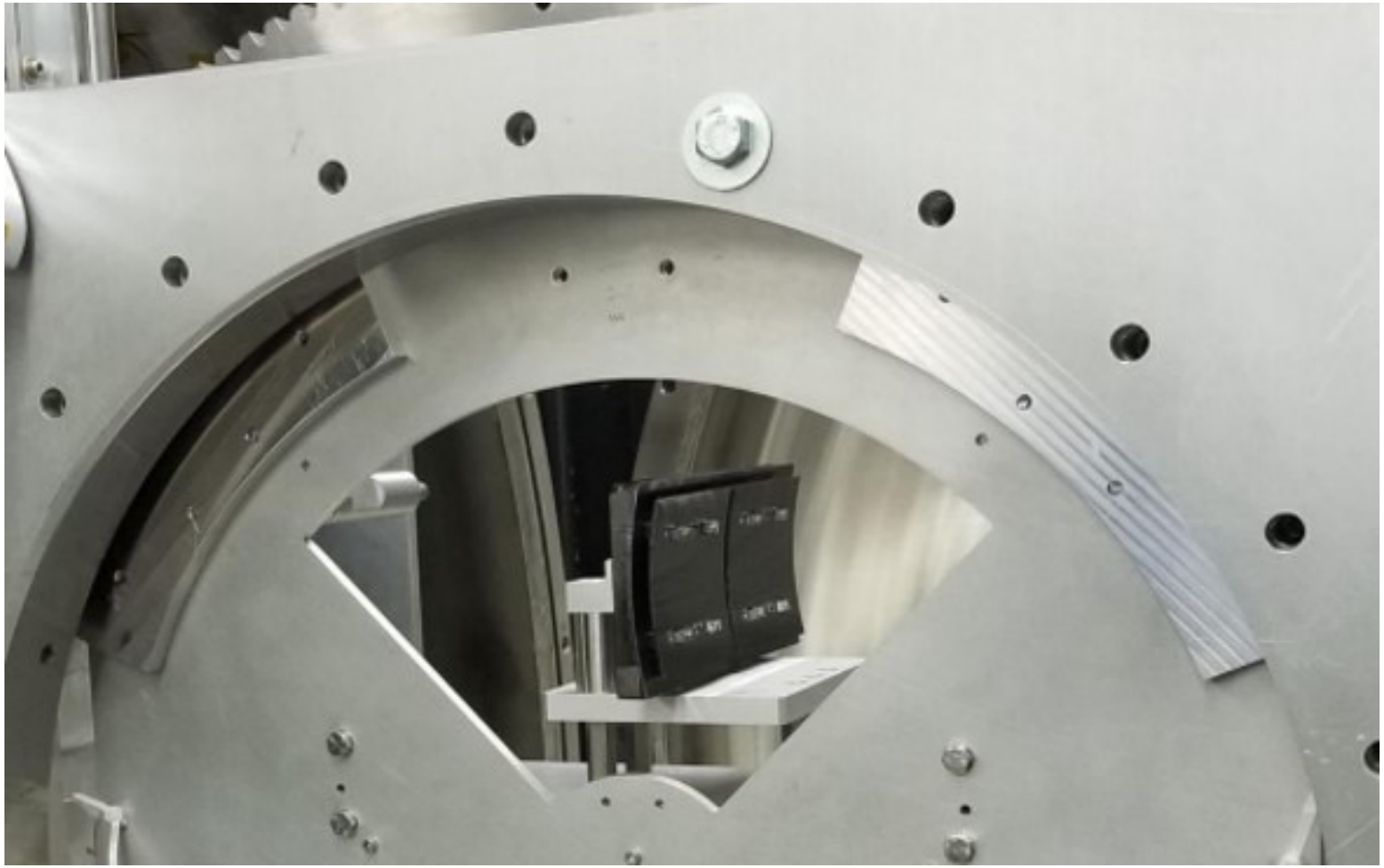
2022 Hardware Images

PhysCOS and COR Strategic Technology Portfolio

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

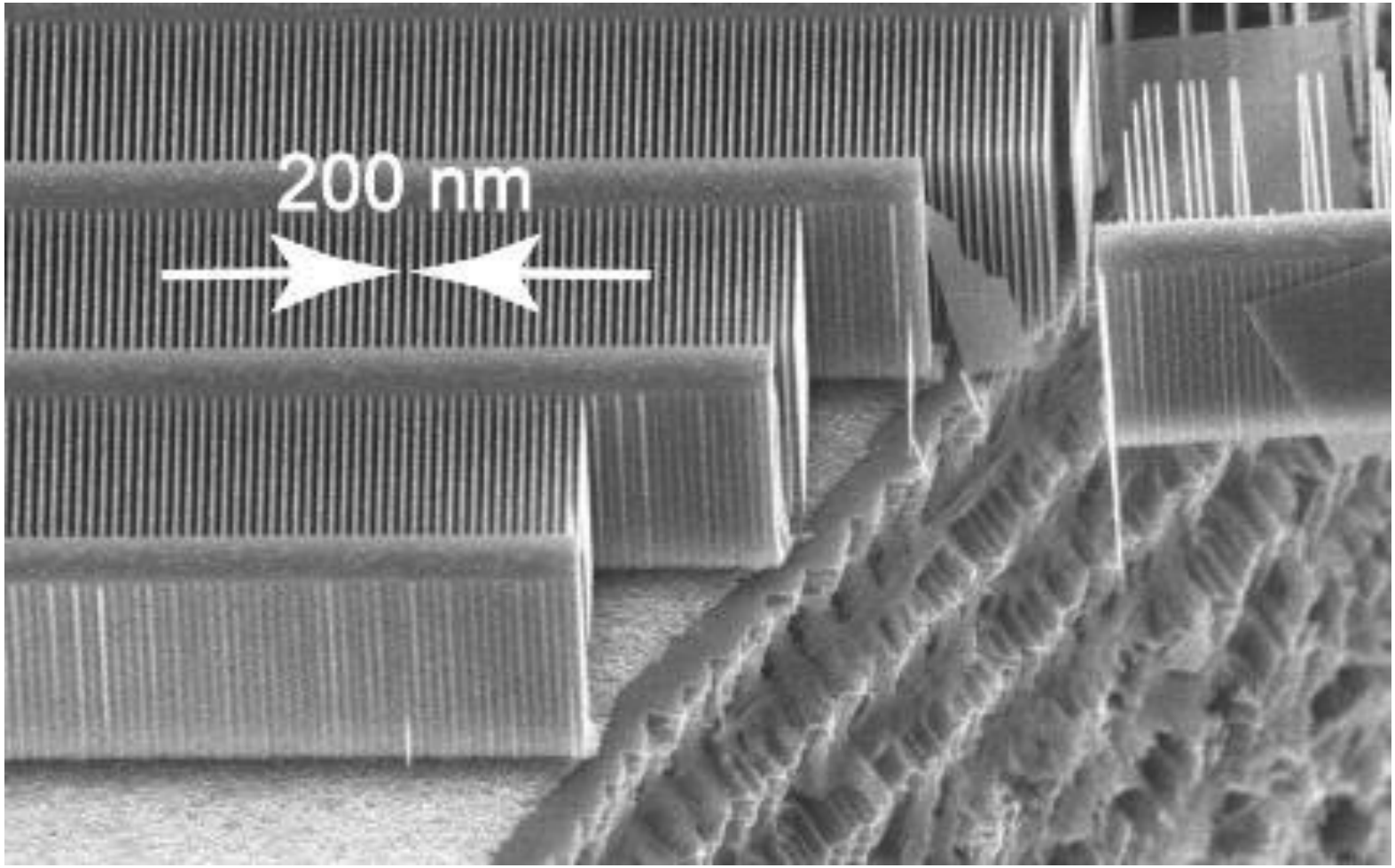


Thin grazing-angle X-ray mirror module ready for X-ray testing at GSFC's Area 200

Significance: World-class thin grazing-angle X-ray mirror technology that may 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)

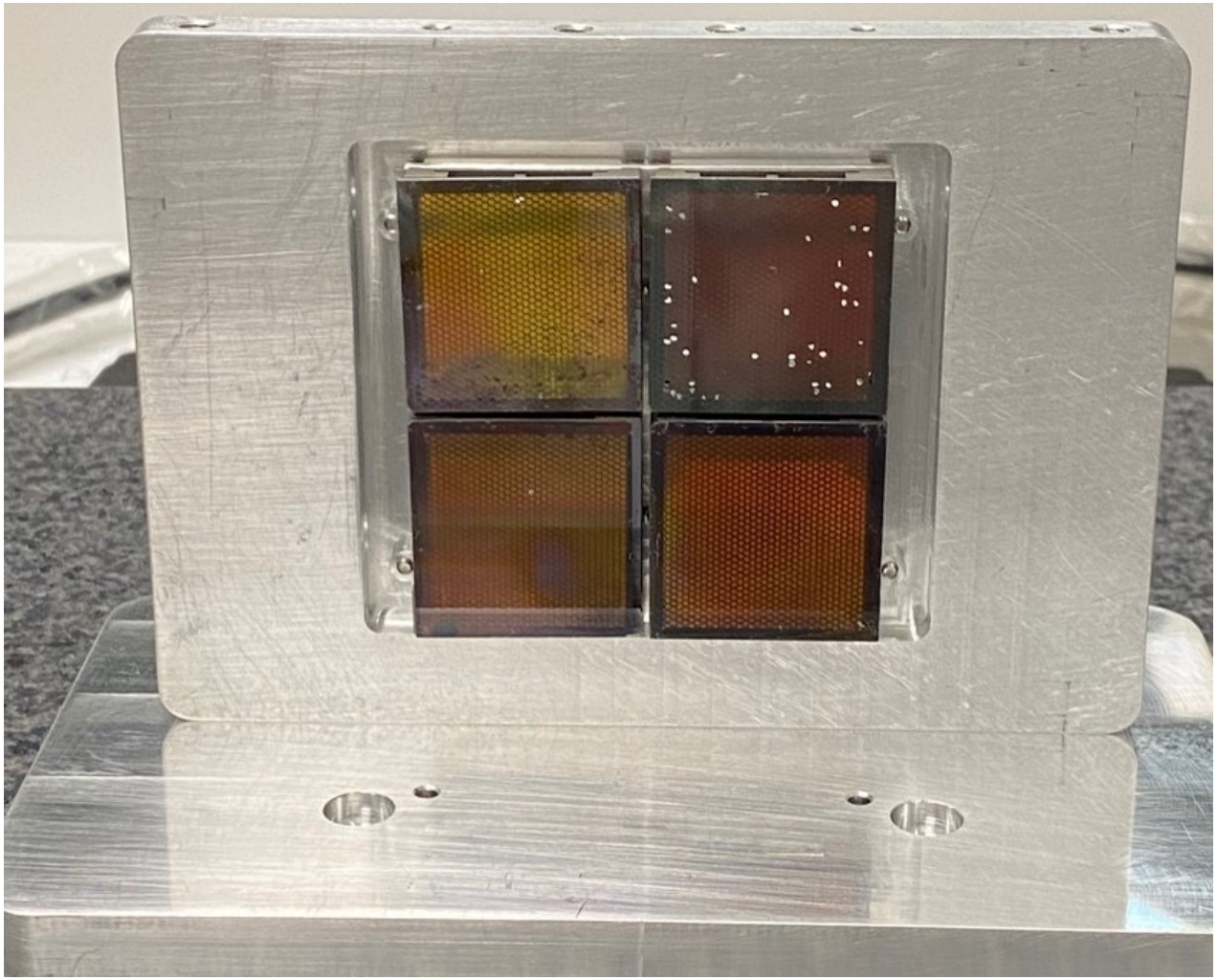


Scanning-electron micrograph of cleaved freestanding Critical-Angle Transmission (CAT) grating sample

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)



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

Significance: Enhances 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)

RFSoC board ready for thermal/vacuum testing

Significance: Fast readouts are crucial for large focal plane arrays in future missions

Project Title: Development of Low-Power FPGA-based Readout Electronics for Superconducting Detector Arrays

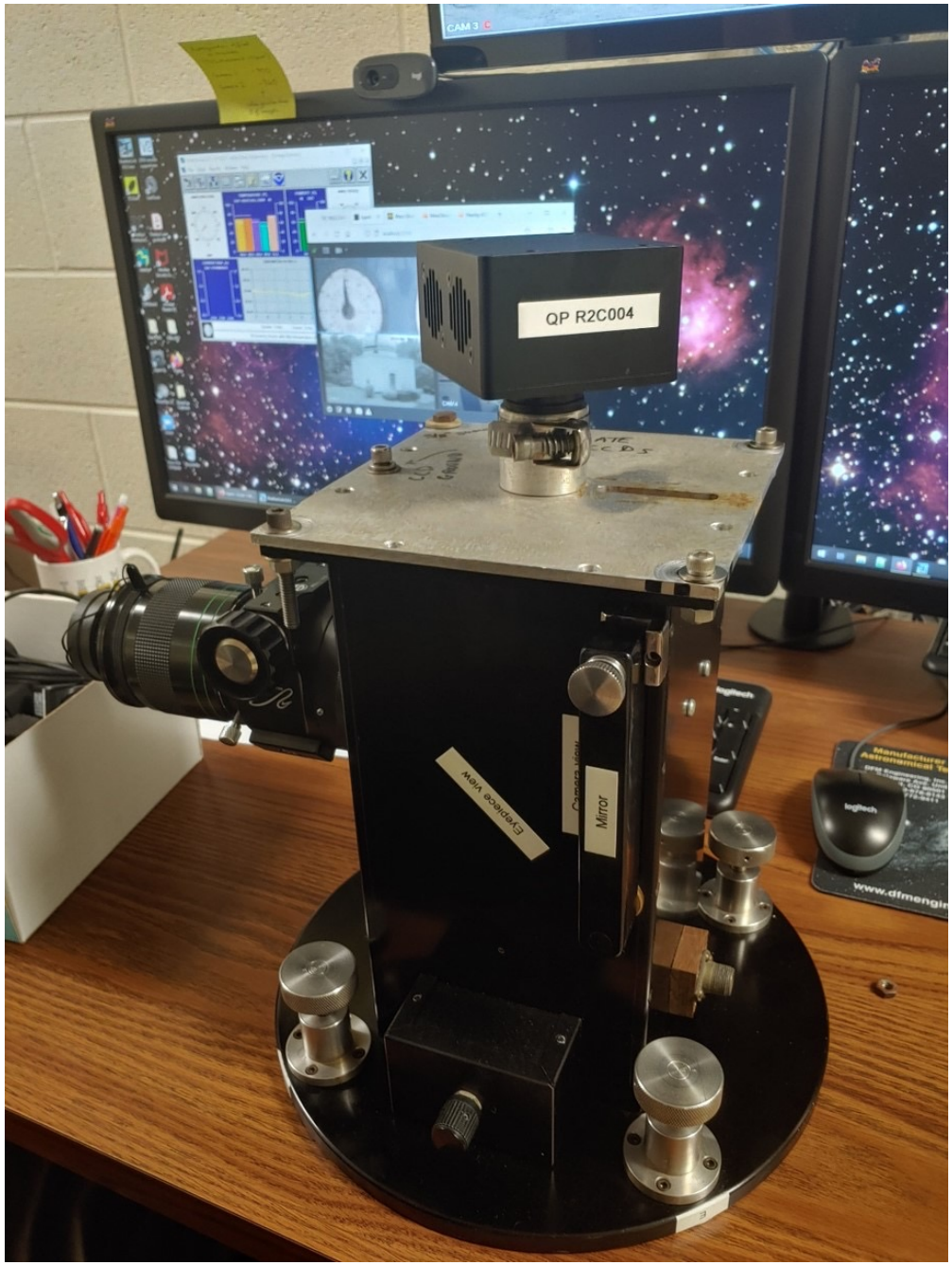
PI: Philip Mauskopf (ASU)

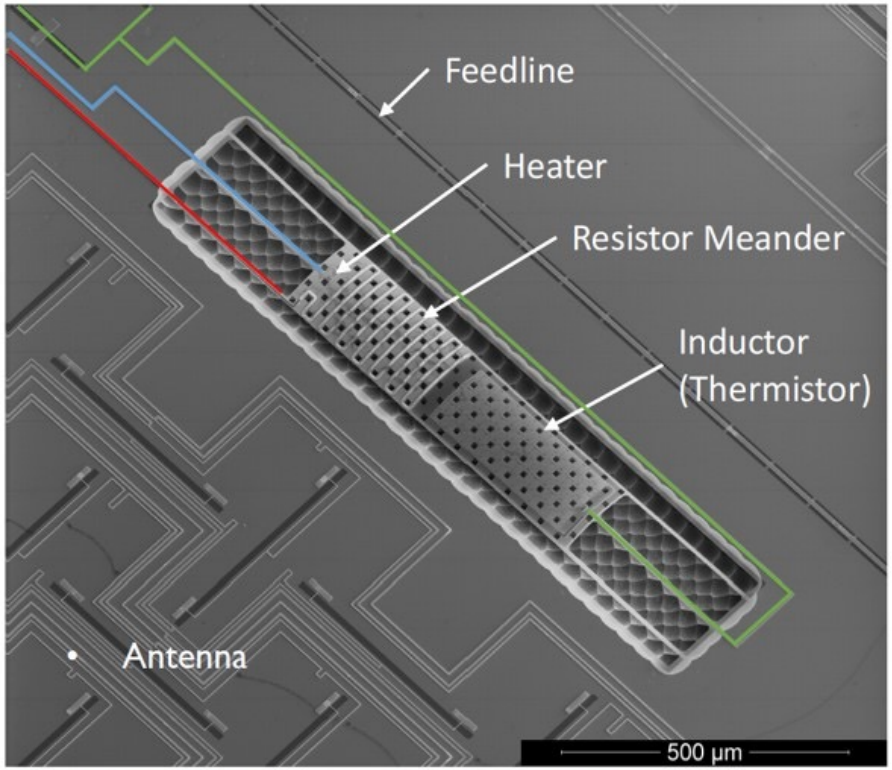
Using QISPF camera at the University of Rochester Mees Observatory

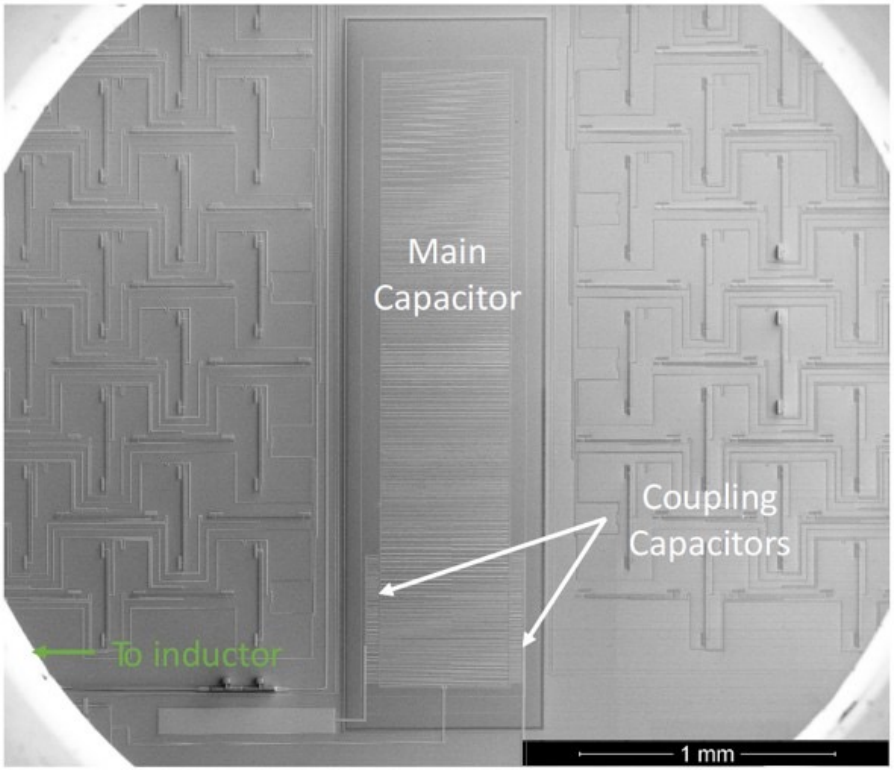
Significance: Low-noise detectors are crucial for future missions

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

PI: Don Figer (RIT)







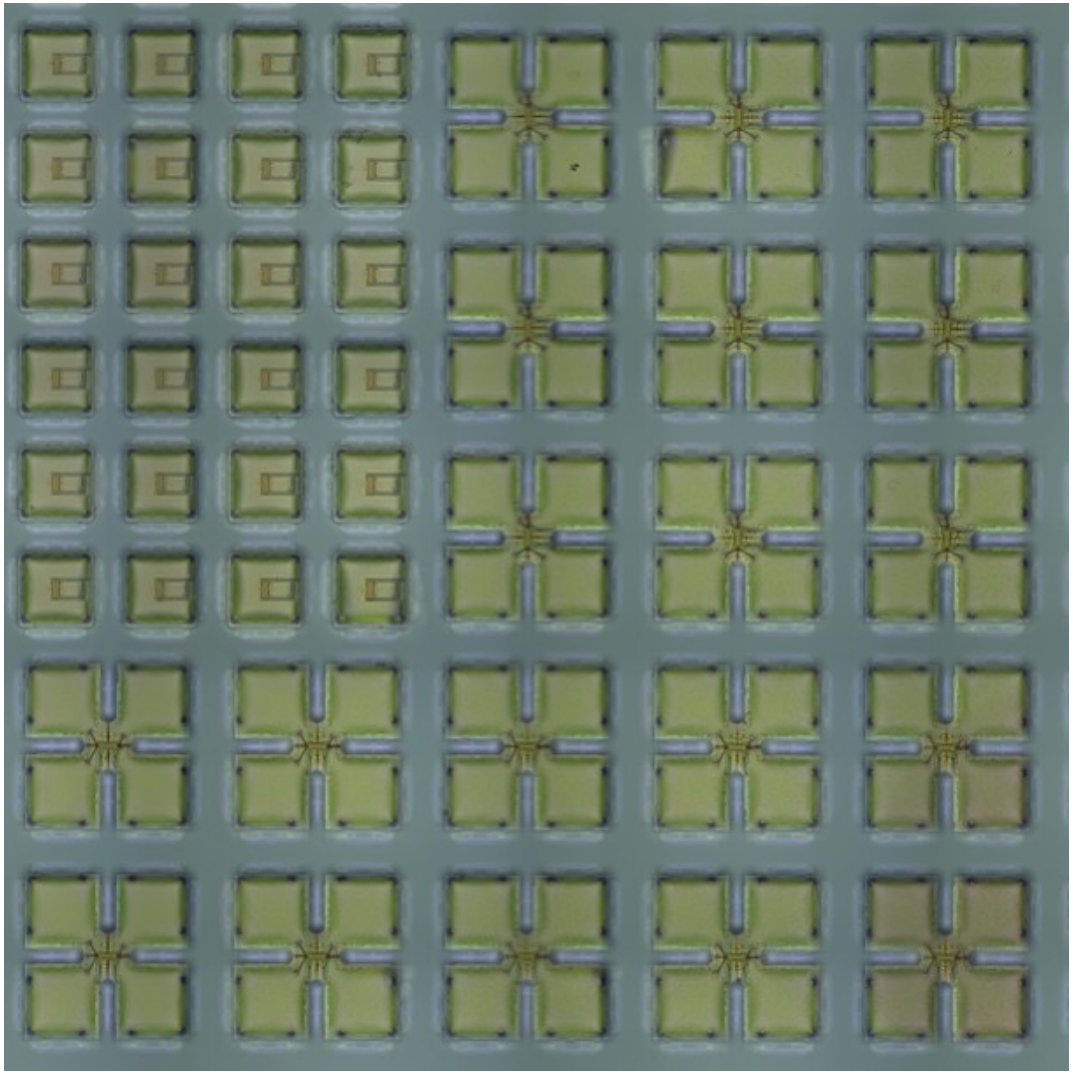
To Capacitor Heater Bias Circuit
To Antenna

Thermal Kinetic Inductance Detectors (TKIDs)

Significance: CMB polarimetry is crucial for identifying echoes of the Big Bang

Project Title: Superconducting Detectors for Cosmic Microwave Background (CMB) Polarimetry in PICO

PI: Roger O'Brient (JPL/Caltech)



Backside of part of LEM-style array showing single pixels and hydra multiplexed readouts

Significance: High-resolution TES microcalorimeters may enable strategic X-ray missions

Project Title: Advanced X-ray Microcalorimeters: TES Microcalorimeters

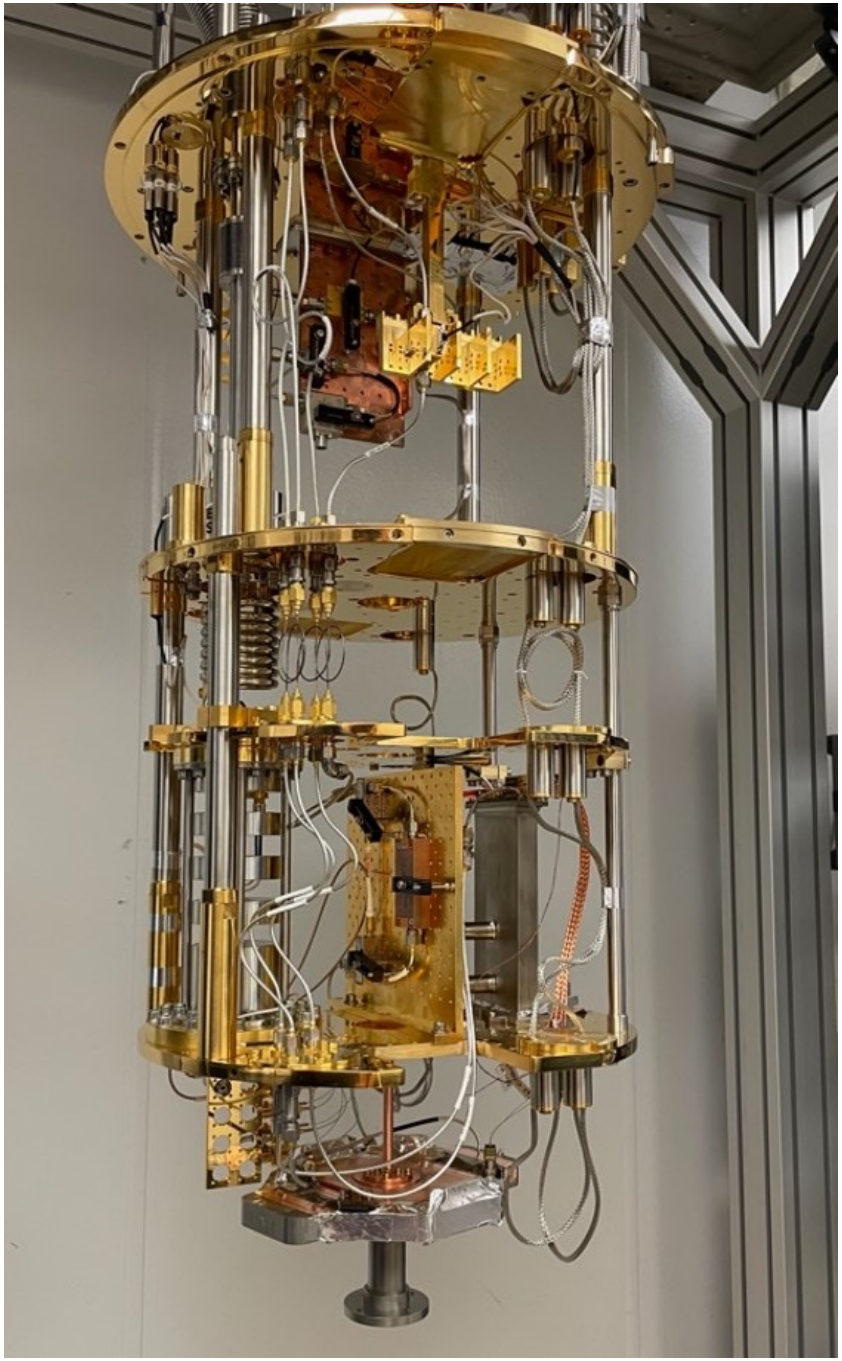
PI: Steve Smith (GSFC)

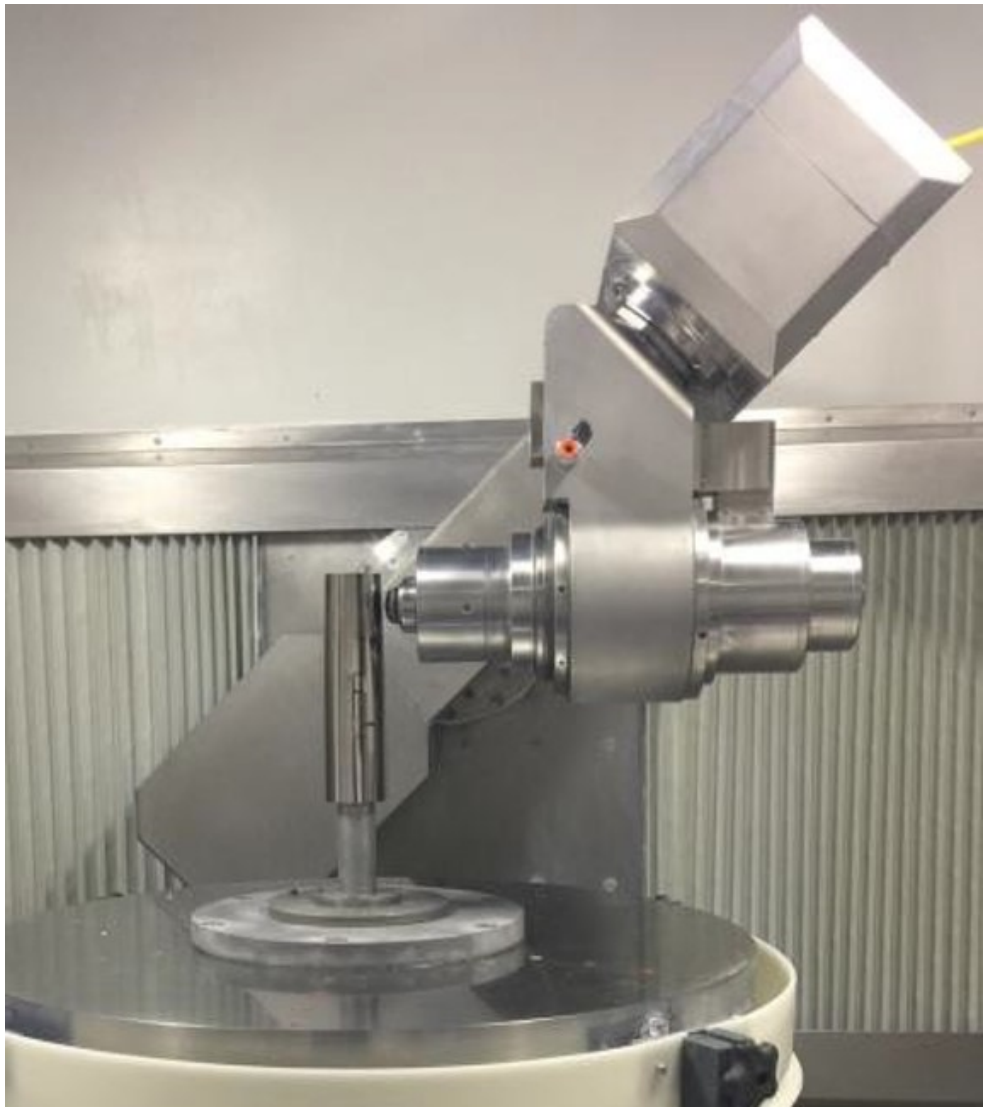
Magnetically coupled Micro-Calorimeters (MMCs) and micro-multiplexer (µMUX) mounted for insertion into new GSFC dilution refrigerator

Significance: MMCs offer energy resolution that may enable the next X-ray Great Observatory

Project Title: MMC Arrays for X-ray Astrophysics

PI: Simon Bandler (GSFC)



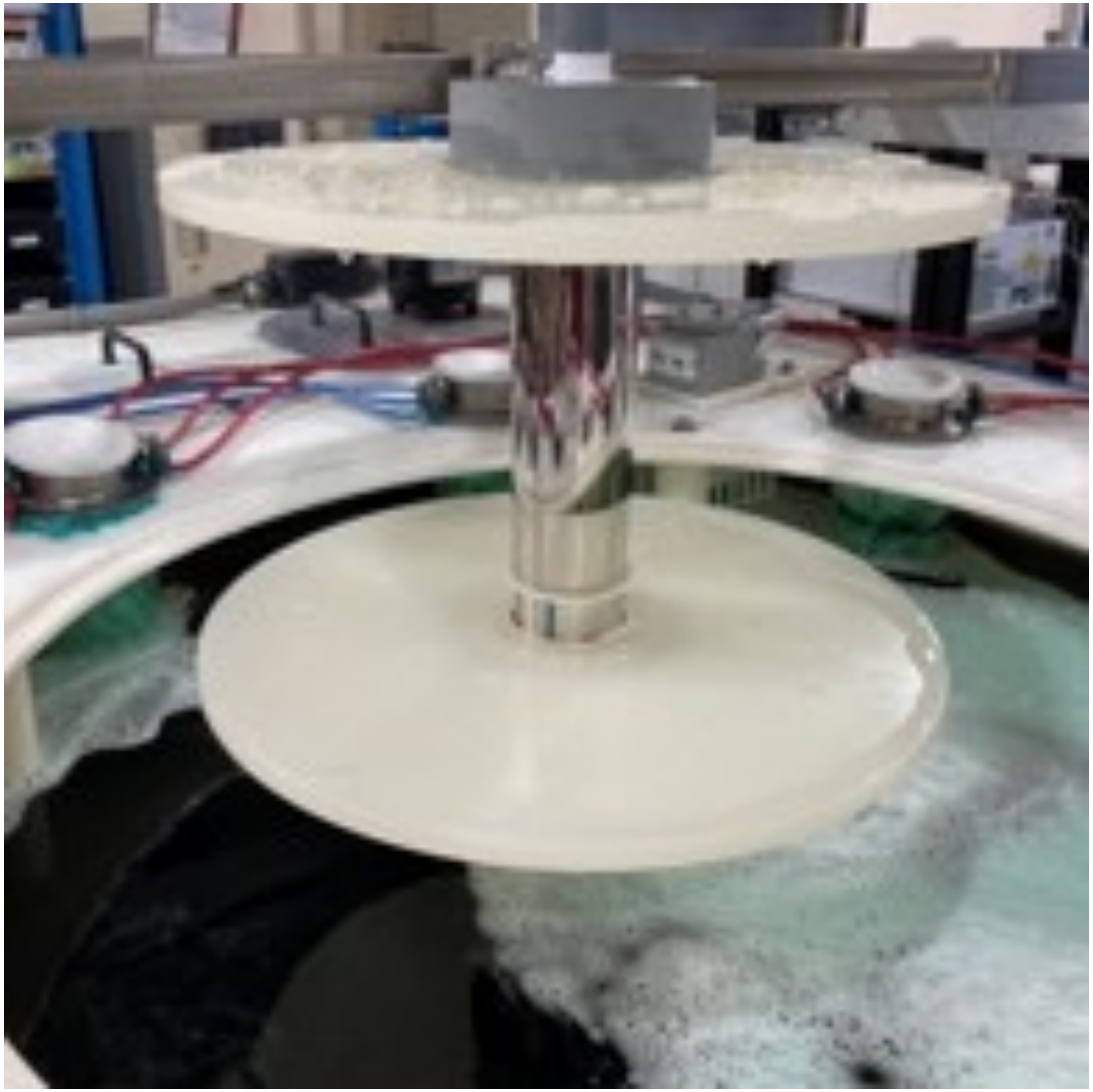


Deterministic polishing of National Ignition Facility (NIF) mandrel in Zeeko CNC polishing machine

Significance: High-quality X-ray optics may enable or enhance future Astrophysics missions

Project Title: X-ray Mandrel and Shell Polishing

PI: Jeff Kolodziejczak (MSFC)

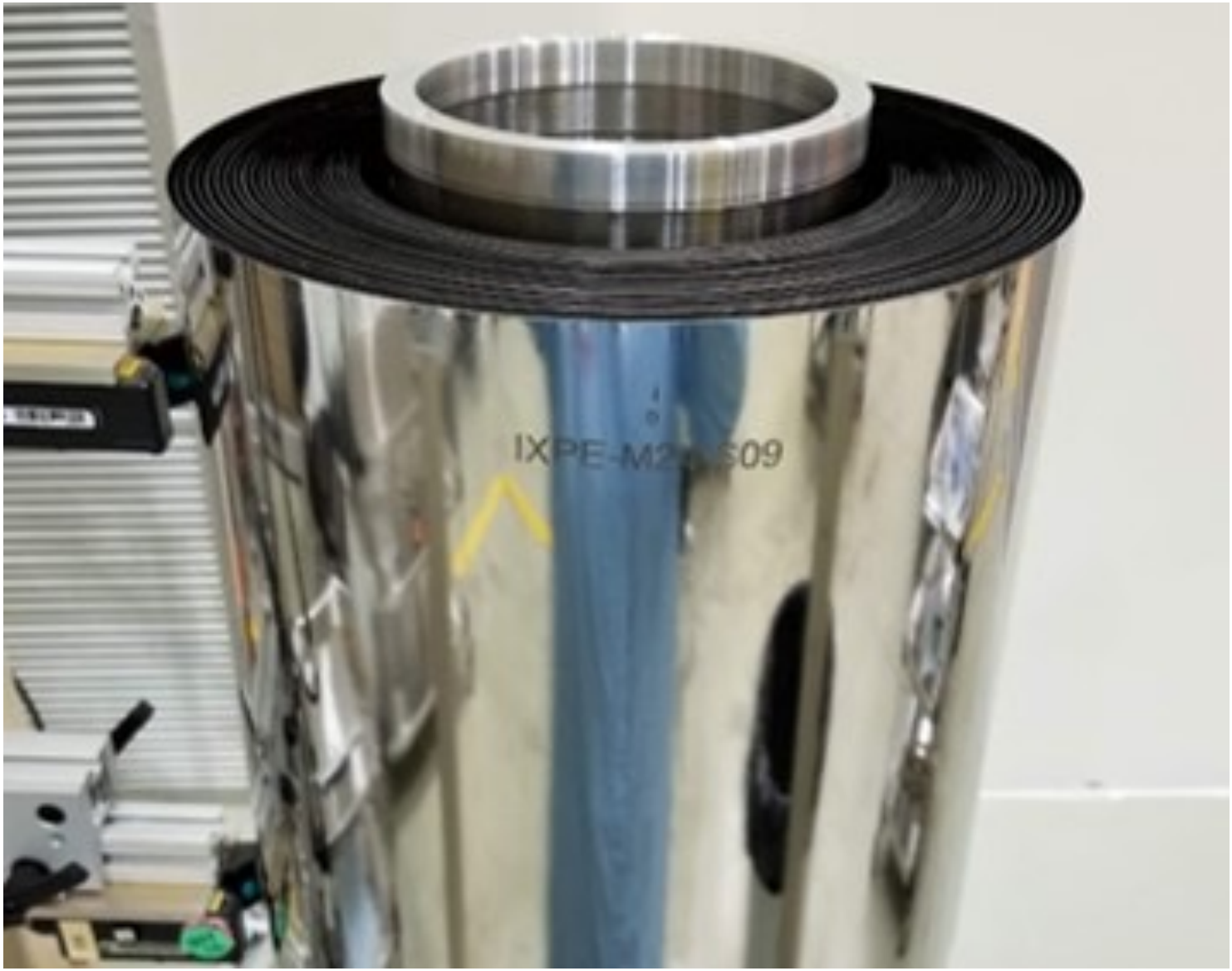


Mandrel with NiCo Plating

Significance: High-quality X-ray optics may enable or enhance future Astrophysics missions

Project Title: Advanced X-ray Optics: Mirror Fabrication – Electroforming Replication

PI: Panini Singam (MSFC)



IXPE X-ray mirror shells

Significance: High-quality X-ray optics may enable or enhance future Astrophysics missions

Project Title: Advanced X-ray Optics: Shell Alignment and Mounting

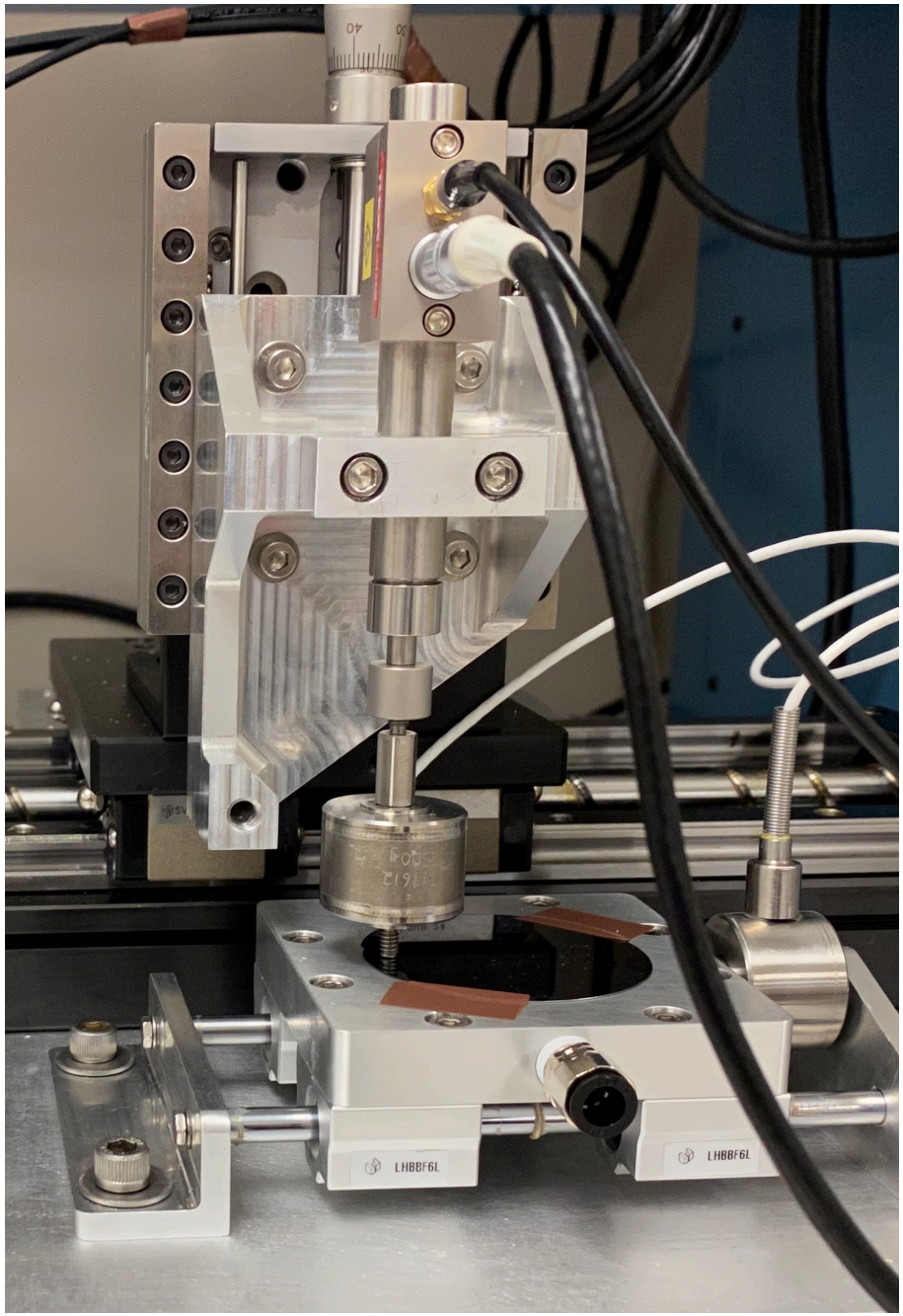
PI: Stephen Bongiorno (MSFC)

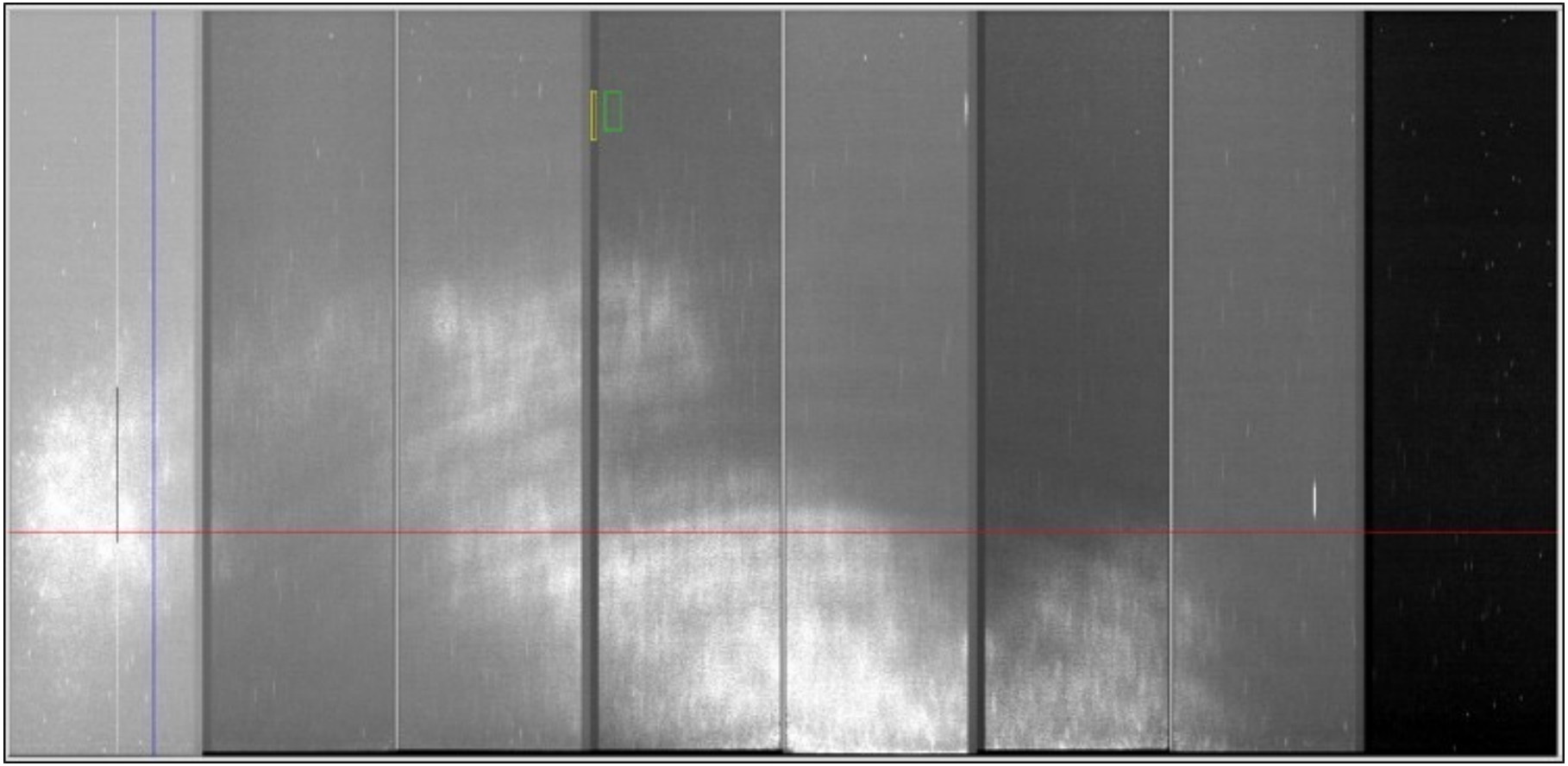
Adhesion test system with coated wafer

Significance: High-quality X-ray optics may enable or enhance future Astrophysics missions

Project Title: Advanced X-ray Optics: X-ray Optic Thin-Film Coatings

PI: Danielle Gurgew (MSFC)



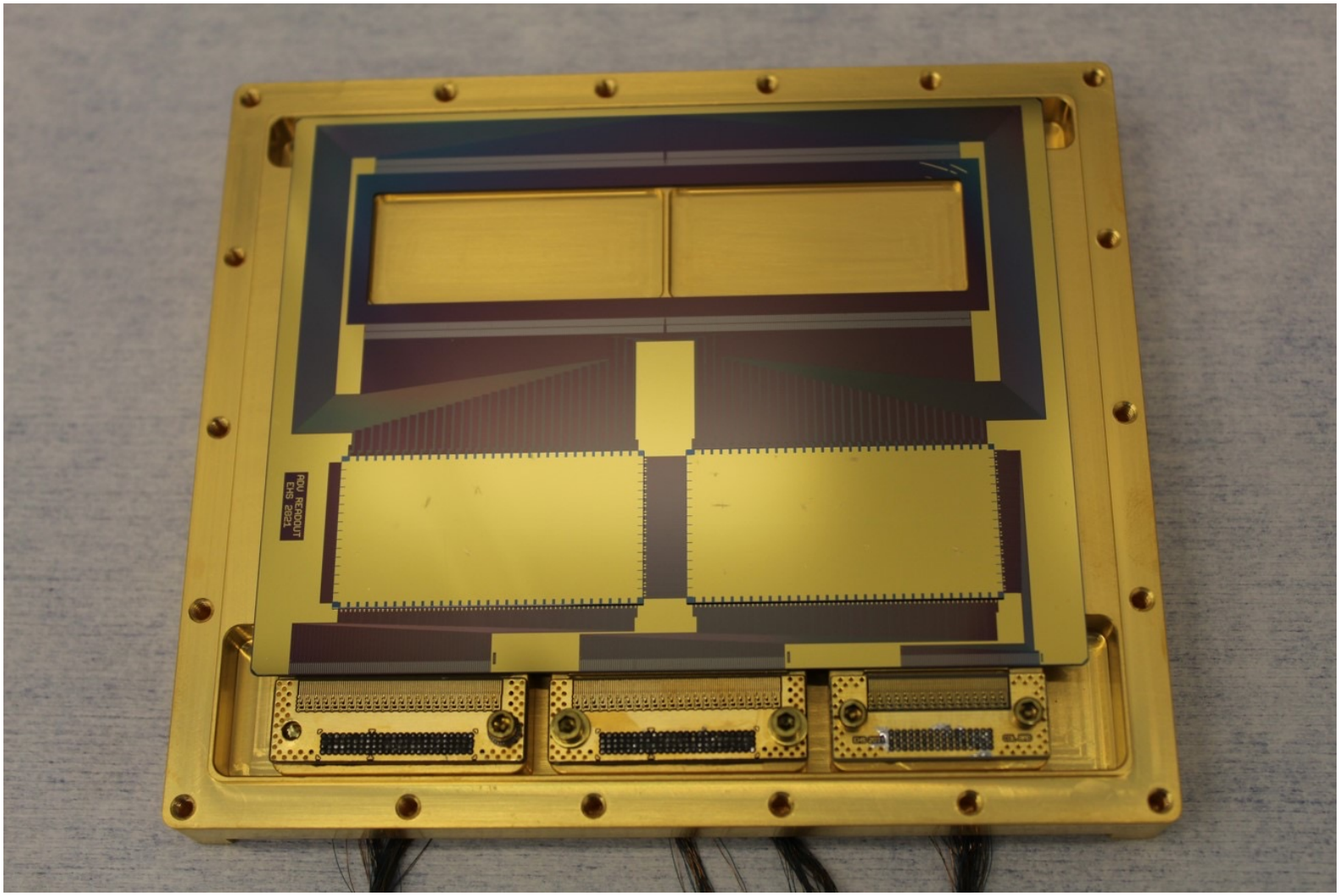


Dark current map in back-illuminated X-ray CCD

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

Project Title: Toward Fast, Low-Noise, Radiation Tolerant X-ray Imaging Arrays for Lynx: Raising Technology Readiness Further

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



A kilo-pixel Transition-Edge Sensor (TES) test package

Significance: Advancing time-domain multiplexing (TDM) technology for large-format 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

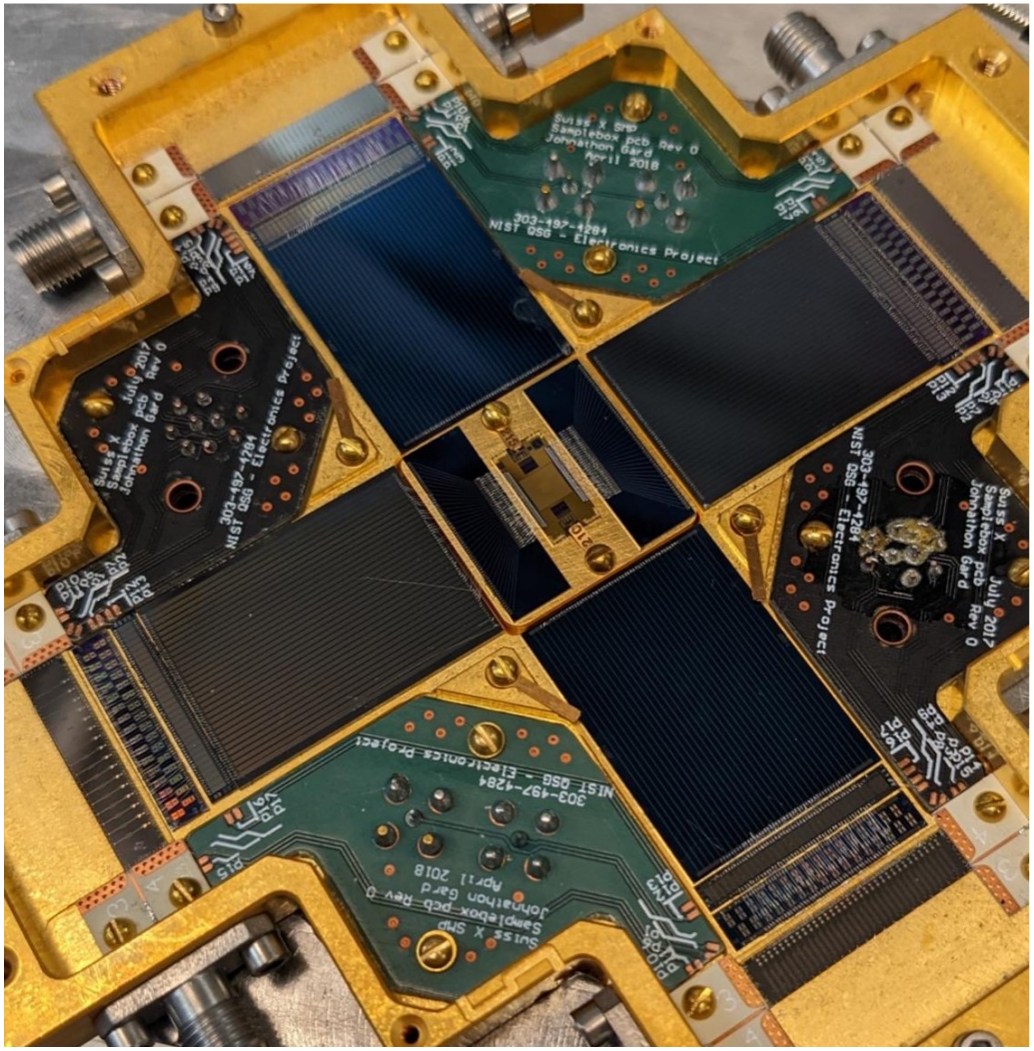
PI: Karwan Rostem (GSFC)

Radio Frequency System-on-Chip (RFSoC) brassboard prepared for thermal performance test

Significance: High-density readout may enable large focal planes needed for future missions

Project Title: Advancing High-Density Readout Technology for Superconducting Sensor Arrays for Spaceflight

PI: Larry Ruckman (SLAC)

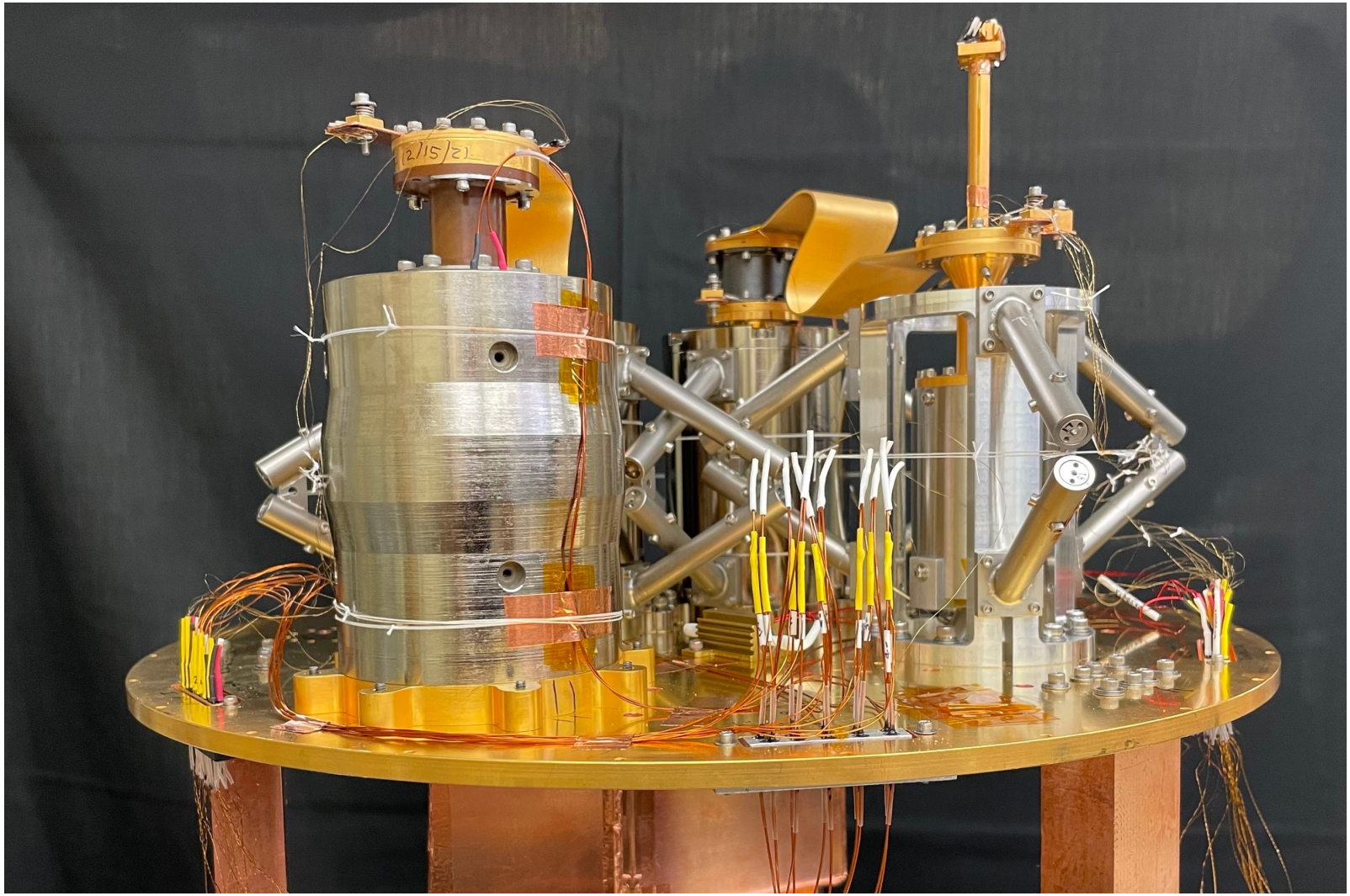


Hydra Transition-Edge Sensor (TES) integrated with 8 MHz μmux chip

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

Project Title: Technology development for Microwave Superconducting QUantum Interference Device (SQUID) multiplexing for the Lynx X-ray Observatory

PI: Douglas Bennett (NIST)

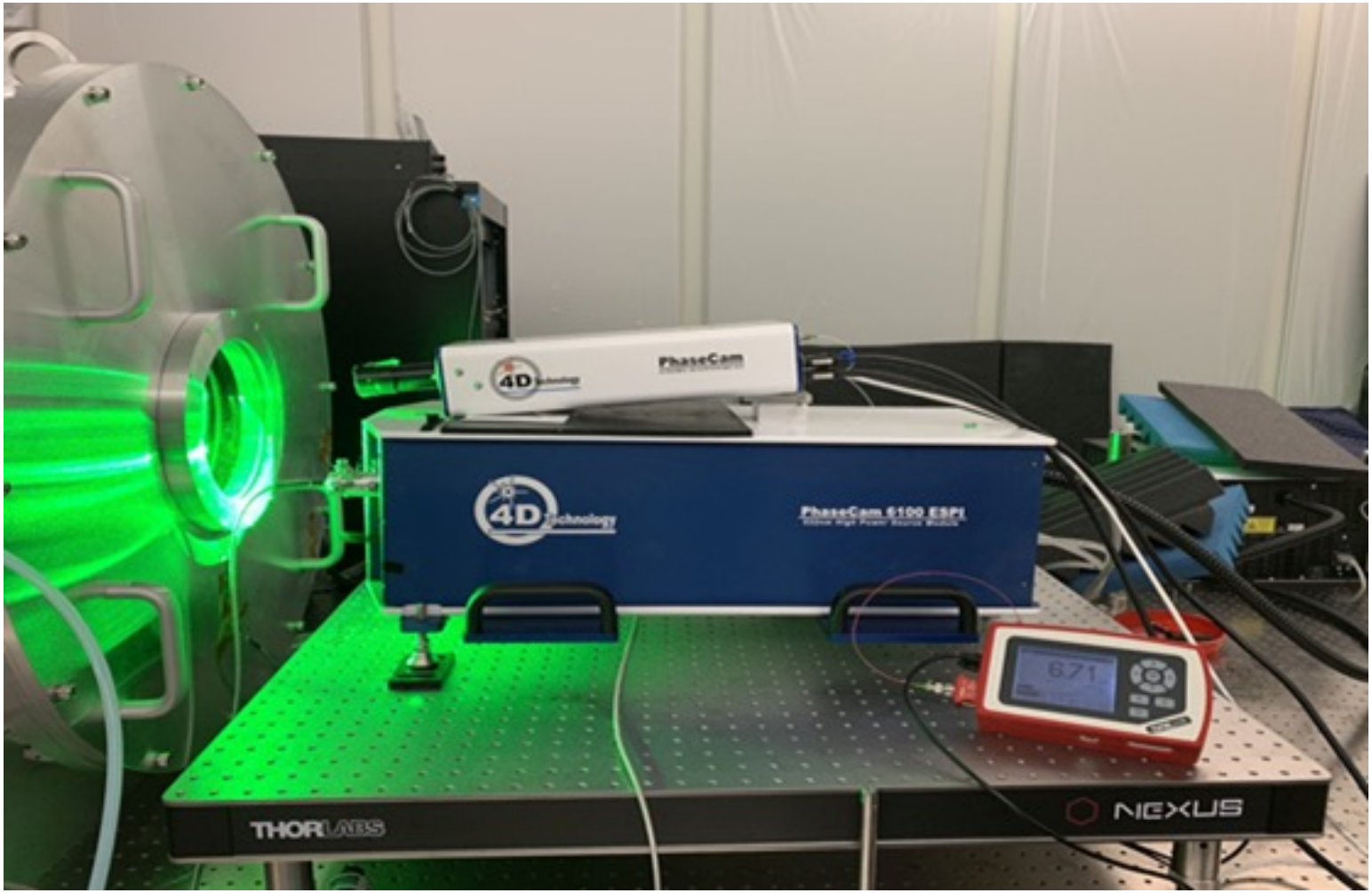


Performance testing of 4-K-to-0.05-K Continuous Adiabatic Demagnetization Refrigerator (CADR) subsystem

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

Project Title: High-Efficiency Continuous Cooling for Cryogenic Instruments and sub-Kelvin Detectors

PI: James Tuttle (GSFC)

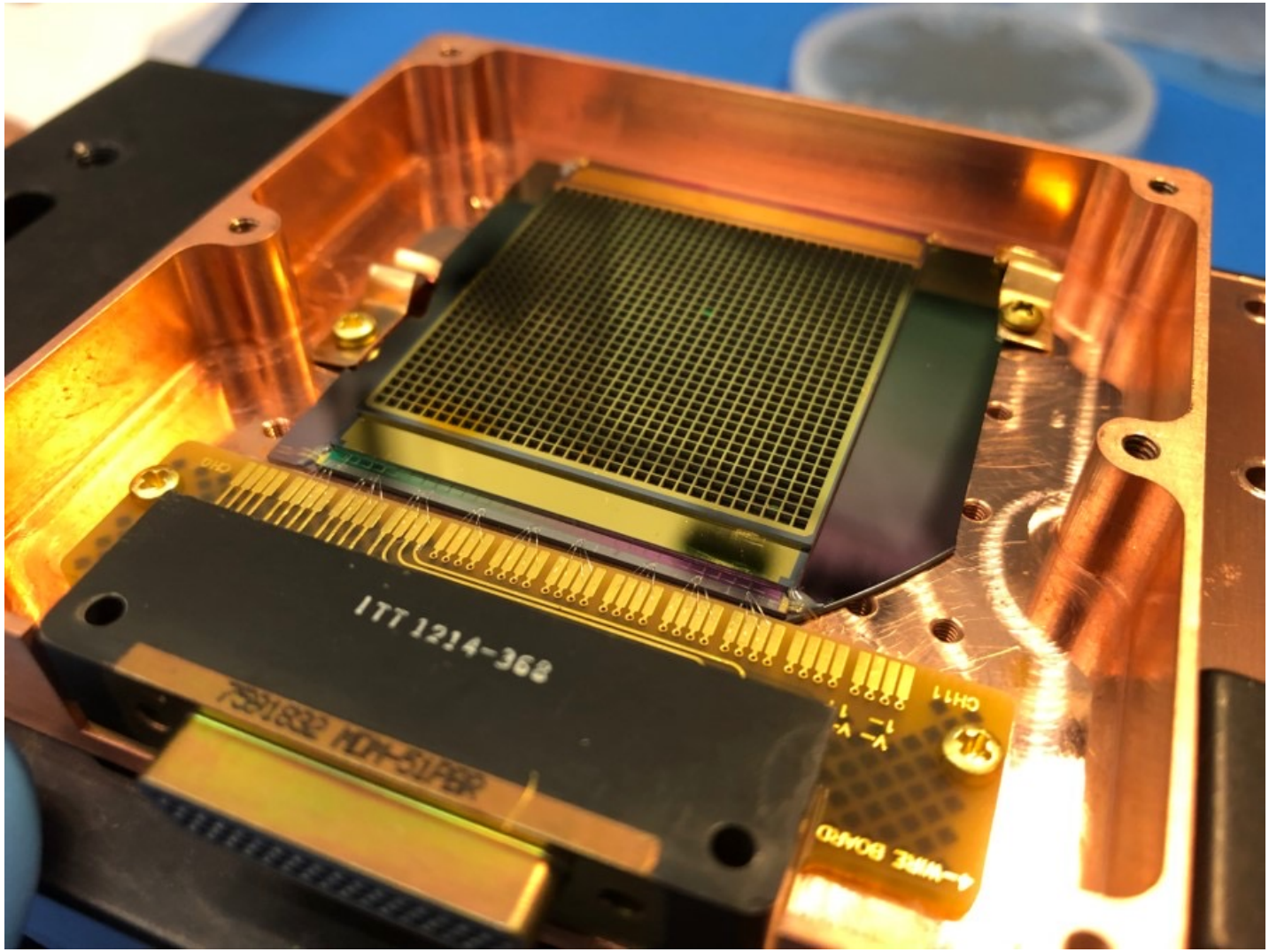


Speckle interferometer used in ultra-stable test bed

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)



Fully Hybridized far-IR triple-stack detector array

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

Project Title: Development of a Robust, Efficient Process to Produce Scalable, Superconducting Kilopixel Far-IR Detector Arrays

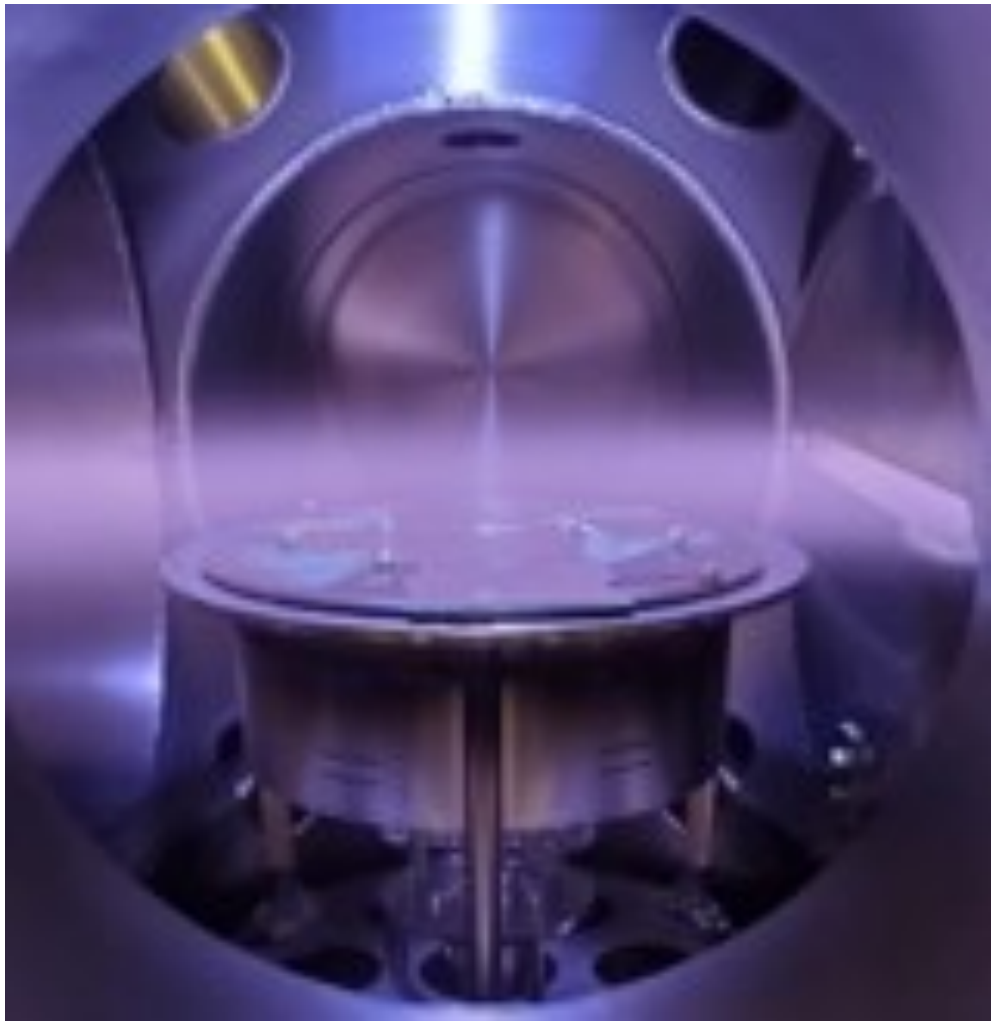
PI: Johannes Staguhn (JHU & GSFC)

SPRITE CubeSat primary mirror LiF-capped using hybrid PVD/ALD process

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)

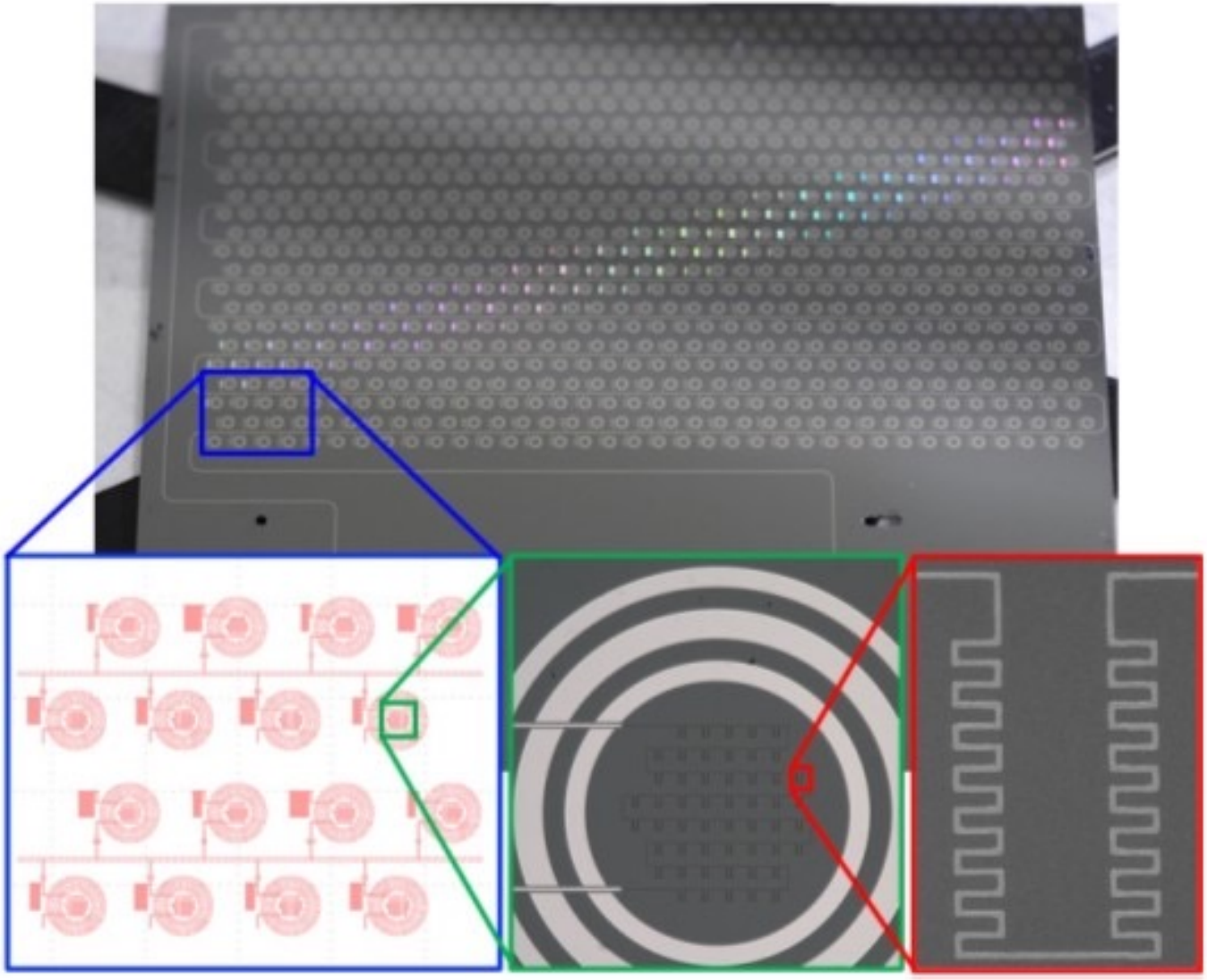


Processing setup for uniformity of film thickness across a 6”-diameter sample stage

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

Project Title: E-Beam-Generated Plasma Etching for Developing High-Reflectance Mirrors for Far-Ultraviolet Astronomical Instrument Applications

PI: Manuel Quijada (GSFC)

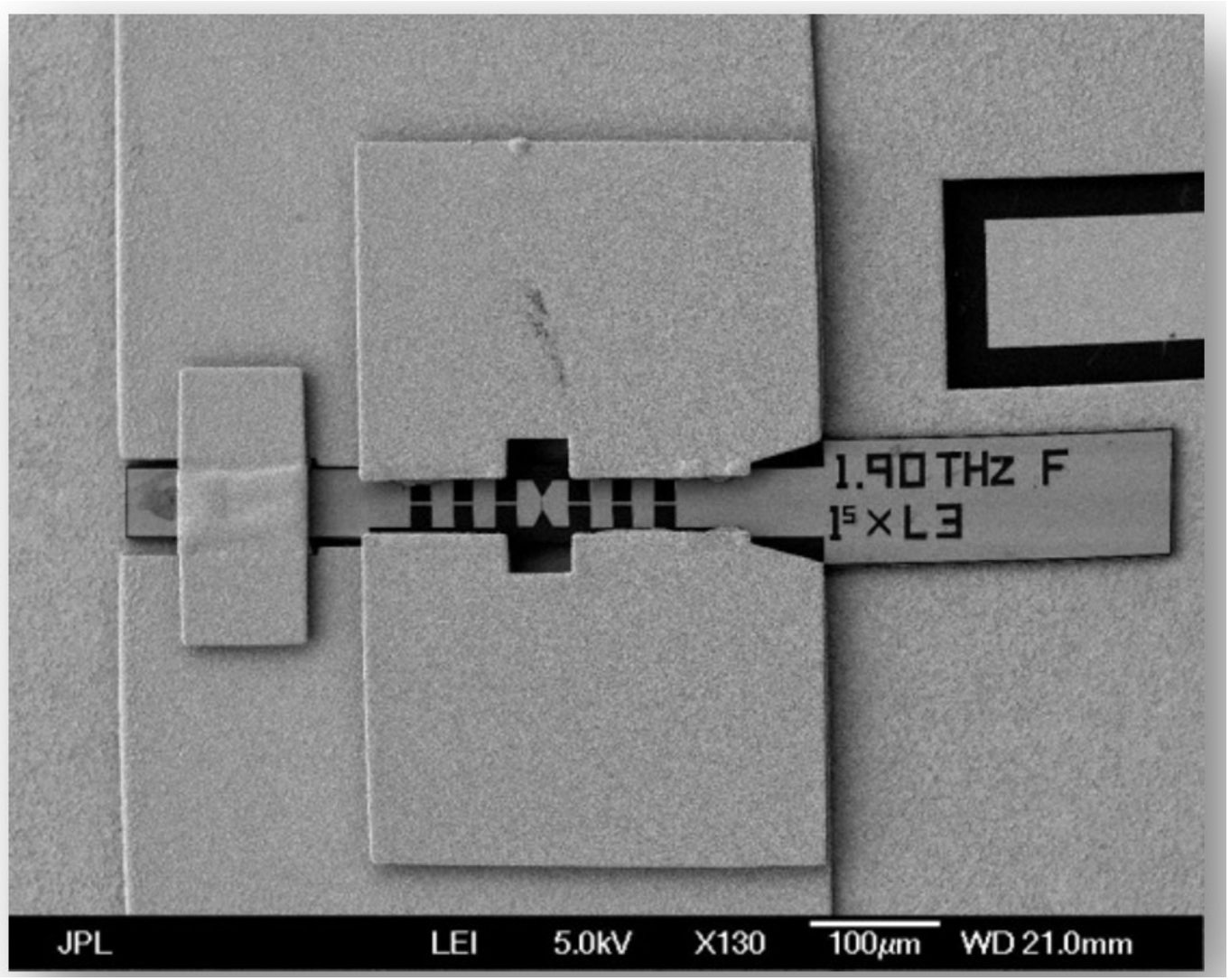


Kinetic Inductance Device (KID) array with >800 pixels and two wirebonds

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

Project Title: Ultra-Sensitive Bolometers for Far-IR Space Spectroscopy at the Background Limit

PI: C. Matt Bradford (JPL)

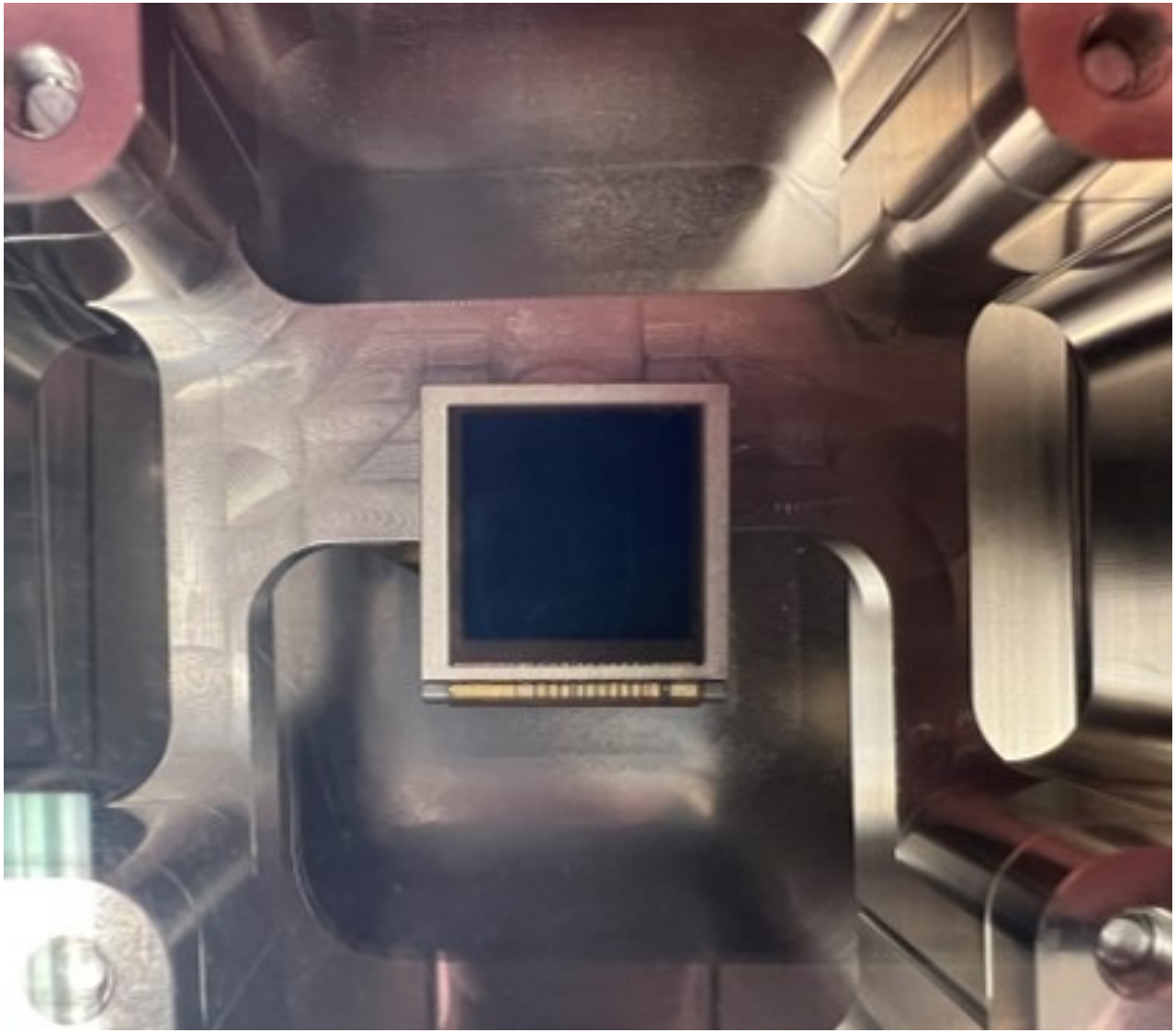


SOI waveguide mixer block for far-IR detector array

Significance: Further development of this high-resolution far-IR detector technology to higher pixel numbers may enable or enhance future missions

Project Title: Development of High-Resolution Far-IR Arrays

PI: Imran Mehdi (JPL)

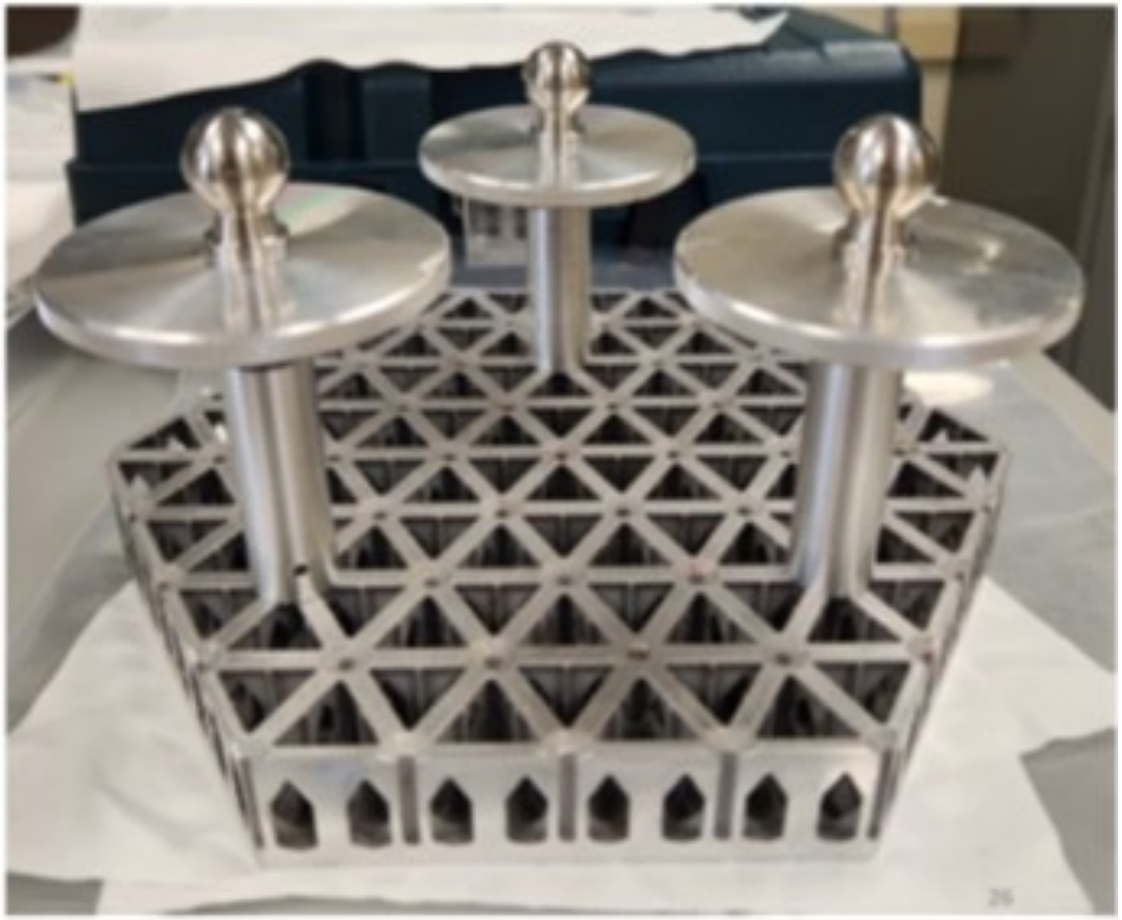


Science-grade photon-counting near-IR detector

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

Project Title: Photon counting NIR LmAPD Arrays for Ultra-low Background Space Observations

PI: Michael Bottom (U. of Hawaii)

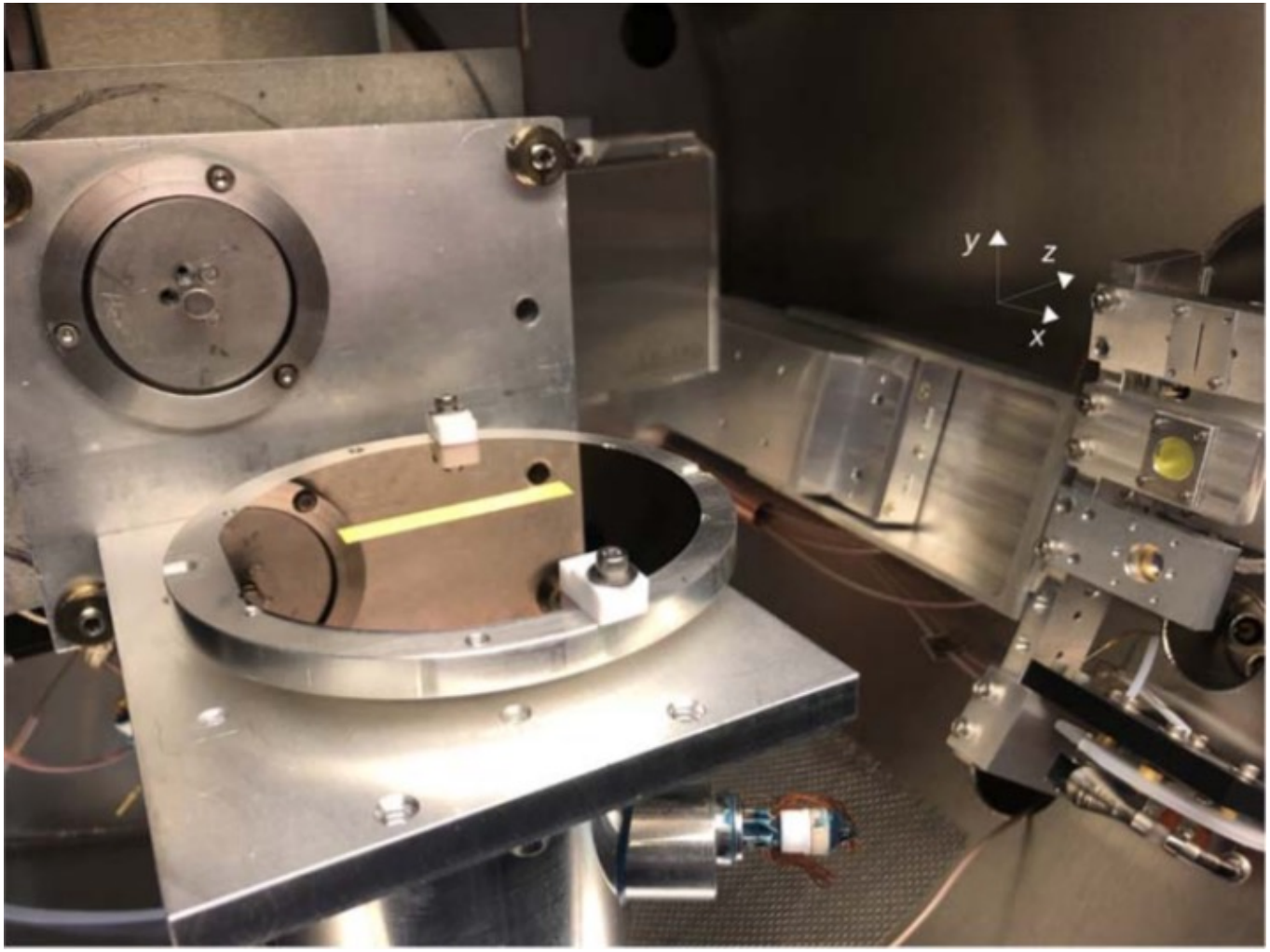


Testing CTE homogeneity of additive-manufacture aluminum mirror segment

Significance: This technology may enable required ultra-stability (~10 pm) for the next IR/Optical/UV Great Observatory

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

PI: H. Philip Stahl (MSFC)

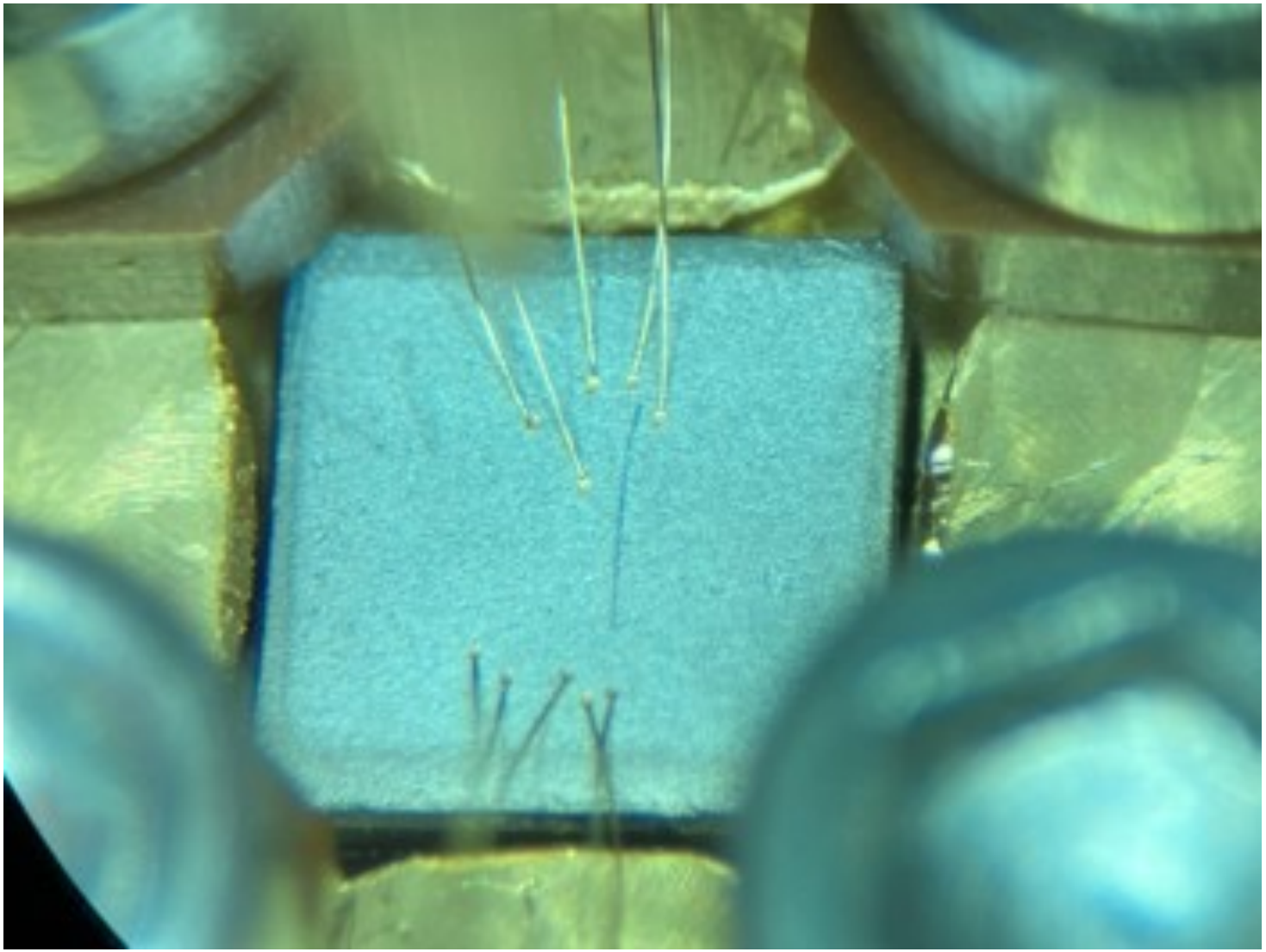


Test flat grating in ALS measurement configuration

Significance: May enable future UV/optical spectroscopic missions; enables current UV suborbital missions

Project Title: Electron-Beam-Lithography Ruled Gratings for Future UV/Optical Missions: High Efficiency and Low Scatter in the Vacuum UV

PI: Brian Fleming (U. of Colorado)

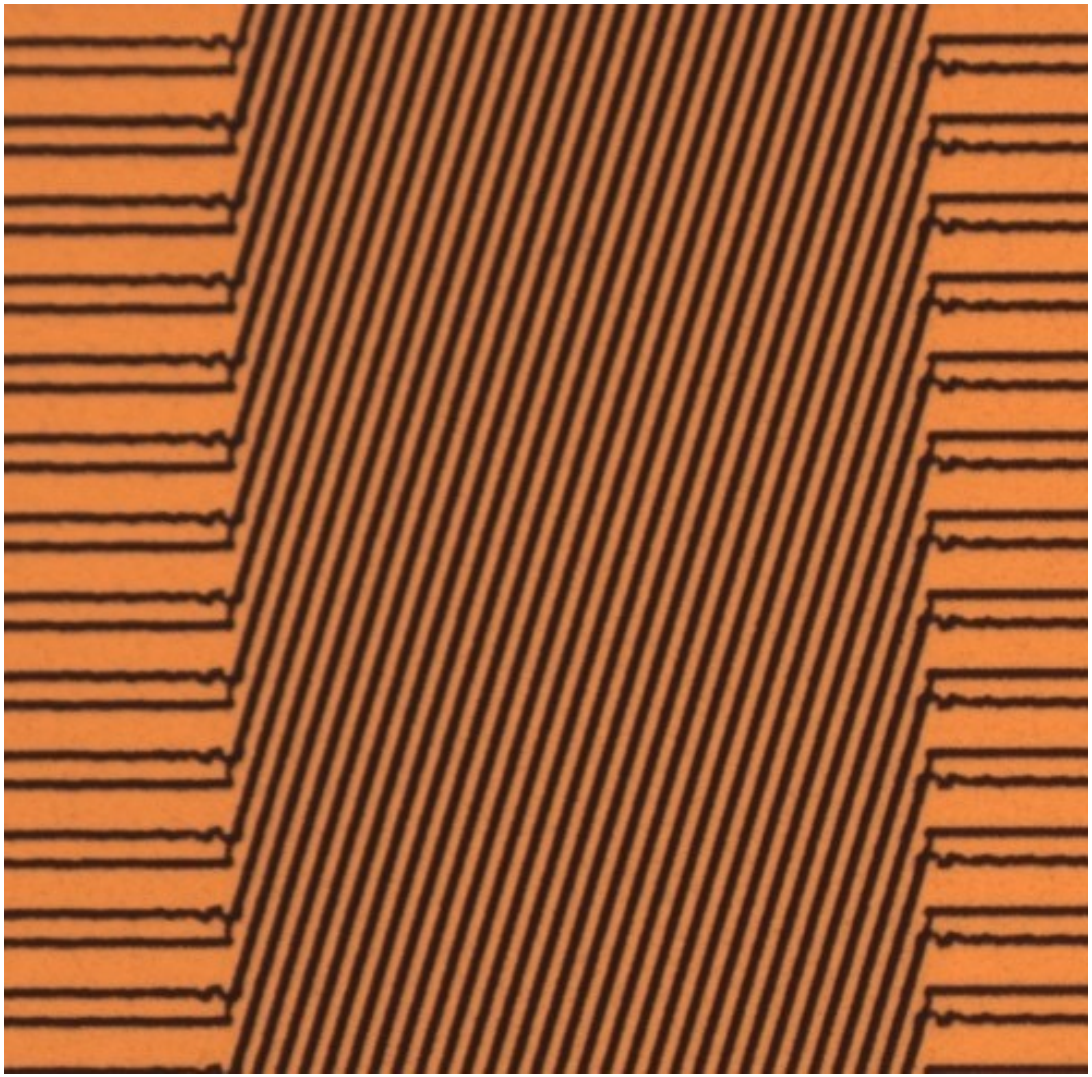


Palladium and gold used to heat-sink back of detector

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)



High-density 3D-printed traces on ceramic substrate

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

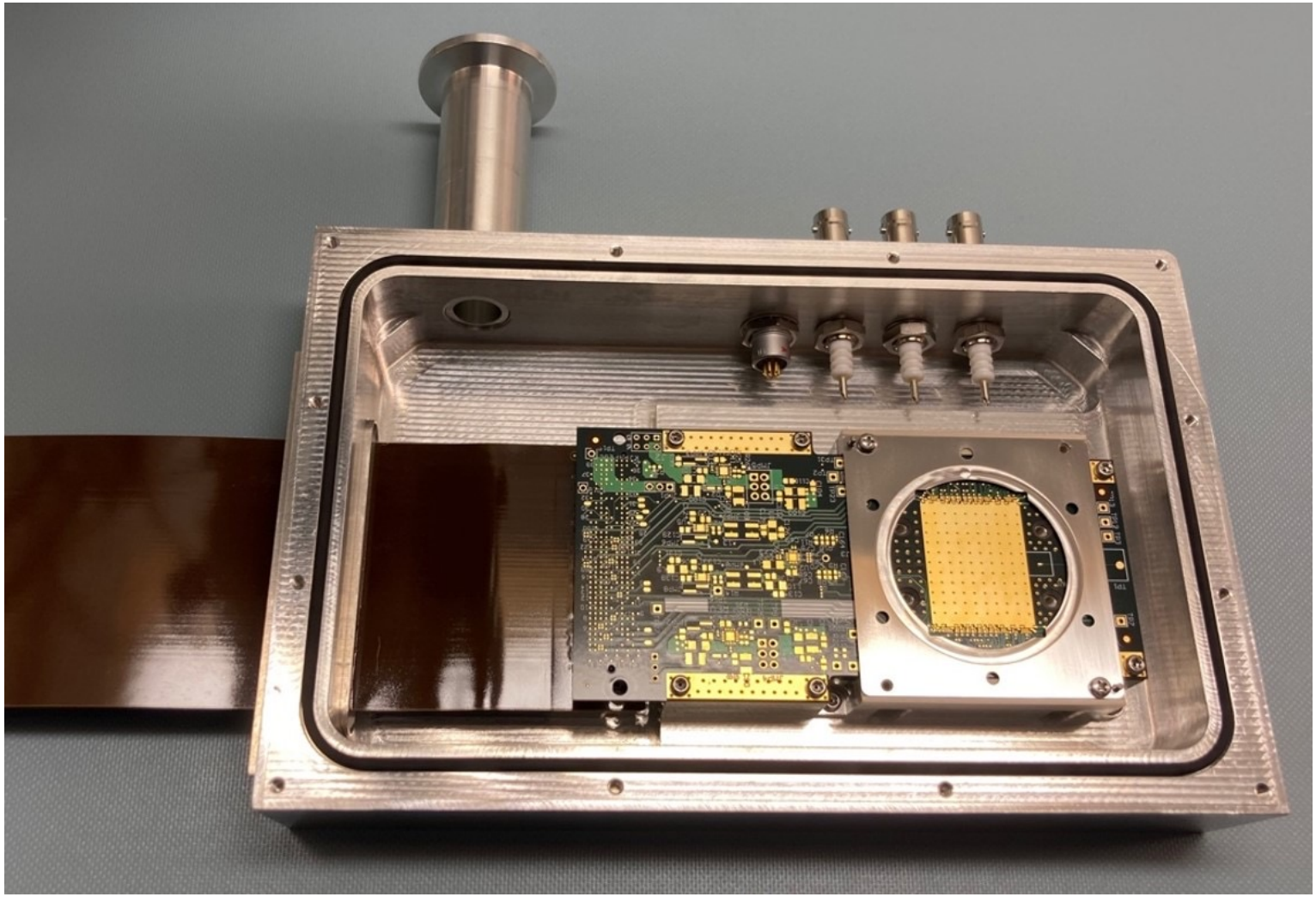
PI: Matt Greenhouse (GSFC)

Planacon tube body with MgF_2 entrance window and hermetic XS anode

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)



Multi-Channel Plate (MCP) assembly mounted over TPX4 test board in vacuum

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

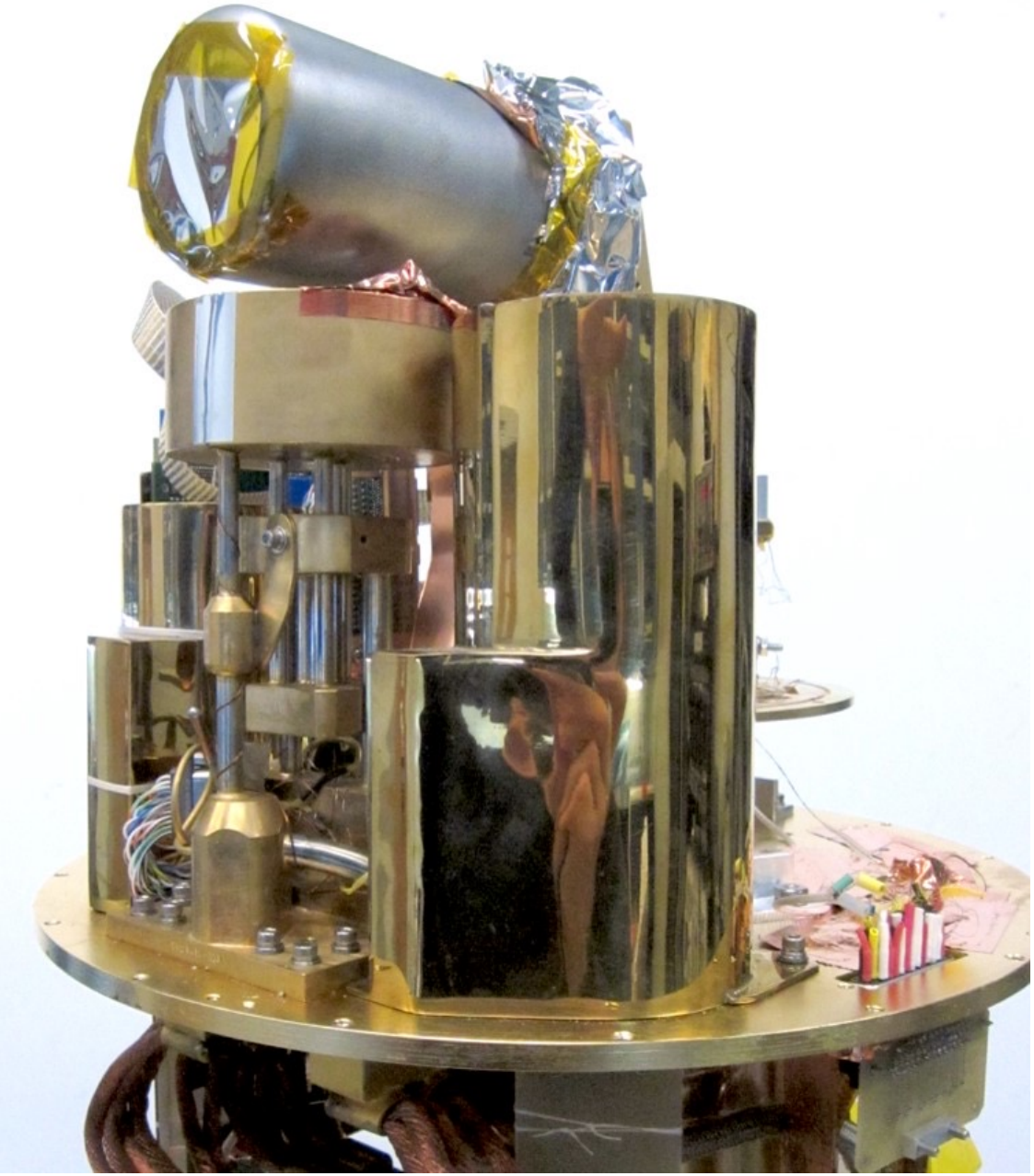
PI: John Vallerga (UC Berkeley)

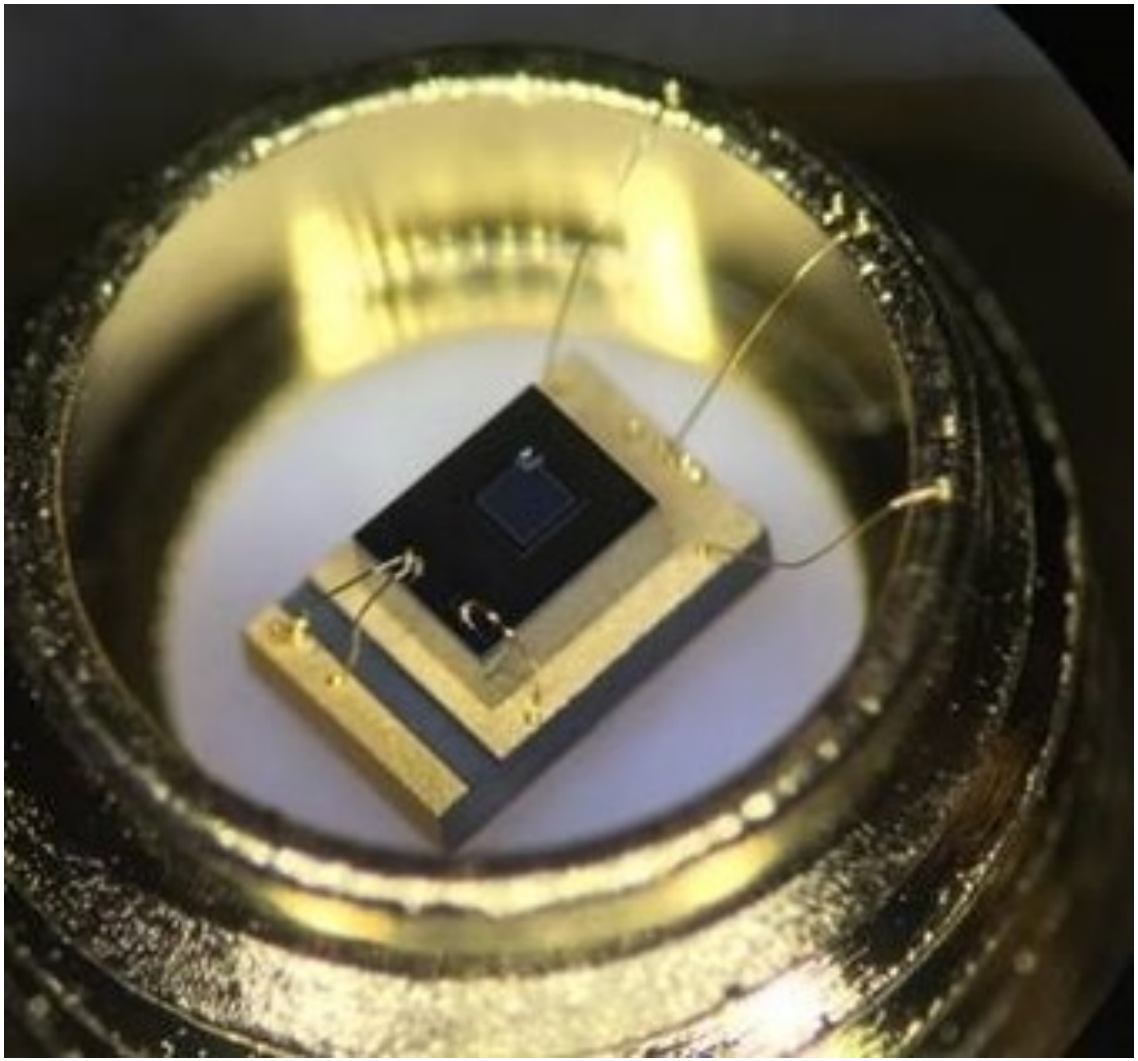
TEMS sub-4-K cryogenics package and detector assembly

Significance: Supports NASA X-ray observatories by developing similar instruments in ground-based labs, replicating conditions in astrophysical sources observed by spaceflight instruments, and observing them parametrically to help interpret space-based data

Project Title: Advanced X-ray Microcalorimeters: Lab Spectroscopy for Space Atomic Physics

PI: F. Scott Porter (GSFC)



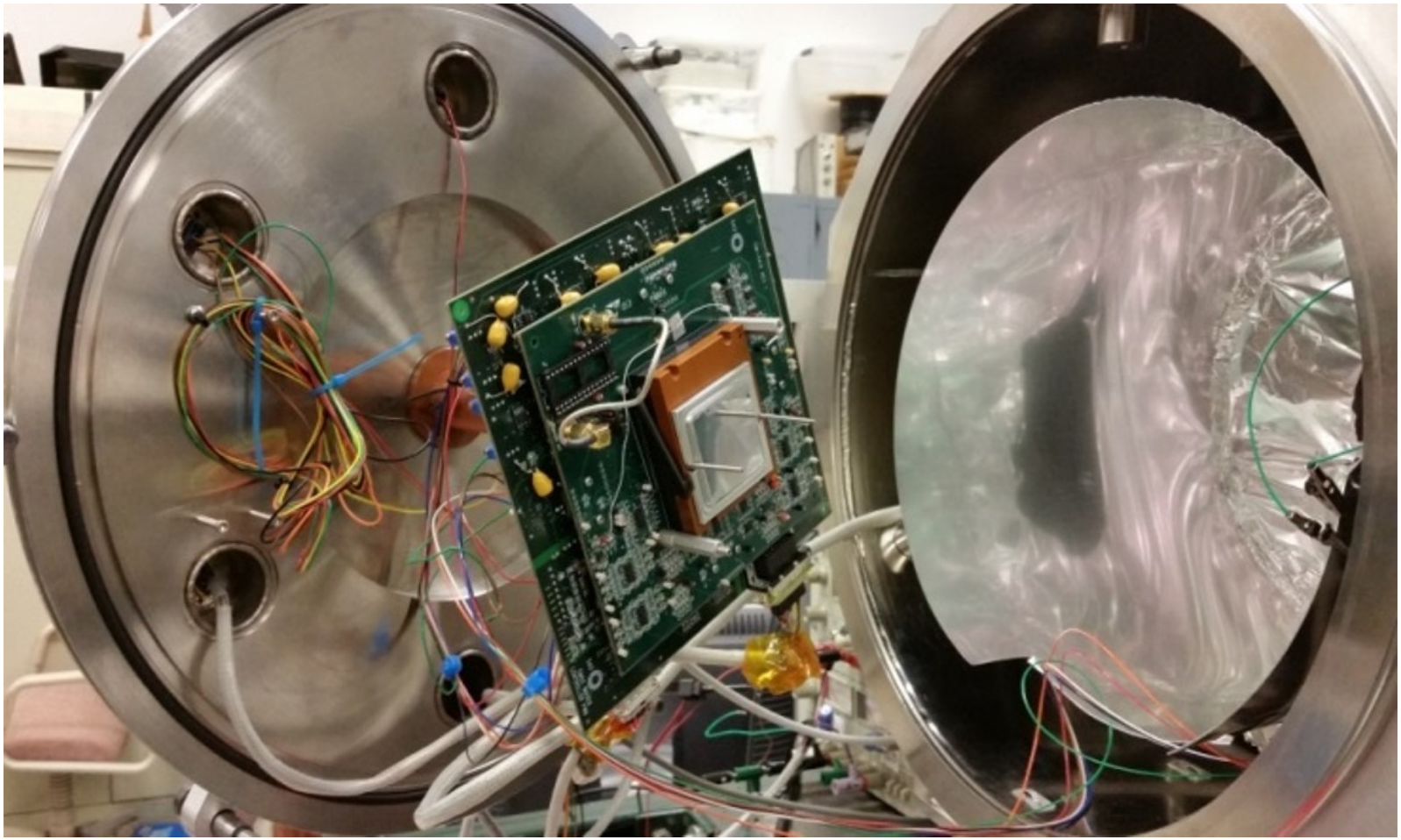


Superlattice-doped, 3D-stacked detector

Significance: Multi-gigapixel mosaic focal planes with large format CMOS detectors, low noise, small pixels, and broadband UV/O/IR response or visible-blind high-quantum-efficiency near-UV detectors may enable such future strategic missions as the IR/O/UV Great Observatory

Project Title: High Performance FUV, NUV, and UV/Optical CMOS Imagers

PI: Michael Hoenk (JPL)

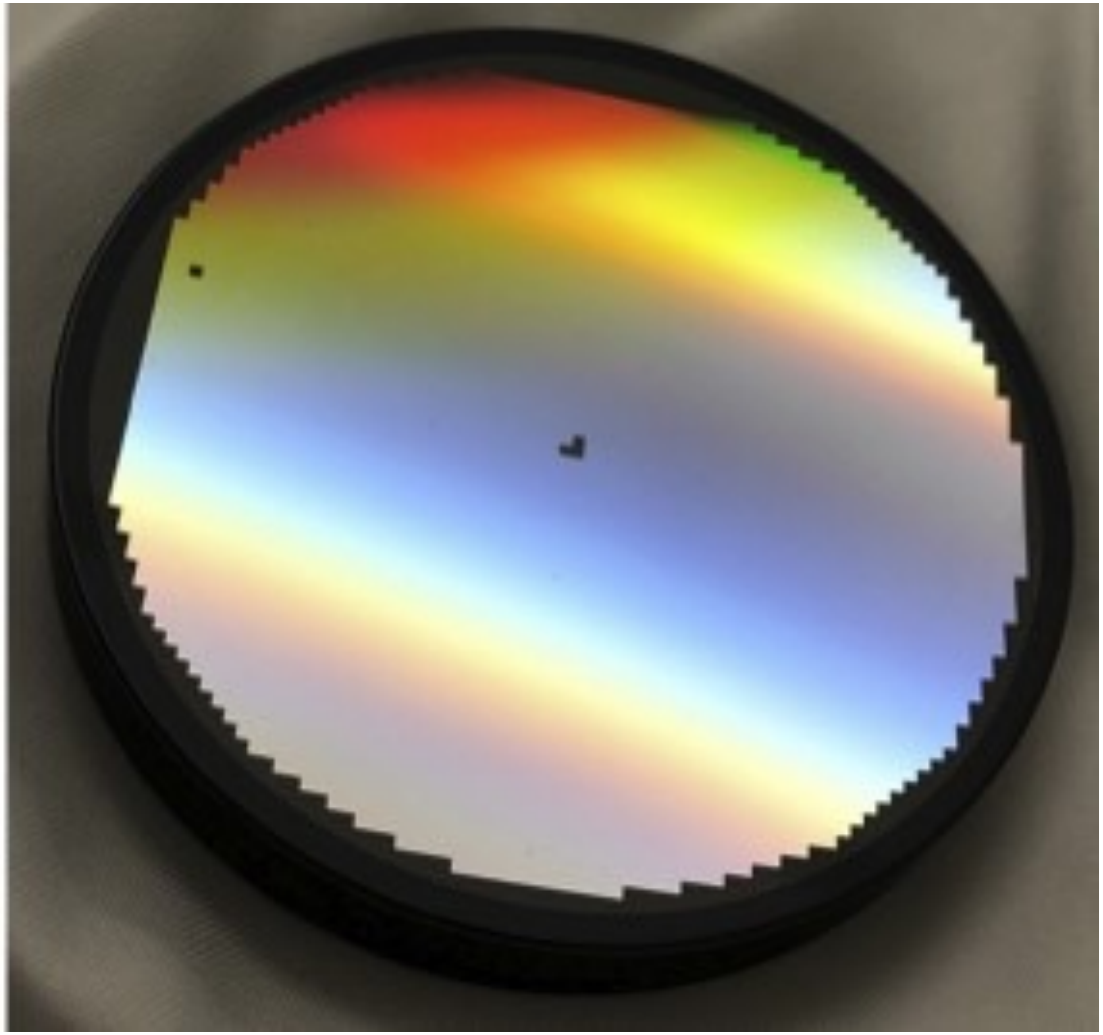


Test facility for detector calibration, including quantum efficiency (QE) and energy resolution

Significance: This work may retire development risks and satisfy performance and technical requirements for detectors needed for future strategic X-ray missions

Project Title: Development of Advanced Pixelated Si Sensors for the Next Generation of X-ray Observatories

PI: Ralph Kraft (SAO)



Polished Si grating with 80 mm diameter, 250 mm radius of curvature, and hyperbolic grooves

Significance: High-efficiency echelles and full-sized, curved-substrate, flight-like UV gratings may enable spectroscopy for strategic missions such as the IR/O/UV Great Observatory, Probes, Explorers, and sounding-rocket missions

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

PI: Randall McEntaffer (PSU)