**PI:** Zhang, William (GSFC)

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

**Significance:** Baseline for Lynx grazing X-ray optics

**Image Caption:** Single mirror segment plus stacked segments with support panel
PI: Mark Schattenburg (MIT Kavli Institute for Astrophysics and Space Research)

Project Title: High Resolution and High Efficiency X-ray Transmission Grating Spectrometer

Significance: Baseline for Lynx X-ray gratings

Image Caption: SEM images of cleaved freestanding Critical-Angle Transmission (CAT) grating
PI: Randall Smith (SAO) & Alexander Bruccoleri (Izentis, LLC)

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

Significance: Baselined for Lynx X-ray gratings

Image Caption: 200-mm wafer patterned with 16 ARCUS-style CAT gratings
PI: Philip Mauskopf (ASU)

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

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

**Image Caption:** Auxiliary IF boards for reading out superconducting resonators with resonant frequencies from 0.1 – 8 GHz, implemented for ground-based Toltec experiment
PI: Don Figer (RIT)
Project Title: A Single-Photon-Sensing and Photon-Number-Resolving Detector for NASA Missions
Significance: Low-noise detectors are crucial for future missions
Image Caption: One of three assembled detector boards in a panel
PI: Roger O’Brien (JPL/Caltech)
Project Title: Superconducting Detectors for CMB Polarimetry in PICO
Significance: CMB polarimetry is crucial for identifying echoes of the Big Bang
Image Caption: Field-testing detectors in BICEP (Antarctica)
PI: Caroline Kilbourne (GSFC)
Project Title: Advanced X-ray Microcalorimeters: TES Microcalorimeters
Significance: TES microcalorimeters may enable future X-ray missions such as Lynx
Image Caption: First prototype Lynx TES arrays with 25 absorbers
PI: Simon Bandler (GSFC)

Project Title: Magnetically-Coupled Microcalorimeter Arrays for X-ray Astrophysics

Significance: MMCs may enable future X-ray missions such as Lynx

Image Caption: 8” wafer with 4” MMC core
PI: Jacqueline Davis (MSFC)

Project Title: Advanced X-ray Optics: Computer-Controlled Polishing of High-Quality Mandrels

Significance: High-quality X-ray optics may enable Explorers and other missions

Image Caption: High-resolution metrology to measure polished mandrel
**PI:** Kiranmayee Kilaru (MSFC)

**Project Title:** Advanced X-ray Optics: Differential Deposition for Figure Correction in X-Ray Optics

**Significance:** High-quality X-ray optics may enable Explorers and other missions

**Image Caption:** Active slit for differential deposition
PI: Stephen Bongiorno (MSFC)
Project Title: Advanced X-ray Optics: Full-shell direct polishing
Significance: High-quality X-ray optics may enable Explorers and other missions
Image Caption: Mandrel being polished
PI: David Broadway (MSFC)
Project Title: Advanced X-ray Optics: Mirror Coatings
Significance: High-quality X-ray optics may enable Explorers and other missions
Image Caption: Hi-C primary EUV multilayer mirror
PI: David Broadway (MSFC)
Project Title: Advanced X-ray Optics: Hybrid X-Ray Optics by Additive Manufacturing
Significance: High-quality X-ray optics may enable Explorers and other missions
Image Caption: Polyimide aerogel
PI: Paul Reid (SAO)
Project Title: Adjustable X-Ray Optics
Significance: Adjustable X-ray optics are a backup technology for Lynx
Image Caption: Back side of X-ray mirror segment with row-column ZnO TFTs, ESD circuits, and piezo cells
PI: Mark Bautz (MIT Kavli Institute for Astrophysics and Space Research)

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

Significance: Advanced X-ray detectors may enable Lynx

Image Caption: Six next-generation devices on 200-mm wafer. Inset shows current, much smaller sensor
PI: Zoran Ninkov (RIT)

Project Title: Development of Digital Micromirror Devices for Far-UV Applications

Significance: May enable multi-object spectrometry in future missions

Image Caption: COTS DMDs being recoated
PI: Josef Frisch (SLAC)

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

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

Image Caption: RFSoc board
**PI:** Douglas Bennett (NIST)

**Project Title:** Technology development for Microwave SQUID multiplexing for the Lynx X-ray Observatory

**Significance:** May enable the Lynx mission

**Image Caption:** Measuring hydra TESs using μMUX
PI: James Tuttle (GSFC)

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

Significance: Baselined by the Lynx, Origins, PICO, and GEP

Image Caption: Two-stage 10K-to-4-K Continuous Adiabatic Demagnetization Refrigerator (CADR)
PI: Babak Saif (GSFC)
Project Title: Ultra-Stable Structures
Significance: May enable the HabEx and LUVOIR missions
Image Caption: Speckle interferometer for ultra-precise measurements of non-reflective objects
**PI:** Johannes Staguhn (JHU & GSFC)

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

**Significance:** May enable the Origins mission

**Image Caption:** Far-IR detector array
PI: John Hennessy (JPL)

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

**Significance:** May enable future far-UV missions

**Image Caption:** Custom 0.9-m ALD tool, developed to coat ground-based astronomical mirrors for ALD-protected silver
PI: Manuel Quijada (GSFC)

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

Significance: May enable future far-UV missions

Image Caption: Large Area Plasma Processing System (LAPPS) at NRL used for removing oxidation from aluminum optics
PI: C. Matt Bradford (JPL)
Project Title: Ultra-Sensitive Bolometers for Far-IR Space Spectroscopy at the Background Limit
Significance: May enable future far-IR missions
Image Caption: Initial TES bolometer fabrication
**PI:** Imran Mehdi (JPL)

**Project Title:** Development of High-Resolution Far-Infrared Arrays

**Significance:** May enable future far-IR missions

**Image Caption:** 16-Pixel 1.9-2.06 THz Local Oscillator Subsystem
PI: Michael Bottom (U. of Hawaii)

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

Significance: May enable spectroscopy of extrasolar planets

Image Caption: Growth uniformity of wafer yielding six usable sites for 1k×1k LmAPD detector
PI: H. Philip Stahl (MSFC)

**Project Title:** Predictive Thermal Control (PTC) Technology to enable Thermally Stable Telescopes

**Significance:** May enable required ultra-stability for HabEx and LUVOIR missions

**Image Caption:** 1.5-m AMTD-2 ULE® mirror in active thermal enclosure
PI: Brian Fleming (U. of Colorado)

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

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

**Image Caption:** Protoflight CHESS echelle grating and SEM image of ruled grating
PI: Adrian T. Lee (UC Berkeley)

Project Title: Technology Development for LiteBIRD and other CMB Missions

Significance: May enable future CMB missions

Image Caption: Mock array in vibration test
PI: Matt Greenhouse (GSFC)

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

Significance: May enable sparse-field multi-object spectroscopy for e.g. LUVOIR, HabEx, CETUS, and/or AERIE

Image Caption: Mask layout for 734×348 array; Small sections in sub-arrays consist of microshutters with various keystone structures
PI: Oswald Siegmund (UC Berkeley)

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

Significance: Baselined by HabEx, LUVOIR, and CETUS

Image Caption: Planacon 50-mm sealed tube with sapphire input window, bialkali cathode, ALD borosilicate MCPs, and LTCC XS anode
PI: John Vallerga (UC Berkeley)
Project Title: Large-Format, High-Dynamic-Range UV detector using MCPs and Timepix4 readouts
Significance: May enable future far-UV missions with large focal planes
Image Caption: MCP/Timepix detector with 2×2 array of Timepix chips in the center
PI: F. Scott Porter (GSFC)

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

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

Image Caption: NIST-developed 8-column × 32-row TDM “snout” package
PI: Shouleh Nikzad (JPL/Caltech)

Project Title: Advanced FUV/UV/Visible Photon-Counting and Ultralow-Noise Detectors

Significance: Detectors baselined by SHIELDS, HabEx, LUVOIR, and ground facilities

Image Caption: 2D Delta-Doped EMCCD Detector