INTERNATIONAL FORUM ON DETECTORS FOR PHOTON SCIENCE

Argonne NATIONAL LABORATORY

2024 APS FACILITY UPDATE

TEJAS GURUSWAMY
X-ray Science Division
Detectors Group
tguruswamy@anl.gov

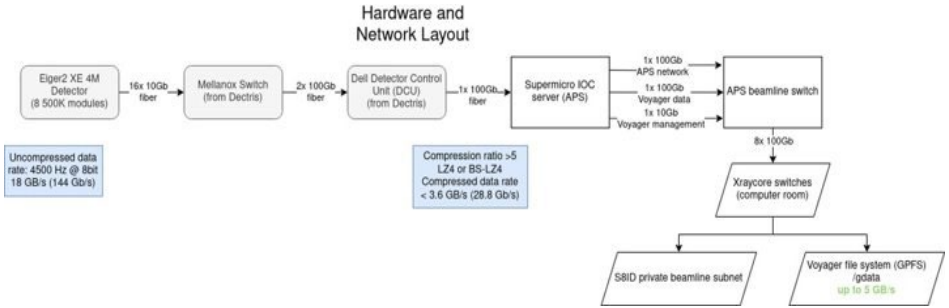
2024-Mar-18
BNL/Port Jefferson, NY

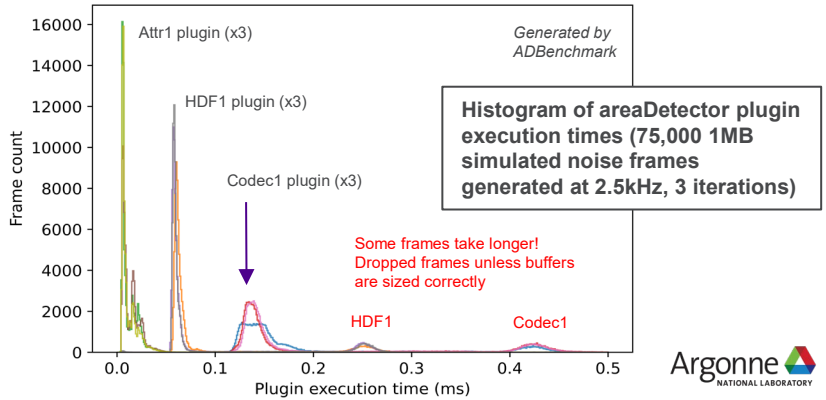
APS-U AND DETECTOR POOL

Refreshed pool hardware, integration with APS-U data pipelines

- **Detector Pool** selection of commercial detectors expanded, updated hardware and software
- Supporting **APS-U feature beamlines**
  - Help procure, commission, integrate new detectors
  - Multiple DECTRIS up to 16M, Rigaku XSPA 3M, multi-element SDDs
  - Synchronized multi-detector acquisition
  - EPICS areaDetector controls
- APS-U beamline operation scheduled this summer!

- **Beamline Data Pipelines (BDP)** working group *(DET, BC, IT, SDM, CAI)* developing end-to-end workflows for feature beamlines
- Tuning detectors and software for high data rate and volume
  - Not plug and play! Measure, optimize, remeasure
- High bandwidth connections to storage and analysis systems *(local, APS & ALCF)*
- Integration with **experiment orchestration** and **compute task/data transfer** software (*Bluesky, APS-DM, Globus)*

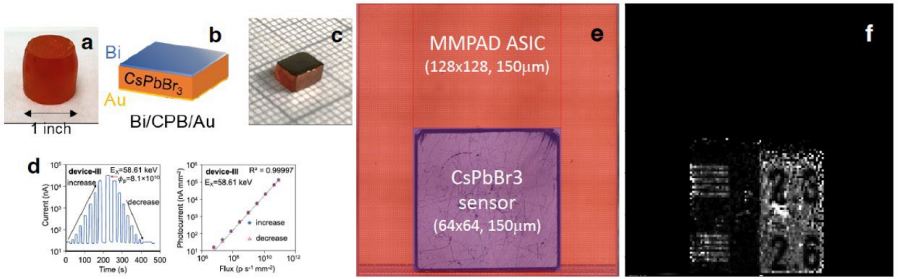




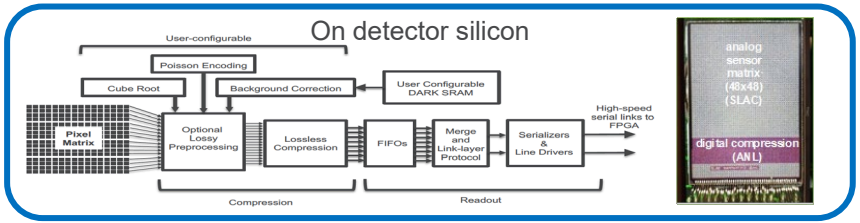
SEMICONDUCTOR-BASED

High-Z Perovskites, co-design with analysis, on-chip compression

- $CsPbBr_3$ for **high-Z pixel detectors**
- Response linearity demonstrated
- Integration with readout ASICs (e.g. MMPAD) ongoing



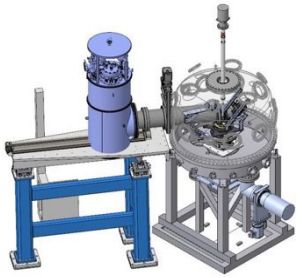
- On-pixel implementation of **lossy compression**
- Faster readout from ASICS, **increased frame rates**
- **Co-design** of sensor and readout with analysis groups
- Connect to edge compute and HPC for AI/ML-driven fast feedback
- See talks by Lorenzo Rota (SLAC) and Tau Zhou (ANL) -- Session 7, Tuesday



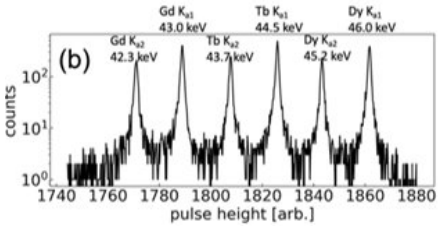
L. Pan, I. R. Pandey, A. Miceli, V. V. Klepov, D. Y. Chung, M. G. Kanatzidis, Perovskite $CsPbBr_3$ Single-Crystal Detector Operating at 10^{10} Photons s^{-1} mm^{-2} for Ultra-High Flux X-ray Detection. *Adv. Optical Mater.* 2023, 11, 2202946. https://doi.org/10.1002/adom.202202946

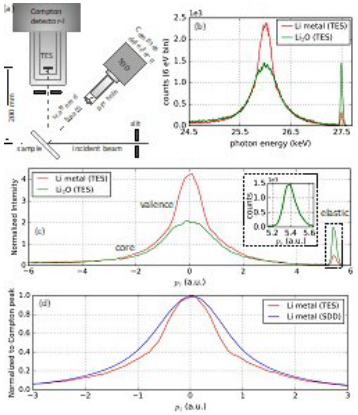
SUPERCONDUCTOR-BASED

Transition Edge Sensor spectrometer arrays and spin-offs



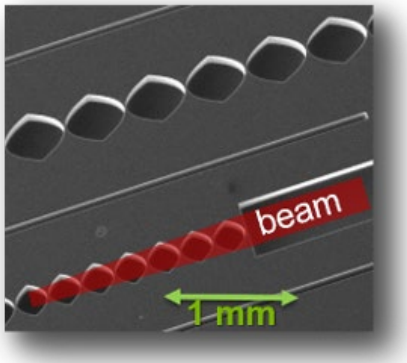
- **High-resolution calorimeters** operating at 60 mK
- Hard X-ray instrument expanded to 96 pixels
- Typical ΔE/E = 1/1000 up to 75 keV
- Demonstrated application: **Compton spectroscopy** of light elements (Li, H) using hard X-rays
- Planned move from 1-BM to **11-ID** for user access, multi-modal XRD & spectroscopy

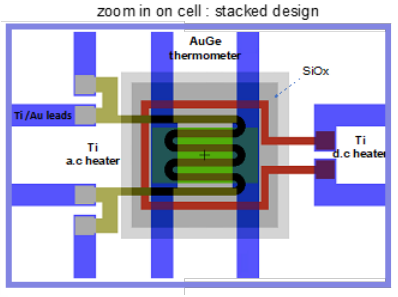




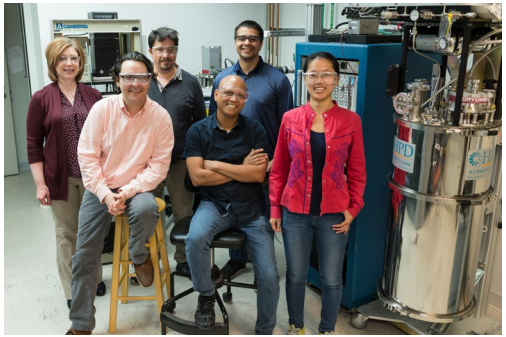
- Developing **soft X-ray TES instrument for 29-ID** (resonant soft X-ray scattering)
- Expected resolution ~1 eV up to 2 keV
- Integration of TES cryostat with UHV sample chamber
- Collaboration with *NIST (Boulder) Quantum Sensors Group*

Spin-offs: 1-D silicon micromachined X-ray lenses
Sample platforms with in-situ nanocalorimeters

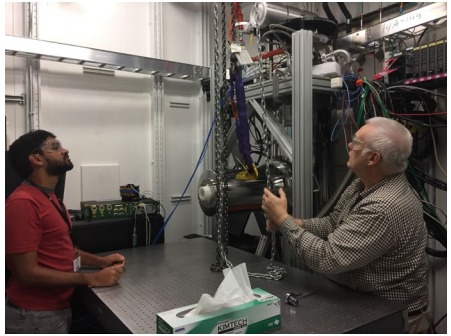




XSD-DET AND COLLABORATORS



Lisa, Nino, Orlando, Umesh, Sunil, Daikang (student)



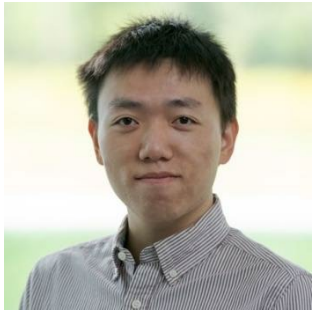
Tejas & Jon

Chris

Pietro King (SLAC), Kaz, Mike, Aseem Gupta (SLAC)

John

Henry



Tao Zhou

Sebastian

Senthil (student)