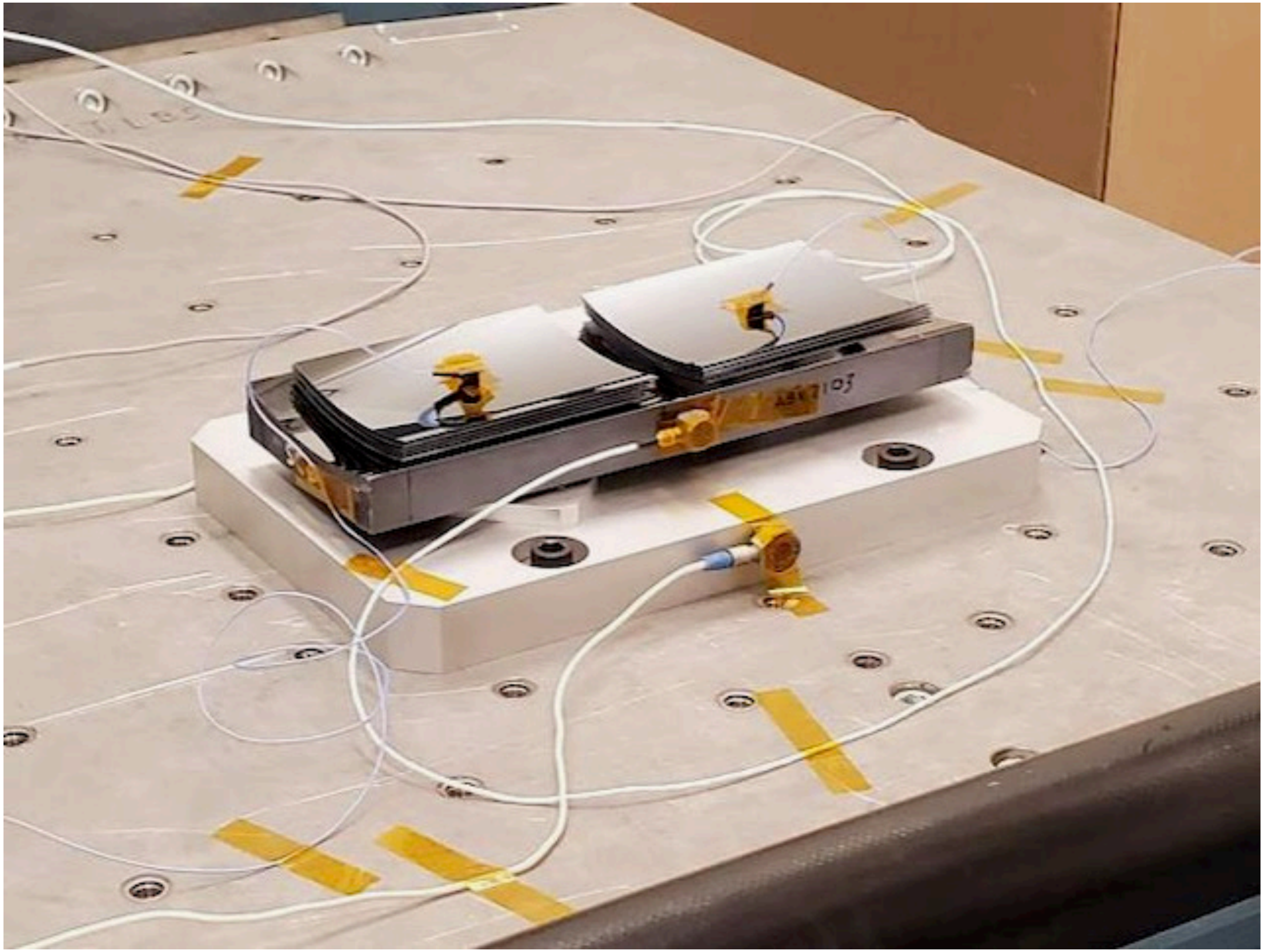
2023 Hardware Images

PhysCOS and COR Strategic Technology Portfolio

For more information about these technologies visit our Technology Database (http://www.astrostrategictech.us)



An X-ray mirror module on a vibration table

Significance: World-class thin grazing-angle X-ray mirror technology that would enable the next X-ray Great Observatory

Project Title: Next Generation X-ray Optics: High Resolution, Light Weight, and Low Cost

PI: Zhang, William (GSFC)

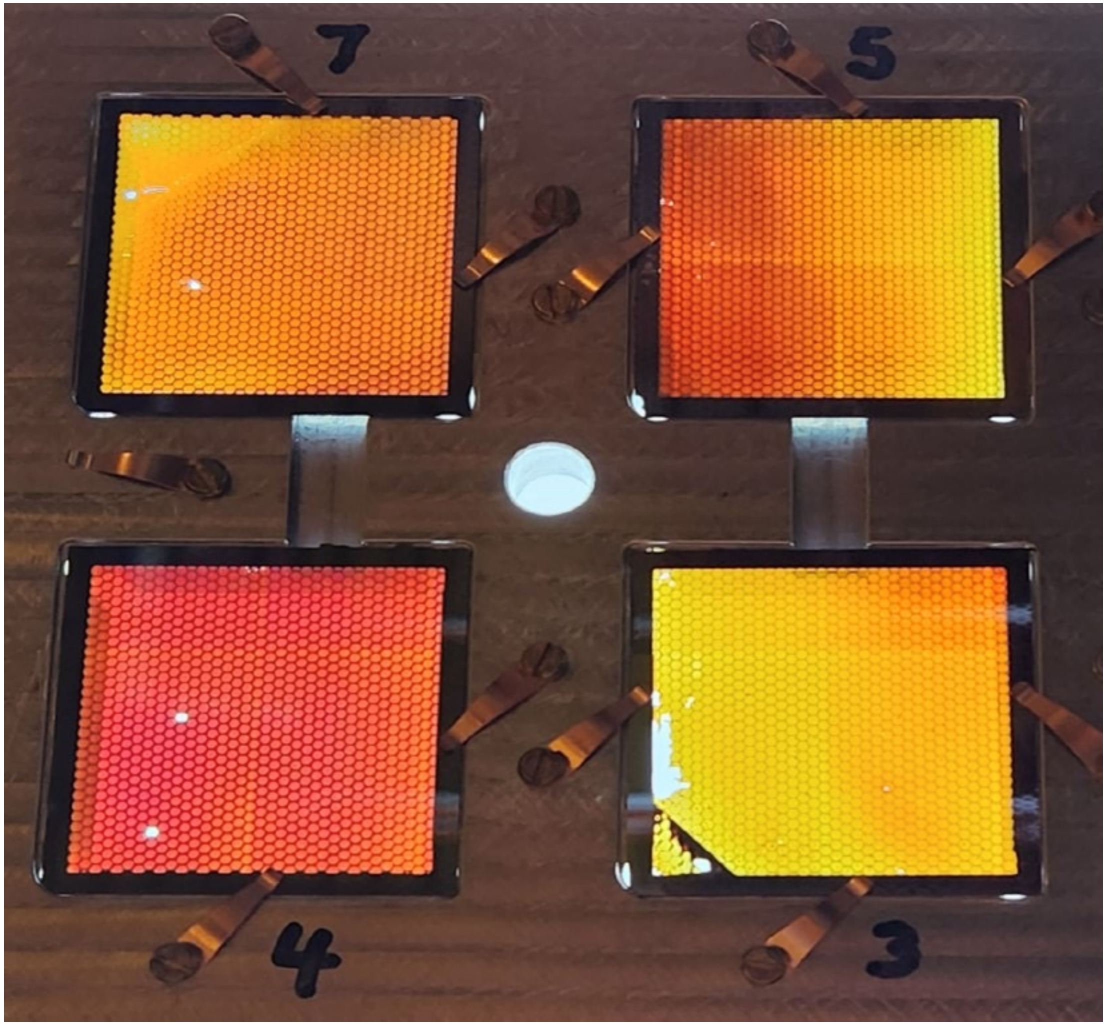
Critical-Angle Transmission (CAT) gratings being tested at the PANTER X-ray facility

Significance: Highest-resolution X-ray transmission grating technology that could fly on the next X-ray Great Observatory

Project Title: Technology Maturation for a High-Sensitivity and High-Resolving-Power X-ray Spectrometer

PI: Mark Schattenburg (MIT Kavli Institute for Astrophysics and Space Research)

Co-I: Ralf Heilmann

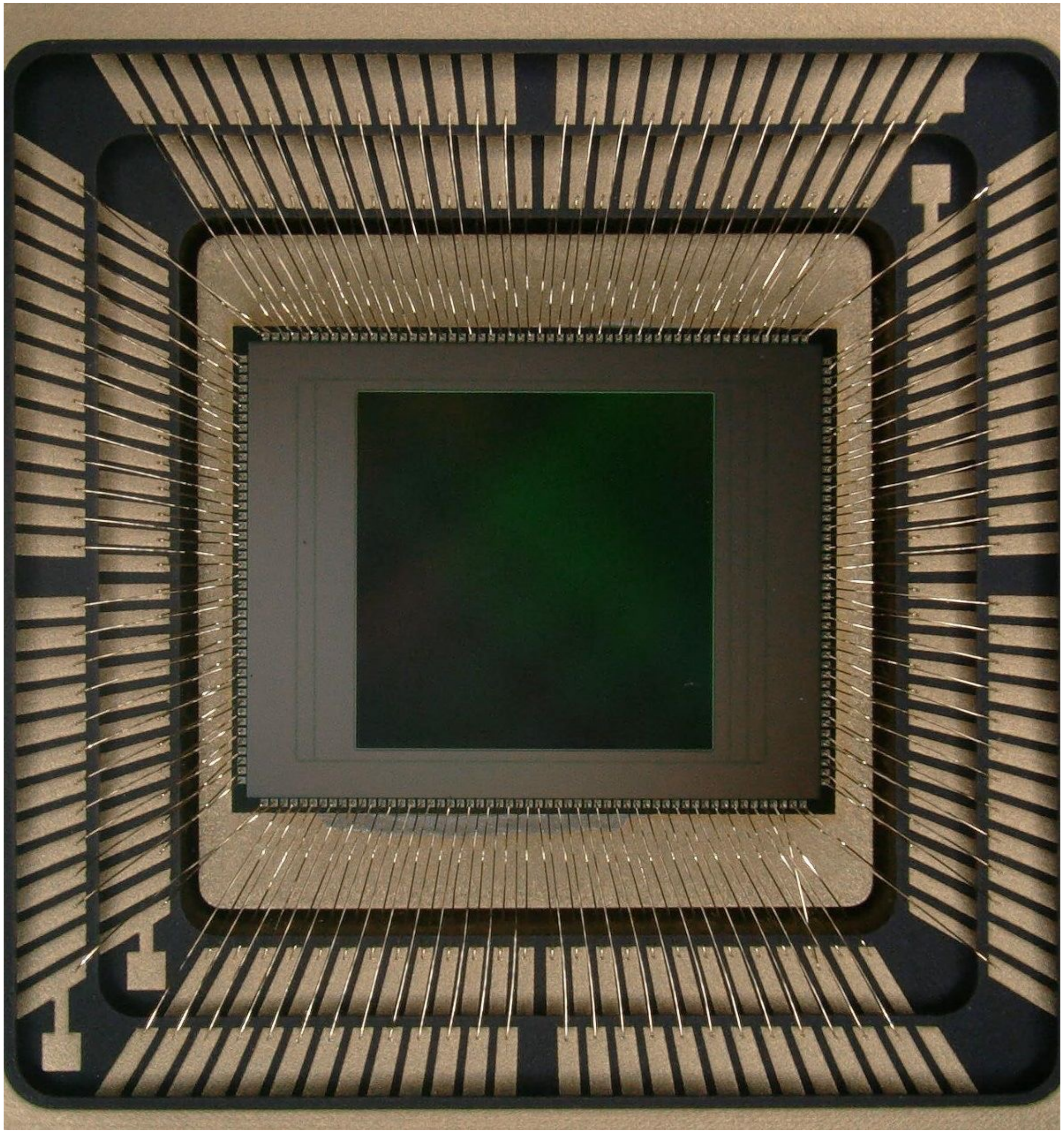


Four Critical-Angle Transmission (CAT) grating facets aligned and mounted for testing

Significance: Demonstrates manufacturability of highest-resolution X-ray transmission grating technology that could fly on the next X-ray Great Observatory

Project Title: Readying X-ray Gratings and Optics for Space Applications: Manufacturability and Alignment

PI: Randall Smith (SAO)

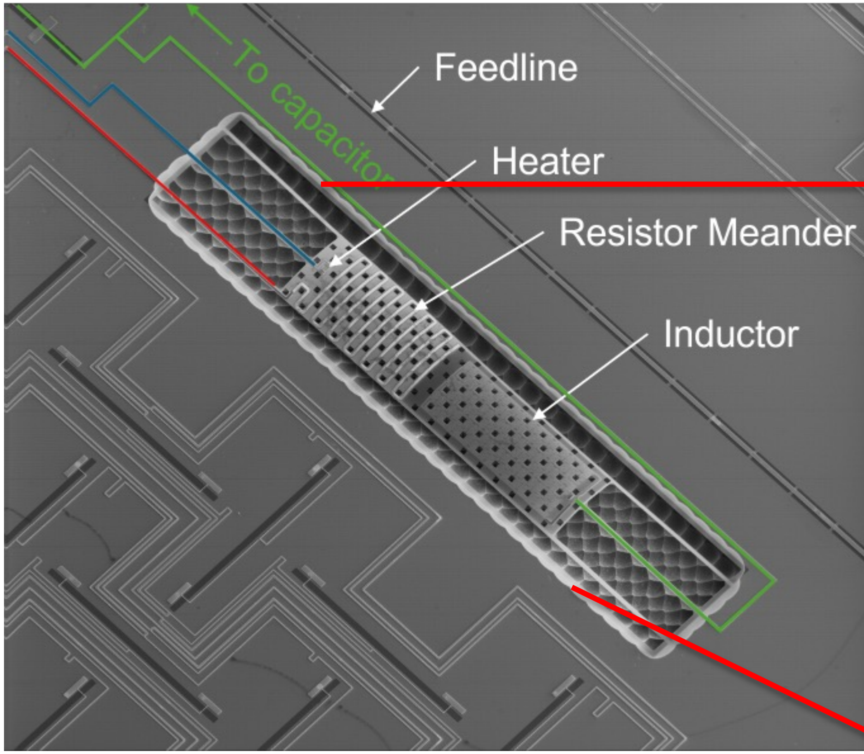


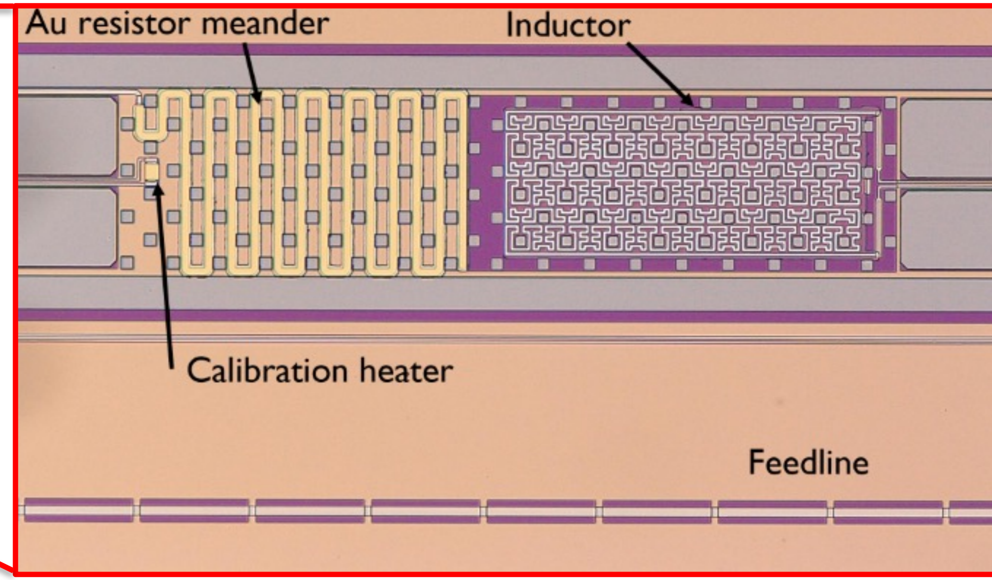
16.7-MPixel CMOS image sensor

Significance: Low-noise detectors are crucial for future missions

Project Title: A Single-Photon-Sensing and Photon-Number-Resolving Detector for NASA Missions

PI: Don Figer (RIT)



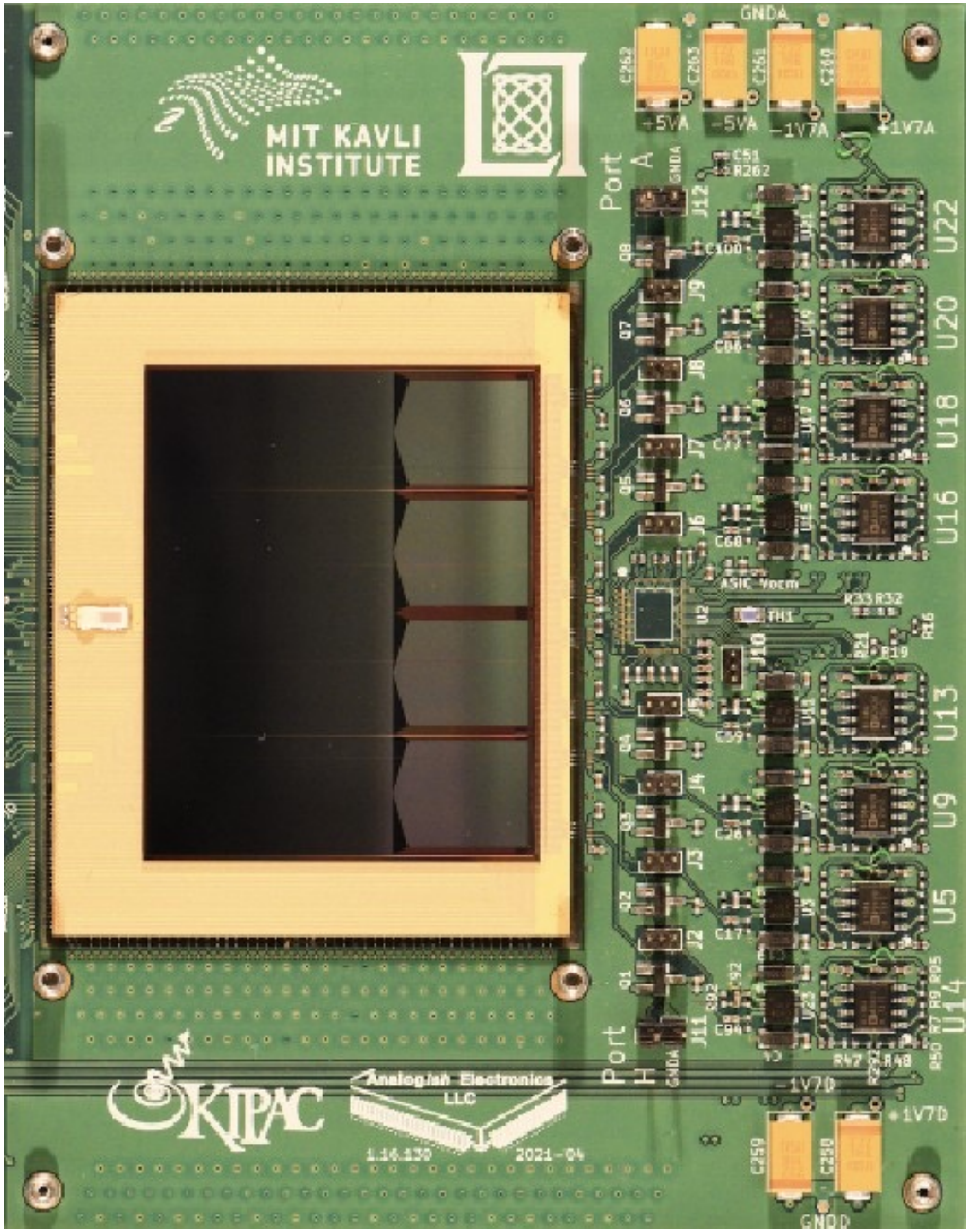


Detailed images of a Thermal Kinetic Inductance Detector (TKID)

Significance: Cosmic Microwave Background (CMB) polarimetry is crucial for understanding early universe physics. This project aims to ready NASA for the Inflation Probe identified by the 2020 Decadal Survey.

Project Title: Superconducting Detectors for CMB Polarimetry in PICO

PI: Roger O'Brient (JPL/Caltech)

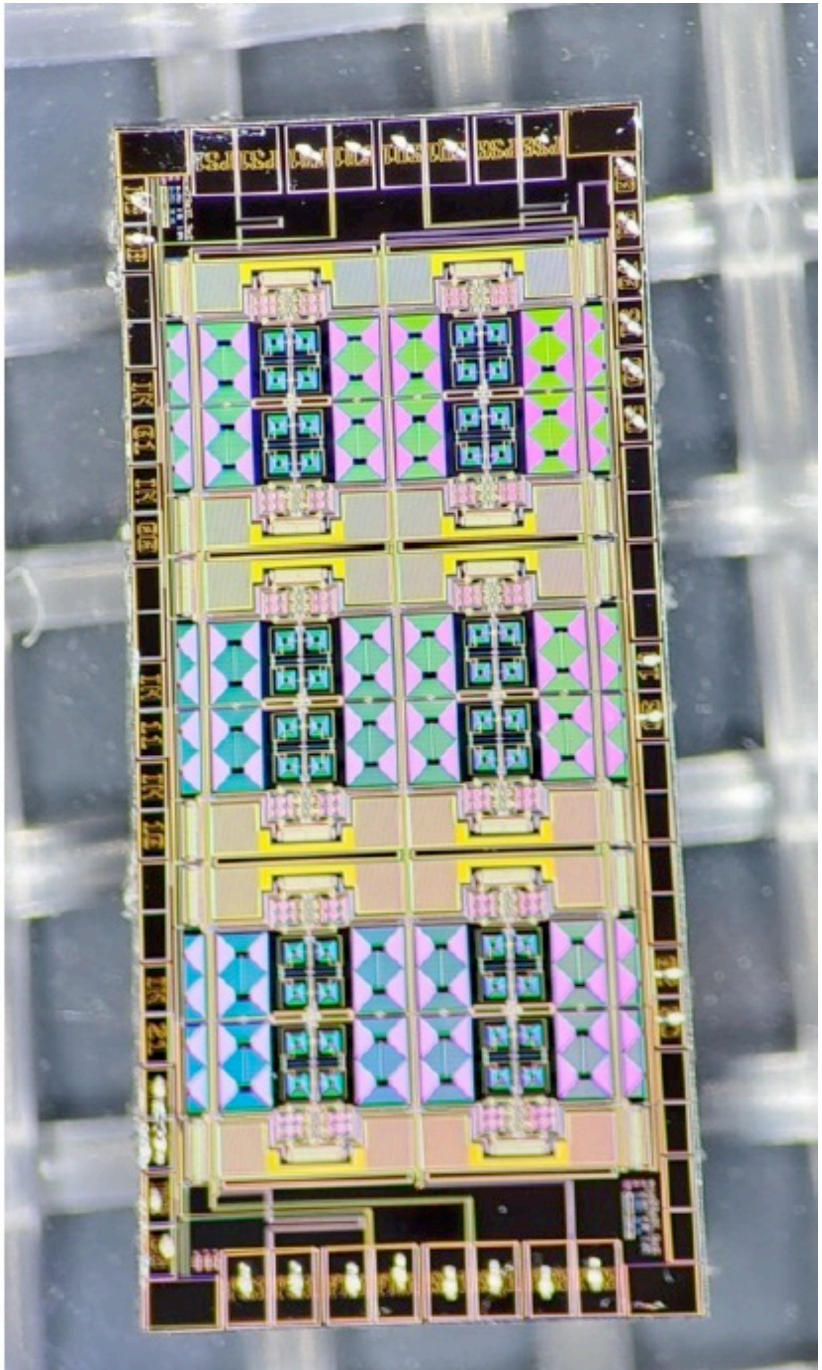


X-ray CCD with Multi-Channel Readout Chip (MCRC) ready for testing

Significance: Advanced X-ray detectors may enable the next X-ray Probe or Great Observatory

Project Title: Extremely Low-noise, High Frame-rate X-ray Image Sensors for Strategic Astrophysics Missions

PI: Mark Bautz (MIT Kavli Institute for Astrophysics and Space Research)

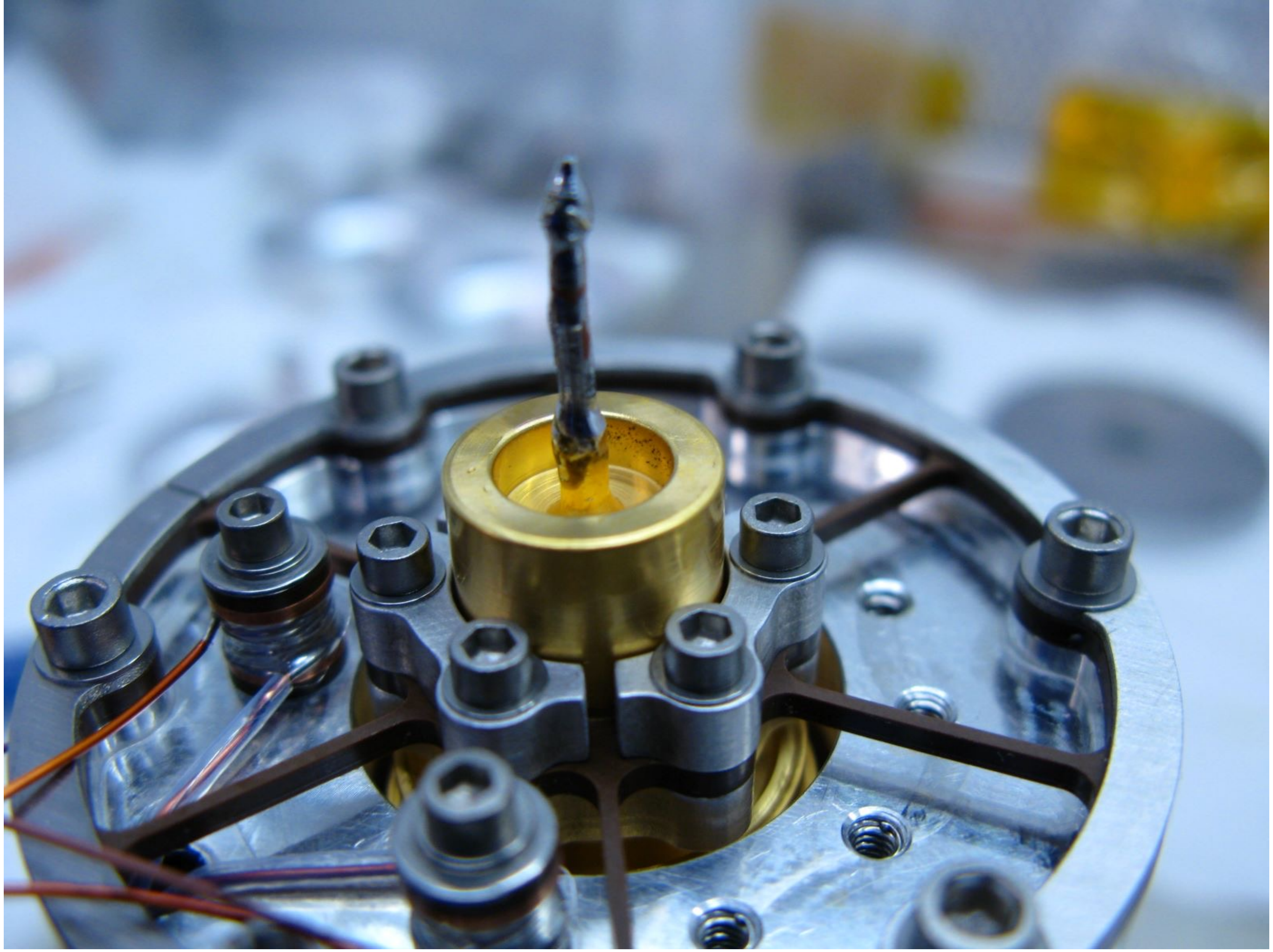


LEM 6-channel prototype readout for Transition-Edge-Sensor (TES) arrays

Significance: High-multiplexing-factor readouts may enable missions such as the next X-ray Great Observatory

Project Title: Microwave Superconducting QUantum Interference Device (SQUID) Multiplexing for Future X-ray Astrophysics Missions

PI: Douglas Bennett (NIST)

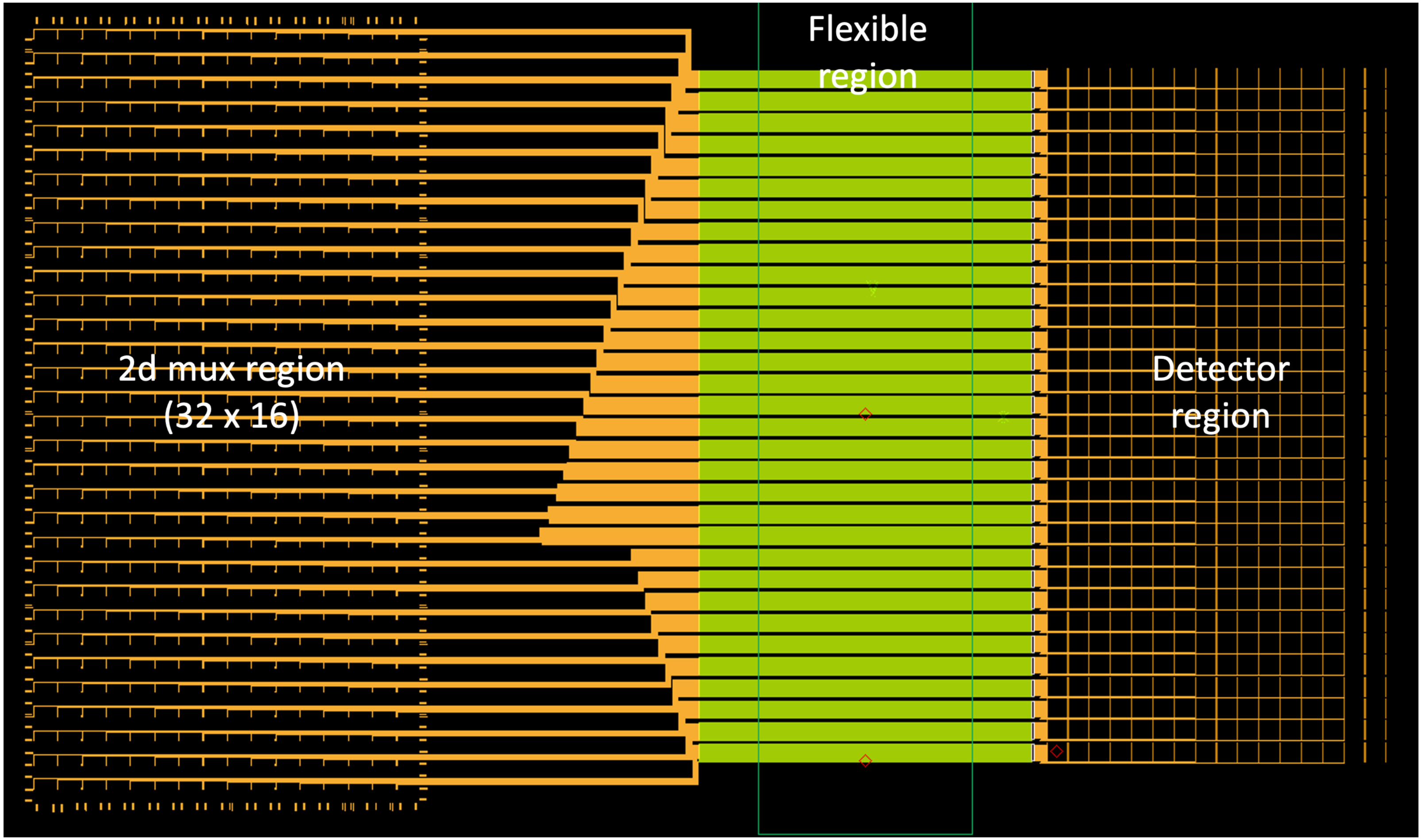


An ADR salt pill suspended in the bore of a 3-Tesla superconducting magnet via a low-thermal-conductivity suspension

Significance: This advanced sub-Kelvin cooling technology may enable multiple future strategic missions

Project Title: Development of ultra-low-temperature Continuous Adiabatic Demagnetization Refrigerator (CADR) with a Continuous Intermediate Stage for Heat Intercept

PI: Mark Kimball (GSFC)

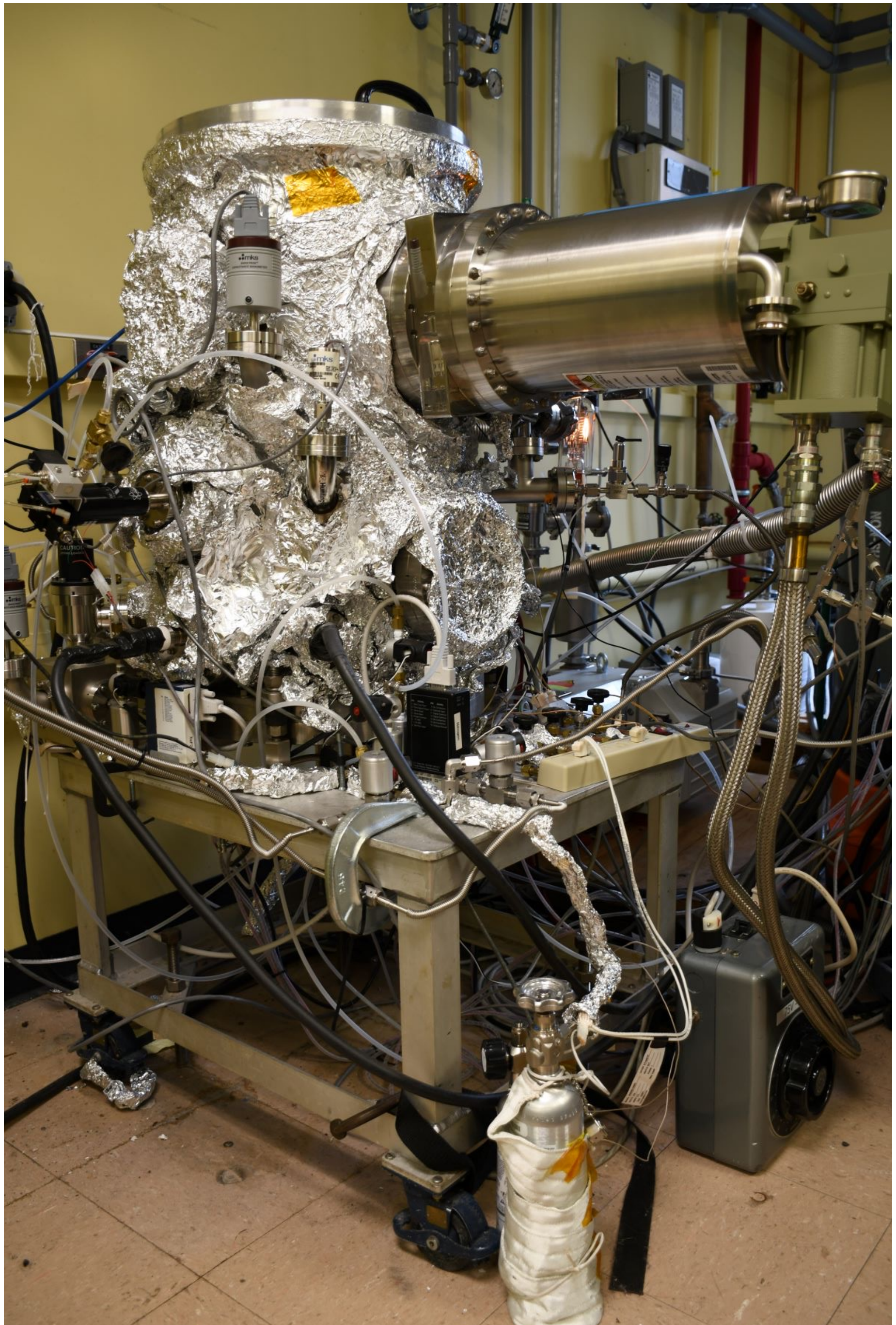


Fanout board with superconducting flex lines, accommodating a 32 x 16 detector array and SQUID multiplexer for array readout. The board has a flexible region between two rigid ones. The rigid regions have indium bumps, to which a 2d-SQUID mux chip and a detector chip will be flip chip bonded. Having no vias simplifies board fabrication and ensures good reliability.

Significance: Advanced far-IR detectors may enable the next Far-IR Great Observatory

Project Title: Demonstrating Large, Low-Noise, Transition-Edge-Sensor Arrays for Future Far-IR Space Missions

PI: Johannes Staguhn (JHU & GSFC)

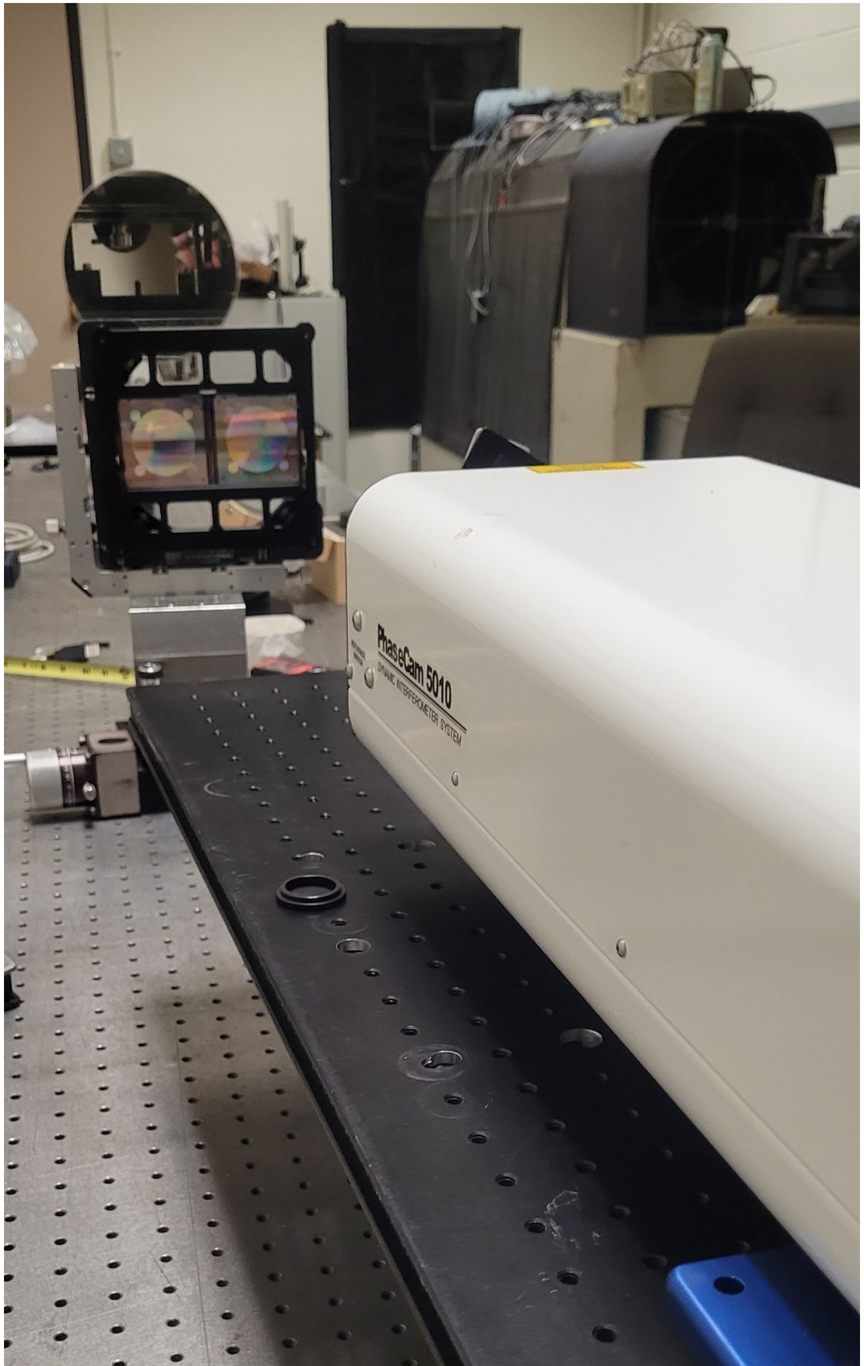


Ultra-High-Vacuum research chamber capable of reactive thin-film physical vapor deposition (rPVD) and passivation process

Significance: High far-UV reflectance is hindered by oxidation of aluminum mirrors; preventing it may enable future far-UV missions

Project Title: Advanced Aluminum Mirrors with Passivated LiF for Environmentally Stable 1-m-Class UV Space Telescopes

PI: Manuel Quijada (GSFC)

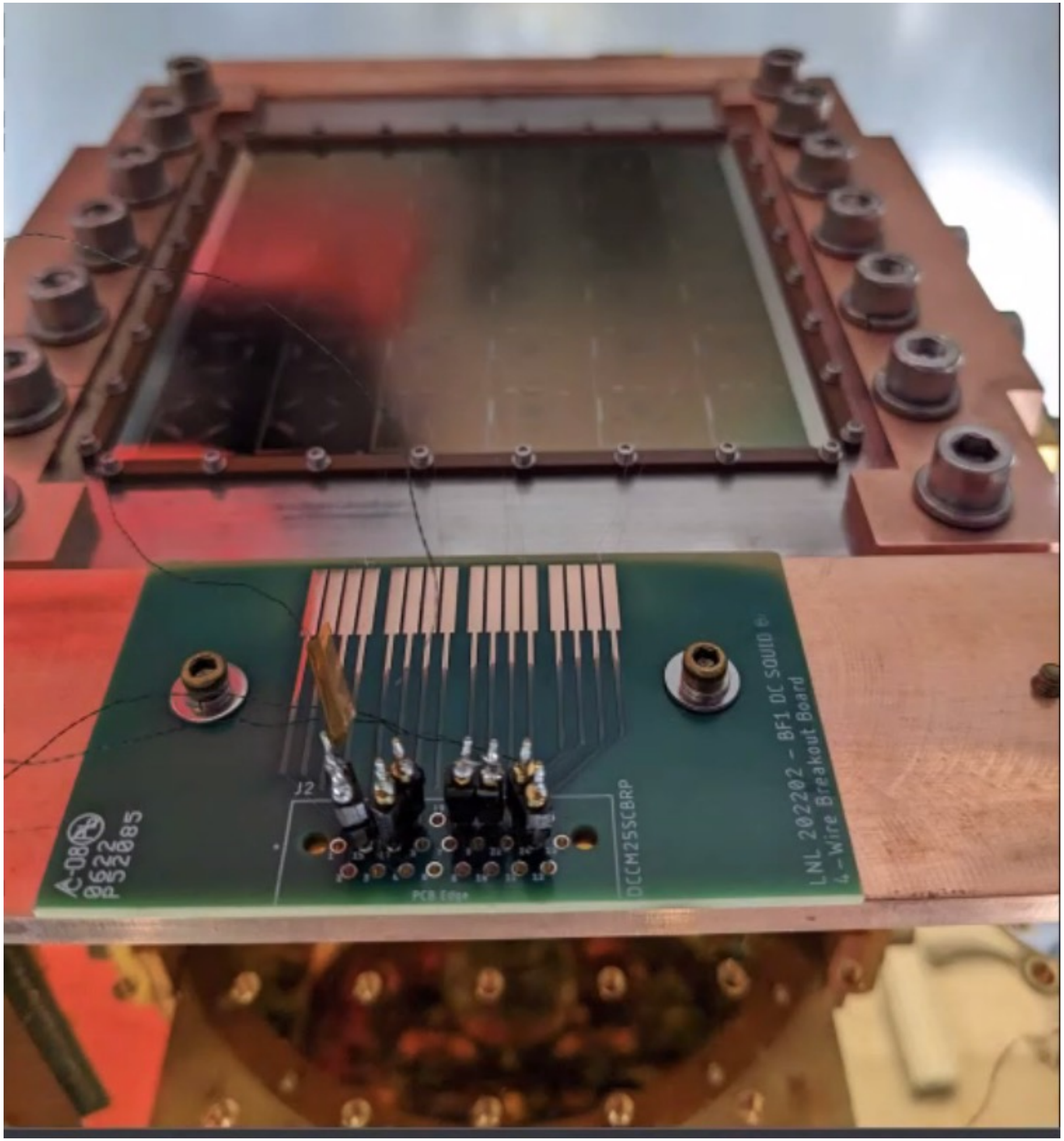


Using Computer-Generated Hologram (CGH) to absolutely characterize gravity-sag of mirrors

Significance: Ultra-high resolution general astrophysics observations require that the next IR/Optical/UV Great Observatory be diffraction- limited at 500 nm or better, this requires a primary mirror whose gravity-sag is known absolutely to a few nanometers rms.

Project Title: UV/Optical to Far-IR Mirror and Telescope Technology

PI: H. Philip Stahl (MSFC)

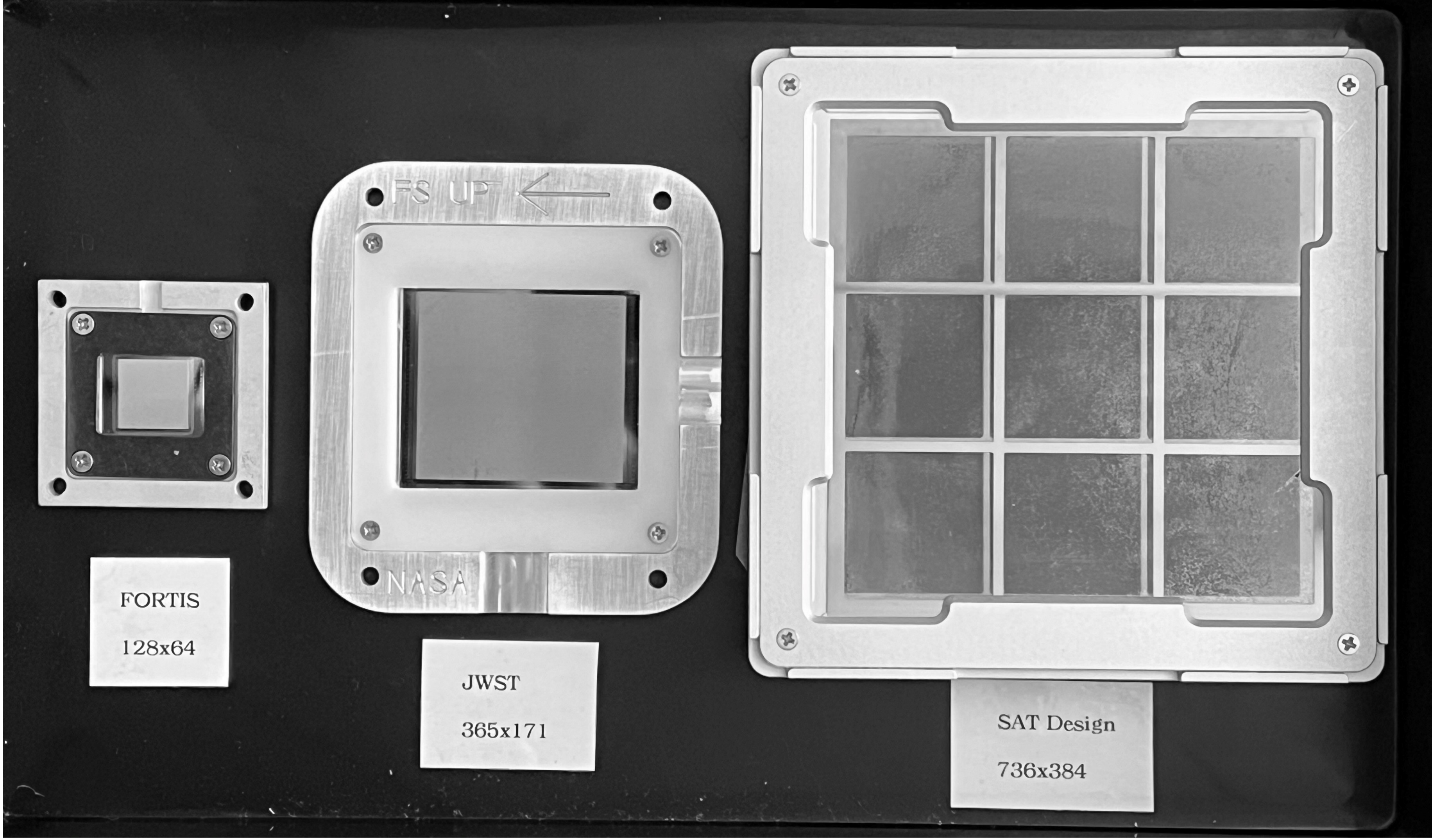


LiteBIRD-specification low-frequency detector array mounted in a dilution refrigerator for test

Significance: May enable future Cosmic Microwave Background (CMB) missions, e.g. LiteBIRD

Project Title: Technology Development for LiteBIRD and other CMB Missions

PI: Adrian T. Lee (UC Berkeley)

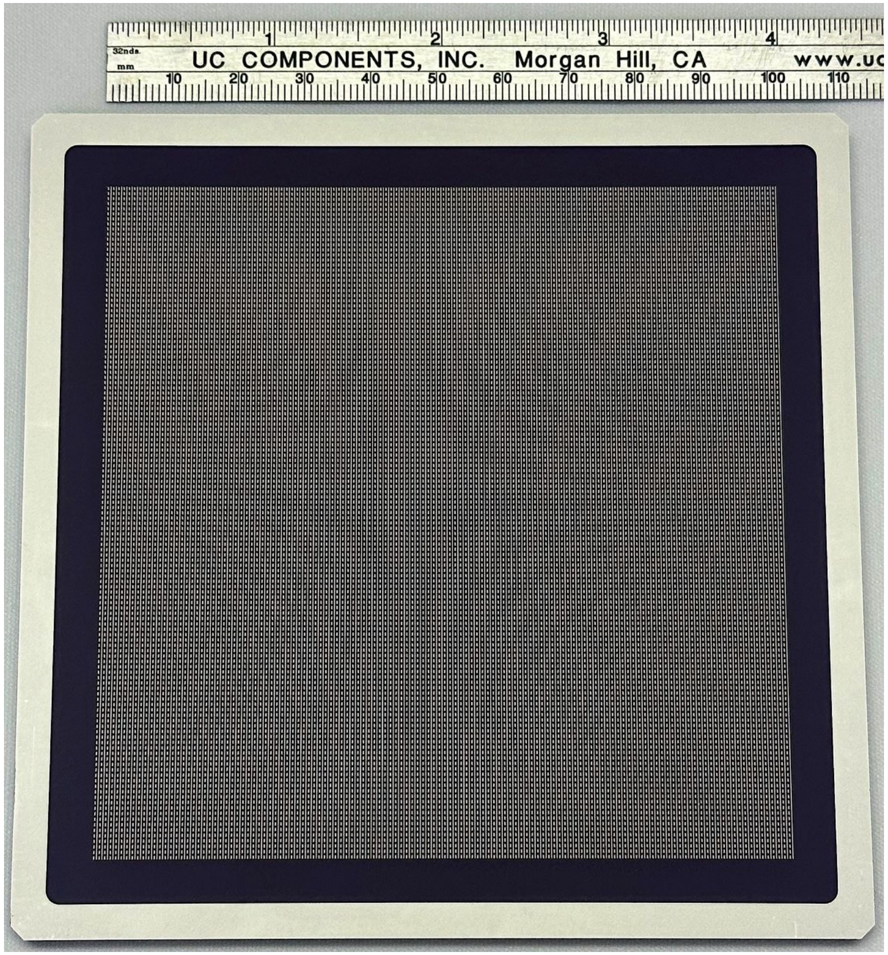


Evolution of microshutter arrays: A 128×64 FORTIS pilot on the left, a 365×171 JWST array in the center, and a space-qualified 736×384 next-gen array on the right

Significance: May enable sparse-field multi-object spectroscopy for future strategic and other missions

Project Title: Scalable Microshutter Systems for UV, Visible, and IR Spectroscopy

PI: Paul Scowen (GSFC)

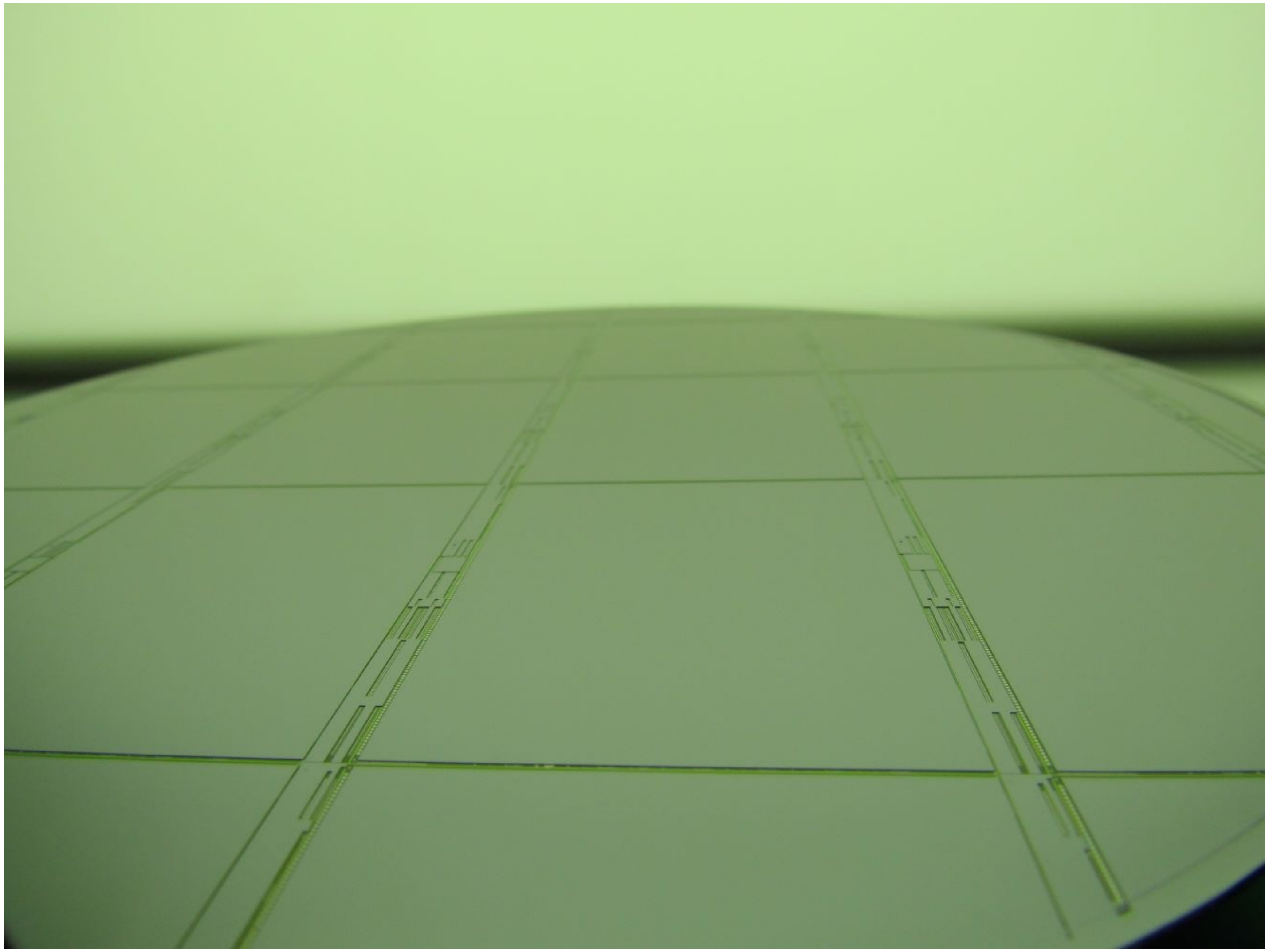


100-mm cross-strip anode fabricated with high-temperature co-fired ceramic (HTCC, 800°C) for applications in open-face and sealed-tube Micro-Channel-Plate MCP) detectors with high spatial resolution (20 µm) and high event rates (> 5MHz) to address some HWO technology gaps.

Significance: May enable UV/Visible light detection for future strategic missions such as an IR/O/UV Great Observatory

Project Title: High-Performance Sealed-Tube Cross-Strip (XS) Photon-Counting Sensors for UV-Vis Astrophysics Instruments

PI: Oswald Siegmund (UC Berkeley)

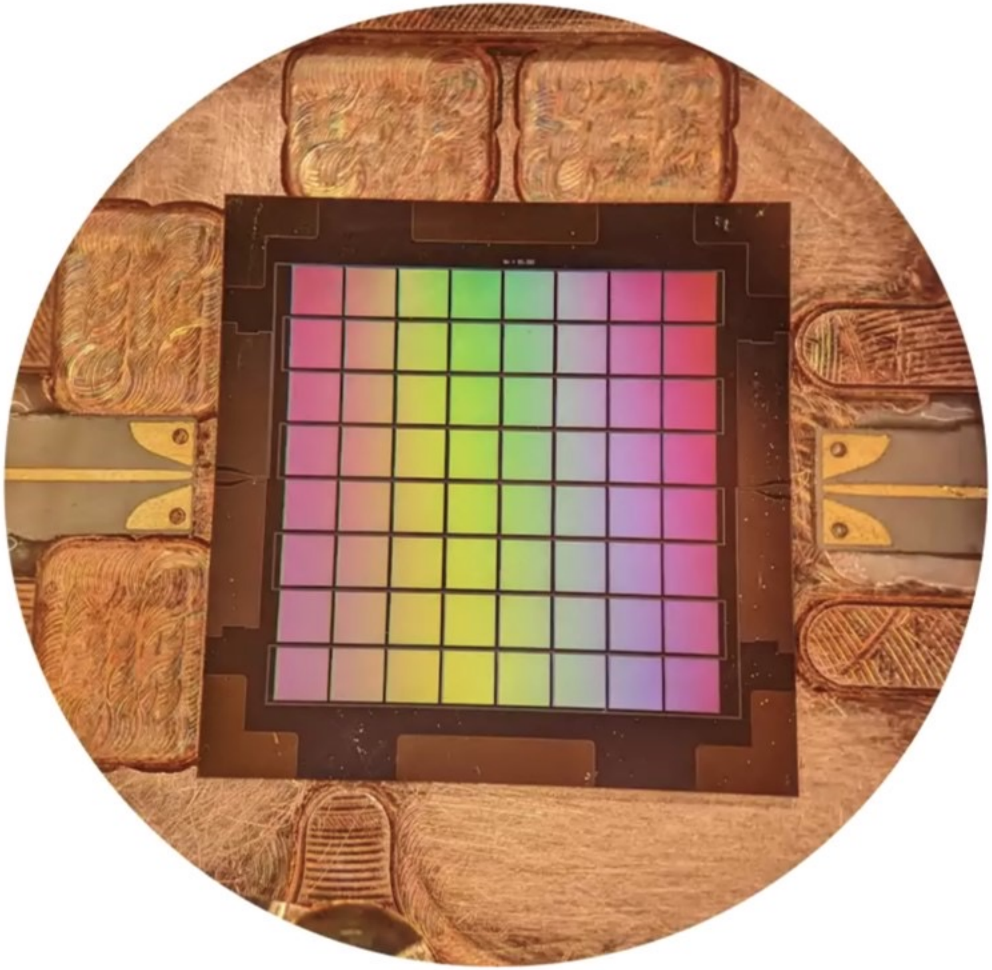


Completed 200-mm diameter, back-illuminated CCD wafer

Significance: Future strategic X-ray observatories require soft X-ray (sub-keV) spectral response close to the Fano limit over large detector areas and for multiple detectors

Project Title: Optimized Soft X-ray Sensors for Strategic X-ray Astrophysics Missions: Achieving TRL 5

PI: Christopher Leitz (MIT/LL)

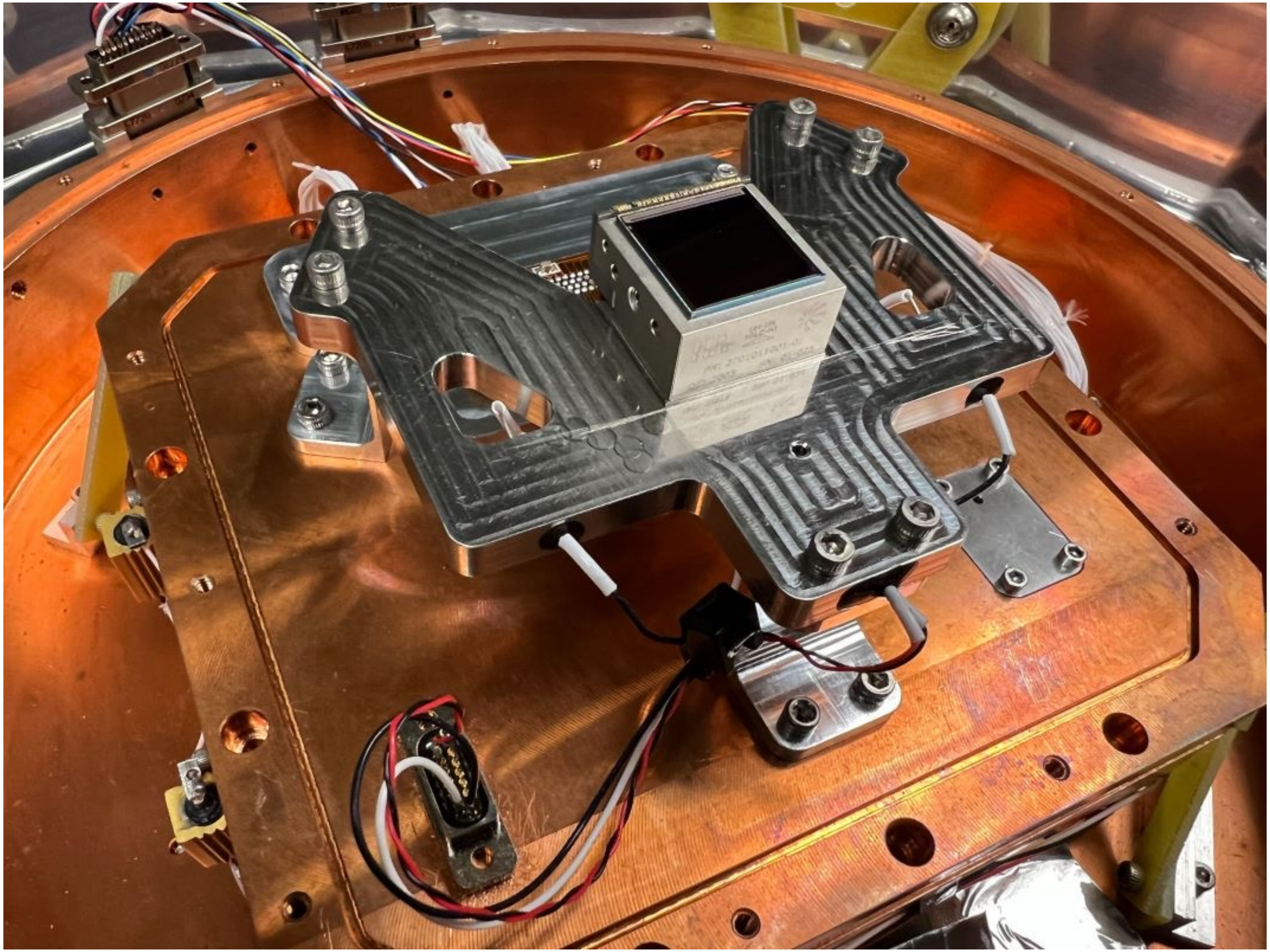


64-pixel prototype broadband far-IR Microwave Kinetic Inductance Detector (MKID) with multiplexed readout electronics

Significance: New broadband, scalable, and generalizable far-IR detector technology with compact and efficient data acquisition applicable to future NASA missions

Project Title: Far-IR Detector Solutions for Low Noise, Large Format, Direct Absorption Kinetic Inductance Detector Array

PI: Jason Austermann (NIST)

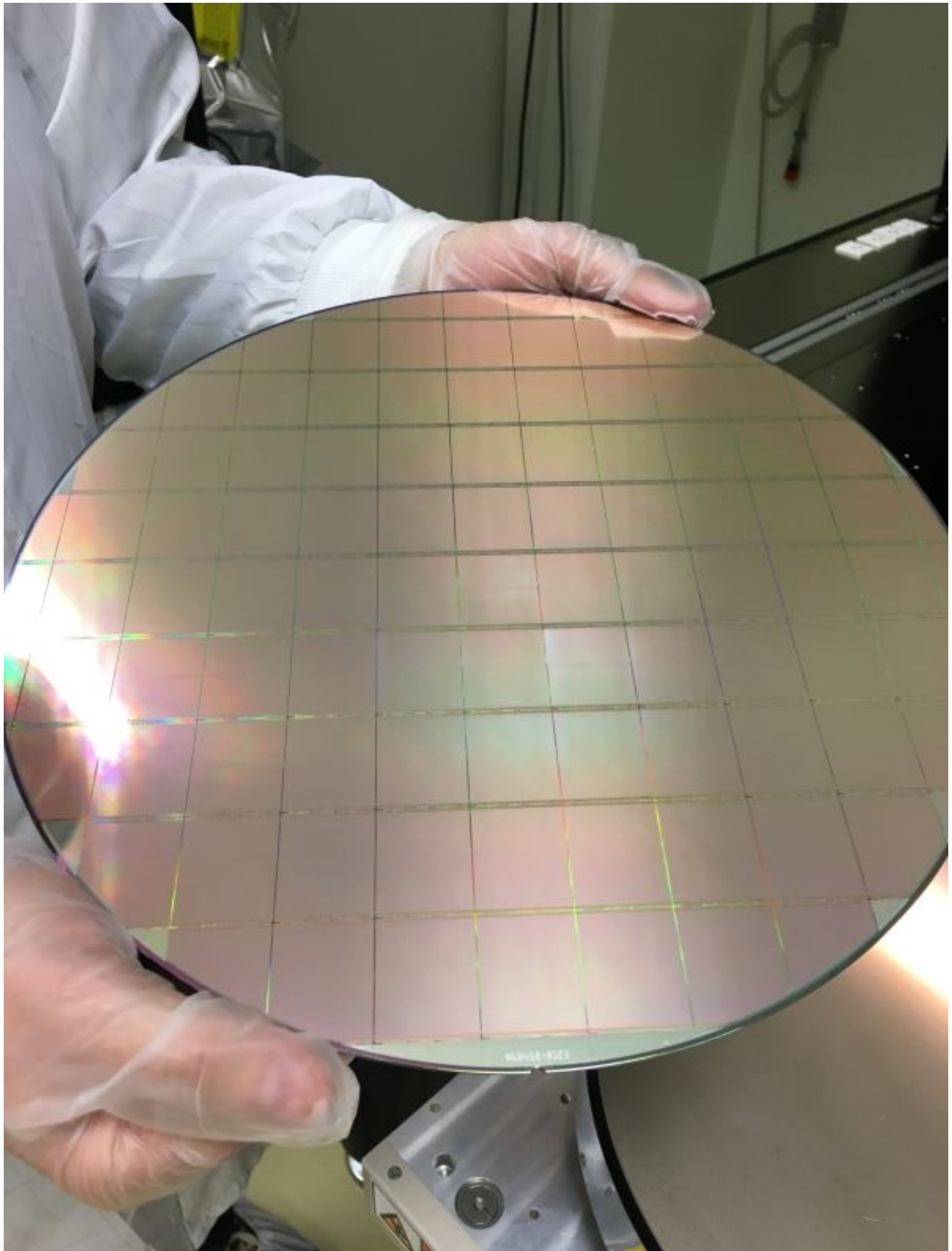


Test setup for LmAPD detectors

Significance: Ultra-low-noise detectors may enable spectroscopy of extrasolar planets

Project Title: Photon-Counting Near-IR Linear-mode Avalanche-Photo-Diode (LmAPD) Arrays for Ultra-low Background Space Observations

PI: Michael Bottom (U. of Hawaii)

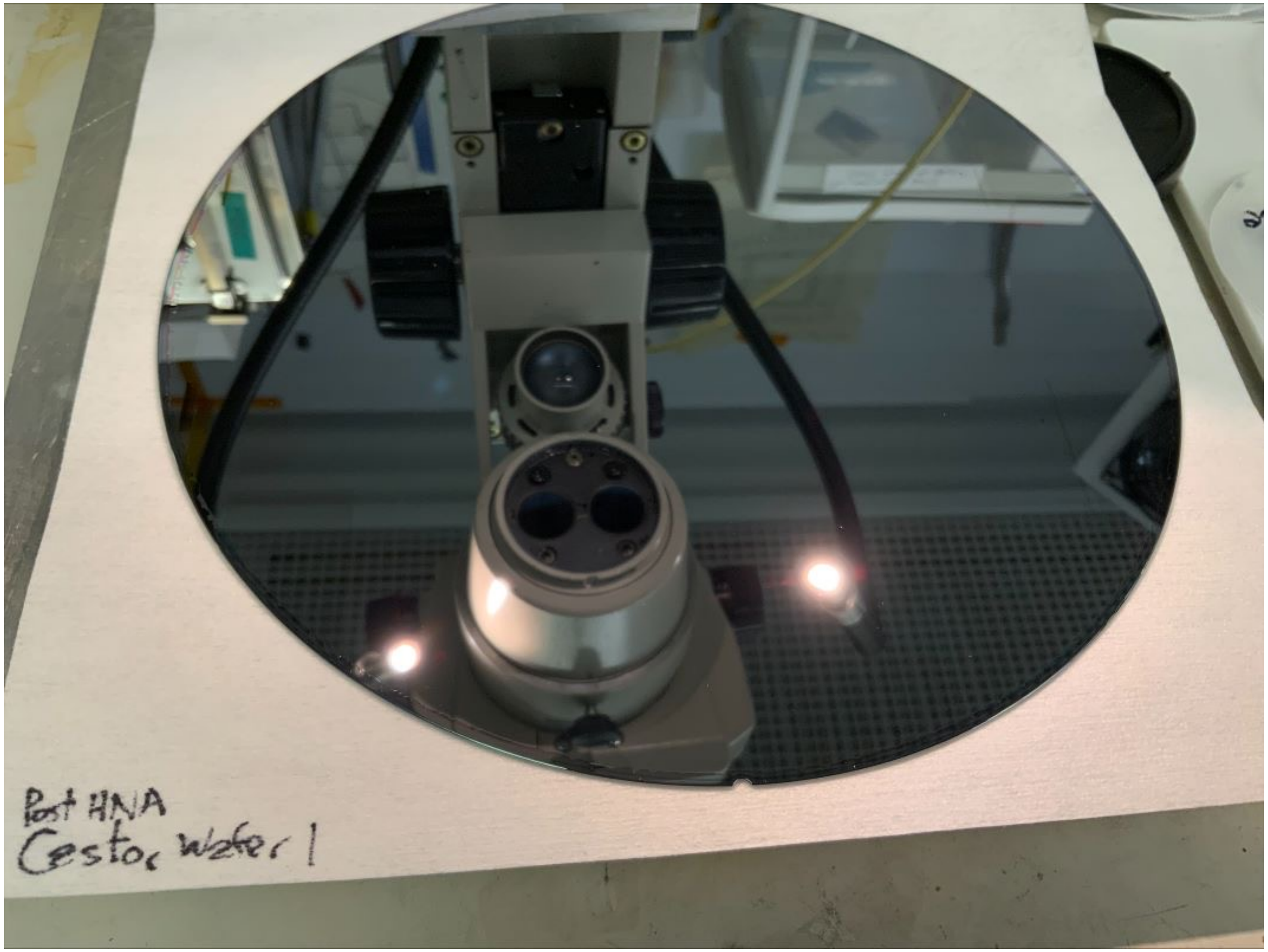


Timepix4 512 x 448 pixelated readout ASIC on a 300-mm wafer

Significance: Four-side-buttable low-power readout chips may enable future far-UV missions with large focal planes

Project Title: Large-Format, High-Dynamic-Range UV detector using MCPs and Timepix4 readouts

PI: John Vallerga (UC Berkeley)

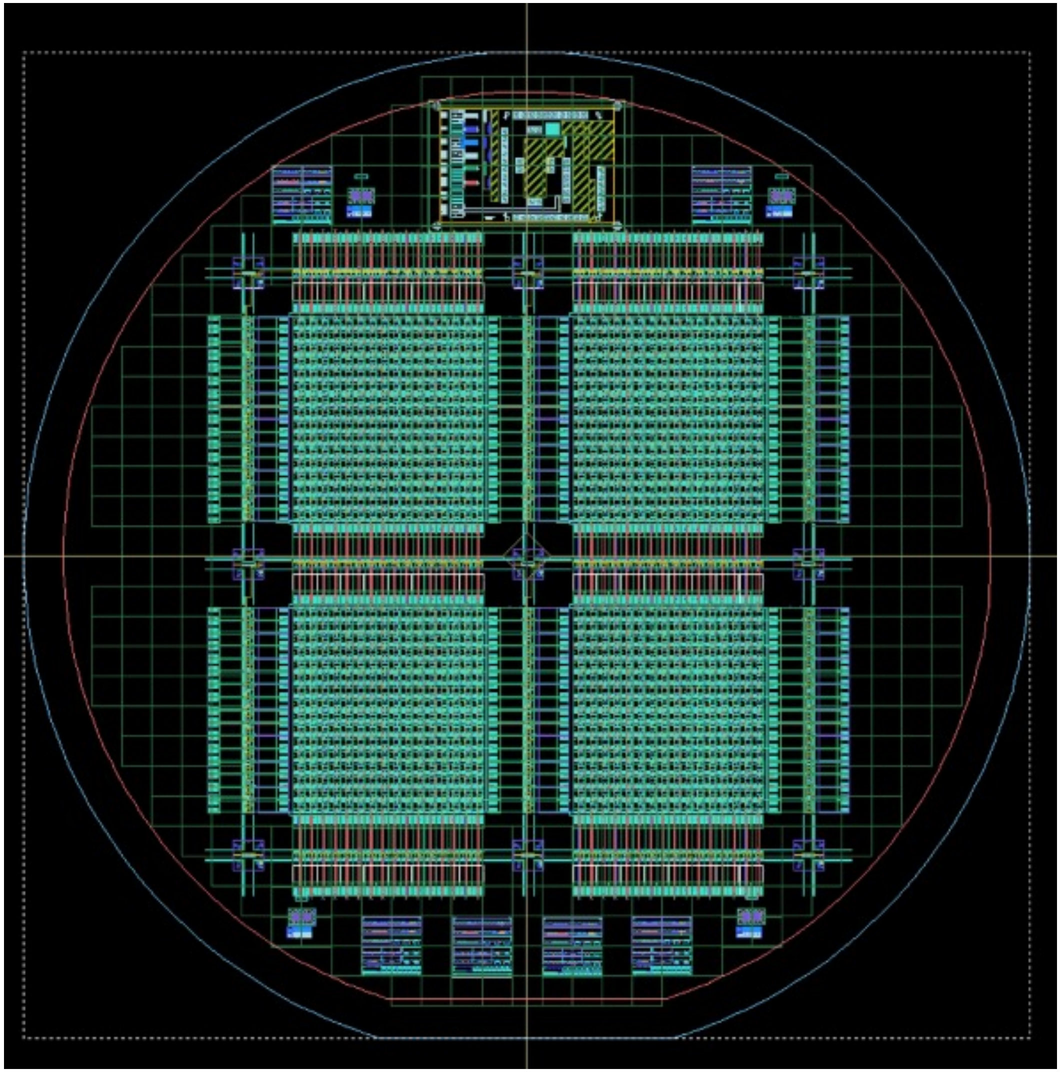


Delta-doped CMOS image sensors

Significance: Astro2020 science goals require multi-gigapixel mosaic focal planes with large-format CMOS detectors (8k×8k), low-noise (< 2.5 e-), small pixels (5-10 µm), broadband UV/Optical/IR response (>50% Quantum Efficiency, QE), and visible-blind near-UV detectors with high QE for 200-400 nm

Project Title: High Performance Far-UV, Near-UV, and UV/Optical CMOS Imagers

PI: Michael Hoenk (JPL)

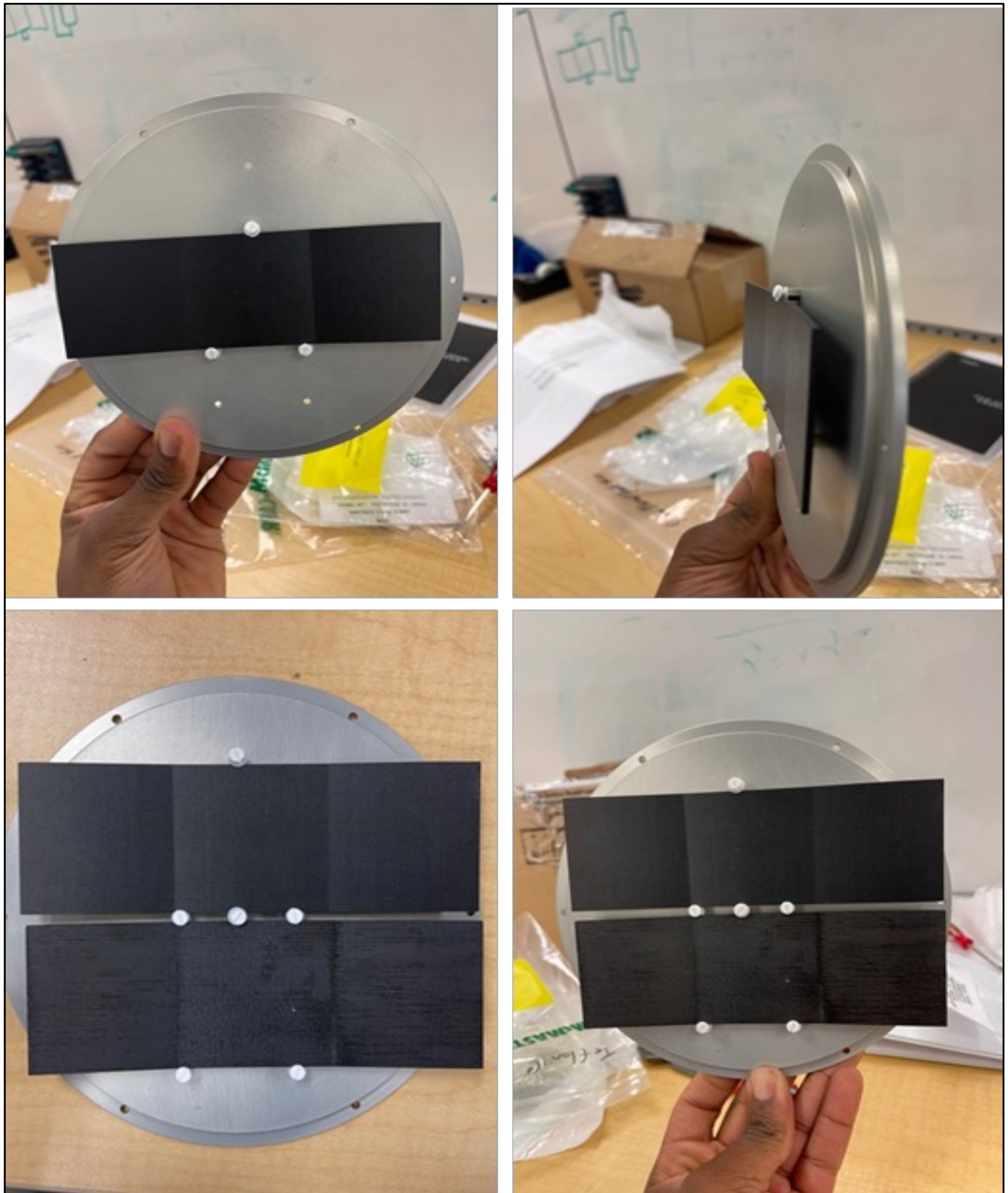


SQUID-based multiplexer arrays with Two-Level Switching (TLS) optimized for bolometer readout

Significance: Advancing time-domain multiplexing (TDM) readout for large-format Transition-Edge-Sensing (TES) bolometers could enable or enhance the next far-IR Great Observatory

Project Title: Advancing Readout of Large-Format Far-IR Transition-Edge Sensor Arrays

PI: Karwan Rostem (GSFC)

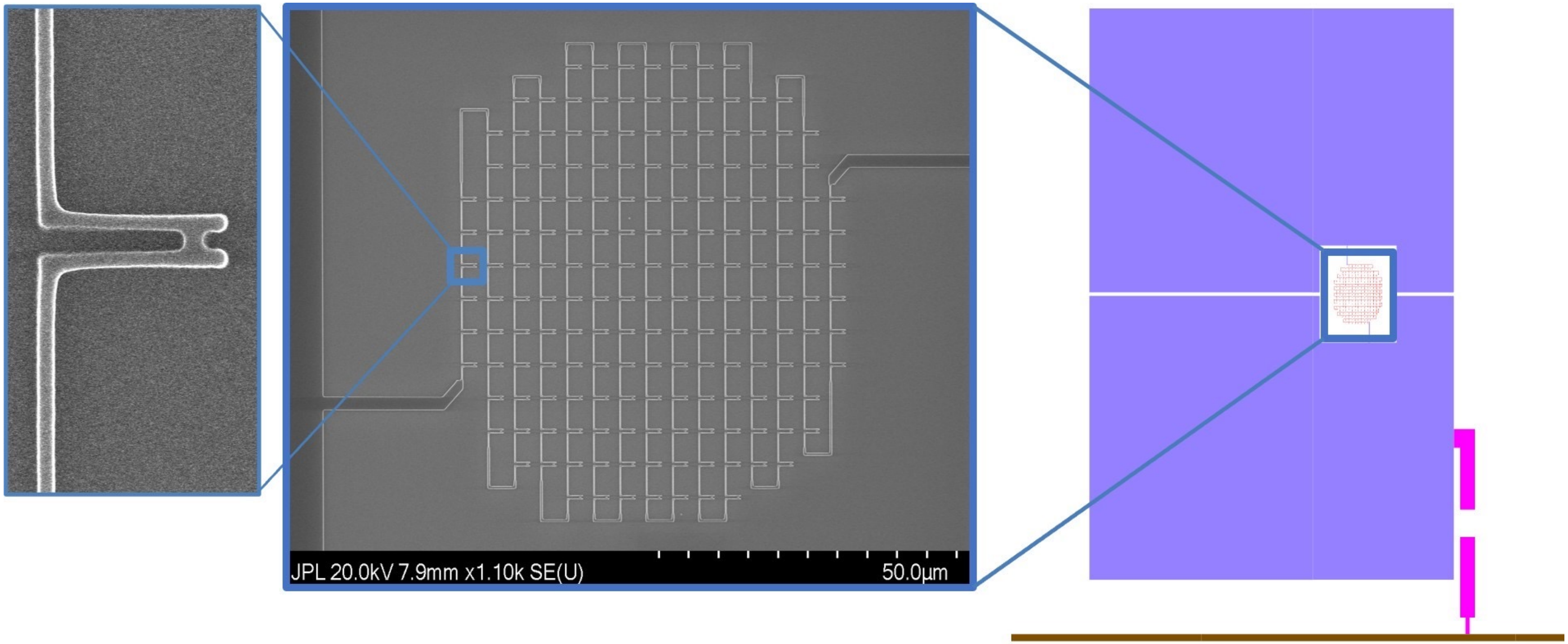


Coefficient of Moisture Expansion (CME)/Creep specimens for testing in ultra-stable test bed

Significance: Ultra-stability and -precision (~10 pm) may enable the next IR/optical/UV Great Observatory

Project Title: Ultra-Stable Structures: Development and Characterization Using Spatial Dynamic Metrology

PI: Babak Saif (GSFC)



Short-wavelength (25 μm) absorber/inductor design

Significance: Large-format arrays of sensitive far-IR detectors will enable space-based spectroscopy many orders of magnitude more sensitive than previous facilities

Project Title: Ultrasensitive Far-IR Kinetic Inductance Detector (KID) Arrays for Space

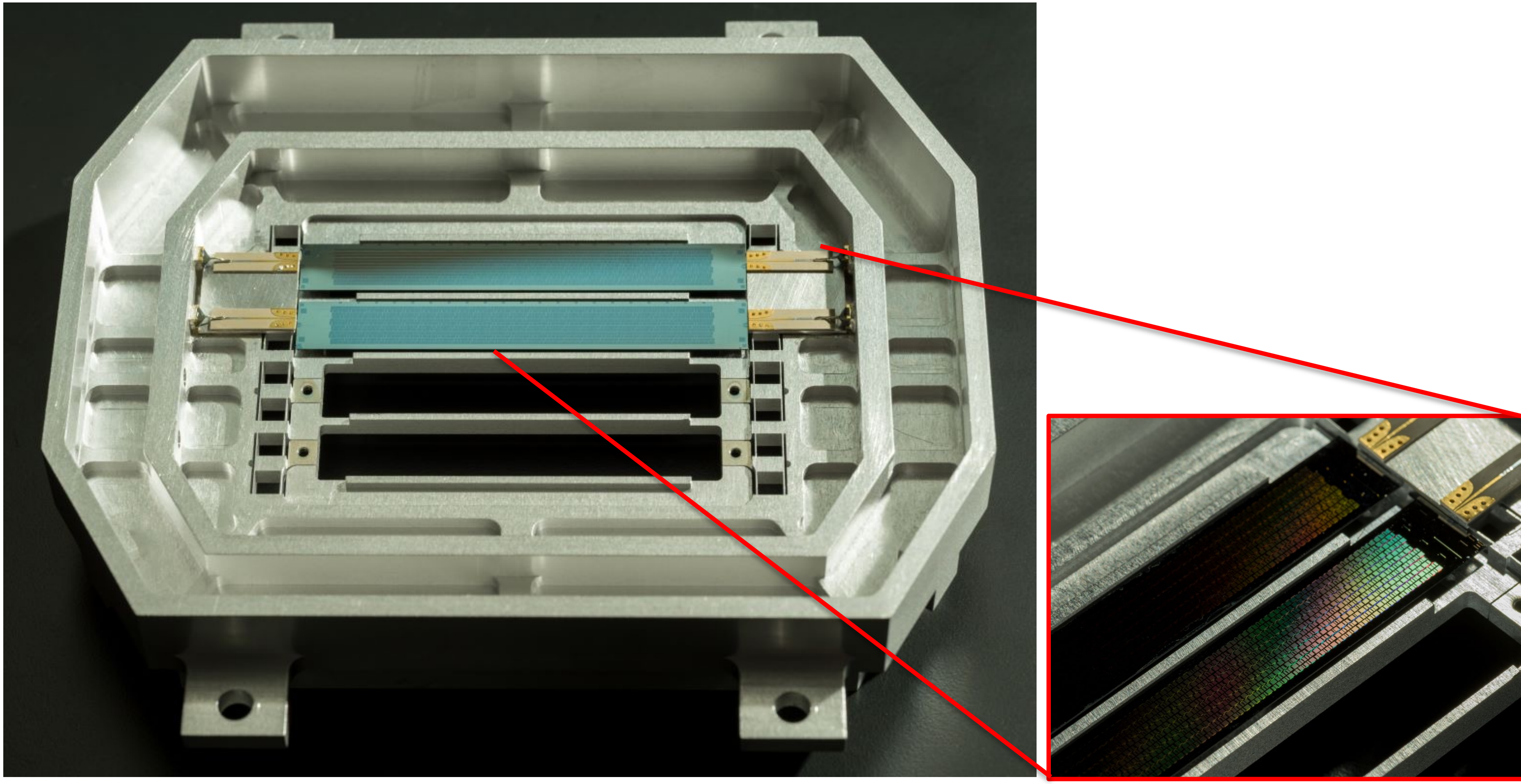
PI: Steven Hailey-Dunsheath (California Institute of Technology)

A very-low-blaze angle grating prototype made for the FORTIS sounding rocket (PI: McCandliss)

Significance: Very-low-blaze angle (< ~1 deg) UV gratings enable spectroscopy for missions such as FORTIS, as well as Explorers, Probes, and Flagships like the Habitable Worlds Observatory

Project Title: UV Spectroscopy for the Next Decade Enabled Through Nanofabrication Techniques

PI: Randall McEntaffer (PSU)

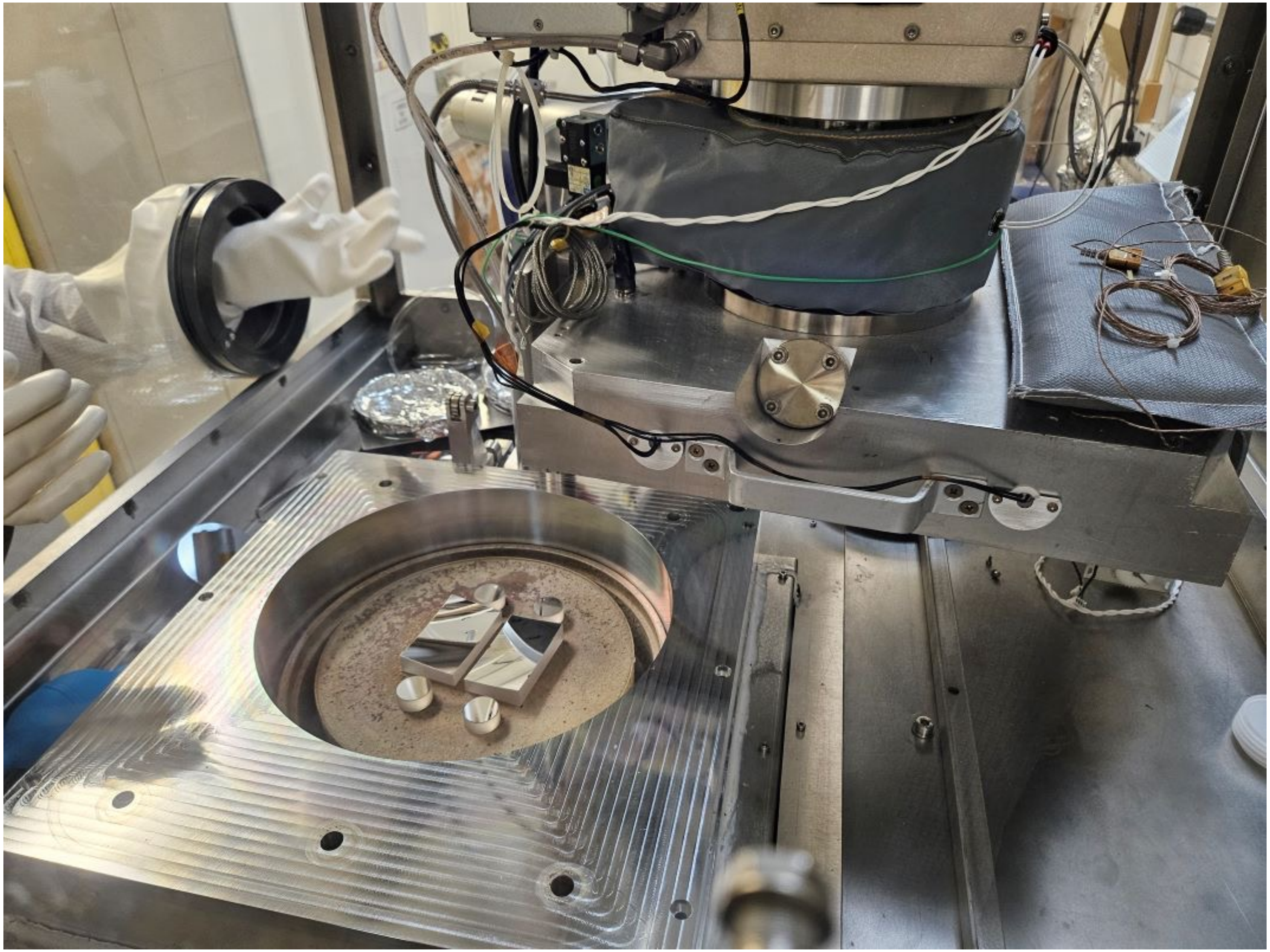


Flight-like JPL package for hybridized 12x84-pixel kinetic inductance detector (KID) array bonded to a matching GSFC microlens array (on the back side of the KID) with a zoom-in showing individual pixels (right)

Significance: Extremely sensitive far-IR detectors may enable future missions

Project Title: Ultrasensitive Far-IR Kinetic Inductance Detector (KID) Arrays: Maturation for Flight

PI: C. Matt Bradford (JPL)



Atomic-Layer-Deposition (ALD) encapsulation of Physical-Vapor-Deposition (PVD) mirror coatings for improved stability, same as used for the SPRITE and Aspera missions

Significance: Advanced coatings may enable future far-UV missions

Project Title: High-Performance, Stable, and Scalable UV Aluminum Mirror Coatings Using ALD

PI: John Hennessy (JPL)