Advanced Photon Source

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ADVANCED PHOTON SOURCE

72
X-ray beamlines

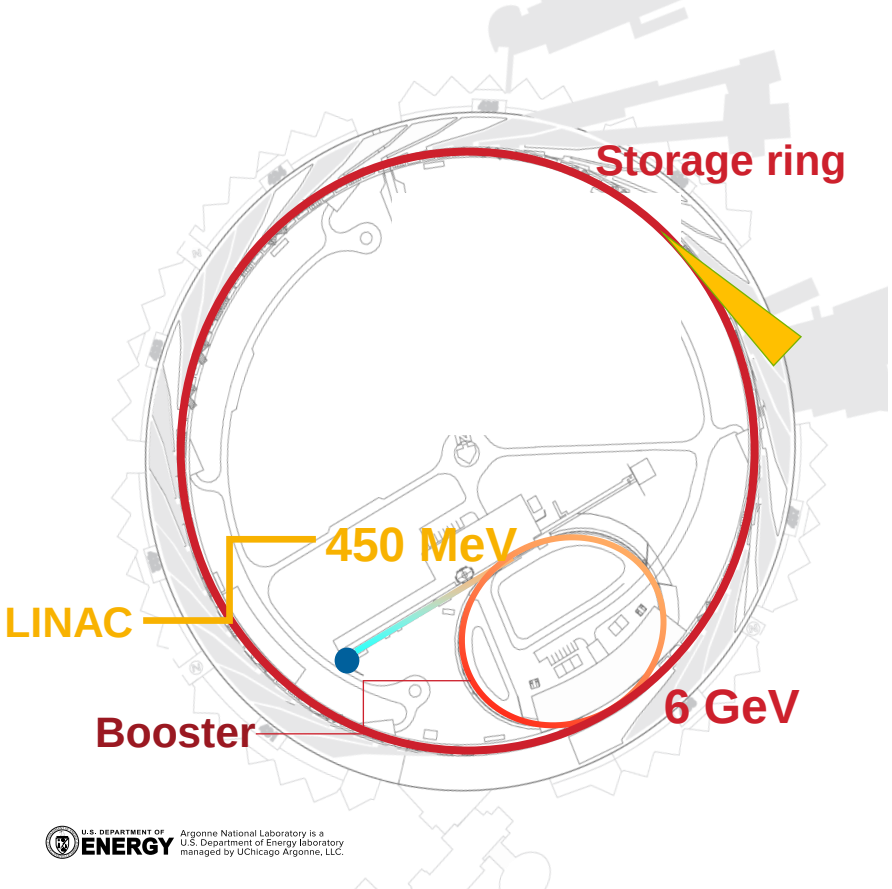
5,500
Unique users
in a typical year
~2000 grad students
~1000 postdocs

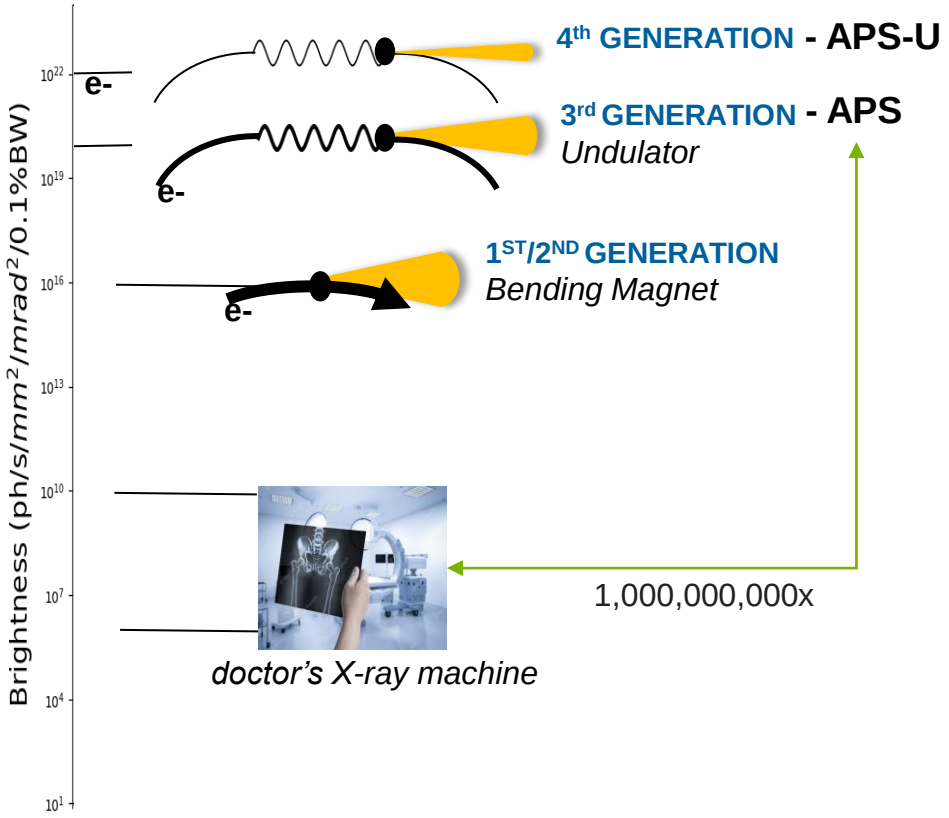
6,000
Experiments
per year

2,000
Publications
per year

Countless
Societal impacts

SYNCHROTRON: AN EXTREMELY BRIGHT X-RAY SOURCE

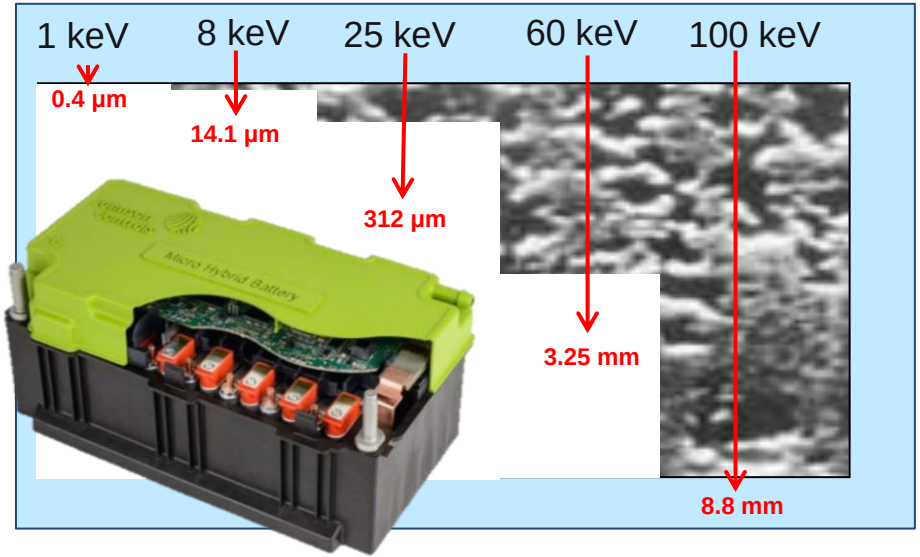


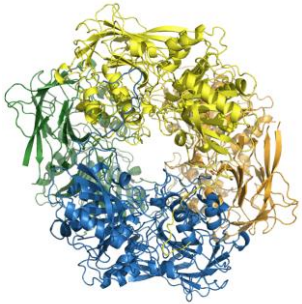


THE POWER OF HARD AND HIGH-ENERGY X-RAYS

Hard and high-energy X-rays

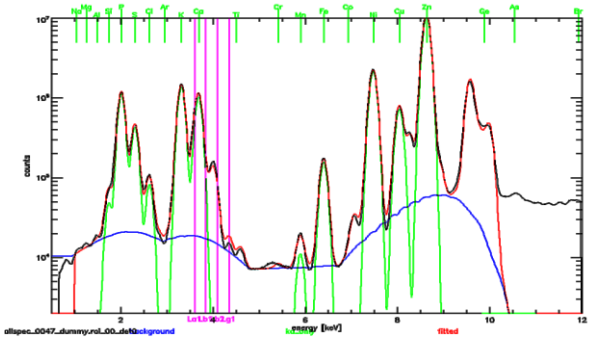
- **Deep penetration**





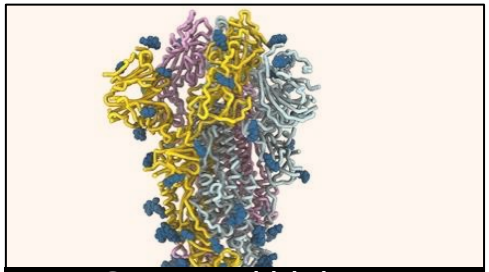
- **X-ray Diffraction:**

Comprehensive
reciprocal space information

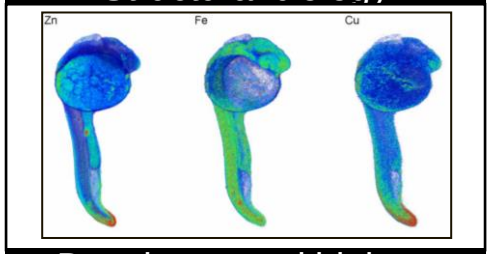


- **X-ray Fluorescence & Spectroscopy:**
  Chemical information, with trace sensitivity

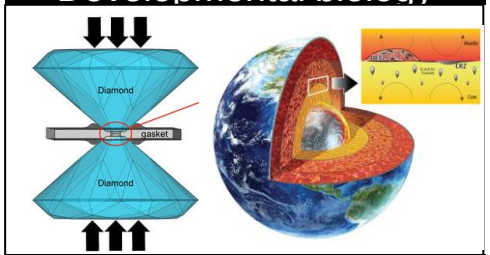
A WIDE RANGE OF SCIENCE



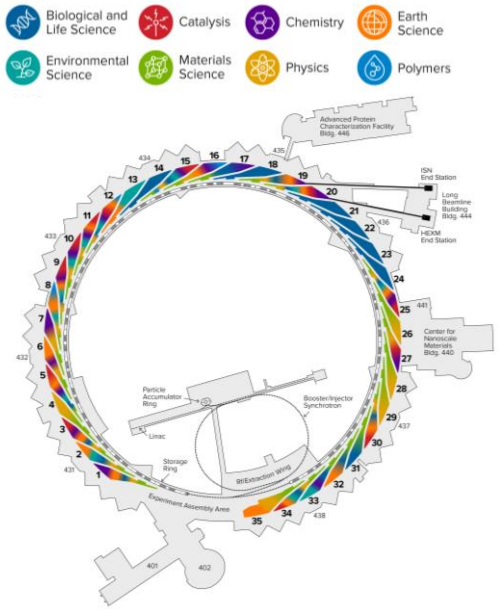
Structural biology

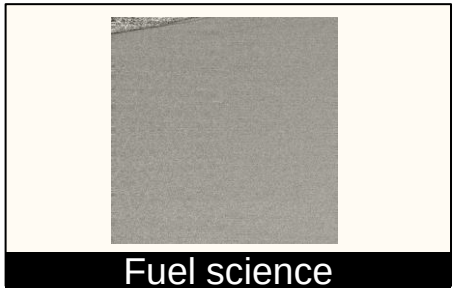


Developmental biology

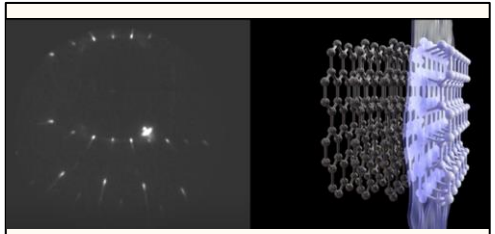


Earth science

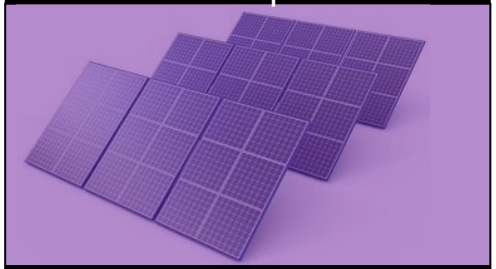




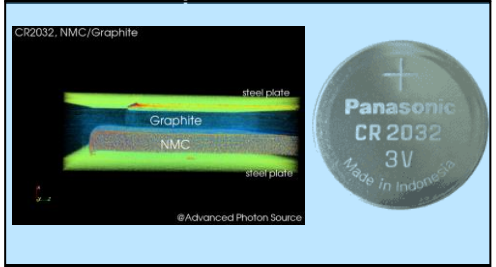
Fuel science



Shock compression

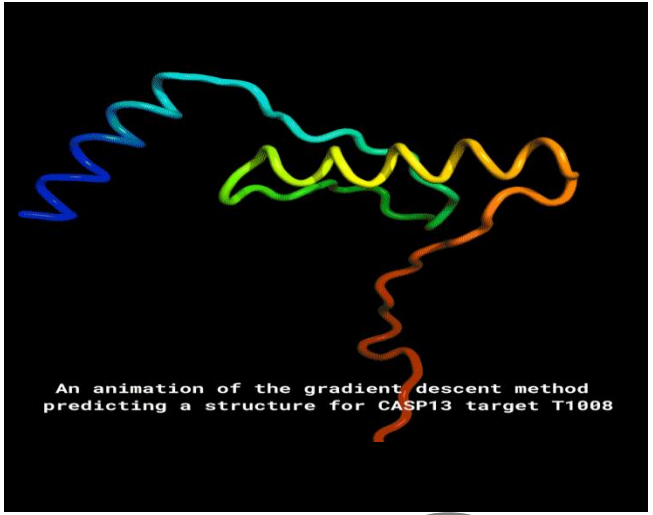


New photovoltaics

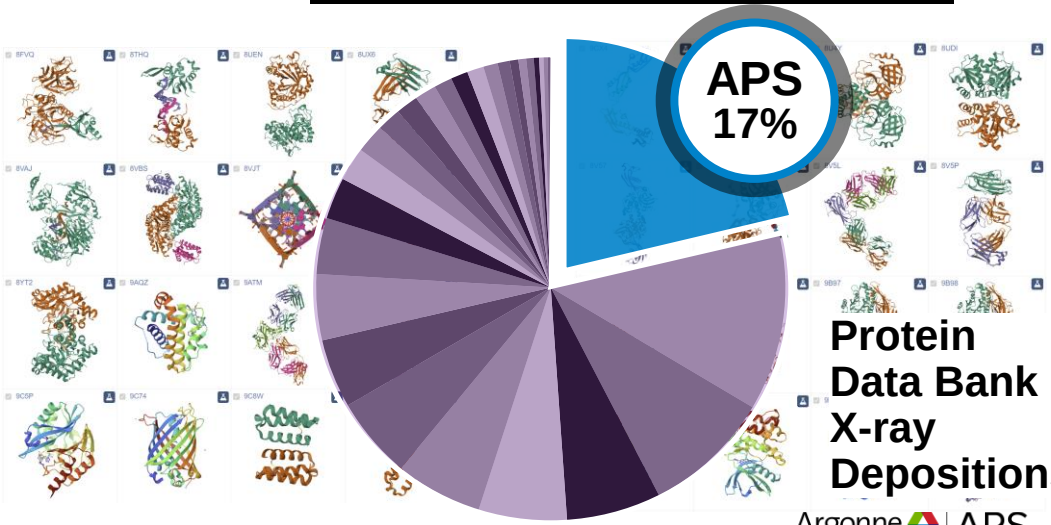


Batteries

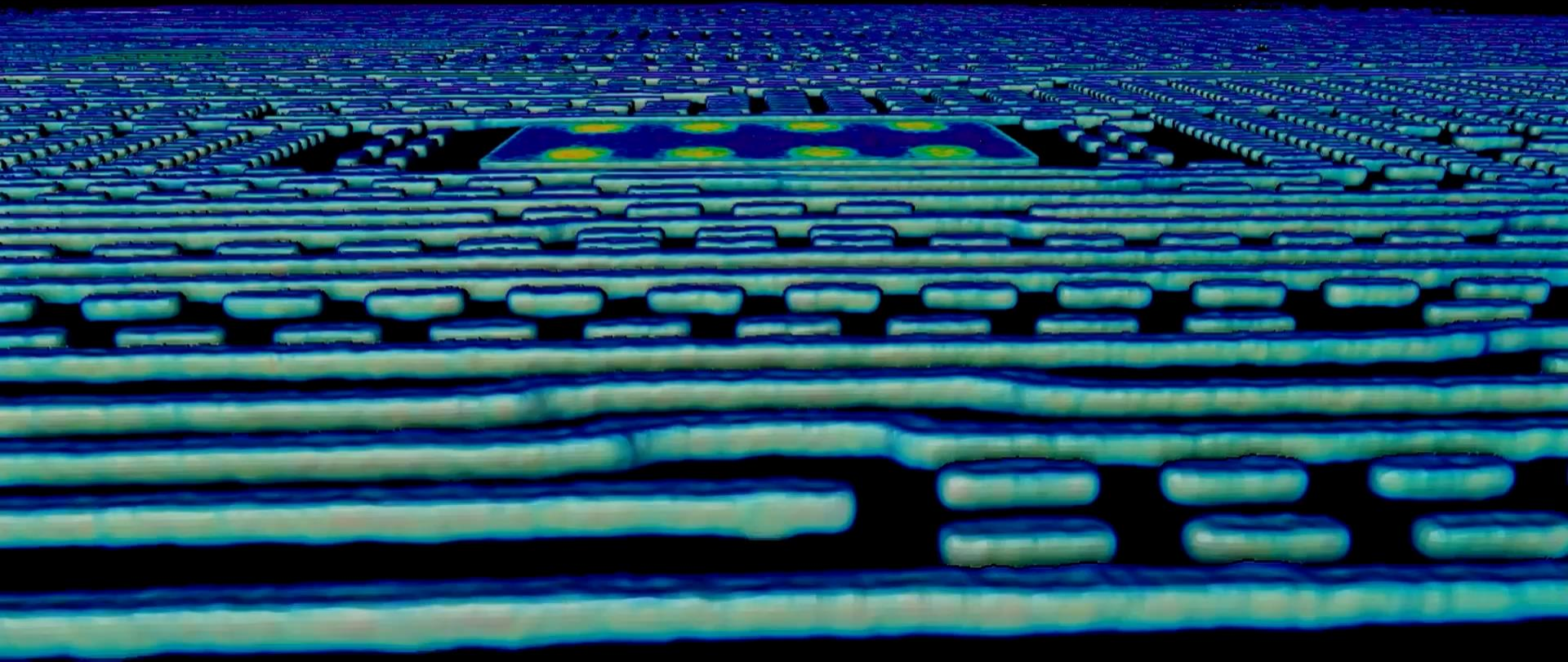
STRUCTURAL BIOLOGY



Development of Paxlovid enabled by data collected at the IMCA-CAT beamline at the APS.

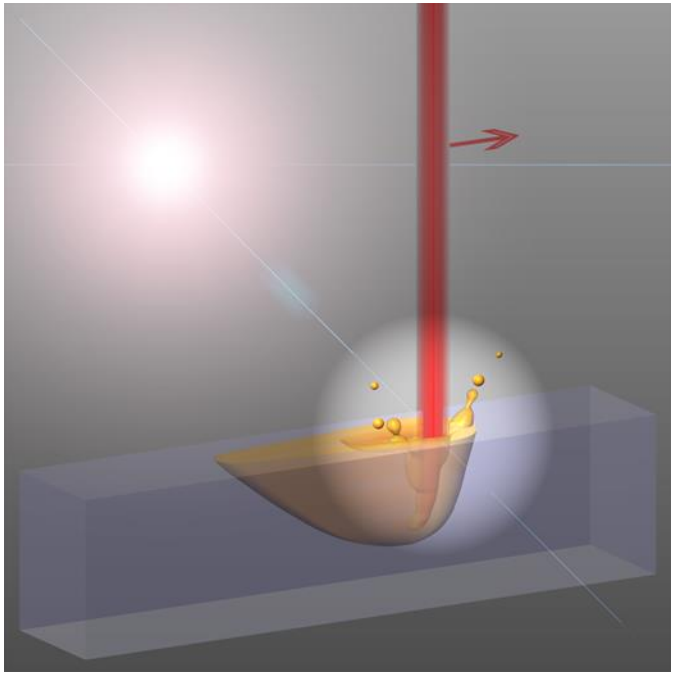


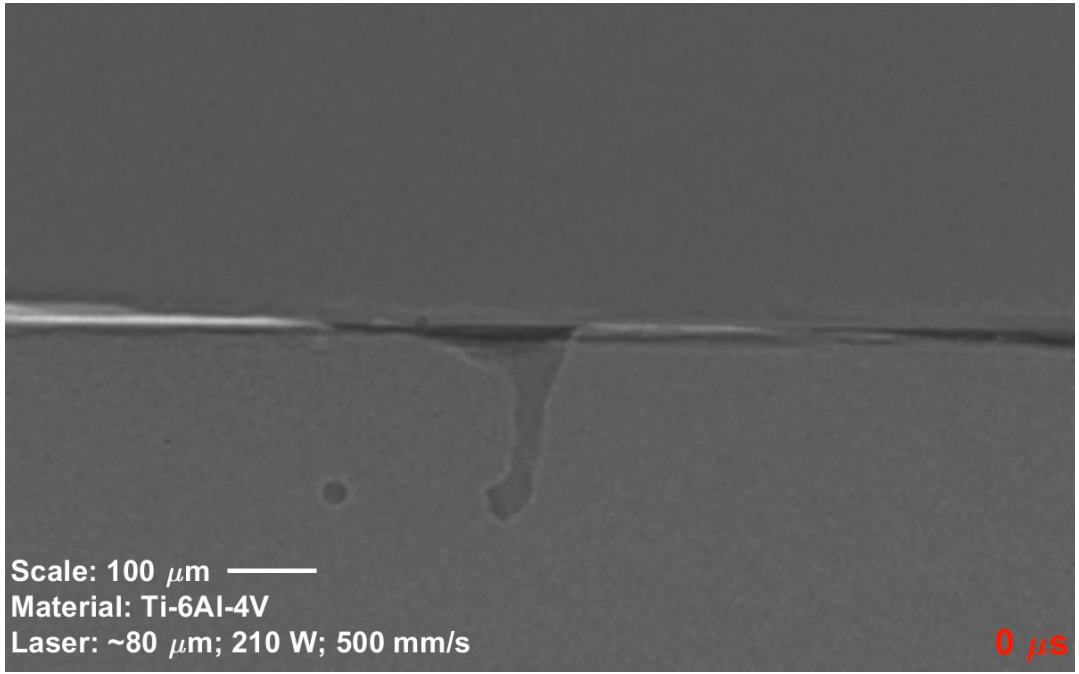
Protein Data Bank X-ray Depositions



ADDITIVE MANUFACTURING

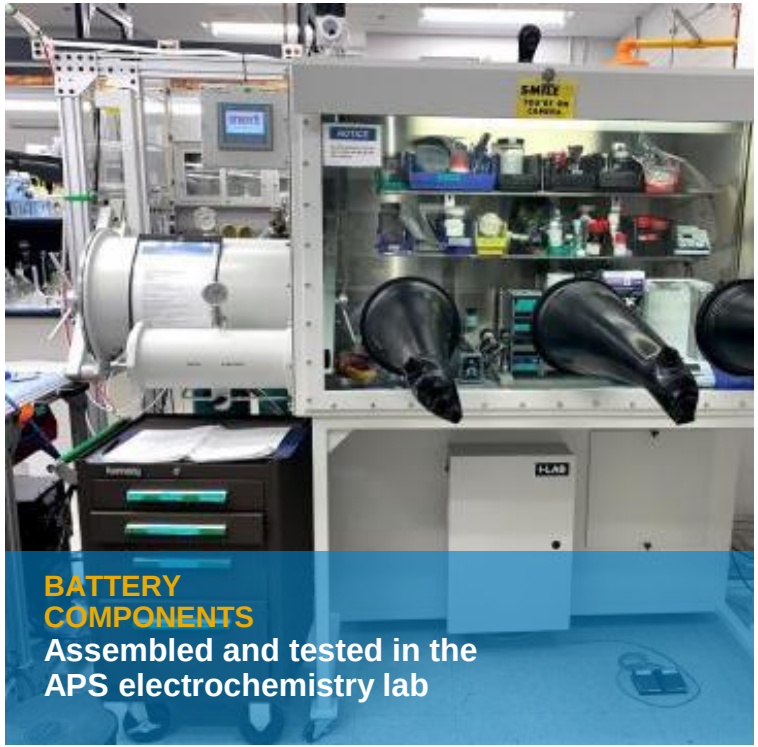
X-ray imaging of metal 3D printing process

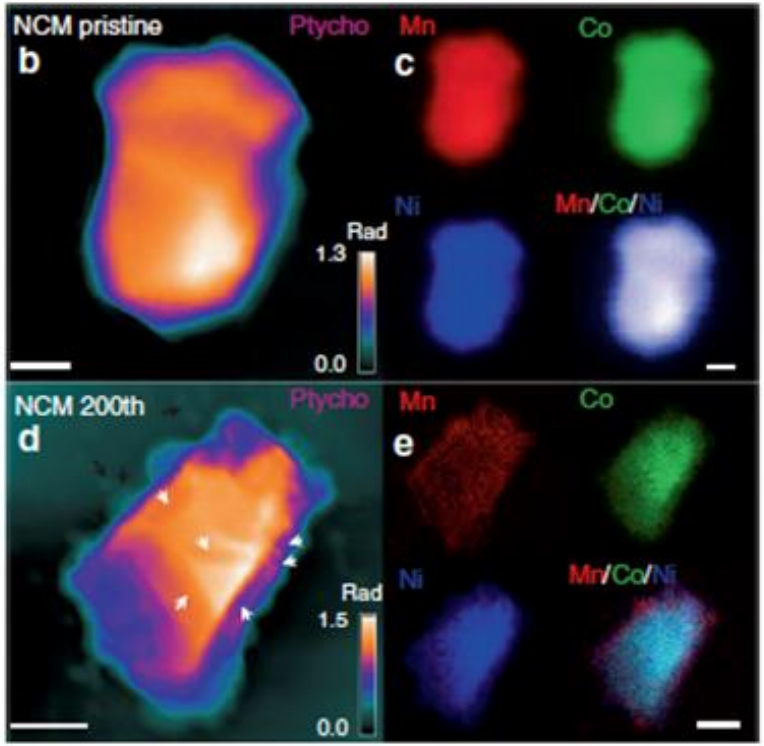




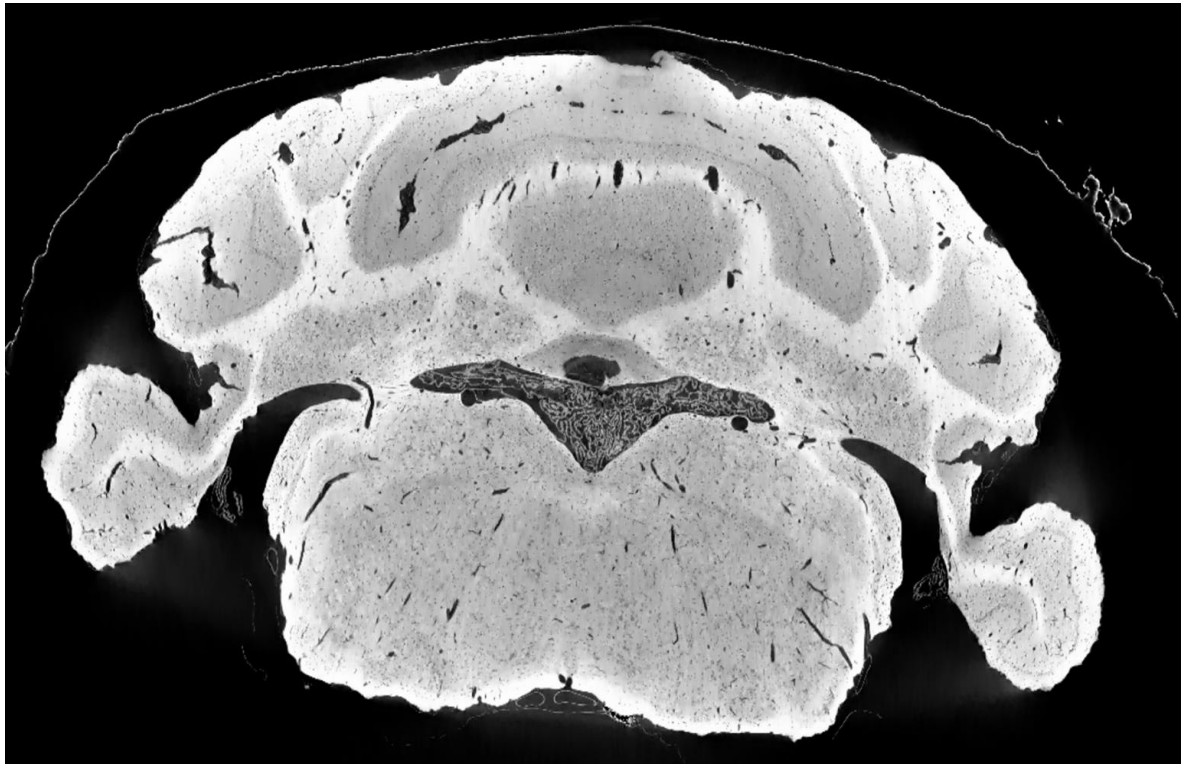
BATTERY MATERIALS

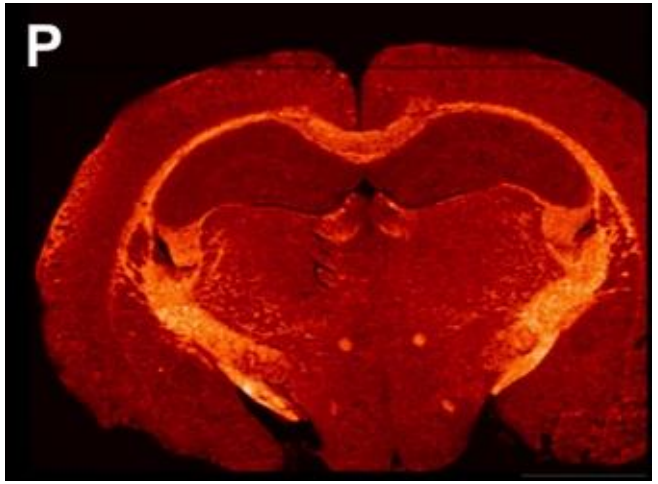
Understanding the degradation process with X-ray beams

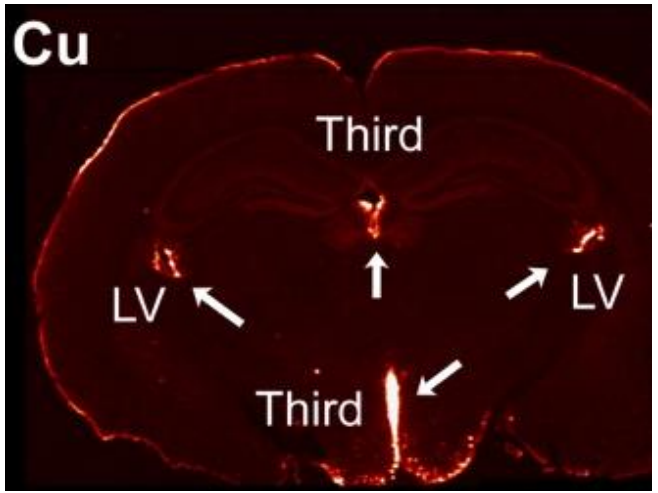




BETTER UNDERSTANDING THE BRAIN

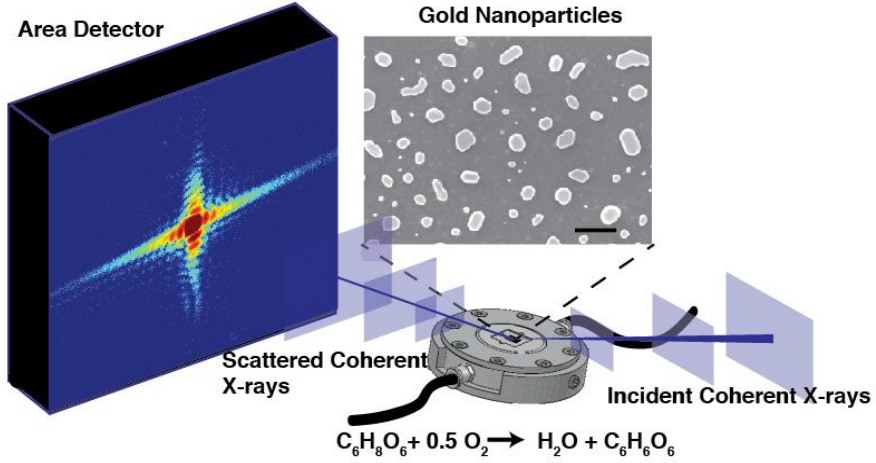






BRAGG CDI SCIENCE

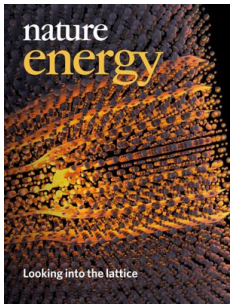
Operando Nanoscale Imaging

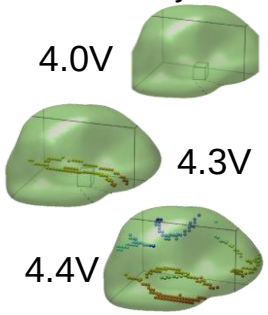


Increased coherent flux enables

- Increase in both temporal and spatial resolution.
  - Rapid charging battery.
  - Catalysis with more realistic reagents.
  - Phase transformation for energy storage.
  - Multi-Bragg peak full strain tensor imaging.

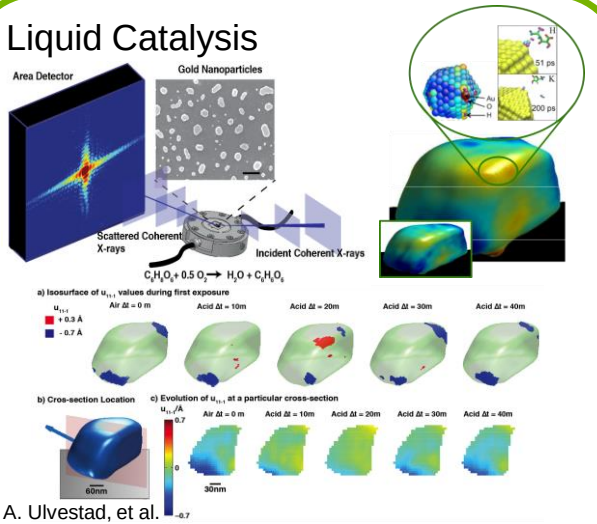
Dislocation in Li-Ion battery





Singer, A., et al. *Nature Energy*, *3*(8), 641–647. Aug. 2018

Liquid Catalysis



A. Ulvestad, et al. *J. Phys. Chem. Lett.*, vol. 7, no. 15, pp. 3008, Aug. 2016.

x500

$815M

$1.5B

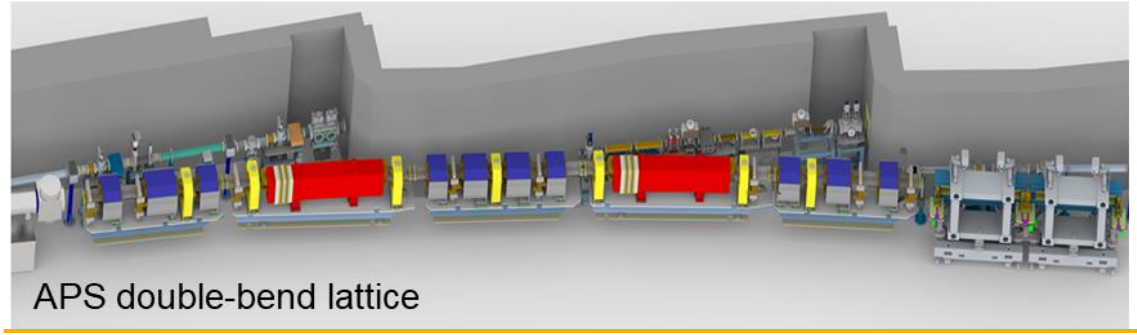
A new storage ring

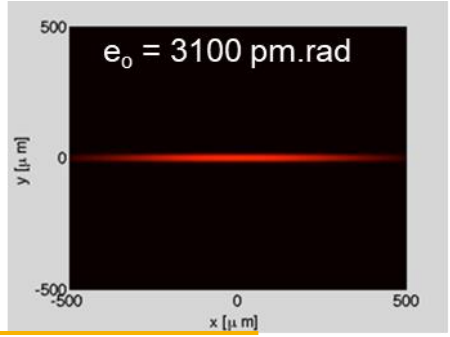
New experimental facilities

New infrastructure, which will house two feature beamlines

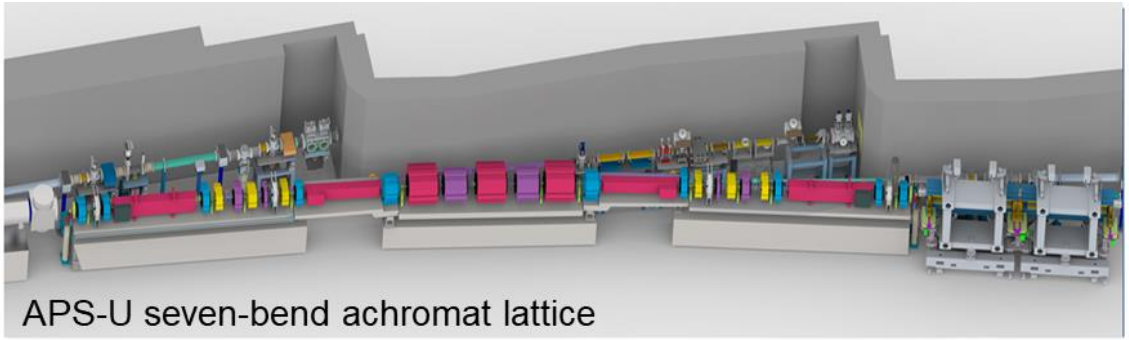
The APS upgrade opened the door to ultra-low emittance

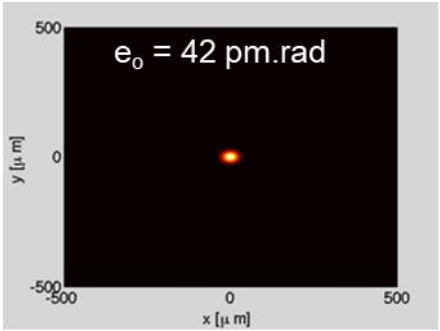
ORIGINAL APS



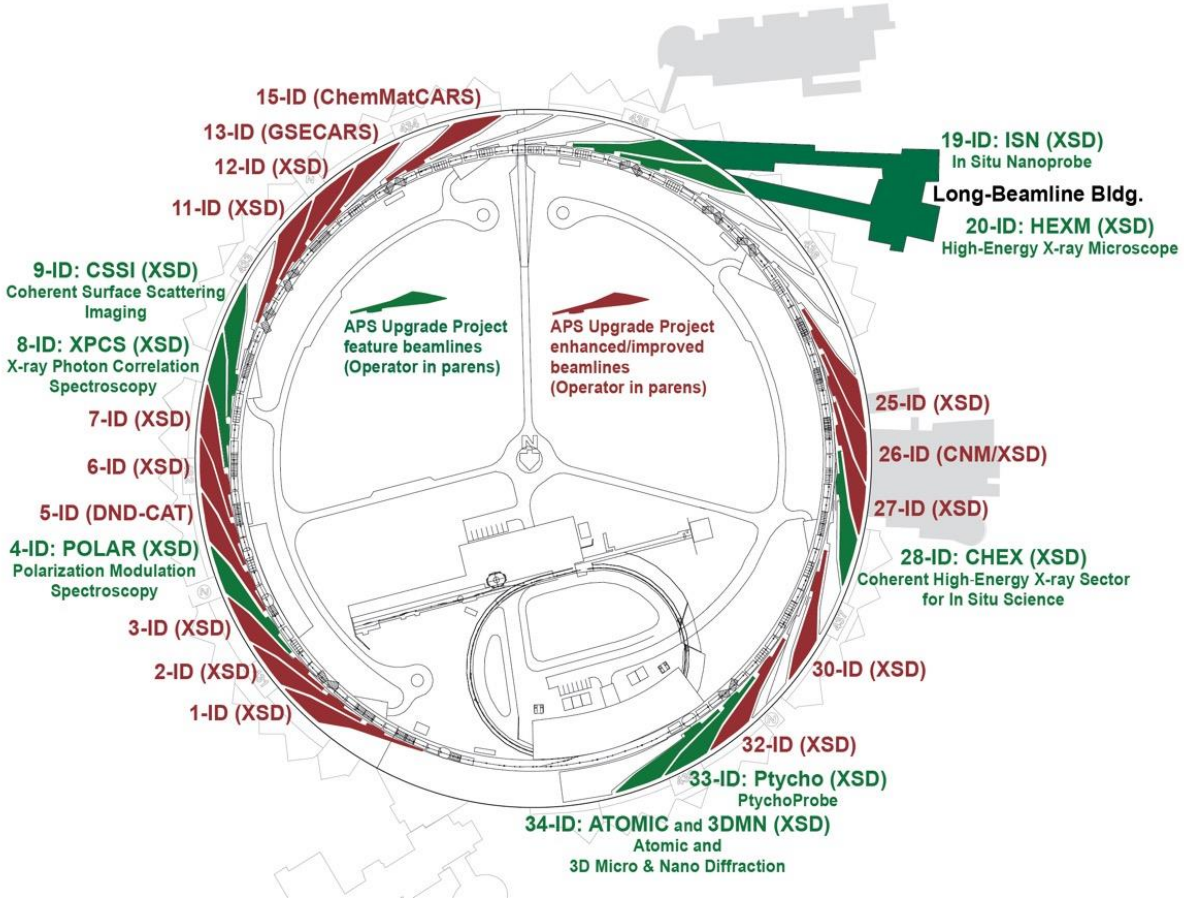


UPGRADED APS





APS UPGRADE PROJECT - BEAMLINES



- New and updated insertion devices for optimum spectral performance.
- 9 new feature beamlines + Long Beamline Building (green)
- 14 enhanced and improved beamlines
- 18 bending magnet beamline relocations

- CAT beamline upgrades (off-project)
- Other XSD BL upgrades (off-project)

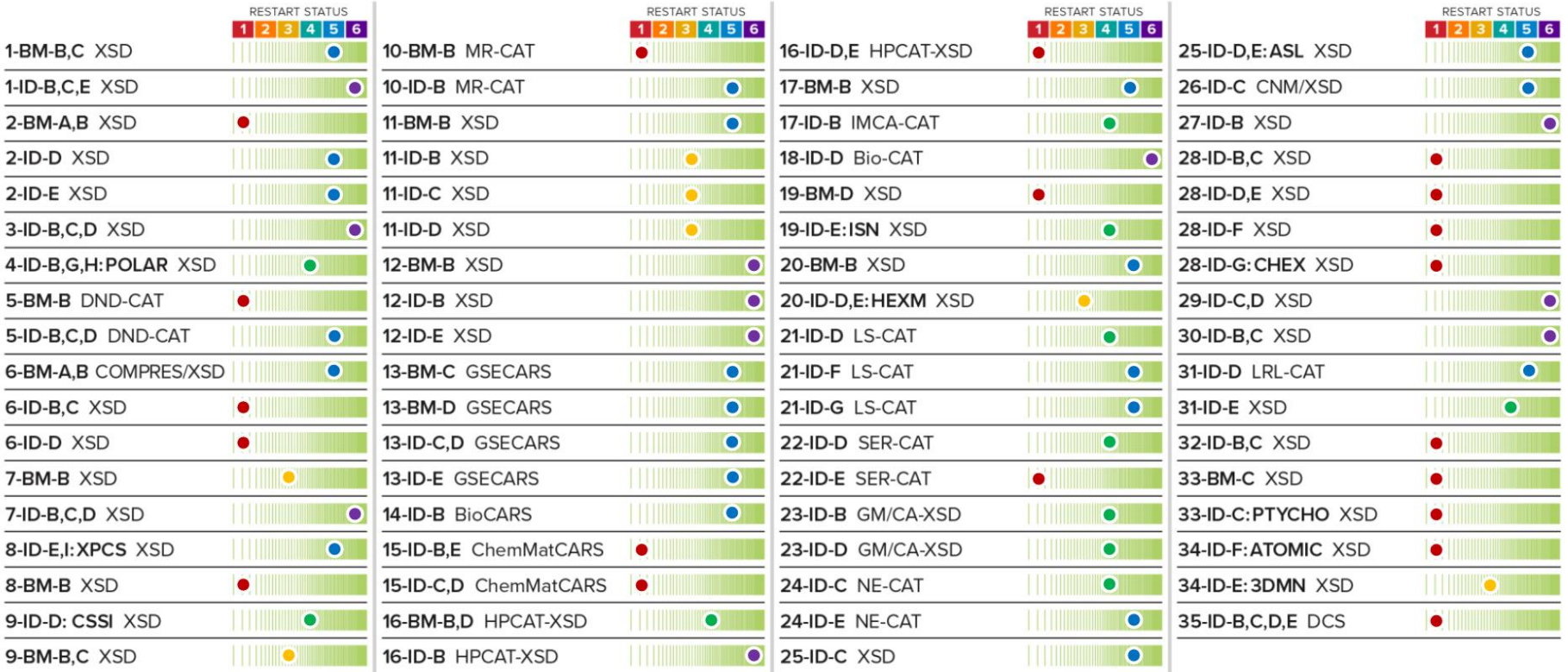
Argonne NATIONAL LABORATORY | APS

BEAMLINE COMMISSIONING PROGRESS

MARCH 3, 2025

Argonne NATIONAL LABORATORY | Advanced Photon Source

KEY 1 Installation Ongoing | 2 Installation Complete | 3 Ops Commissioning | 4 Technical Commissioning | 5 Scientific Commissioning and Early Experiments | 6 Restart of General User Program

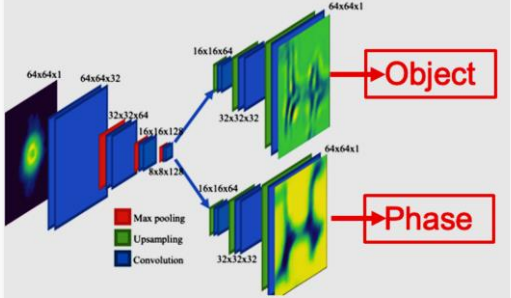


BIG DATA FOR THE FUTURE OF SCIENCE

Unique co-location of brightest synchrotron and leadership computing

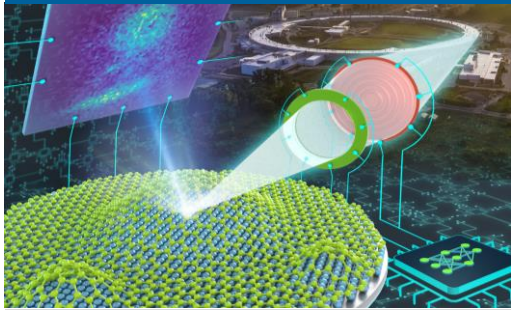
VISION: AI-POWERED X-RAY SCIENCE

AI4Analysis



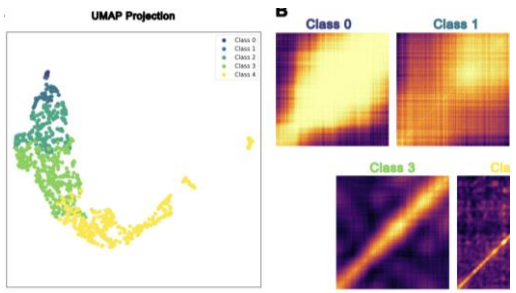
- AI@Edge: >100X faster & (sometimes) more accurate analysis
- Enables real-time analysis on Gb/s data streams

AI4Steering



- AI@Edge: Self-driving experiments and instruments: maximize info gain in minimal time

AI4Knowledge



- Learn material physics directly from measurements

HOW CAN YOU MAKE USE OF THESE RESOURCES ?

- Beamtime is available to users through a competitive proposal process.
- Proposal submission deadlines 3 times a year.
- General User Proposals
  - Open to anyone, just have to write a good proposal. Proposals get reviewed by committee, assigned based on scores. Users typically come for experiments 3-4 days (9-12 shifts), carry out experiments with help of beamline scientist
  - No cost for beamtime, the expectation is that results will be published.
- Most importantly: try to identify possible beamlines in advance, and **contact the beamline scientist** well **before writing the proposal.**
  - **Often possibility to do feasibility studies before actual experiment, to acquire preliminary data for proposals (beamtime, funding)**
- **Please contact me with any questions: svogt@anl.gov**

THE FUTURE IS BRIGHT

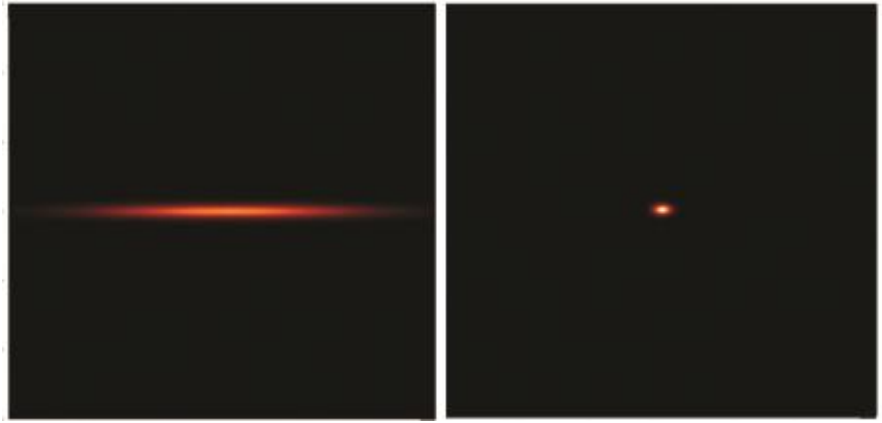
⇒ **Up to 500x higher brightness**

⇒ **Micro/nanoprobe: increased flux**

⇒ **smaller spot sizes**

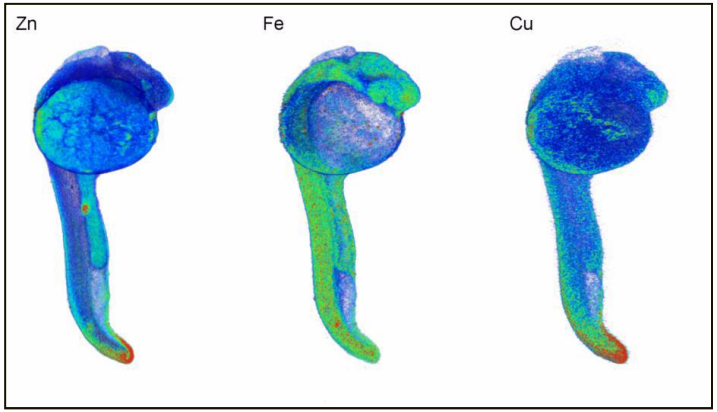
⇒ **increased contrast, better SNR**

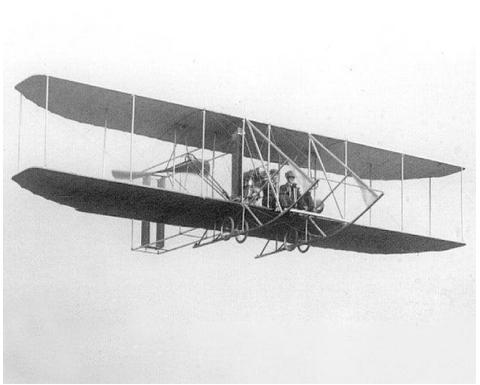
⇒ **higher speed**



Old APS beam

Upgraded APS beam





500x

Thank you !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ADDITIONAL RESOURCES

- APS user information (including how to register as a user):

https://www.aps.anl.gov/Users-Information

- Proposals and proposal deadlines (next one is June 2025 for beamtime in the fall):

https://www.aps.anl.gov/Users-Information/About-Proposals/Proposal-Deadlines-and-Meetings