

Dark Matter

Sho Uemura

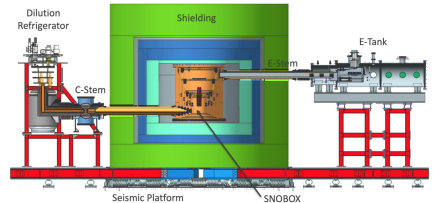
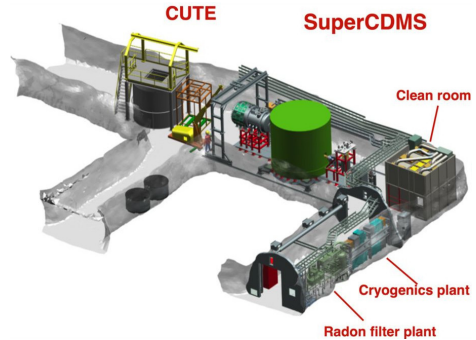
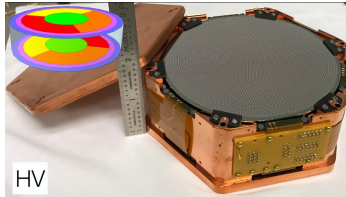
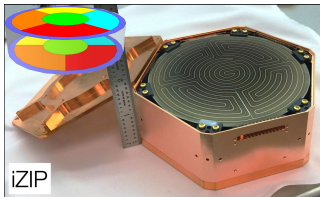
Fermilab

MINOS cavern



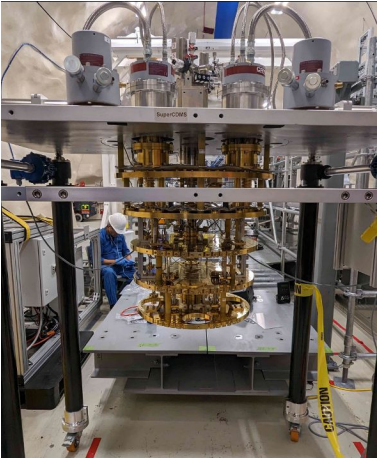
SuperCDMS at SNOLAB

- Large-scale cryogenic detector with Si and Ge targets and two detector types
 - ▶ iZIP: charge+phonon readout, for ER/NR discrimination
 - ▶ HV: NTL amplification, for low thresholds
- Fermilab plays a leading role and delivers major subsystems
- Under construction, commissioning next year



SuperCDMS: cryostat and shield

- Cryostat and shield assembly well underway

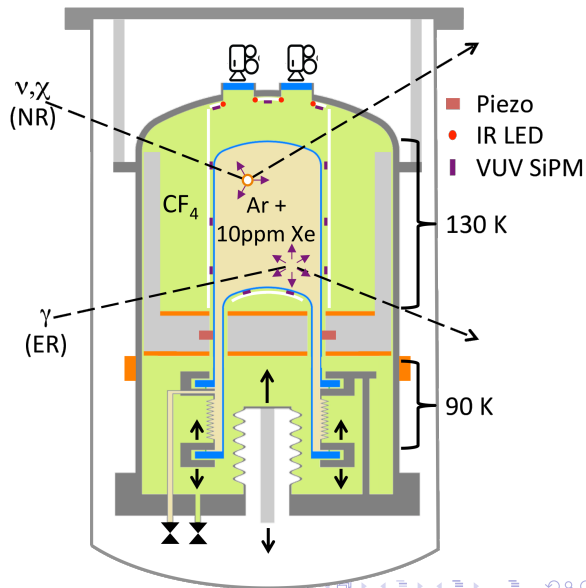


NEXUS/QUIET at MINOS

- Low-background R&D facilities for cryogenic detectors
- NEXUS: SuperCDMS, MKIDs, qubits, and more
 - ▶ Identifying and reducing backgrounds for SuperCDMS HVeV detectors with single-electron charge resolution
 - ▶ Measuring impact of ionizing radiation on superconducting qubits and investigating possibilities for qubit-based DM detection
 - ▶ Now transitioning to a dedicated facility for NR calibration
- QUIET: new dedicated facility for quantum detectors, with a companion surface facility (LOUD)



- First physics-scale deployment of a new technique for low-threshold ($O(100\text{eV})$) NR detection
- Inherently blind to electron recoils; further background discrimination with scintillation signal

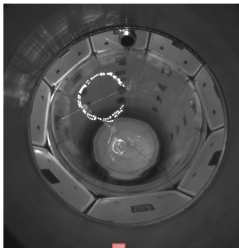




SBC-LAr10



SBC: Eric Dahl



Dark Matter



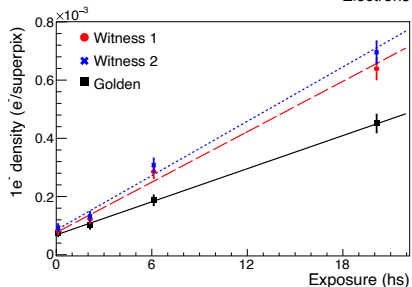
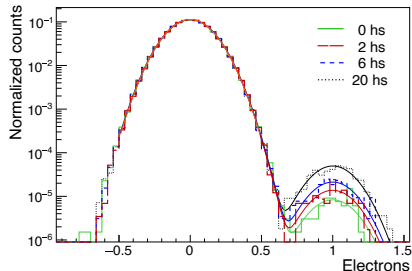
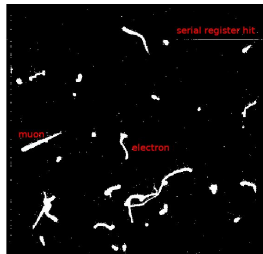
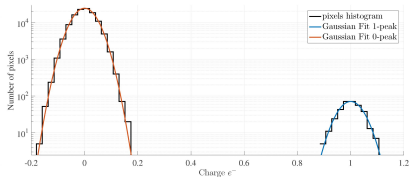
SBC in MINOS

- Demonstrate operation of the physics-scale detector
- Determine maximum superheat for ER-blind operation
- Calibrate NR threshold



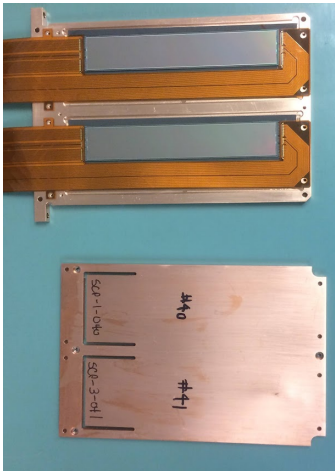
Skipper CCDs

- “Skipper” readout enables repeated measurement of charge packets for sub-electron charge resolution
- SENSEI: first application, for electron-recoil searches
 - ▶ World-leading sensitivity for sub-GeV DM
 - ▶ Record-low dark currents for a semiconductor detector, $1.39(11) \times 10^{-5}$ e/pix/day (preliminary)



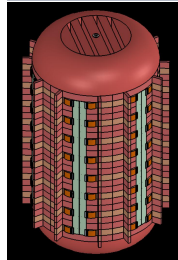
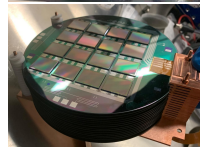
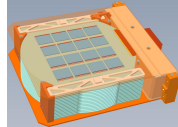
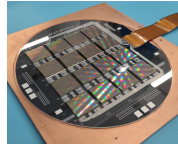
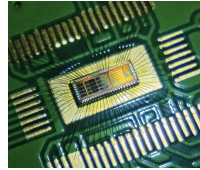
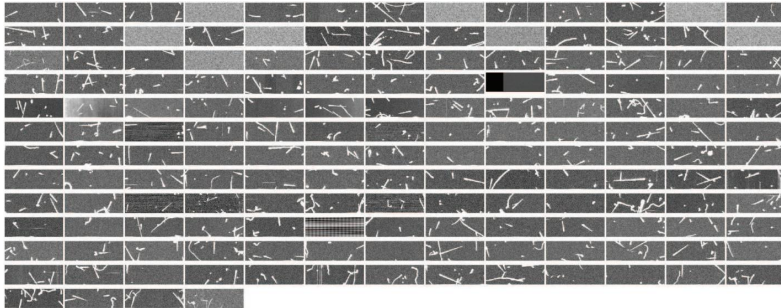
Skipper CCDs: SENSEI

- First Skipper-CCD experiment, with DM results from SiDet, MINOS, now SNOLAB



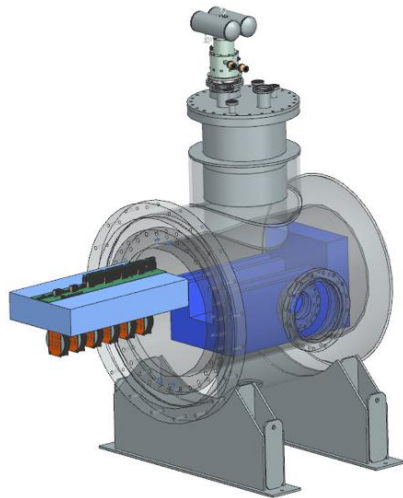
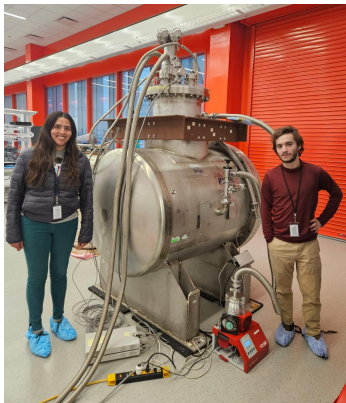
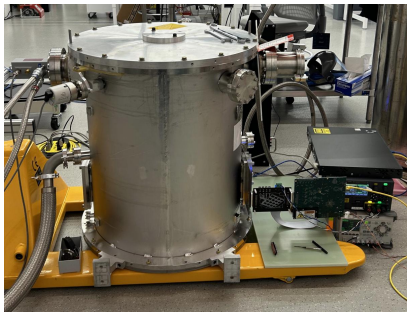
Skipper CCDs: Oscura

- Large-scale Skipper-CCD experiment: 24576 CCDs, 10 kg active mass
- R&D and design under DMNI program, on track for construction FY26
 - ▶ Highly multiplexed analog readout
 - ▶ Radiopure cabling and assembly
 - ▶ Convective nitrogen cooling



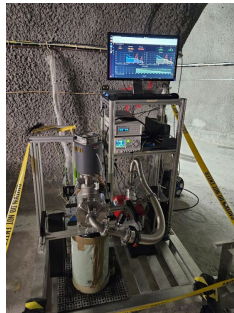
Skipper CCDs: Oscura

- Scaling up to a 1/16-scale integration test

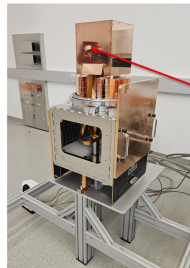


Skipper CCDs: millicharge

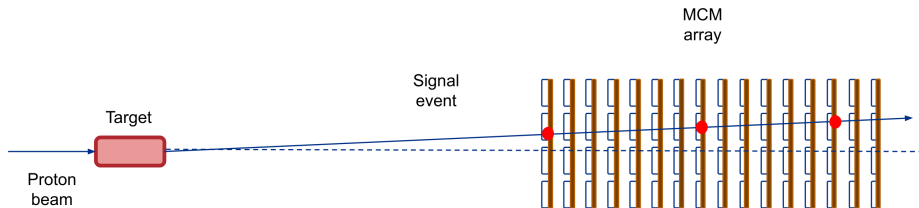
- Low-threshold, pixelized detectors ideal for millicharged-particle searches
 - ▶ Competitive limits from 2-gram SENSEI run at MINOS; what if we leverage Oscura technology?
- MOSKITA now running at CERN; DarkBeaTS soon in MINOS



Dark BeaTS
(Dark Beam Tracker with Skipper-CCDs)



50 g (120 g) skipper-CCD array with 7 (16) layers (21.6 MPix each)



Skipper CCDs: DarkNESS

- 6U CubeSat with four Oscura CCDs
- Search for strongly-interacting DM and peaks in the diffuse X-ray sky
- Preparing for launch slot in late 2025-early 2026

