# Facility update: CHESS

#### **Cornell High Energy Synchrotron Source**

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#### **CHESS: overview**

4 funding partners7 beamlines operational2 beamlines under construction









- Efficient detection of high-energy x-rays (especially >20 keV)
- Support for imaging, scattering, and spectroscopic techniques
- Large area detectors to support key scattering techniques (e.g. protein crystallography, high-energy diffraction microscopy)
- Wide dynamic range to make full use of available photons, and allow uninterrupted measurement of dynamic signals
- Fast frame rates to support time-resolved and high-throughput experiments
  - > MHz-capable burst-mode detectors to support single-bunch imaging and diffraction
- Movement towards on-the-fly, in-line data processing to help users wrangle large datasets
- Unique HMF beamline requirement: detectors must survive and perform reliably in high magnetic field (first round of testing summer 2023 @ National High Magnetic Field Laboratory w/ reps from Dectris)

This talk: quick summary of select detector upgrade, deployment, and characterization efforts around CHESS

## **Detector upgrade: energy dispersive diffraction**

**Motivation:** high-throughput residual strain mapping of engineering components



5-element EDD detector @ SMB beamline allowed us to probe a single component of elastic strain at a time.

> Leads to prioritizing a limited number of strain components in a measurement (hard to calculate STRESS)

The new 23-element detector enables us to probe 23 components of strain simultaneously

Delivered Summer 2023, First Commissioning Fall 2023



## **Detector upgrade: energy dispersive diffraction**

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SMB beamline EDD detector upgrade: From 5 to 23 elements

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Result: typical scan times reduced from days to hours

**Impact:** enormous boost in throughput *requires* advances in analysis workflow automation – ongoing work facilitated by CHESS software engineers and National Science Data Fabric visualization dashboard (K. Nygren, A. Woll, J. Dobbins, K. Soloway, R. Verberg)

## **Detectors for single-bunch imaging + diffraction**

**Shimadzu HPV-X2** for single-bunch imaging procured and under commissioning – feasibility demonstrated @ FAST w/ loaner unit from Johns Hopkins (K. Shanks, A. Das, T. Hufnagel @ JHU)



Single-bunch x-ray (side view) FOV: 2.6 x 1.6 mm 1.42 us frame-to-frame



Optical (top view) FOV: 4.0 x 6.4 mm 1.42 us frame-to-frame





**CdTe-sensor Keck-PAD** (photon-integrating PAD designed @ Cornell) for singlebunch diffraction being integrated into CHESS detector pool (K. Shanks, M. Tate) – previous builds thoroughly vetted via beamline characterization and user exp'ts



- Dedicated CdTe Eiger 16M for structural materials research rec'd December 2023; beamline commissioning begins this week @ SMB beamline
- Active detector R&D effort in physics department (S. Gruner, J. Thom-Levy):
  - Multi-lab "high-Z collaboration" (ANL, BNL, SLAC, Northwestern, Cornell) for evaluation of high-Z sensors beyond CdTe
  - ASIC design and system development for next-generation Keck-PAD compatible w/single-bunch studies at APS-U (77 ns bunch separation)
- ONR-funded project to incorporate *detector-firmware-based data compression and monitoring* for dataintensive *in-situ* diffraction experiments (K. Shanks, K. Nygren, M. Hromalik @ SUNY Oswego)

#### Thank you!