

XSD/Detectors Group Strategy and FY2023 Goals

Strategy

The mission of the XSD Detectors (DET) Group is to deliver cutting-edge detectors to APS beamlines. Our mission is accomplished in two ways. First, we introduce new, cutting-edge commercial detectors to the APS community via the Detector Pool. We accelerate and facilitate early access to new detectors that come on the market. We also provide technical detector advisory services in a variety of ways (e.g., market research, design reviews, etc.) to assist beamlines with detector purchases and best detector practices. XSD-DET includes staff who work as users in the CNM cleanroom and are available to consult on microfabrication projects for other groups in XSD. Ongoing microfabrication projects include X-ray lens arrays fabricated by deep silicon etching and nanocalorimeter sample platforms.

Second, we develop new, cutting-edge detectors which are unlikely to be commercially available. The group is engaged in a number of detector R&D projects to meet the future needs of the APS. These projects were chosen to align with the major scientific thrusts of the APS, take advantage of the source, leverage strategic partnerships with external detector groups and leverage unique Argonne facilities. We focus our detector R&D efforts in three areas: pixel array detectors, high-energy sensors, and high-resolution emission detection. For pixel array detectors, this includes the MM-PAD and Keck-PAD detectors with Cornell and a detector ASICs with on-chip edge capabilities (e.g., compression) in collaboration with MCS and SLAC. For high-energy sensors, we are collaborating on a project on high-Z sensors for pixel detectors with BNL, Cornell, SLAC and ANL/MSD; the ANL component consists with developing perovskite sensors. For emission detection, we are collaborating with NIST on transition edge sensors for high energy-resolution emission detection applications. Finally, we are exploring AI/ML methods to accelerate data processing at the detectors' edge.

Detector Pool Goals – FY2023

- Upgrade as many computers to RHEL 8 as possible and verify DPbin EPICS functionality
- Deploy software configuration management using Ansible for Detector Pool machines
- Support detector/equipment loans from outside vendors
- Support APS-U beamlines with detector advisory services

Detector R&D Goals – FY2023

- Superconducting Detectors (XSD + NIST)
 - Characterization of the NIST Swiss-X box at 1-BM-C in real experimental conditions
 - Deployment of multimodal Compton and X-ray diffraction system and application for battery research at 11-ID-D

- MM-PAD v2.1 & Keck-PAD v2.0 (XSD + Cornell)
 - Build the first complete (2x3) MM-PAD detector with Si and CdTe sensors
 - Support development of Keck-PAD ASIC with CdTe for 13 MHz operation
- Detector ASIC with on-chip compression (XSD + MCS + Bergamo/Pavia + SLAC)
 - Tapeout SparkPix-RT prototype
 - Evaluate FALCON analog prototype
- High-Z collaboration (XSD + MSD)
 - Support with X-ray beamline testing
 - Investigate metallization options for perovskites
- AI/ML (AISDC: Actionable Information from Sensor to Data Center) (XSD + DSL + SLAC)
 - Support the ANL/SLAC project to accelerate high-energy diffraction microscopy data processing using edge AI/ML
- Microfabrication support (XSD + CNM)
 - Continue to improve performance of silicon micromachined lenses for high-energy focusing and deliver lenses to CHEX
 - Deploy nanocalorimeter at 6-ID