer' Design and Solution Assembly

10:00 – 10:40 Rohit Batra (Center for Nanoscale Materials, Argonne National Laboratory)
Artificial Intelligence-guided Discovery of Self-assembly Peptide Sequences Using Monte Carlo Tree Search and Coarse-grained Simulations

10:40 – 11:20 Byeongdu Lee (Advanced Photon Source, Argonne National Laboratory)
Use of X-ray Scattering for Assemblies of DNA Functionalized Nanoparticles

11:20 – 12:00 Murali Ghantasala (Western Michigan)
3D Printed PLA and ABS Lab-on-chip Structures for Cell Growth Studies

12:00 – 1:00 Break

1:00 – 1:40 Adam Gormley (Rutgers University)
Machine Learning-guided Robotics for the Data-driven Design of Soft Materials

1:40 – 2:20 Jie Xu (Center for Nanoscale Materials, Argonne National Laboratory)
Autonomous Robotic Platform (PolyBot) for Controlled Conjugated Polymer Processing

2:20 – 3:00 Julia Ortony (Massachusetts Institute of Technology)
Reactive Supramolecular Nanostructures

3:00 – 3:40 Peter Maurer (University of Chicago)
Quantum Sensing: Probing Biological Systems in a New Light

3:40 Closing Statements

APS Workshop 5: Dark Field X-ray Microscopy for Mesoscale Phenomena in Ordered Materials at APS-U

Organizers: Ashley Bucsek, Stephan Hruszkewycz, Zahir Islam, and Zhan Zhang

Materials with complex mesoscale structure display a wide range of properties, from enhanced mechanical strength to shape memory to electrical polarization and magnetism, that can be controlled and manipulated via routes including synthesis, processing, and phase transformation. An ability to observe how these internal building blocks (domains, microstructures, etc.) interconnect and rearrange themselves (e.g., as they are heated or cooled), optically stimulated (via optical, electrical, or magnetic means), dynamically stressed, or bent, etc., in real time is of great interest. A special x-ray imaging modality, known as dark-field x-ray microscopy (DFXM) is poised to do just that in the hope of reconstructing in real-time three-dimensional network of these 'mesoscopic' structures deep inside materials indispensable to metallurgy, condensed-matter physics, and device applications. However, a set of critical experimental capabilities, analyses methods, and algorithms need to be developed for reconstruction of readily interpretable images and subsequent extraction of essential features of interest for a successful use of DFXM, which is an active field of research here in the U.S. and abroad. The primary goal of this workshop is to bring researchers together to share their experience, assess experimental needs of user community of DFXM at the APS Upgrade, and outline a development path forward for this exciting diffraction-contrast imaging modality for quantum, functional, structural, and ordered materials.

Wednesday, May 4, Morning

9:15 – 9:20 Organizers Zahir Islam, Stephan Hruszkewycz, Zhan Zhang (Argonne National Laboratory), and Ashley Bucsek (University of Michigan)
Introduction and Welcome

Session 1 State of Dark Field X-ray Microscopy (Chair: Lahsen Assoufid)

9:20 – 9:30 Zhi Qiao (Argonne National Laboratory)
Overview of the Development of Large Field-of-view High-resolution Hard X-ray Microscope at Advanced Photon Source

9:30 – 10:00 Arndt Last (Karlsruhe Institute of Technology)
Optics for X-ray Microscopy from KIT/IMT

10:00 – 10:30 Can Yildirim (European Synchrotron Radiation Facility)
3D Mapping of Strain and Orientation of Embedded Crystalline Structures Using Dark Field X-ray Microscopy

10:30 – 10:45 Break

Session 2 Irreversible Phenomena/Pump-probe (Chair: Matthew Highland)

10:45 – 11:05 Michael Armstrong (Lawrence Livermore National Laboratory)
Dark Field X-ray Microscopy for Characterization of Materials Under Dynamic Compression

11:05 – 11:25 Leora Dresselhaus-Marais (Stanford University)
Time-resolved DFXM to Visualize 3D Dynamics in Dislocations

11:25 – 11:45 Haidan Wen (Argonne National Laboratory)
Time-resolved and In Situ *Dark-field X-ray Imaging for Material Science*

11:45 – 12:00 Xianbo Shi (Argonne National Laboratory)
Wrap-up and Discussion

12:00 Adjourn

Thursday, May 5, Morning

Session 3 Novel Image Contrasts (Chair: Sid Maddali)

9:15 – 9:40 Paul Fenter (Argonne National Laboratory)
Imaging Interfacial and Thin-film Topography without and with Coherent X-ray Illumination

9:40 – 10:05 Michael Sangid (Purdue University)
Examining Grain Substructure of Structural Polycrystalline Alloys Subjected to Fatigue Loading

10:05 – 10:30 Ishwor Poudyal (Argonne National Laboratory)
Opportunities of Dark-field X-ray Microscopy at Coherent Sources

10:30 – 10:45 Break

Session 4 Way Forward with Bulk Systems (Chair: Ashley Bucsek)

10:45 – 11:05 Richard Sandberg (Brigham Young University)
Measuring Strain and Dislocation Dynamics in Adjacent Crystalline Grains through Coherent X-ray Imaging

11:05 – 11:25 Darren Pagan (The Pennsylvania State University)
Future Considerations for Mapping Strain and Stress in 3D around Defects Using DFXM

11:25 – 11:45 Jayden Plumb (University of California, Santa Barbara)
Study of Defect Structures in NaMnO2 Using Dark Field X-ray Microscopy

11:45 – 12:00 Peter Kenesei (Argonne National Laboratory)
Wrap-up and Discussion

12:00 Adjourn

APS Workshop 8: Materials for Neuromorphic Computing: *Operando* Studies to Optimize Performance

Organizers: Joseph Strzalka, Jie Xu, and Qingteng Zhang

The growing ubiquity of artificial intelligence in many different applications is creating pressure for more efficient implementation of computing architectures for machine learning with the ability to operate in challenging environments such as the human body. Recently, organic mixed ionic electronic conductor (OMIEC) materials are receiving increased interest because of their ability to efficiently implement neuromorphic circuits built up from organic electrochemical transistors (OECTs), as well as their biocompatibility and stretchability. In OECTs, doping of the OMIEC materials with ionic species from the surrounding electrolyte solution can modulate the charge mobility within the channel, analogous to tuning the transmission of electrical nerve impulses across synapse gaps between neurons by small-molecule neurotransmitters. As with organic semiconductors, grazing incidence x-ray scattering (GIXS) can help characterize the morphology and quantify the crystallinity of these materials. *Operando* scattering studies of OECT materials as a function of applied potential pose challenges with regard to sample cell design and experimental protocols, but can offer insight into the mechanism of the adaptive charge transport properties of these materials. Grazing incidence x-ray photon correlation (GI-XPCS) studies can reveal the dynamics of these materials, further advancing their rational design. This workshop will bring together participants in the field to discuss the role of OMIEC materials and OECT devices in neuromorphic computing, strategies to boost performance, fabrication techniques, and how best to address the needs for *operando* characterization of these materials.

Wednesday, May 4, Afternoon

1:00 – 1:30 Fangfang Xia (Data Science and Learning Division, Argonne National Laboratory)
Co-design Opportunities in Neuromorphic Computing

1:30 – 2:00 Yoeri van de Burgt (Microsystems and Eindhoven Artificial Intelligence Systems Institute, Eindhoven University of Technology)
Organic Neuromorphic Electronics and Biohybrid Systems

2:00 – 2:30 Bryan D. Paulsen (Northwestern University)
In Situ *and* Operando *Characterization of Organic Mixed Ionic-electronic Conductors for Neuromorphics, Bioelectronics, and Beyond*

2:30 – 2:45 Break

2:45 – 3:00 Joseph Strzalka (X-ray Science Division, Argonne National Laboratory)
Preview of GIXS and Surface XPCS Capabilities at APS-U Beamline 9-ID

3:00 – 3:30 A. Alec Talin (Sandia National Laboratory)
Electrochemical Random Access Memory (ECRAM) for Neuromorphic Computing

3:30 – 4:00 Sihong Wang (Pritzker School of Molecular Engineering, University of Chicago and Nanoscience and Technology Division, Argonne National Laboratory)
Skin-like Neuromorphic Devices for Intelligence and Personalized Wearable Technology

4:00 - 4:15 Discussion

4:15 Adjourn

APS Workshop 10: Impact of Bright Sources on EXAFS Measurements and Analysis

Organizers: Shelly Kelly and Matt Newville

This workshop is focused on EXAFS analysis and measurements with bright x-ray sources that can cause changes to the materials during the measurement. These tools will become increasingly important for the community after the APS-U.

Thursday, May 5, Afternoon

1:00 – 1:30	Matt Newville (University of Chicago) *XAS Analysis Software with Larch, XAS Viewer, and Python*
1:30 – 2:00	Carlo Segre (Illinois Institute of Technology) *Future of X-ray Absorption Spectroscopy at Sector 10 after the APS Upgrade*
2:00 – 2:30	Tony Lanzirotti (University of Chicago) *Recent Developments at the GSECARS X-ray Microprobe Beamline and Preparations for APS-U*
2:30 – 3:00	Liz Cottrell (Smithsonian Institution) *Can I Have Fewer Photons Please? Analytical Challenges Arising from Radiation-induced Redox Changes in Planetary Materials*
3:00 – 3:15	Break
3:15 – 4:00	Bhoopesh Mishra (Illinois Institute of Technology) *Applications of Synchrotron for Designing Sustainable Carbon-based Materials of the Future*
4:00 – 4:45	Yulia Pushkar (Purdue University) In Situ *XAS to Study Mechanisms of Metalloproteins and Biomimetic Systems for Clean Energy and Environmental Remediation*
4:45 – 5:00	Wrap-up and Discussion
5:00	Adjourn

Special Session DEI Workshop: Allyship at Work

Organizers: Michelle Mejia and Becky Sikes

Allyship at Work helps employees recognize their privilege and positional power and learn what specific actions they can take to show up as allies. Through individual explorations and group discussions, participants develop a shared understanding of allyship and prepare to take action in ways that center impact. Breakout rooms will be activated throughout the presentation to discuss key points. All attendees, regardless of identity, role, or seniority, will learn something new about allyship, their privilege, their positional power, or specific, data-backed strategies for practicing allyship.

Friday, May 6

8:55 – 9:00 Becky Sikes (Argonne National Laboratory)
Welcome and Introduction to Allyship Part 1

Session 1: Allyship Part 1

9:00 – 9:45 Define Allyship

9:45 – 10:10 Unpack Your Privilege

10:10 – 10:15 Break

10:15 – 10:55 Notice Workplace Inequities

10:55 – 11:00 Session Recap

Session 2: Allyship Part 2

11:00 – 11:10 John Freeland (Argonne National Laboratory)
Recap and Introduction to Allyship Part 2

11:10 – 11:35 Discover Your Power

11:35 – 12:40 Learn Allyship Actions

12:40 – 12:50 Review the Active Allyship Framework

12:50 – 1:00 Closing Remarks

1:00 Session Adjourns

Special Session: Steve Heald Retirement Celebration

Organizers: Shelly Kelly

This special session will celebrate the many contributions of senior physicist and group leader Steve Heald to the APS.

Friday, May 6, Afternoon

1:00 – 1:05 Jonathan Lang (Argonne National Laboratory)
Welcome and Introduction

1:05 – 1:30 Daryl Crozier (Simon Fraser University)
30 Years and Beyond at Sector 20 with Steve Heald

1:30 – 2:00 Scott Chambers (Pacific Northwest National Laboratory)
The Value of X-ray Absorption Spectroscopy in Understanding the Properties of Doped Transition Metal Oxides

2:00 – 2:30 John Tranquada (Brookhaven National Laboratory)
Launching from X-11

2:30 – 3:00 Tsun-Kong TK Sham (University of Western Ontario)
The Interplay of Materials Functionality with X-ray Spectroscopy: Crossing Paths with Steve Heald

3:00 – 3:15 Break

3:15 – 3:45 John Fulton (Pacific Northwest National Laboratory)
A History of Aqueous and Catalyst Chemistry at Sector 20: One User's Perspective

3:45 – 4:15 Gerald T. Seidler (University of Washington)
Photon-in/Photon-out Spectroscopy at APS Sector 20

4:15 – 4:45 Shelly Kelly (Argonne National Laboratory)
Past and Future of Spectroscopy at APS

4:45 – 5:00 Wrap-up and Discussion

5:00 Adjourn

Combined Plenary Session

Monday, May 9, Morning

9:15 – 9:20 Anthony Chappaz, Chair, APS Users Organization (Central Michigan University)
Welcome and Launch of the 2022 APS/CNM Users Meeting

9:20 – 9:30 Paul K. Kearns, Laboratory Director (Argonne National Laboratory)
Welcome from the Laboratory

9:30 – 9:35 Laurent Chapon, Associate Laboratory Director, Photon Sciences (Advanced Photon Source, Argonne National Laboratory)
Introduction of Linda Horton

9:35 – 10:00 Linda Horton, Associate Director of Science (Basic Energy Sciences, Department of Energy)
The DOE Perspective

10:00 – 10:05 Ilke Arslan, Division Director (Center for Nanoscale Materials and the Nanoscience and Technology Division, Argonne National Laboratory)
Introduction of Keynote Speaker Jianwei (John) Miao

10:05 – 10:45 Keynote Address: Jianwei (John) Miao (University of California, Los Angeles)
Solving a Century-old Problem: Three-dimensional Atomic Structure of Amorphous Materials

10:45 – 11:00 Break

11:00 – 11:20 Laurent Chapon, Associate Laboratory Director, Photon Sciences (Advanced Photon Source, Argonne National Laboratory)
APS Update

11:20 – 11:40 Ilke Arslan, Division Director (Center for Nanoscale Materials and the Nanoscience and Technology Division, Argonne National Laboratory)
CNM Update

11:40 Adjourn

APS Plenary Session

Monday, May 9, Afternoon

1:15 – 1:25 Michelle Mejia, Vice-chair, APS Users Organization (Dow Chemical Company)
Welcome and Announcement of the 2022 Gopal K. Shenoy Excellence in Beamline Science Award Winner: Suresh Narayanan

1:25 – 1:40 Jim Kerby, Director, APS Upgrade (Argonne National Laboratory)
APS Upgrade Update

1:40 – 2:20 Qilin Guo (University of Wisconsin, Madison)
2022 Rosalind Franklin Young Investigator Award Recipient
Revealing the Transient Dynamics in Laser Powder Bed Fusion Additive Manufacturing Process via In Situ *X-ray Imaging and Diffraction*

2:20 – 3:00 Colleen Hansel (Woods Hole Oceanographic Institution)
Complexity of Synergistic and Competing Reaction in the Formation of Manganese Oxides

3:00 – 3:10 Break

3:10 – 3:50 Samantha Greasley (Pfizer) and Lisa Keefe (Hauptman-Woodward Medical Research Institute)
Fighting the Pandemic: A Structure-based Drug Design Success

3:50 – 4:30 Shirley Meng (University of Chicago)
Accelerating the Design of Next-generation Battery Materials with Advanced X-ray Scattering Science

4:30 – 5:10 David Yancey (Dow Chemical Company)
Measurement Science Capability Development at Dow: Industrial Collaboration at Universities and National Laboratories

5:10 Adjourn

CNM Plenary Session

Tuesday, May 10, Morning

9:00 – 9:30 Chair A. Jean-Luc Ayitou (Illinois Institute of Technology) and Vice-Chair Badri Narayanan (University of Louisville)
UEC Update

9:30 – 10:00 David Fenning (University of California, San Diego)
CNM User Address
From Single Crystals to Amorphous Halide Perovskites: Insights into Structure-property Relationships Using X-ray Microscopy

10:00 – 10:45 Kamal Soni (Corning, Incorporated)
CNM Keynote Address
Advancing Glass Science Using Novel Characterization and Nanotechnology Tools

10:45 Adjourn

Special Session: APS Upgrade Q&A

Organizers: Andre Salles and Beth Schlesinger

The Advanced Photon Source (APS) will soon undergo a massive upgrade that will result in x-ray beams that are up to 500 times brighter than those the current facility generates. This project will see the current storage ring replaced with a new model, nine new beamlines constructed and enhancements made to 15 further beamlines. This will necessitate a year of downtime, during which the 5,500 scientists from around the world who use the APS each year will not have access to it.

This session is designed to answer the user community's questions about the APS Upgrade, from its schedule and timing to the enhanced capabilities the upgraded APS will bring to the world of scientific research. Representatives from the APS Upgrade project, Argonne's X-ray Science Division and the APS Users Office will take questions from users and offer the most up-to-date information on the project and its impact on the user community.

Tuesday, May 10, Morning

11:00 – 12:00 Jim Kerby, Jonathan Lang, Dennis Mills, John Connolly, John Byrd, Mohan Ramanathan, Dean Haeffner, and Susan White de Pace (Argonne National Laboratory)
APS Upgrade Q&A

APS Workshop 6: X-ray Scattering of Emergent Quantum Phenomenon in 2-D Layered Materials

Organizers: Yongseong Choi, Jong-Woo Kim, and Philip J. Ryan

Two-dimensional (2-D) layered materials exhibit exotic scientific phenomena and are of great potential interest for nano-scale electronic devices due to their unique physical properties as superconductors and topological insulators. These intriguing phases are triggered by various ways, such as defects, electrostatic doping, thickness, and mechanical stress and strain. 2-D materials are particularly suitable for strain engineering since they can tolerate large structural distortions. Critically, strain can modify their atomic and electronic structure as well as lattice phonon vibrations. However, due to the atomically thin nature of 2-D materials, uncontrolled intrinsic/extrinsic deformation happens in multiple-length scales during the strain process, so it is important to identify heterogeneous deformations and the coupling between them. Furthermore, the emerging new functionalities can result from either homogeneous strain or its variation. Therefore, it is essential to understand their nano- and microscopic properties. Fortunately, the APS Upgrade (APS-U) can provide the critical capabilities of flux and coherence to allow for the measurement of the local structural variation as well as the electronic states with nanoscale accuracy. This workshop aims to bring together leading experimentalists and theorists to present their latest research and discuss how to combine resonant x-ray scattering with APS-U to conduct future 2-D material studies of inhomogeneous phases under *in situ* mechanical strain. Here, we introduce the development of cryogenic temperature experimental environments with nanometer stability and positional control. Through this workshop, we will discuss systematic strategies to measure the distribution of elastic strains at the sub-micron-length scale within deformed single crystals and correlate with their complex physical behaviors within individual grains. These developments will provide new opportunities to the community to study the complex phenomena of heterogeneous systems enabling a powerful shift of how we investigate these phenomena that is currently beyond our capabilities.

Wednesday, May 11, Morning

9:00 – 9:15 Jong-Woo Kim (Argonne National Laboratory)
Introduction and Welcome

9:15 – 9:45 Philip Ryan (Argonne National Laboratory)
Current and Future Developments of Strain Capabilities at APS

9:45 – 10:15 Seo Hyeong Chang (Chung-Ang University)
Visualizing Antiferromagnetic Domain Using Full-field Resonant X-ray Magnetic Diffraction Microscopy

10:15 – 10:30 Break

10:30 – 11:00 Jian Liu (University of Tennessee)
Giant Responses and Emergent Spin Modulation of Antiferromagnetic Square-lattice Iridates

11:00 – 11:30 Ambrose Seo (University of Kentucky)
Emergent Magnetic Order in Sr_2IrO_4/Ca3Ru_2O_7 Heterostructures

11:30 – 12:00 Wrap-up and Discussion

12:00 – 1:00 Lunch Break

Wednesday, May 11, Afternoon

1:00 – 1:30 Connor Occhialini (Massachusetts Institute of Technology)
Spontaneous Orbital Anisotropy in the Nematic State of FeSe Probed by Elasto X-ray Linear Dichroism

1:30 – 2:00 Min Gyu Kim (University of Wisconsin, Milwaukee)
Real-space Observation of Antiferromagnetic Domains

2:00 – 2:30 Riccardo Comin (Massachusetts Institute of Technology)
RIXS for Quantum Materials: From Bulk to Monolayer

2:30 – 3:00 Alberto De la Torre Duran (Brown University)
Cooling Rate Dependence of the Charge Density Wave Order in 1T-TaS_2

3:00 – 3:15 Break

3:15 – 3:45 Anisha Singh (Stanford University)
Tuning Charge Density Wave Order in RTe_3 with Uniaxial Strain

3:45 – 4:15 Shane Lindemann (University of Wisconsin, Madison)
Assembled Functional Oxide Membrane Heterostructures

4:15 – 5:00 Srinivasa Rao Singamaneni (University of Texas at El Paso)
Tuning the Magnetic Properties of Quasi-2D Layered van der Waals Crystals

5:00 – 5:10 Wrap-up and Discussion

5:10 Adjourn

CNM Workshop 7: Ultra-wide Bandgap Materials for Microelectronics

Organizers: Martin Holt, Jessica Metcalfe, and Anirudha Sumant

There is growing demand for developing energy efficient devices that can work at extreme environmental conditions and ultrawide bandgap (UWBG) materials beyond silicon carbide and gallium nitride including diamond are considered as the best candidate materials due to their exceptional electronic and thermal properties. However, there are several fundamental challenges such as large area growth in single crystal form, low defect density, efficient doping, and seamless integration with other materials, that still needs to be solved in order to exploit their real potential. Solving these fundamental challenges will require an in-depth understanding of materials at the nanoscale including the ability to visualize defects at the atomic scale, understanding heterojunction interfaces at the nanoscale for their effective integration, etc. Having access to novel and powerful characterization techniques down to atomic scale along with state-of-the art facilities for the synthesis and fabrication of devices along with core expertise in these areas are going to be crucial to break those fundamental barriers. The purpose of this workshop is to bring together experts from academics and industries in the area of UWBG materials for microelectronics and discuss the current challenges and opportunities in this field as well as to introduce the wealth of capabilities and expertise available at the Center for Nanoscale Materials and other divisions at Argonne to the microelectronics community including academic and industrial users towards building mutually beneficial partnerships.

Microelectronics is an emerging area of interest to DOE and there's a focus group established at Argonne to build collaboration with outside academic and industry collaborators to exchange ideas, foster collaborations with user facilities at Argonne, and embark upon new challenges in the areas of microelectronics.

Topics:
• Synthesis and characterization challenges in large area monocrystalline growth of diamond: state of the art in synthesis, doping, and challenges
• Challenges and opportunities in utilizing diamond for active electronics: progress utilizing single crystal and polycrystalline diamond for active electronics
• Diamond-based heterojunction devices: active and passive integration of diamond with other semiconductor materials
• Diamond-based detectors and sensors for extreme environments: progress in developing advanced detectors and sensors in extreme environments.

Wednesday, May 11

Session 1 CVD-diamond: State-of-the-art in Synthesis, Doping, and Challenges (Chairs: Anirudha Sumant and Jessica Metcalfe)

9:00 – 9:05 Anirudha Sumant (Argonne National Laboratory)
Welcome and Introduction

9:05 – 9:15 Kawtar Hafidi (Argonne National Laboratory)
Kickoff Address to Participants

9:15 – 9:45 Ian Friel (Element Six Global Innovation Centre)
A Snapshot of 20 Years of CVD Diamond Research and Production

9:45 – 10:15 John Smedley (SLAC National Accelerator Laboratory)
Diamonds in a Platinum Setting: The Wedding of Beam Diagnostics and Wide Bandgaps

10:15 – 10:45 Timothy Grotjohn (Michigan State University)
Diamond Growth, Doping, and Applications in High-power Electronics

10:45 – 11:00 Break

Session 2 Diamond-based Heterojunction Devices (Chairs: Anirudha Sumant and Martin Holt)

11:00 – 11:30 Can Bayram (University of Illinois at Urbana-Champaign)
From Wide (Al)GaN towards Ultra-wide Bandgap Diamond Electronics

11:30 – 12:00 Zhenqiang (Jack) Ma (University of Wisconsin-Madison)
The Potential of Lattice-mismatched Heterostructures for UWBG Semiconductors

12:00 – 1:30 Lunch Break

Session 3 Diamond Transistors for RF-electronics (Chairs: Anirudha Sumant and Martin Holt)

1:30 – 2:00 Pankaj Shah (CCDC Army Research Laboratory)
Diamond Transistor Development for Future High-power RF Amplifiers

2:00 – 2:30 David Moran (University of Glasgow)
Transfer-doped Diamond for High-performance Field Effect Transistors

2:30 – 3:00 Alexander Balandin (University of California, Riverside)
Noise and Heat in Diamond Materials and Devices

3:00 – 3:30 Mitra Dutta (University of Illinois at Chicago)
Ion-gated FETs on Hydrogenated Diamond Surfaces: Phonon Impact on Mobilities in Diamond FETs

3:30 – 4:00 Stephan Hruszkewycz (Argonne National Laboratory)
Characterization of Nanoscale Structural Heterogeneity in Wide Bandgap Semiconductors with Synchrotron X-ray Methods

4:00 – 4:10 Break

Session 4 Towards Commercialization of Diamond-based Electronics (Chair: Anirudha Sumant)

4:10 – 4:25 Keith Evans (Great Lakes Crystal Technologies)
High Performance Crystalline Diamond Materials for High Technology Applications

4:25 – 4:40 Manpuneet Benipal (Advent Diamond, Inc.)
The Future of Semiconducting Diamond for Electronic Components

4:40 – 4:55 Victor Tabeling (Applied Diamond, Inc.)
Providing Solutions for Diamond Fabrication Across Diverse Industries

4:55 – 5:10 Anirudha Sumant (Argonne National Laboratory)
Closing Remarks

5:10 Adjourn

APS Workshop 9: Accelerated Advances in Energy Storage Systems Enabled by APS and APS-U

Organizers: Shirley Meng and Uta Ruett

Novel and diverse concepts for energy storage systems are required for a decarbonization of transportation and a modern electricity grid adapted to the emerging renewable sources.

The research to advance the energy storage systems addresses not only energy and power density, production cost, fast-charging ability, cycle life, and safety, but also economic and ecologic sustainability, lifetime, and energy justice. The challenges range from materials discovery, synthesis and manufacturing optimization, to detailed understanding best architectures for ion transportation in functional batteries. Essential *in situ* and *operando* characterization tools need to be identified and transformed into core techniques that balance the needs for fast turnover yet highly quantitative characterization, which will also enable applications of machine learning or other artificial intelligence-guided data interpretations. Unprecedented tools for higher spatial, energy, and/or temporal resolution will revolutionize the detailed understanding of the effects of ion transport during operation of energy storage systems after the facility upgrade.

In this workshop, expert users and beamline scientists will discuss state-of-the-art techniques today and identify the required developments for best support of research on cutting edge electrochemical energy storage systems. The scope spans from instrumental design, sample environments for various stimuli, to high-throughput data analysis and simulation for adaptive decisions using artificial intelligence techniques.

Thursday, May 12, Morning

8:45 – 9:00 Shirley Meng (University of Chicago) and Uta Ruett (Argonne National Laboratory)
Welcome

9:00 – 9:15 George Crabtree (Argonne National Laboratory)
Introduction and Welcome

9:15 – 9:45 Jun Lu (Argonne National Laboratory)
Understanding Cobalt Roles towards Developing Co-free Ni-rich Cathodes for Rechargeable Batteries

9:45 – 10:15 Dorthe Ravnsbaek (Aarhus University)
Operando *X-ray Scattering of Battery Electrodes: Probing Average and Local Atomic Structure*

10:15 – 10:30 Break

10:30 – 11:00 Hans Georg Steinrueck (University Paderborn)
Understanding Ion Transport by Bathing Electrolytes in Coherent X-rays

11:00 – 11:30 Maria Chan (Argonne National Laboratory)
Theory and ML-assisted Characterization of Battery Materials

11:30 – 12:00 Mathew Cherukara (Argonne National Laboratory)
Artificial Intelligence-enabled X-ray Science at the Advanced Photon Source

12:00 – 1:00 Lunch Break

Thursday, May 12, Afternoon

1:00 – 1:30 Hui (Claire) Xiong (Boise State University)
Understanding Order/Disorder in Metal Oxide Electrode Materials through Synchrotron Techniques

1:30 – 2:00 Karena Chapman (State University of New York, Stony Brook)
Unraveling Multiscale Phenomena: Harnessing Large Volumes of Multi-modal Data

2:00 – 2:30 Tim Fister (Argonne National Laboratory)
Imaging Electrode and Electrolyte Heterogeneity with High-energy X-rays

2:30 – 3:00 Feng Lin (Virginia Tech)
The Power of Synchrotron Analytical Tools to Guide the Development of Low-cost and Sustainable Batteries

3:00 – 3:15 Break

3:15 – 3:45 Jordi Cabana (University of Illinois at Chicago)
Framing Questions in Battery Research Across Scales of Space, Chemistry, and Time

3:45 – 4:15 Hua Zhou (Argonne National Laboratory)
Multimodal Surface X-ray Probes Revealing Fundamental Processes across Electrochemical Interfaces: Now and Post APS-U

4:15 – 4:45 Kamila Wiaderek (Argonne National Laboratory)
Current and Future Opportunities for Energy Storage Research at APS

4:45 – 5:00 Wrap-up and Discussion

5:00 Adjourn

APS Workshop 11: Advanced Spectroscopy and LERIX (ASL) Workshop

Organizers: Shelly Kelly and Xiaoyi Zhang

We would like to share our vision of the future for spectroscopy programs at 25-ID. The canted beamline will have two independently operating branches that will be jointly operated by the Spectroscopy and Time-resolved Research groups. One branch will host a new generation low-energy resolution inelastic x-ray (LERIX) spectrometer and time-resolved x-ray science and another for a microprobe spectroscopy. The new APS Upgrade LERIX spectrometer will enable x-ray absorption spectroscopy at low energies using hard x-rays. Time-resolved x-ray science will bring together current 11-ID-D and Atomic, Molecular and Optical Physics programs for multiple timescale electronic and structural dynamics of underlying material properties. The microprobe branch will have fast-changing x-ray beam size for large- to small-scale mapping, enabling "the needle in the haystack" to be found and probed. The microprobe branch will host x-ray emission spectroscopy with simultaneous collection of seven emission lines for *in situ*/*operando* studies of multiple elements, high-resolution fluorescence spectroscopy based on three strip-bent analyzers, and single-shot chemical mapping. The structure of this workshop will include brief overviews of these capabilities by members of the Spectroscopy and Time-resolved Research groups followed by guest speakers highlighting science cases.

Friday, May 13, Morning

9:15 – 9:30 Shelly Kelly (Argonne National Laboratory)
Introduction and Welcome

9:30 – 10:00 Xiaoyi Zhang (Argonne National Laboratory)
Time-resolved Program at 25-ID

10:00 – 10:15 Break

10:15 – 10:45 Mikhail Solovyev (Rutgers University)
Introduction to Resonant and Non-resonant Hard X-ray Emission Spectroscopy: Principles and Uses

10:45 – 11:15 Inhui Hwang (Argonne National Laboratory)
X-ray Emission Data Processing and Analysis Using Machine Learning

11:15 – 11:45 Jenny Lockard (Rutgers University)
Resonant and Non-resonant X-ray Emission Spectroscopy Studies of Metal Organic Frameworks under Different Host-guest and External Perturbation Conditions

11:45 – 12:00 Morning Discussion

12:00 Adjourn Session 1

Friday, May 13, Afternoon

1:00 – 1:30 Zou Finfrock (Argonne National Laboratory)
High-energy Resolution Fluorescence Detection Capability Development at Sector 20-ID

1:30 – 2:00 Tsun-Kong (TK) Sham (University of Western Ontario)
Science of Photon-in Photon-out Spectroscopy and Microscopy from Tender to Hard X-rays with High-energy Resolution

2:00 – 2:30 Gerald Seidler (University of Washington)
The Design and Scientific Opportunities of the LERIX Upgrade

2:30 – 3:00 George Sterbinsky (Argonne National Laboratory)
Dispersive X-ray Absorption Spectroscopy for High-resolution Chemical Mapping

3:00 – 3:15 Break

3:15 – 3:45 Burak Guzelturk (Argonne National Laboratory)
Time-resolved Atomic Pair Distribution Function (TR-PDF) Capability and Science Cases

3:45 – 4:15 Jin Yu (Argonne National Laboratory)
Application of X-ray Transient Absorption Spectroscopy in the Field of Solar Energy Conversion

4:15 – 4:45 Eli Kinigstein (Lawrence Berkeley National Laboratory)
Progress in Time-resolved X-ray Transient Absorption Spectroscopy Instrumentation at the APS

4:45 – 5:00 Wrap-up and Discussion

5:00 Adjourn

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PITEC Rua Walter Hadler, S/N (Soma Building) Cidade Universitaria, Campinas/SP 13083-837 Brazil Tel: +55 19 40421992 https://www.pitec.co/	Pitec is an imaging system company specialized in the design and integration of semiconductor detectors for high-performance X-ray applications. Pitec has a complete line of photon-counting hybrid pixel detectors for synchrotron applications.
Quantum Detectors Ltd R103 RAL, Fermie Avenue Harwell, Oxford OX11 0QX United Kingdom Tel: +44 (0) 1235 632047 www.quantumdetectors.com	Quantum Detectors was founded in 2007, a technology spin-out from the Science & Technology Facilities Council (STFC) and Diamond Light Source (DLS), the UK's synchrotron radiation facility. Our core mission was a clear one. Make our cutting-edge technology accessible to the global science community. And that's what we've done. The company today is a market-leading provider of advanced direct electron detectors and readout solutions employed in TEM and synchrotron radiation facilities throughout the world. Serving scientific and commercial research sectors, we have gained a reputation for customer service and support with our lifetime product care, continuous product improvement and bespoke solution capability. Quantum Detectors is now recognized as being at the forefront of 4D STEM analysis, having the largest installed base of DEDs supporting all major TEM brands, including Hitachi, JEOL and Thermo Fisher Scientific. And with several hundred installations operational in the field, our readout systems are leading the way in accessing high-quality beamline data.

Rayonix, L.L.C. 1880 Oak Ave., Suite 120 Evanston, IL 60201 Tel: (847) 869-1548 https://www.rayonix.com/ 	Rayonix L.L.C. integrating Rayonix HS (High-Speed) X-ray detectors, now offer geometries for XFEL applications which allow the direct beam to pass through. Other geometries are useful for simultaneous SAXS/WAXS data collection. Rayonix has two new ultra high speed pixel array X-ray detectors with special features to support pump-probe experiments, 2-color experiments and gain-switching for XFEL applications under development. Input from scientists is welcome.
Teledyne Princeton Instruments 3660 Quakerbridge Road Trenton, NJ 08619 Tel: (609) 587-9797 https://www.princetoninstruments.com/ 	Teledyne Princeton Instruments (TPI), a business unit of Teledyne Digital Imaging US, Inc, designs and manufactures high-performance CCD, sCMOS, ICCD, EMCCD, emICCD, and InGaAs cameras; spectrographs; and optics-based solutions for the scientific research, industrial imaging, and OEM communities. We take pride in partnering with our customers to solve their most challenging problems in unique, innovative ways.
Televac - The Fredericks Company 2400 Philamont Ave. Huntingdon Valley, PA 19006 Tel: 215-947-2500 https://www.frederickscompany.com 	The Fredericks Company manufactures high-quality vacuum sensors gauges and control instrumentation under the Televac brand. We offer full range vacuum measurement solutions for national labs and high energy physics including industry-leading cold cathode gauges with high bakeout temperatures and quick ignition at UHV. We guarantee customer satisfaction, and our “not too big not too small” operation is what enables us to offer a true partnership experience. Covering the entire practical vacuum range our products deliver rapid response vacuum readings and superior sensitivity. For more information visit www.frederickscompany.com or call us at +1 215-947-2500.

X-Spectrum GmbH Luruper Hauptstraβe 1 Hamburg 22547 Germany https://x-spectrum.de/  	We are a full-service detector company which provides off-the-shelf and custom detector solutions. Our detectors can be used for a variety of scientific experiments on advanced X-ray sources and in electron microscopes. X-Spectrum is a spin-off of DESY in Hamburg Germany. We offer several product lines: LAMBDA for X-ray sciences AMBER for electron microscopes SPARTA for high-speed measurements. All our detectors offer high spatial resolution high sensitivity (with CdTe sensor even at 100 keV or more) and extremely high speed (up to 24 kHz for LAMBDA and AMBER 6.5 MHz for SPARTA).