National Aeronautics and Space Administration

OSIRIS-REx VISIBLE AND INFRARED SPECTROMETER

NASA Goddard Space Flight Center

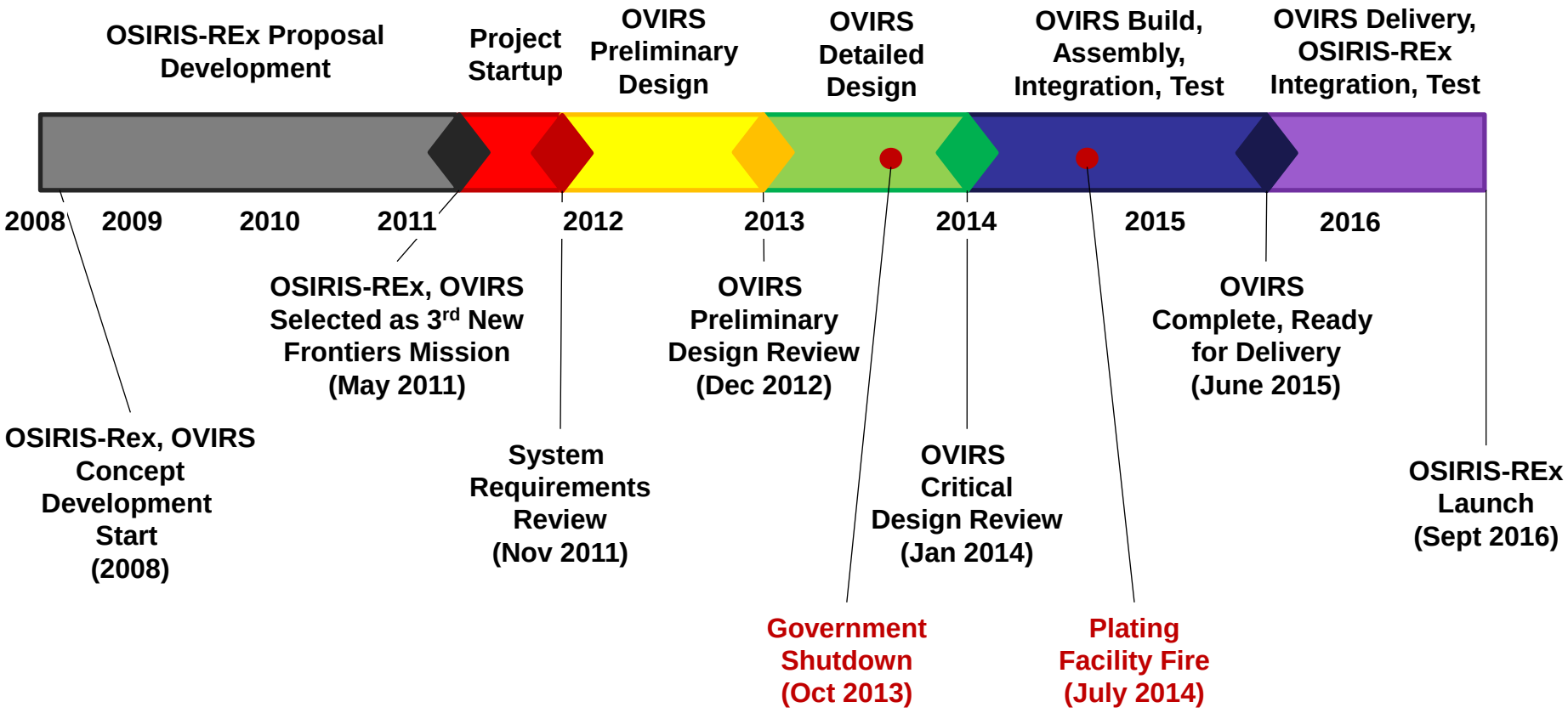
www.nasa.gov

OVIRS Overview: How it was made

Jason Hair – Instrument Project Manager

NASA – GSFC

OVIRS Development Timeline



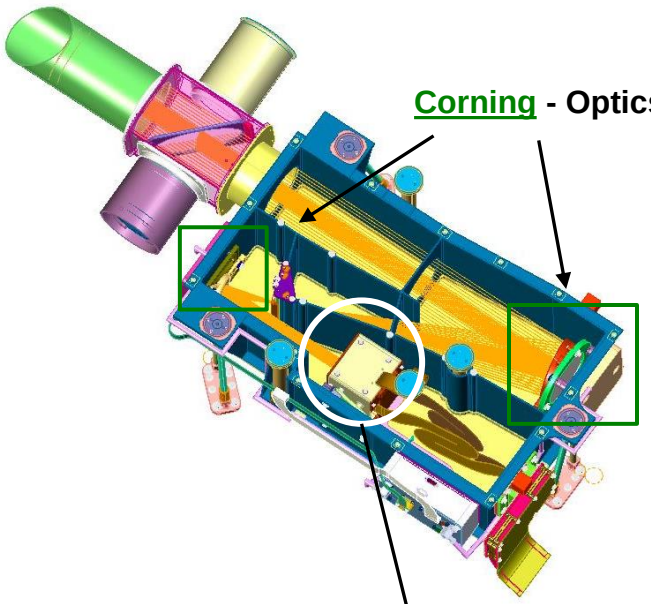
OVIRS has been developed, built, and tested to meet performance requirements and delivered ahead of schedule and within budget

OVIRS Roles and Responsibilities

- **Goddard Space Flight Center**
  - Overall Instrument Responsibility
  - Instrument Scientist and Deputy Instrument Scientist
  - Management & Systems Engineering
  - Mechanical Hardware
  - Harness Assemblies
  - SIDECAR Assembly Code
  - OVIRS Integration and Environmental Qualification
  - OVIRS Performance Testing, Calibration and Characterization
- **Southwest Research Institute**: Main Electronics Box
  - ICDH, Power Supply, Chassis
- **Jackson and Tull**: Focal Plane Electronics
- **Teledyne Imaging Sensors**: Focal Plane Assembly
- **JDS Uniphase (Viavi Solutions)**: Linear Variable Filter
- **Corning**: Optics

OVIRS Team and Partners

GSFC - Optics Box



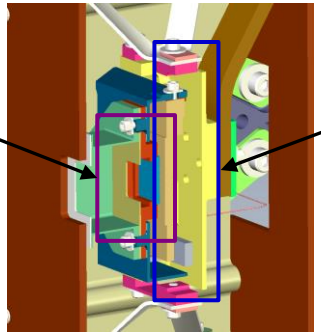
SwRI - Main Electronics Box

SwRI - MEB

J&T - FPE

SwRI - CDH

SwRI - LVPS



JDSU – LVF Array

Teledyne Imaging Sensors – Focal Plane Assembly

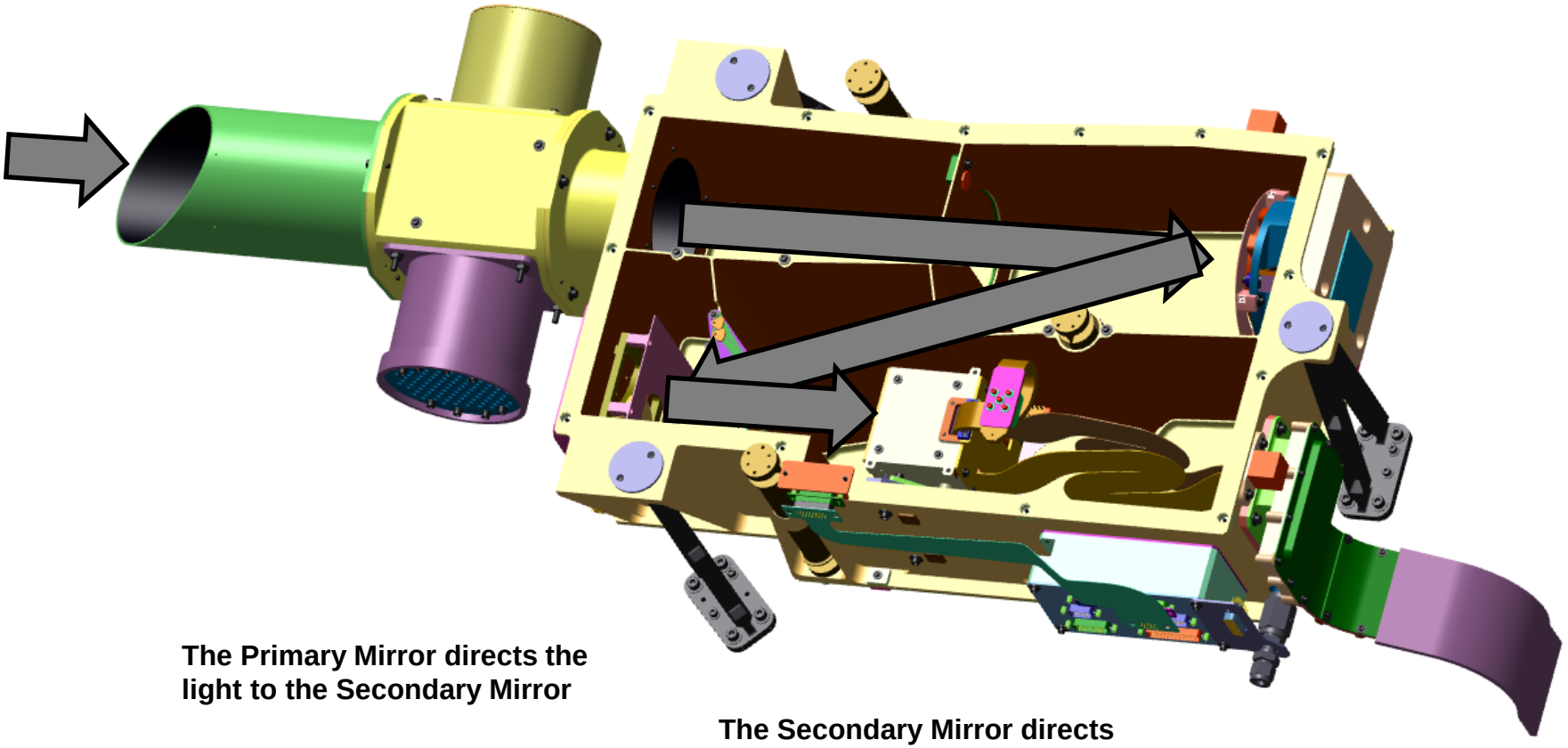
GSFC - Detector Assembly

OVIRS Team (GSFC)

OVIRS Operation – Bennu Measurement

The OSIRIS-REx spacecraft points OVIRS at the target asteroid, Bennu, and light from the Bennu enters OVIRS

The light goes into the Optics Box and to the Primary Mirror

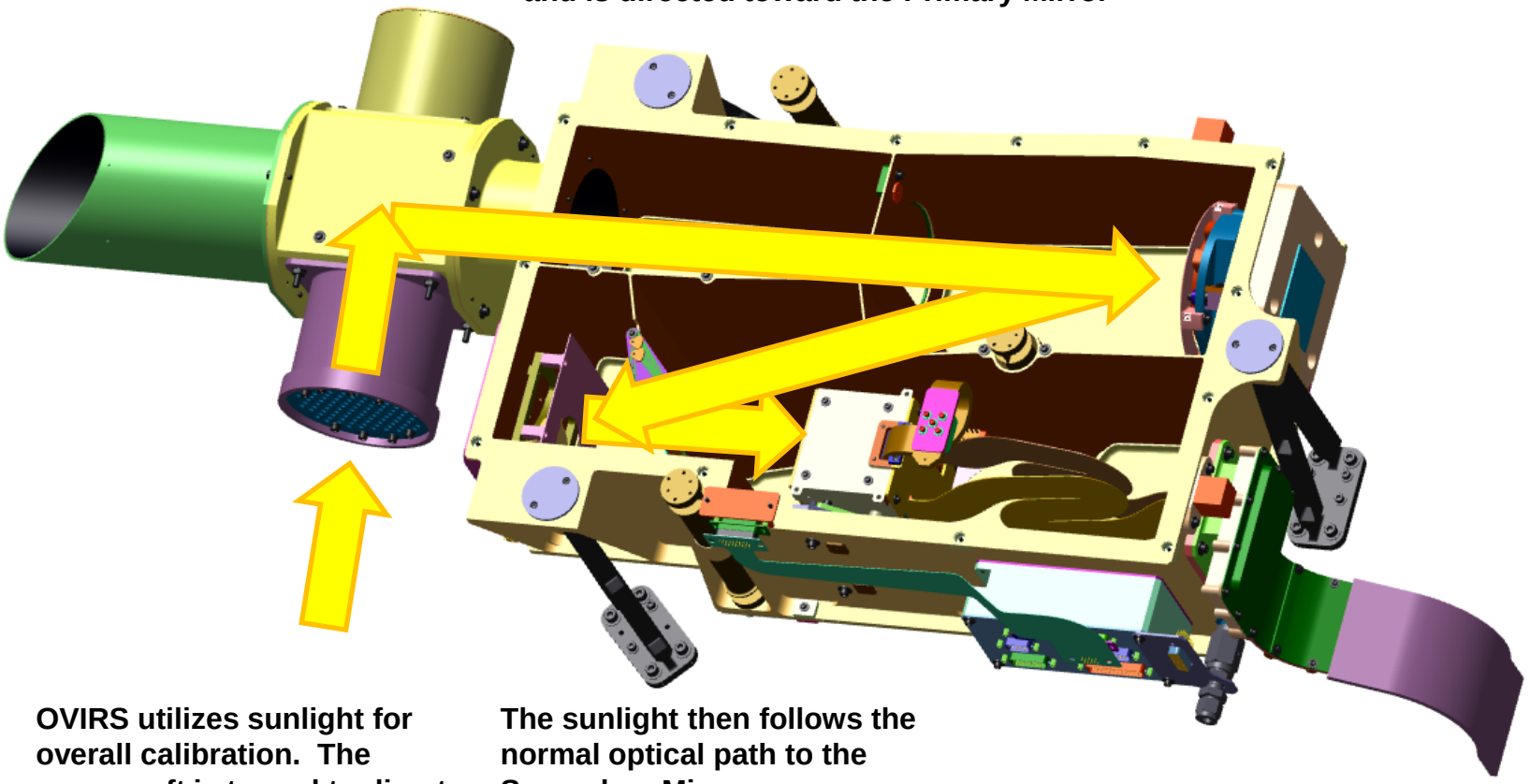


The Primary Mirror directs the light to the Secondary Mirror

The Secondary Mirror directs the light on to the Filters and the Detector

OVIRS Operation – Solar Calibration

A percentage of the sunlight reflects off of a mesh in the solar calibrator assembly and is directed toward the Primary Mirror

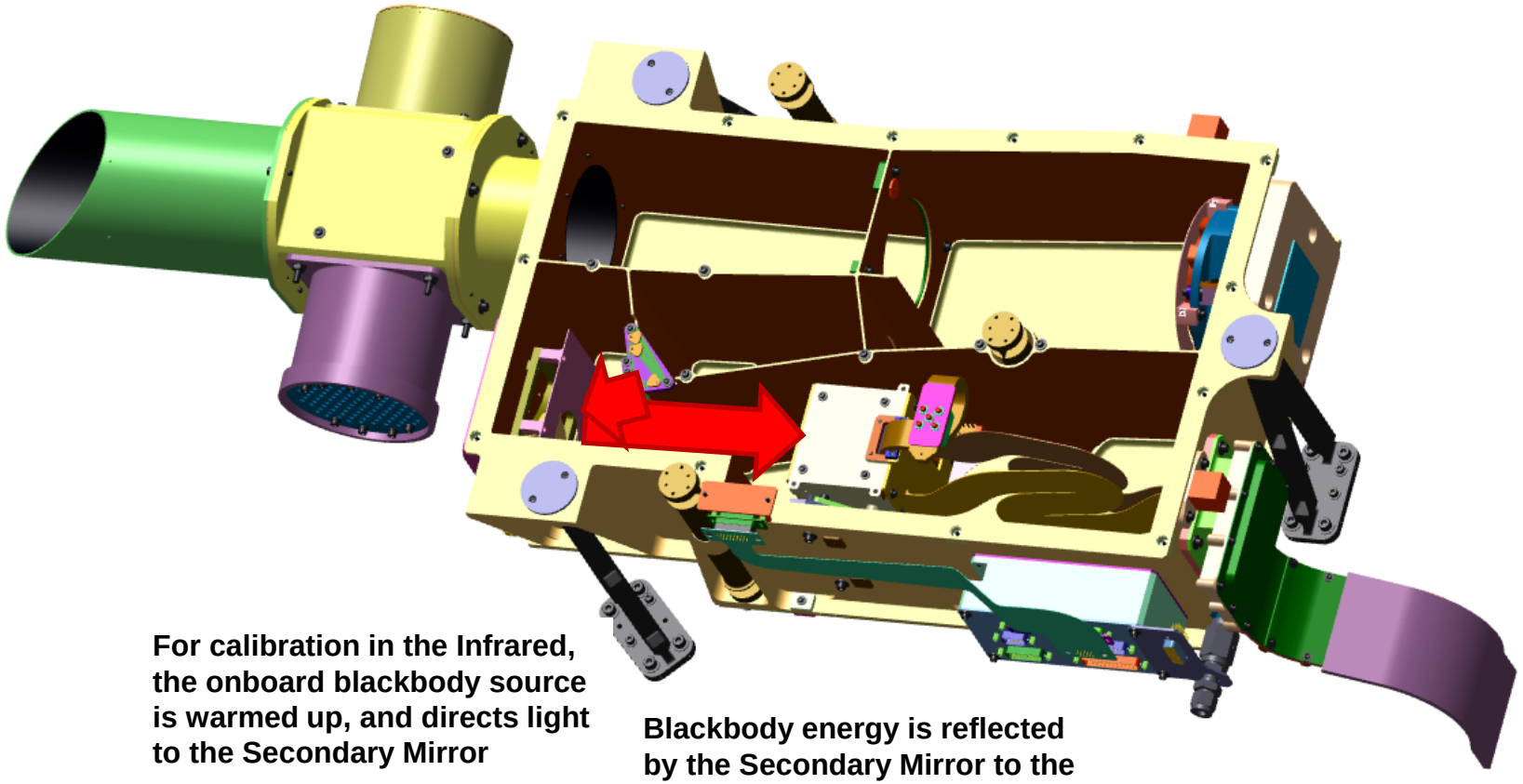


OVIRS utilizes sunlight for overall calibration. The spacecraft is turned to direct sunlight in to the solar port

The sunlight then follows the normal optical path to the Secondary Mirror

The Secondary Mirror directs the sunlight on to the Filters and Detector

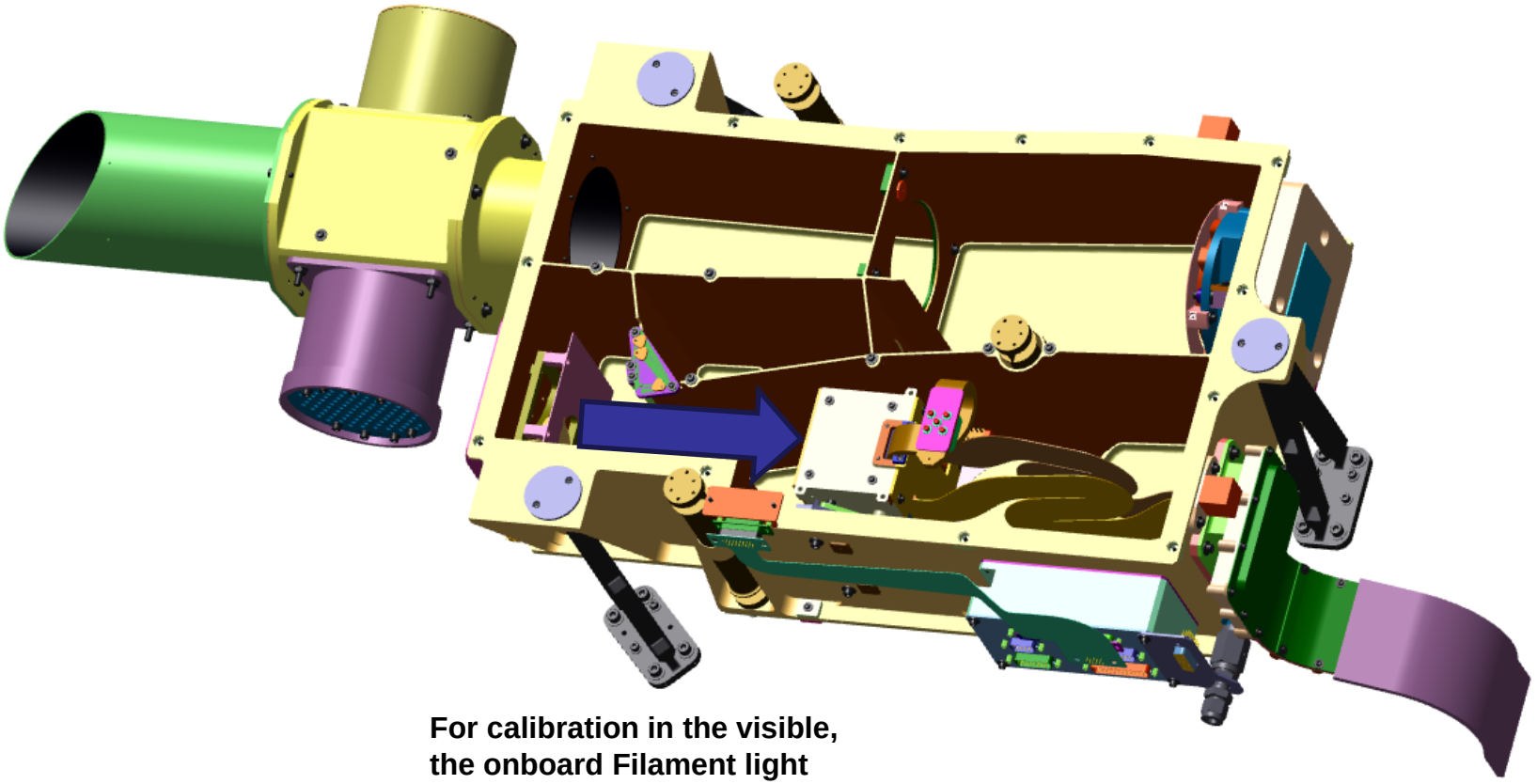
OVIRS Operation – Blackbody Calibration



For calibration in the Infrared, the onboard blackbody source is warmed up, and directs light to the Secondary Mirror

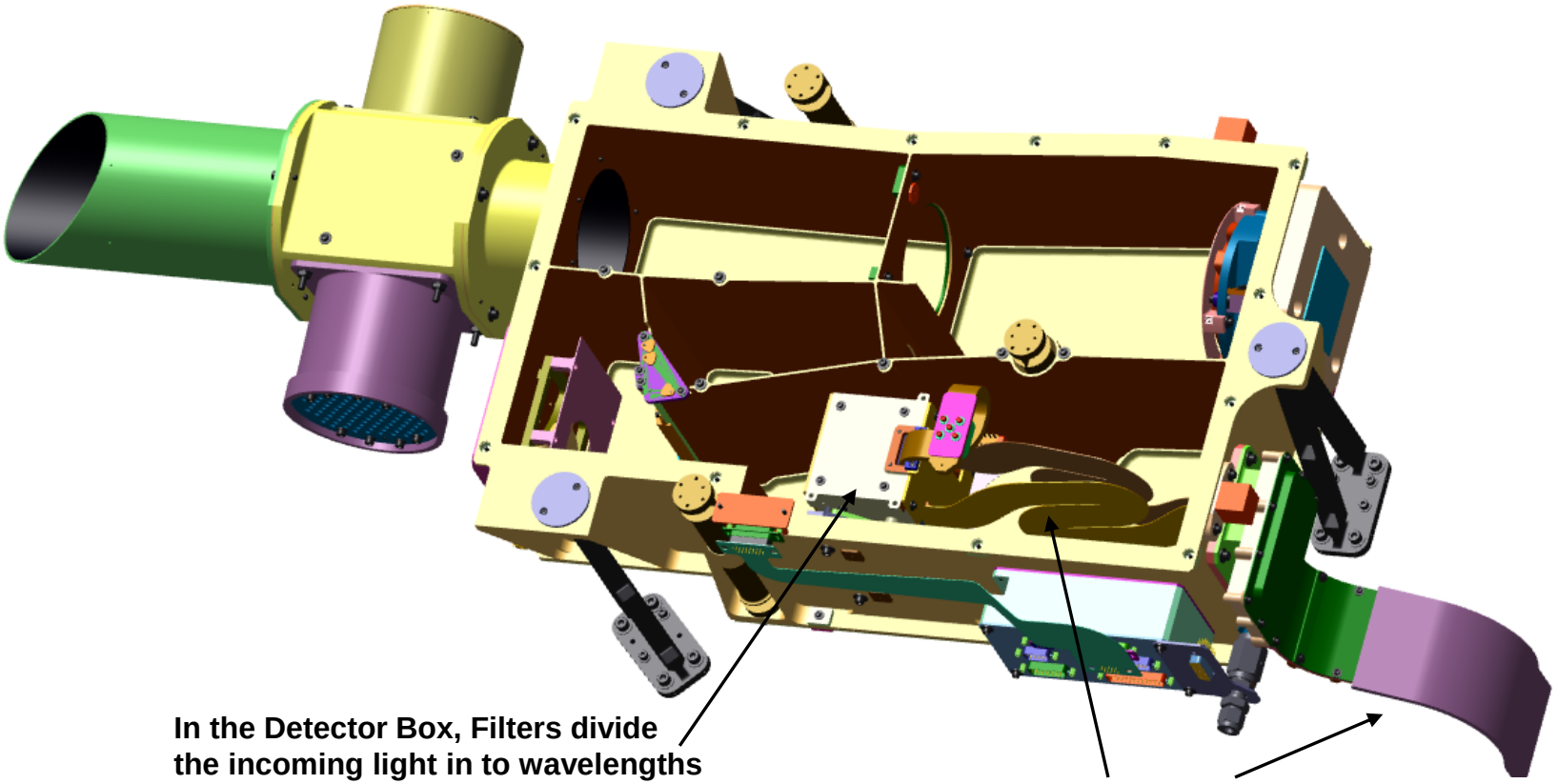
Blackbody energy is reflected by the Secondary Mirror to the Filters and Detector

OVIRS Operation – Filament Calibration



For calibration in the visible, the onboard Filament light source is turned on and directs light directly on to the Filters and Detector

OVIRS Operation

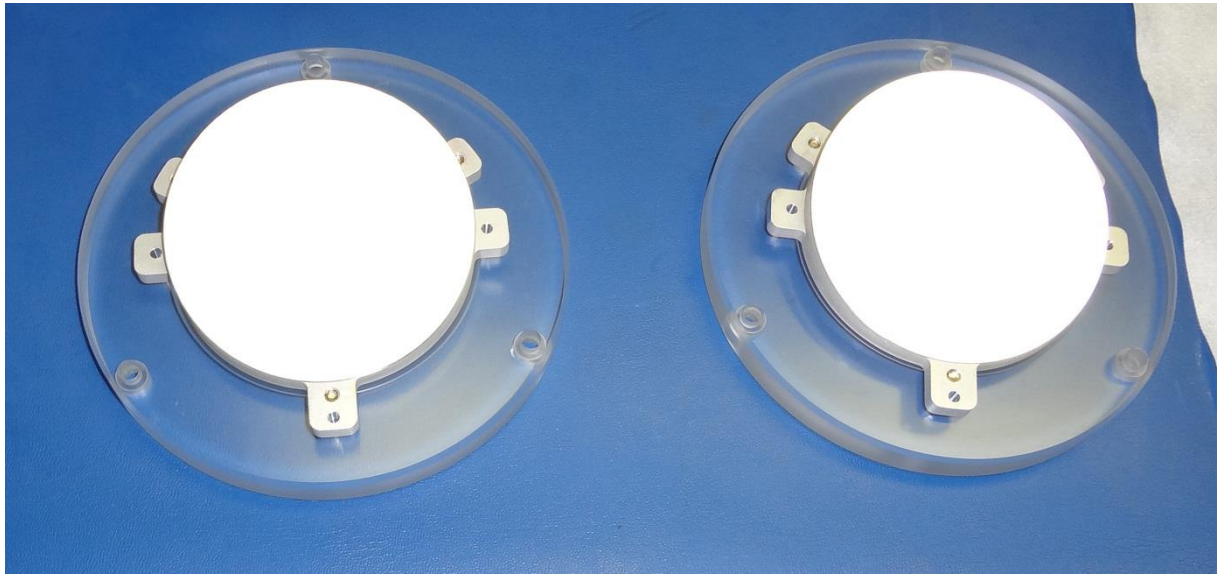


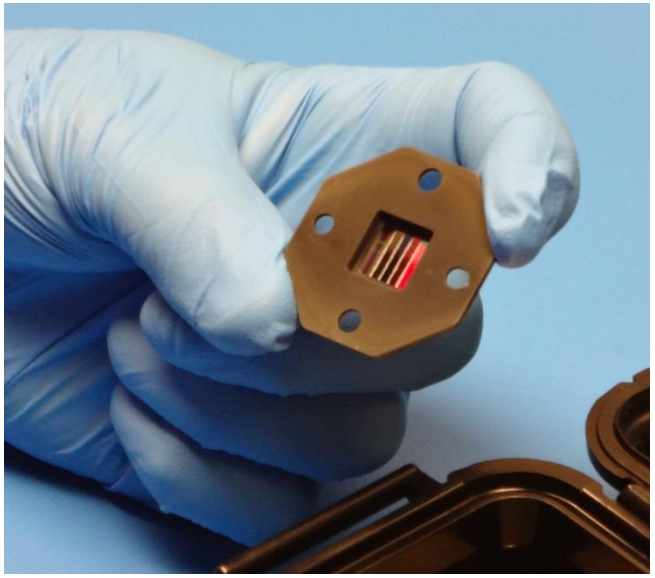
In the Detector Box, Filters divide the incoming light in to wavelengths and the Detector measures the intensity of each wavelength and converts it in to an electrical signal

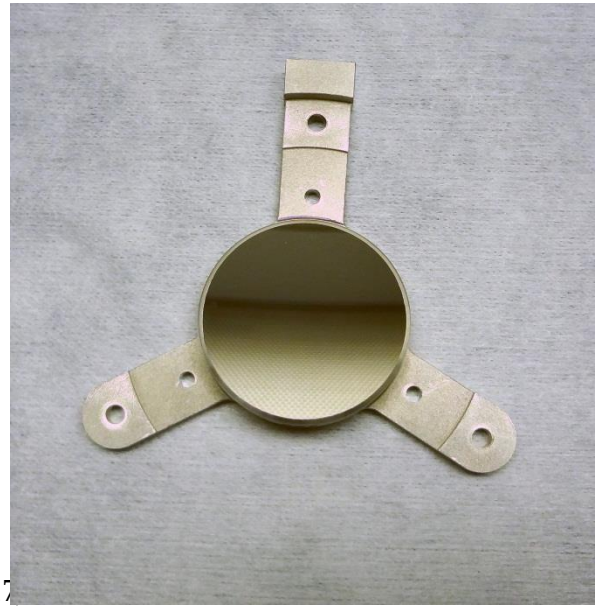
Special harnessing communicates the electrical signal to the Main Electronics Box with low noise, and high thermal isolation to allow the Detector to operate at cryogenic temperatures

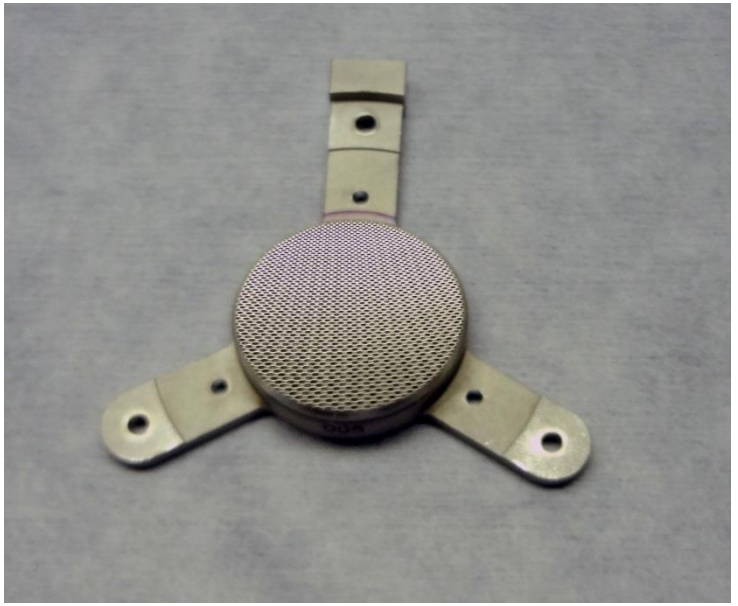
Components

OVIRS Optic Hardware

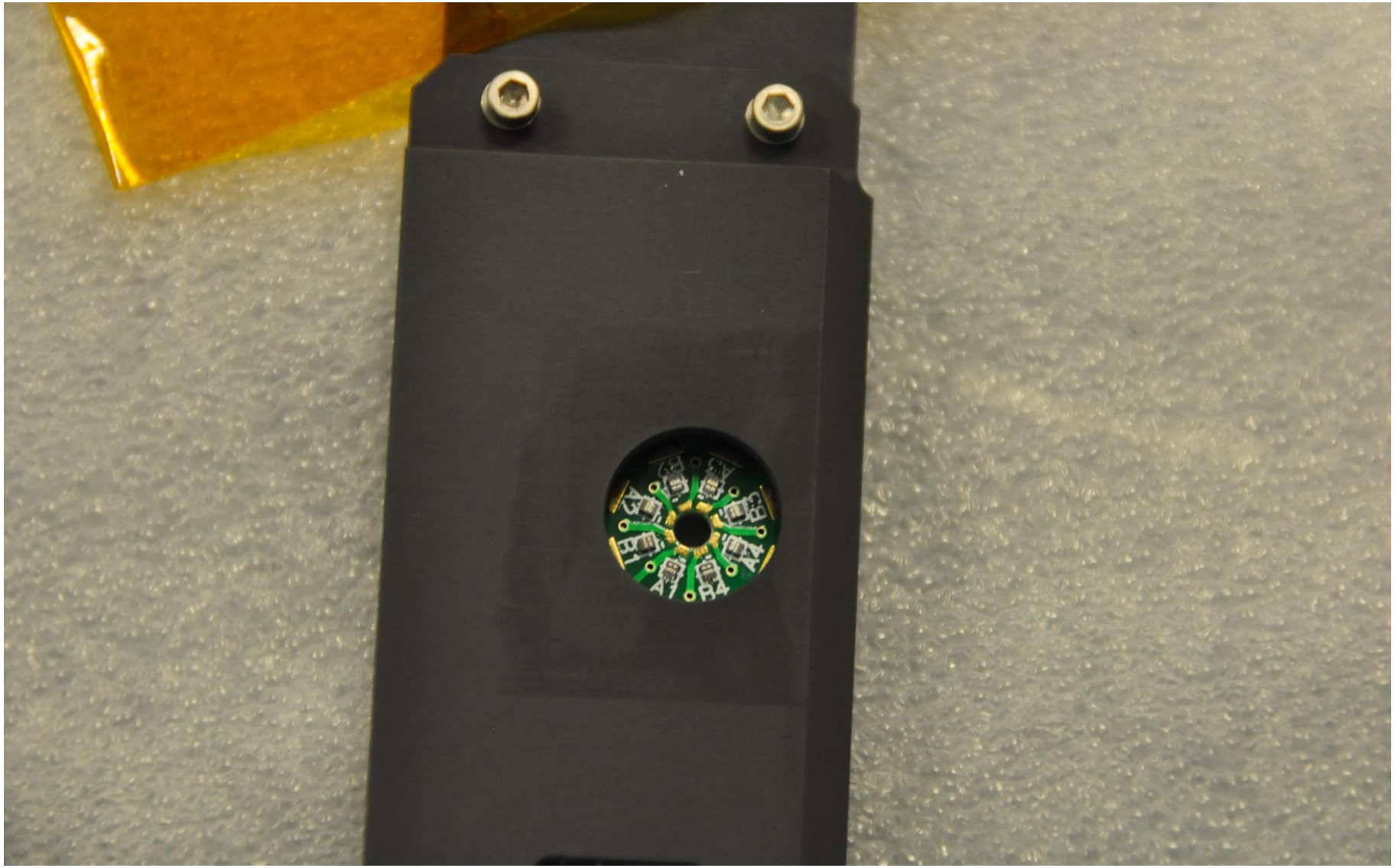




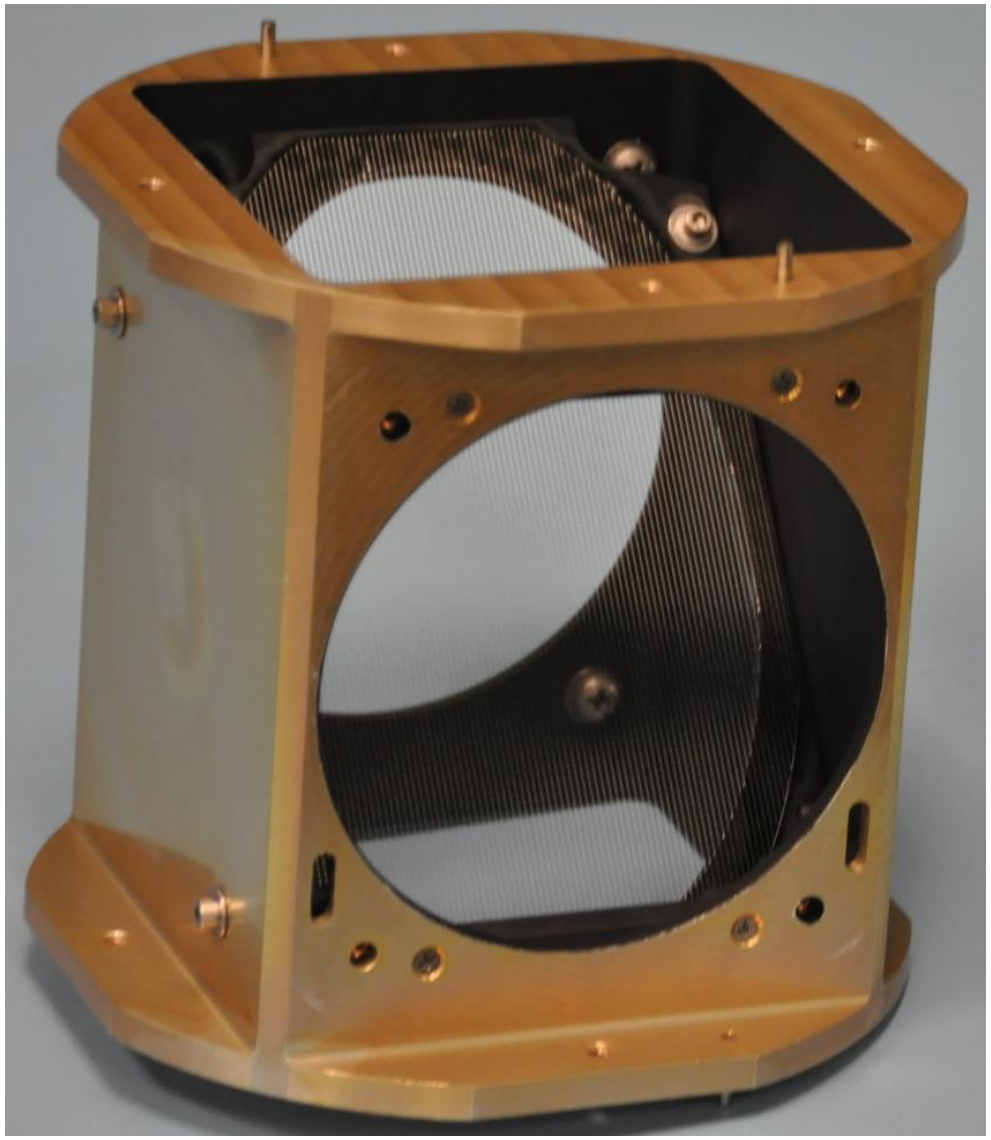


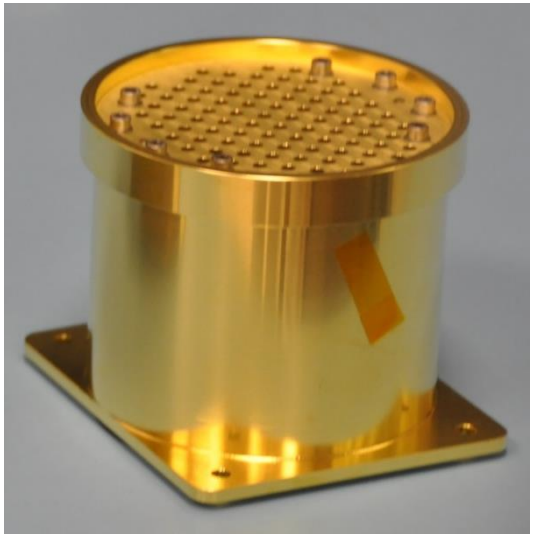


Blackbody Source

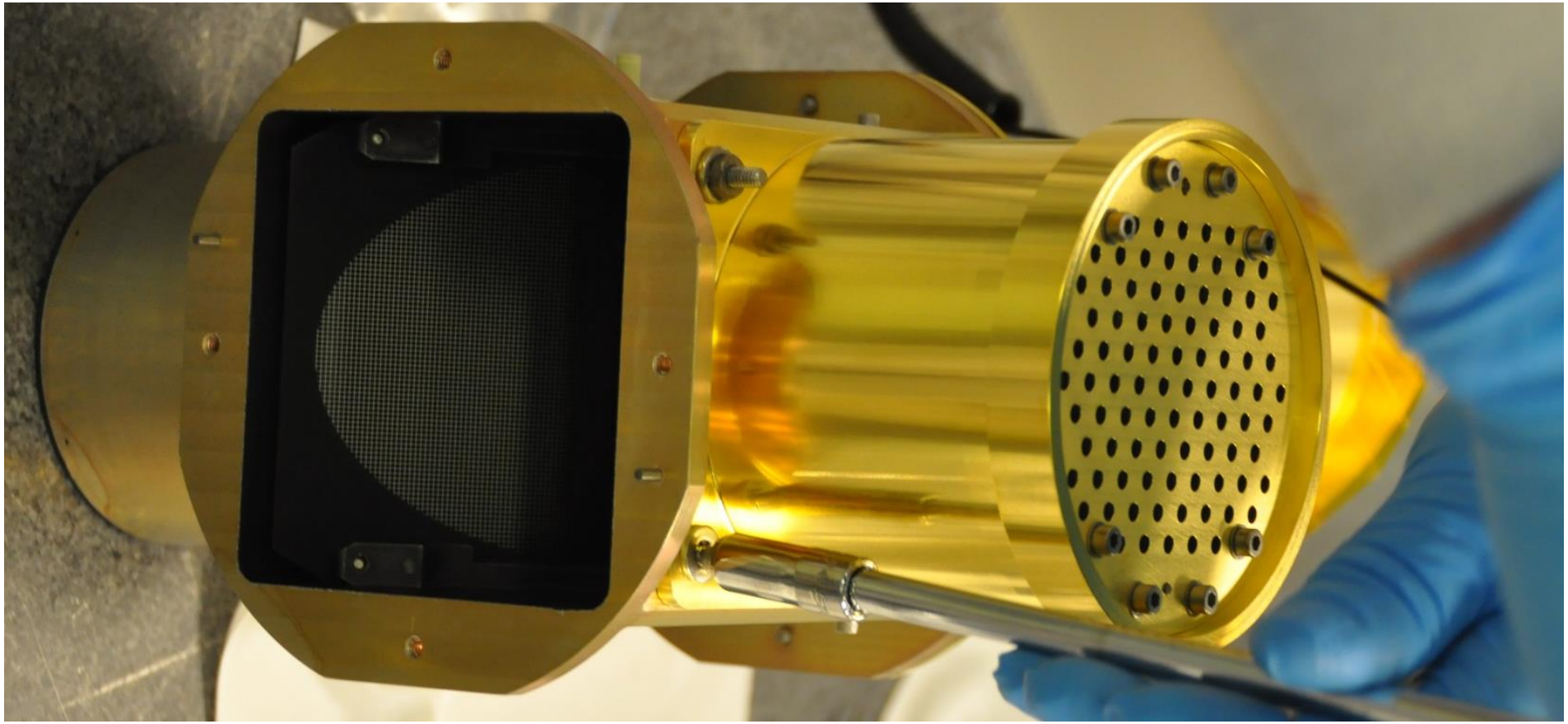


Solar Calibrator

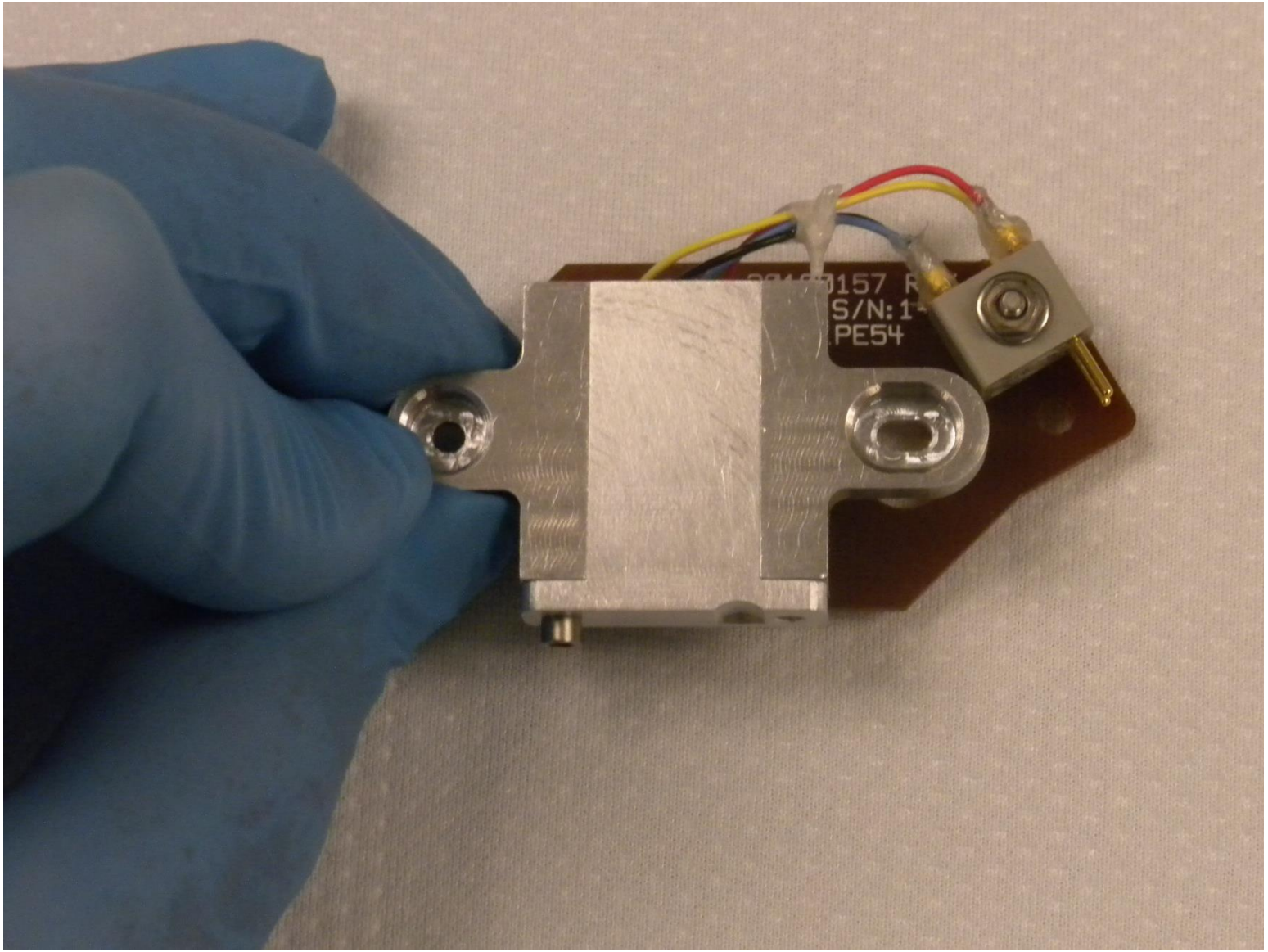




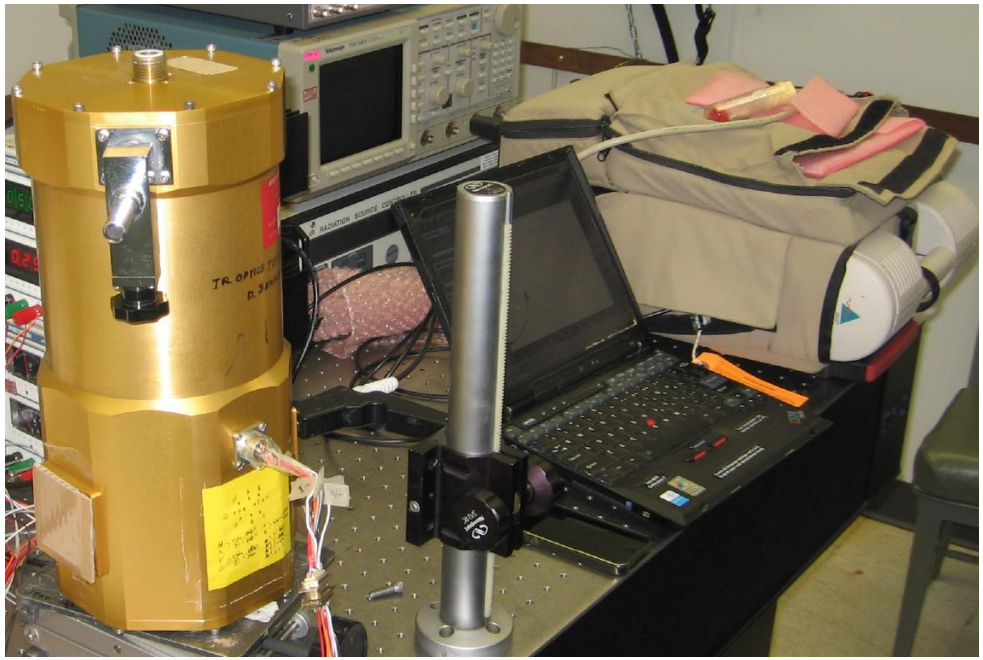
Solar Calibrator



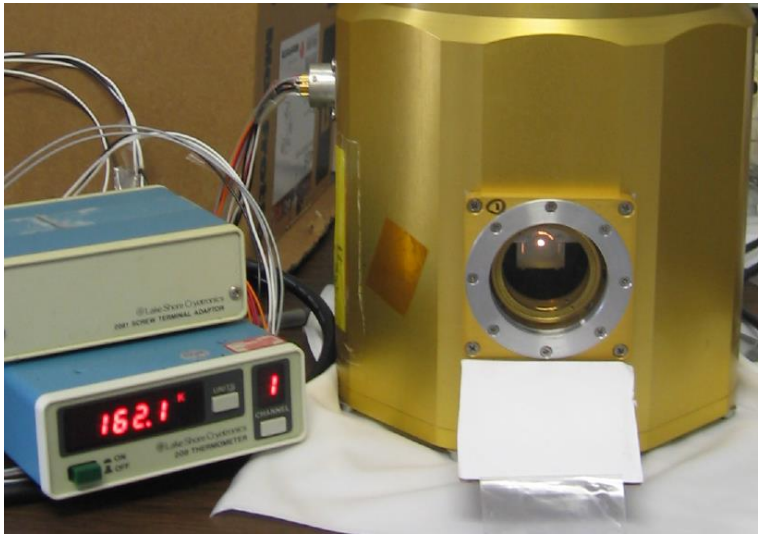
Filament Calibrator



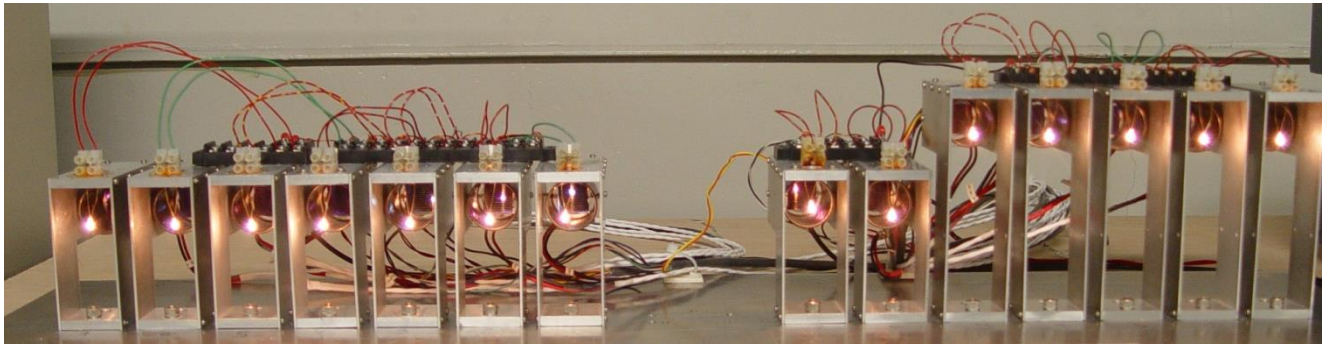
Filament Calibrator Tests



Spectral output measurements of Filament Source in Dewar

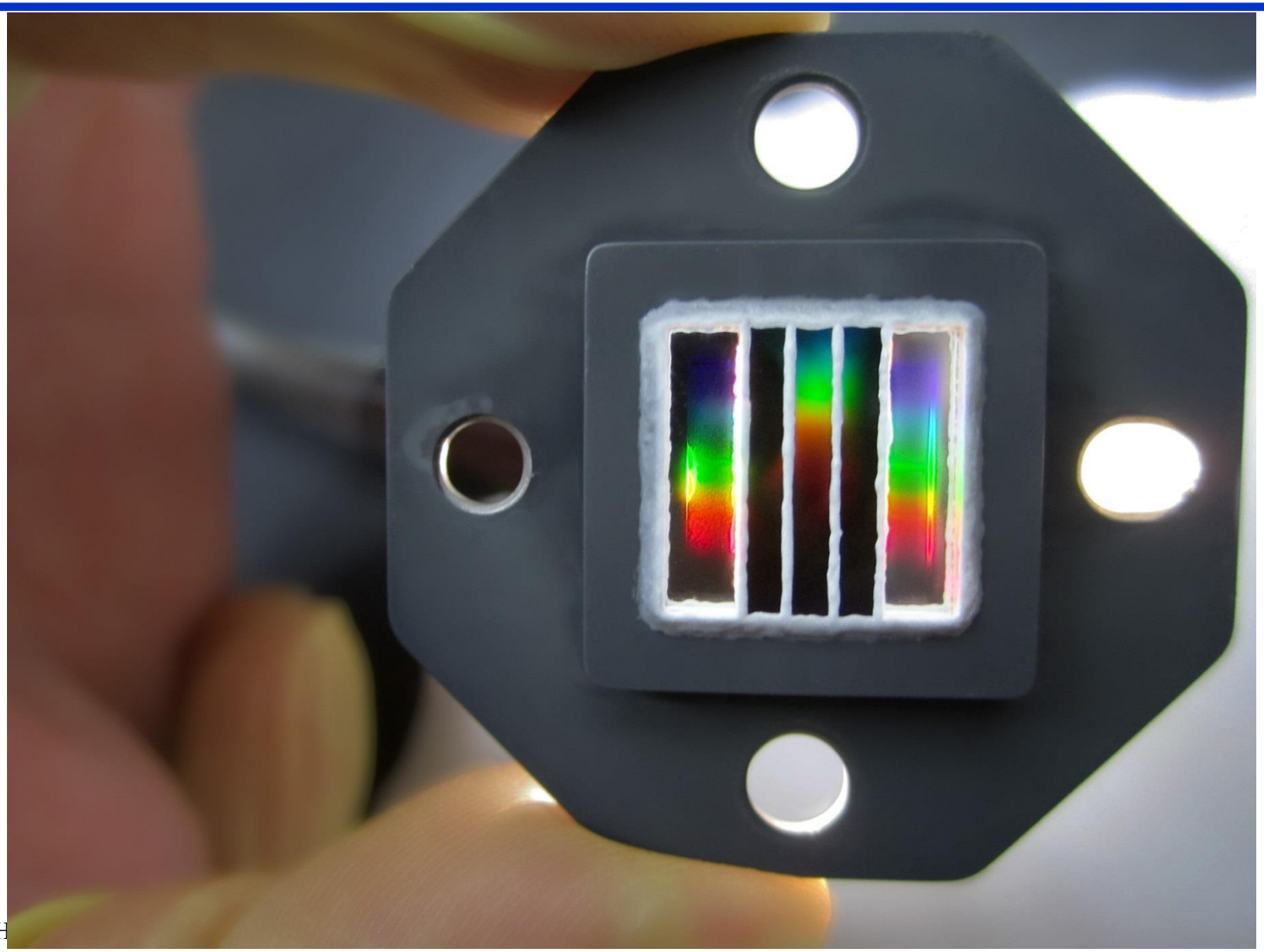


Filament Source in Dewar

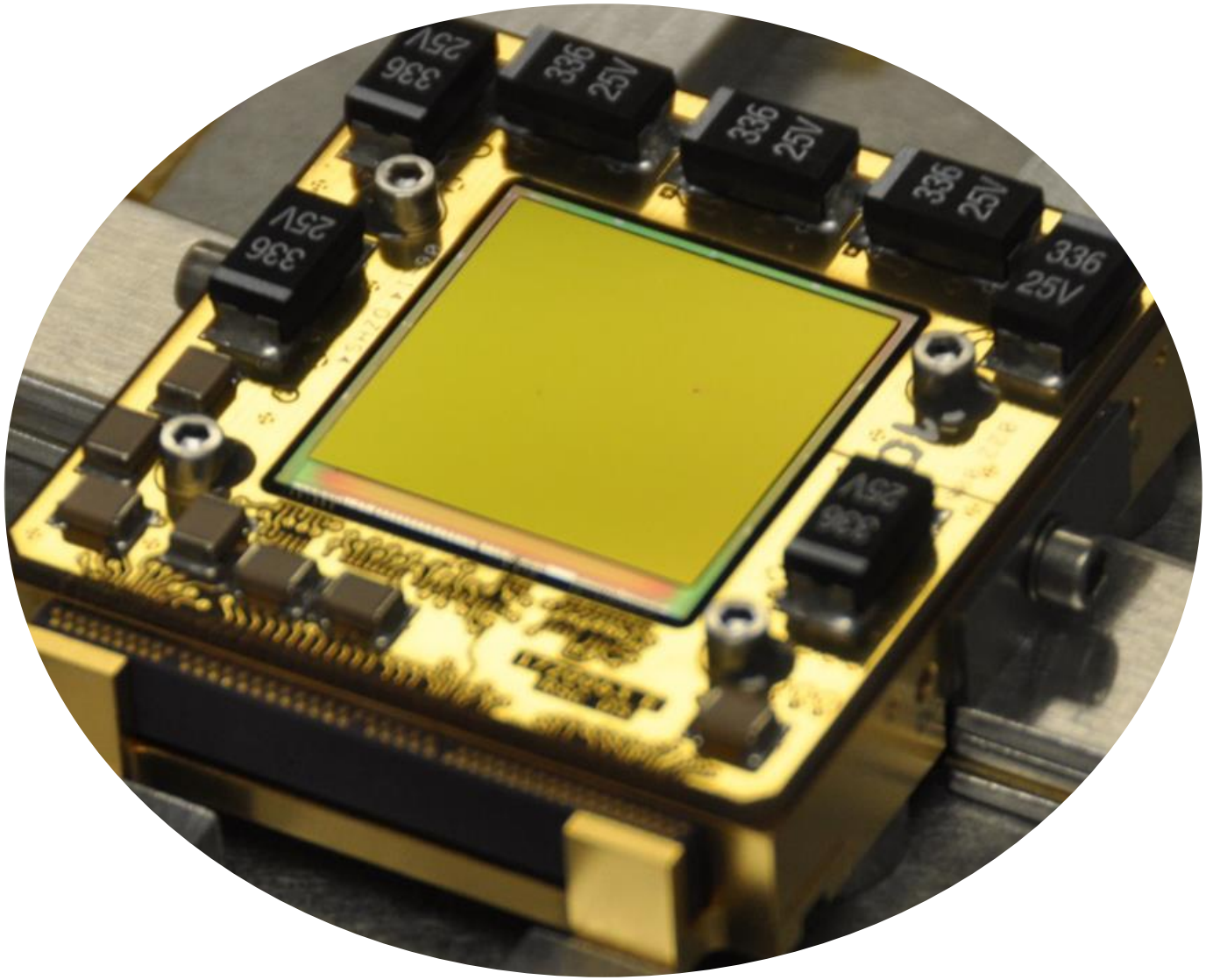


Filament Source burn-in tests

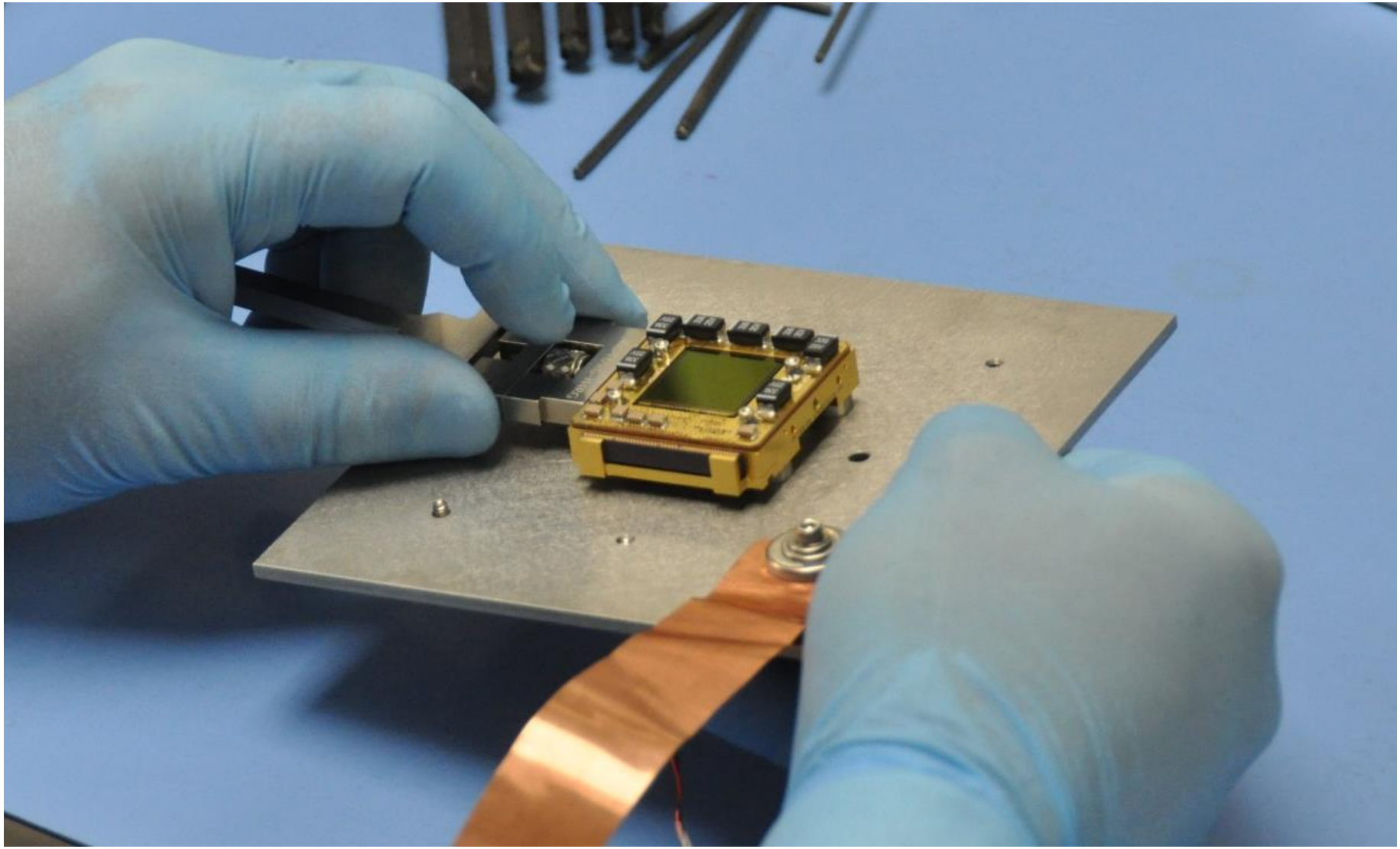
Linear Variable Filter Array



Detector Assembly

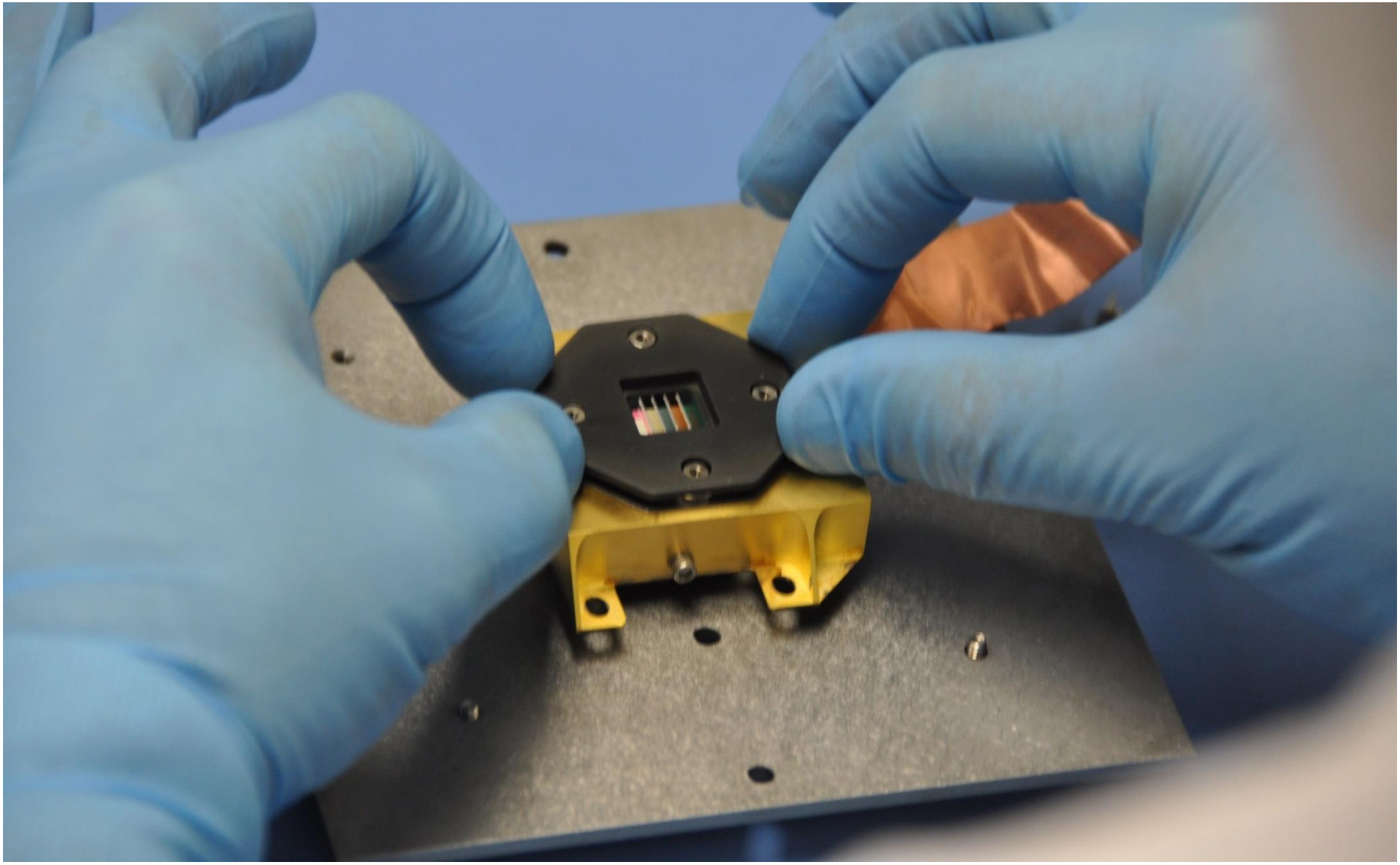


Detector Assembly

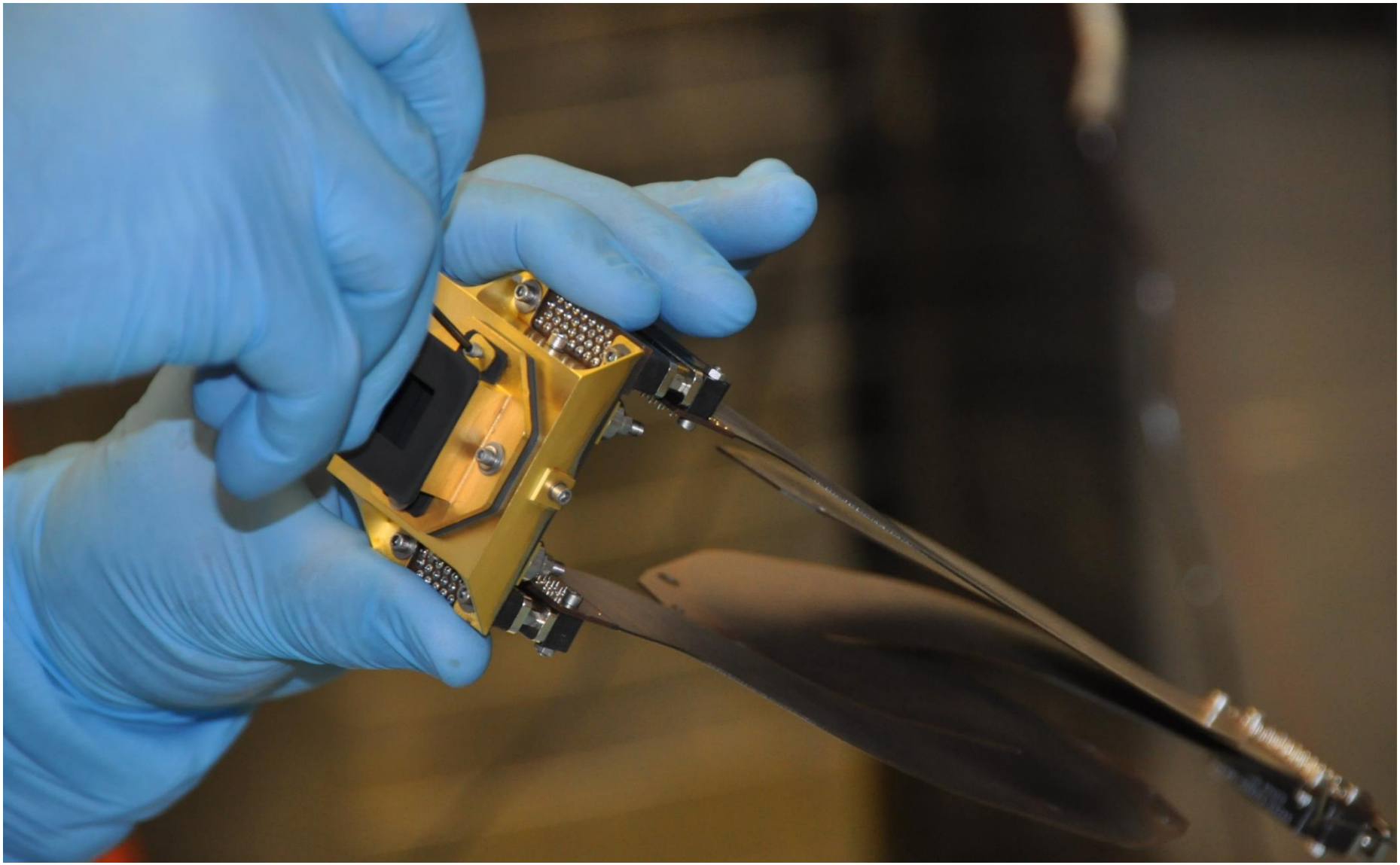


Measurements for Filter Shim sizing

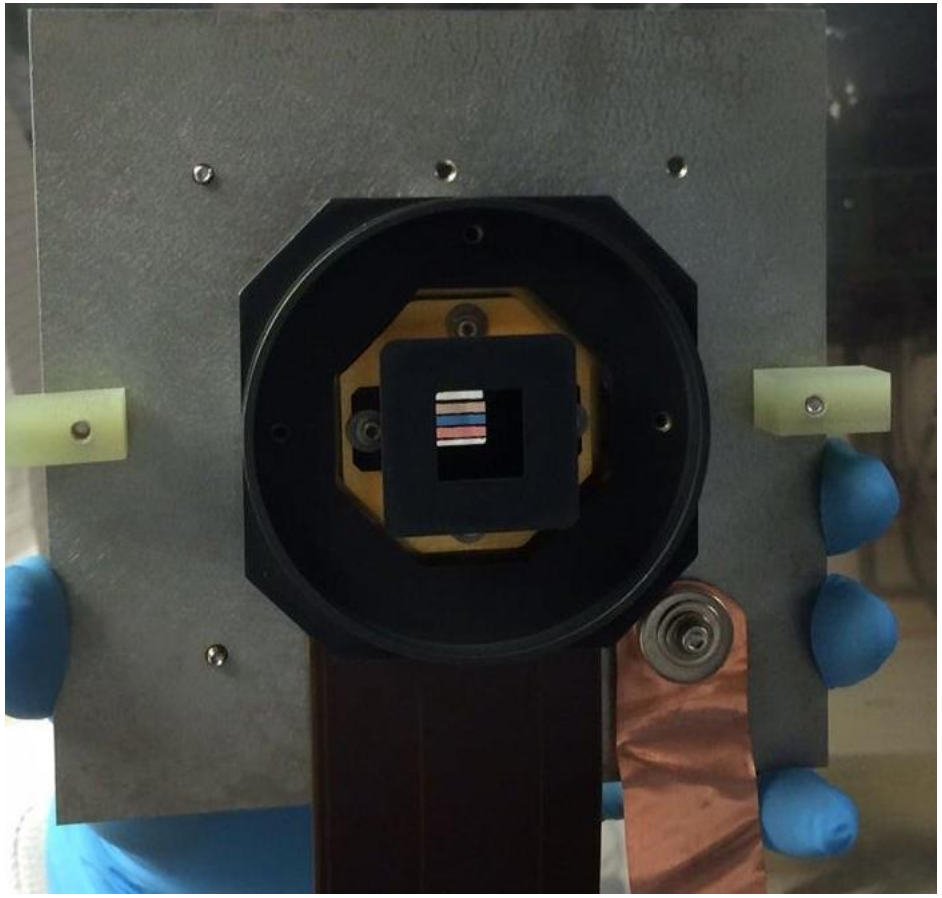
Filter Mounting to Detector



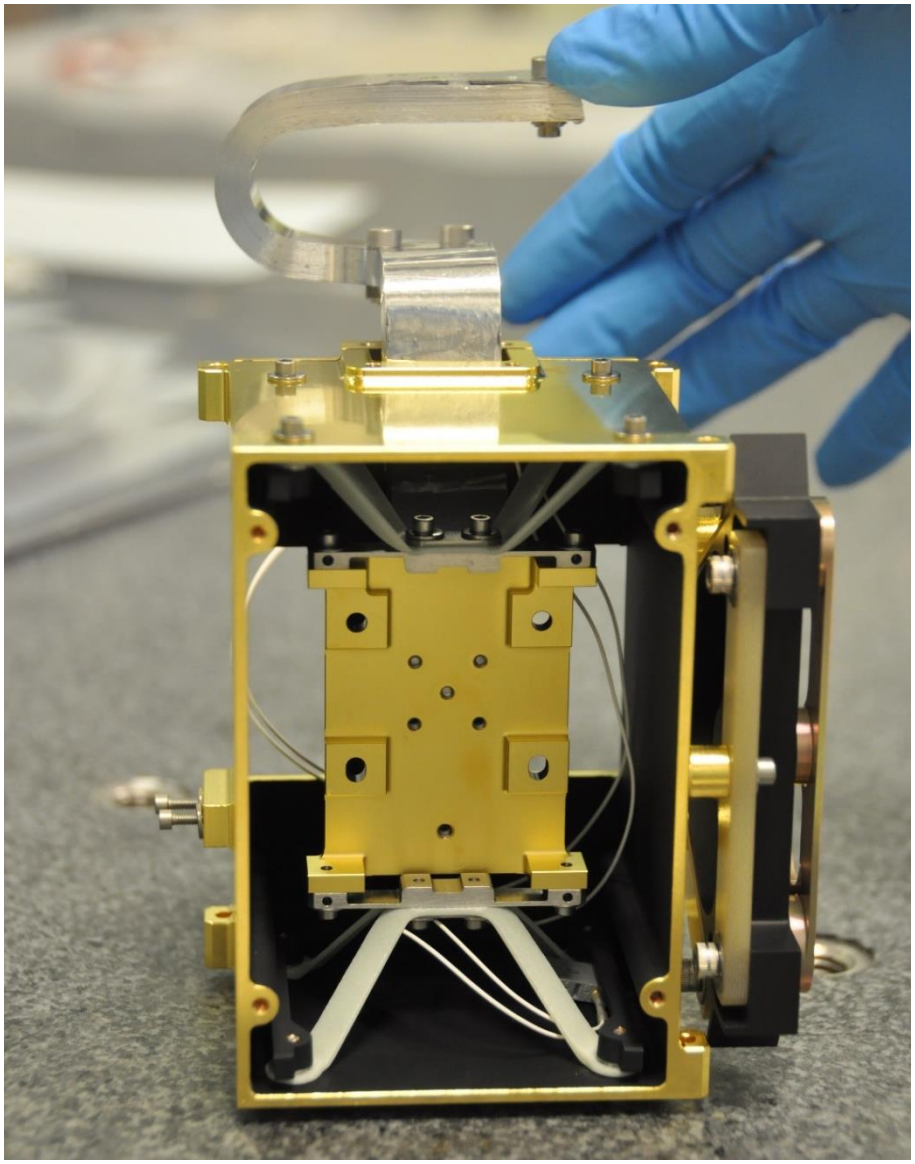
Assembling Detector/Filter with Harness and Baffle

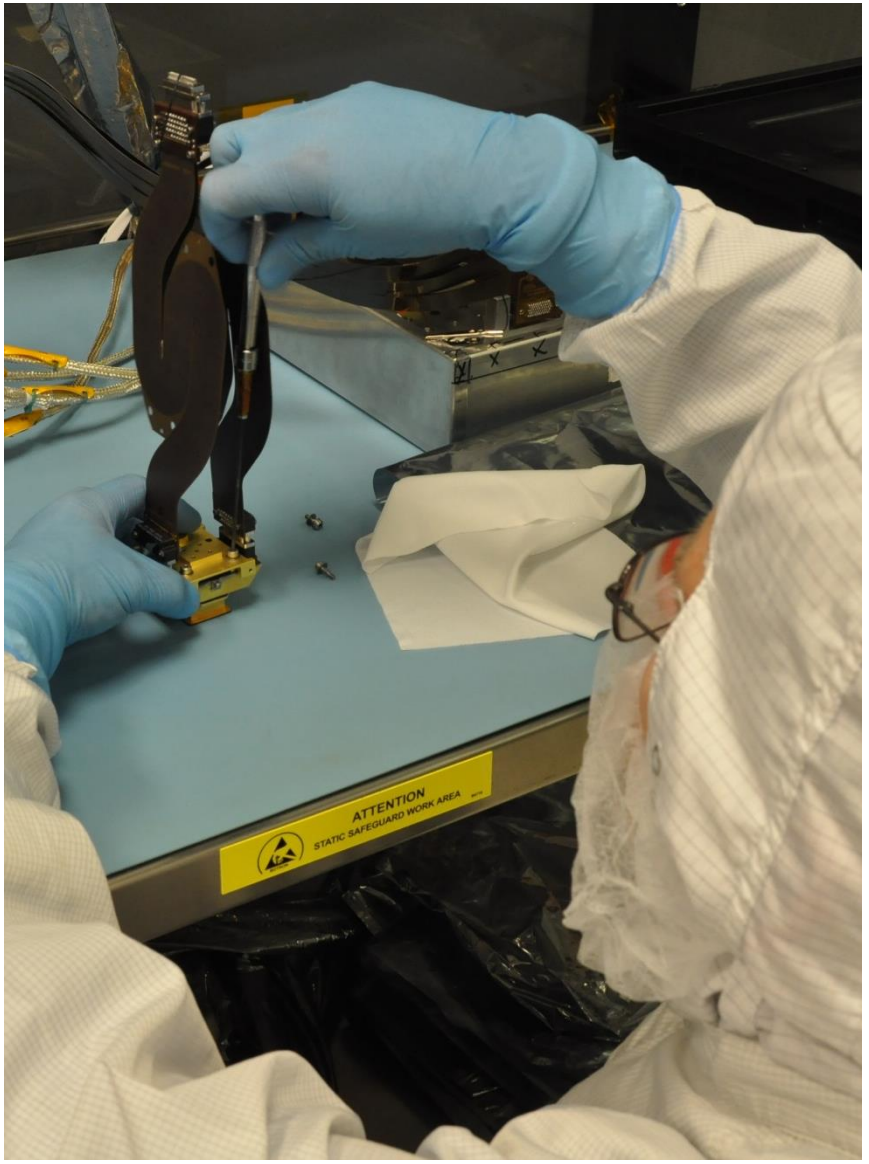


Detector ready for performance test and characterization at cryogenic temperatures

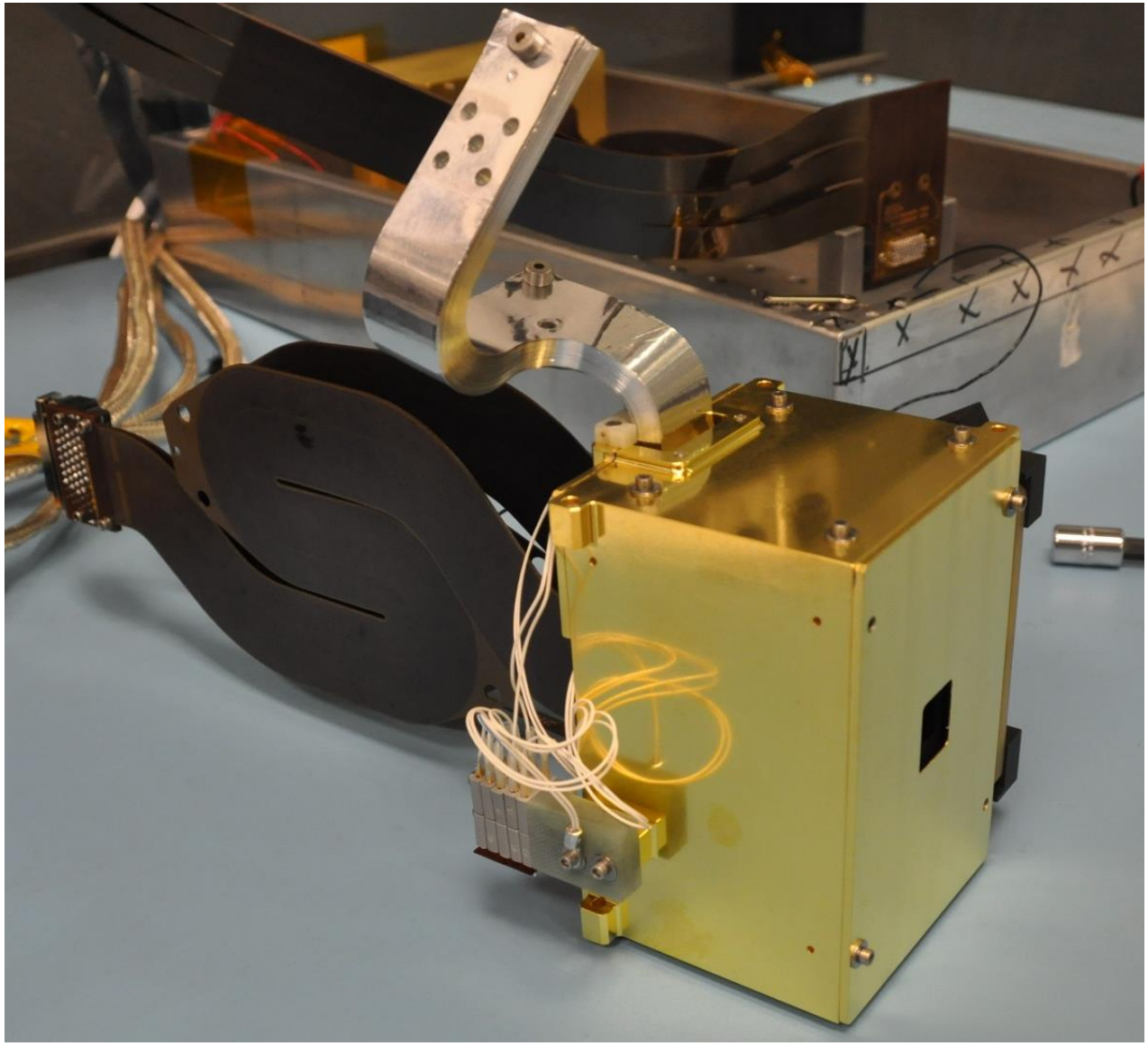


Thermal Isolation and Strap for Detector Mount in Detector Box



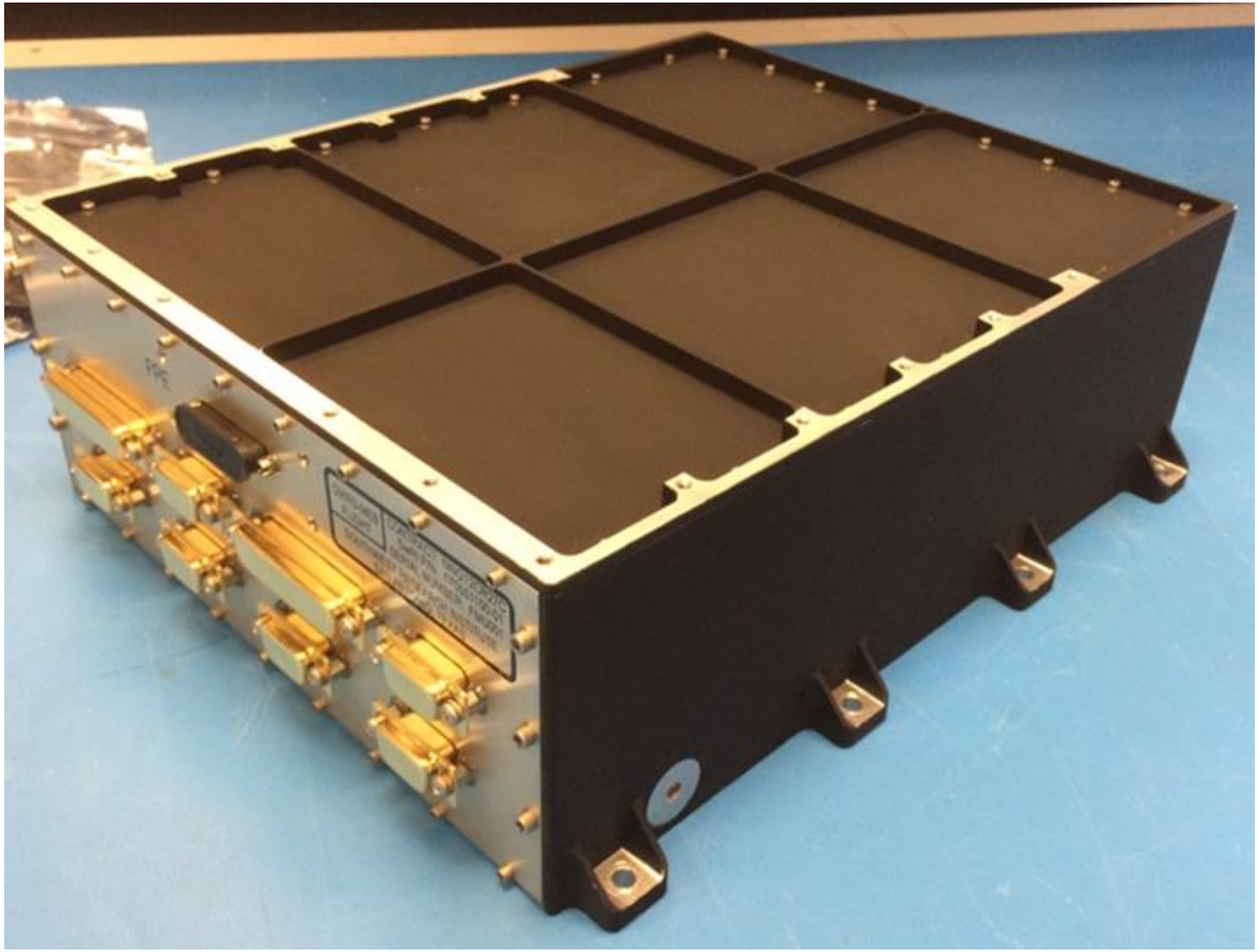


Completed Detector Box Assembly

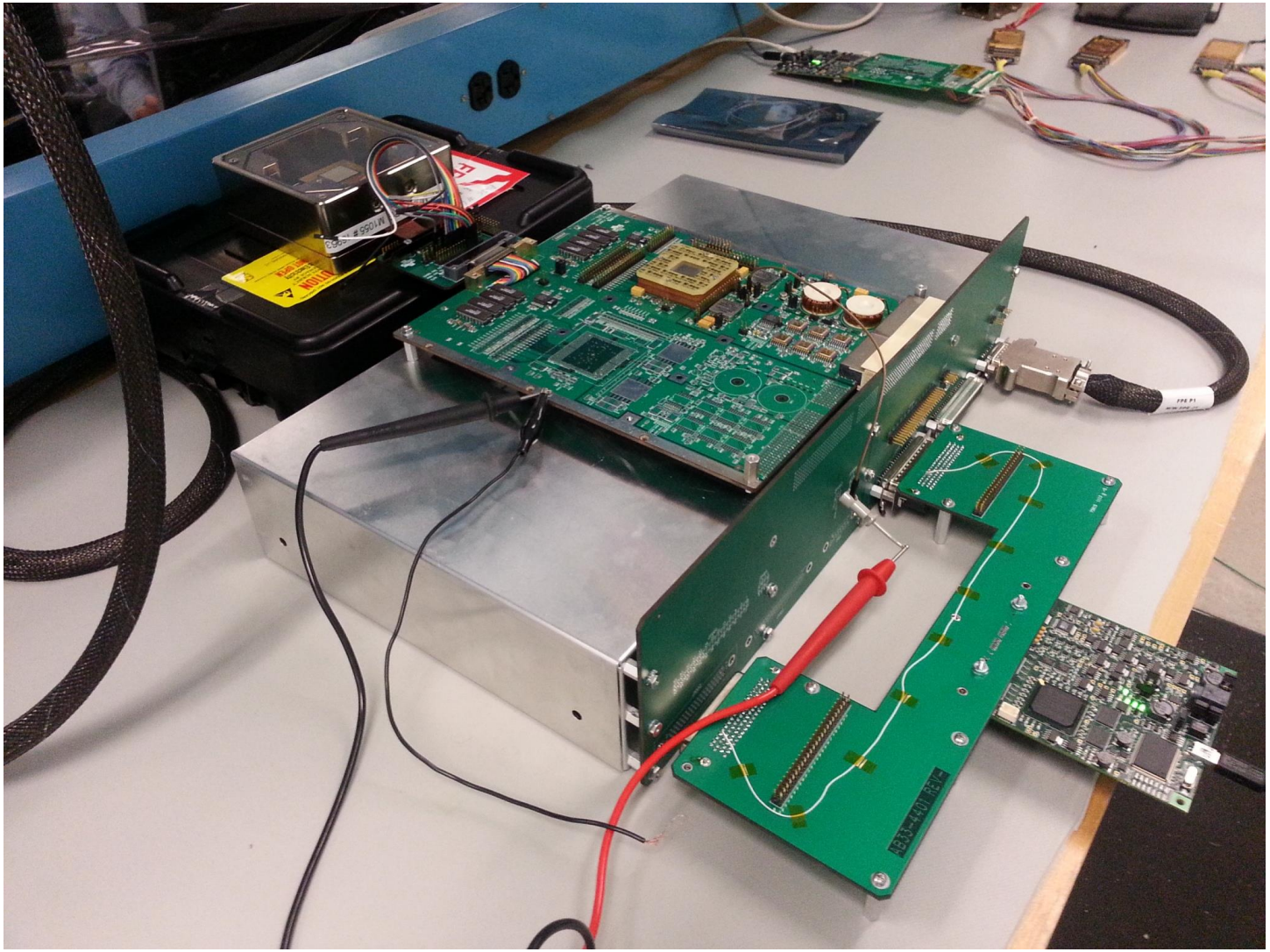


Detector Signal Harness

Main Electronics Box

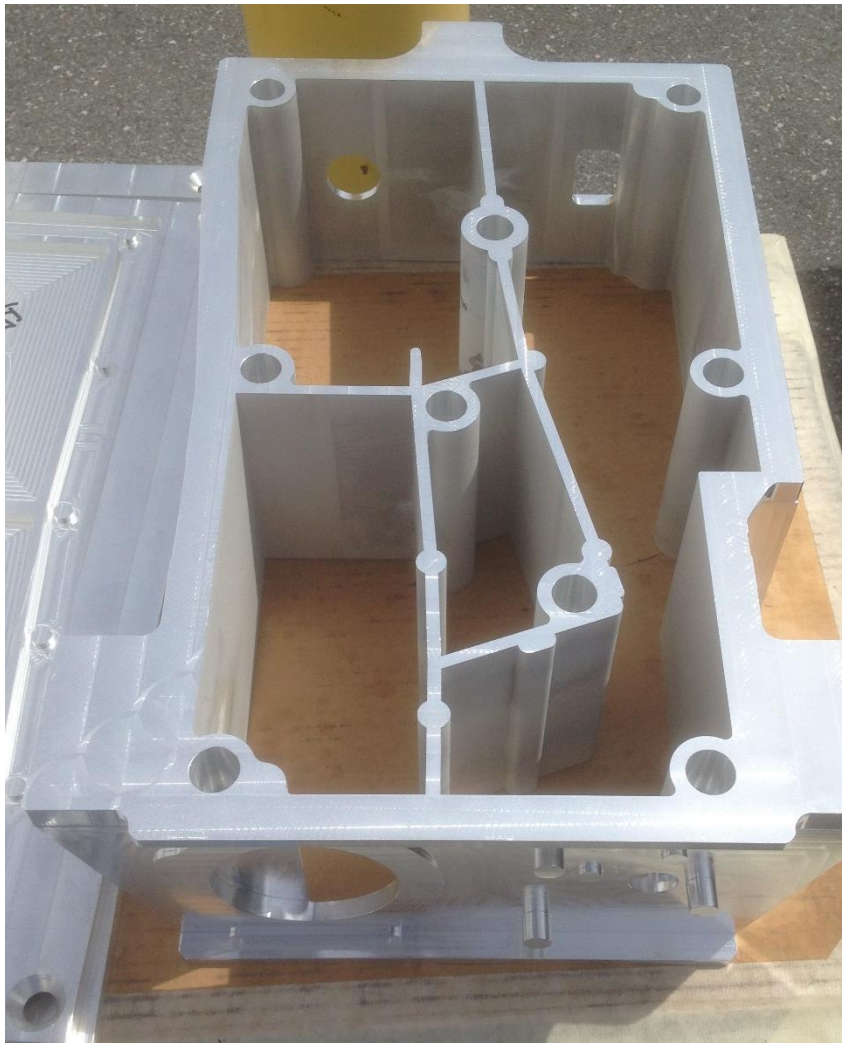


Focal Plane Electronics Testing with a test Detector



Flight Dual-String Focal Plane Electronics (Post Conformal Coat)

Optics Box Housing Fabrication

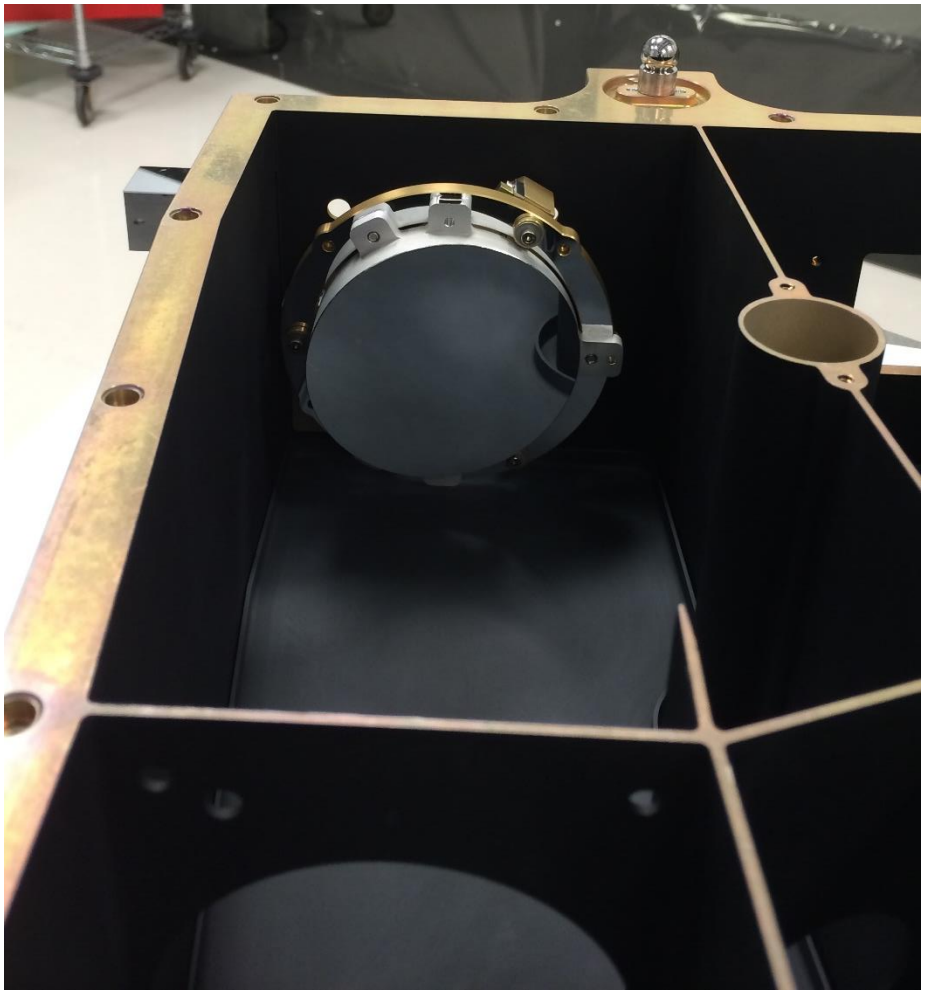


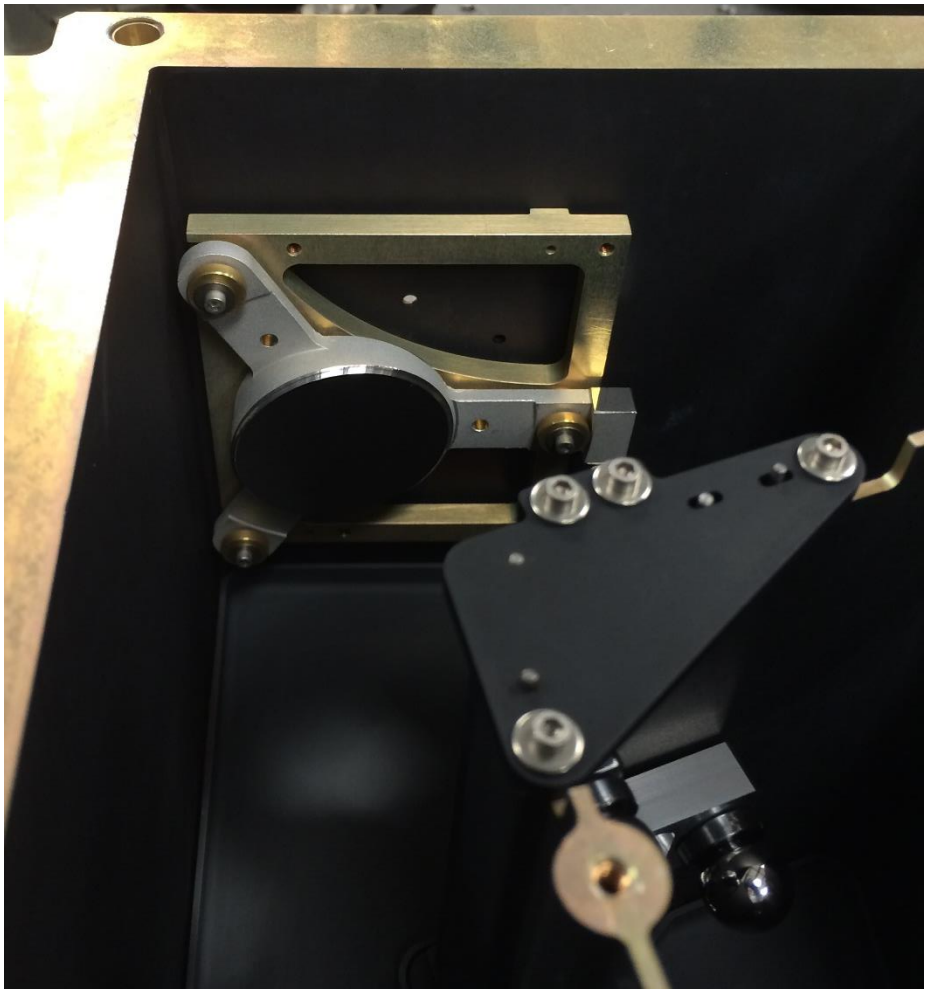
Plating Vendor Fire – Optics Box Housing Destroyed

Completed Optics Box Housing with Plating

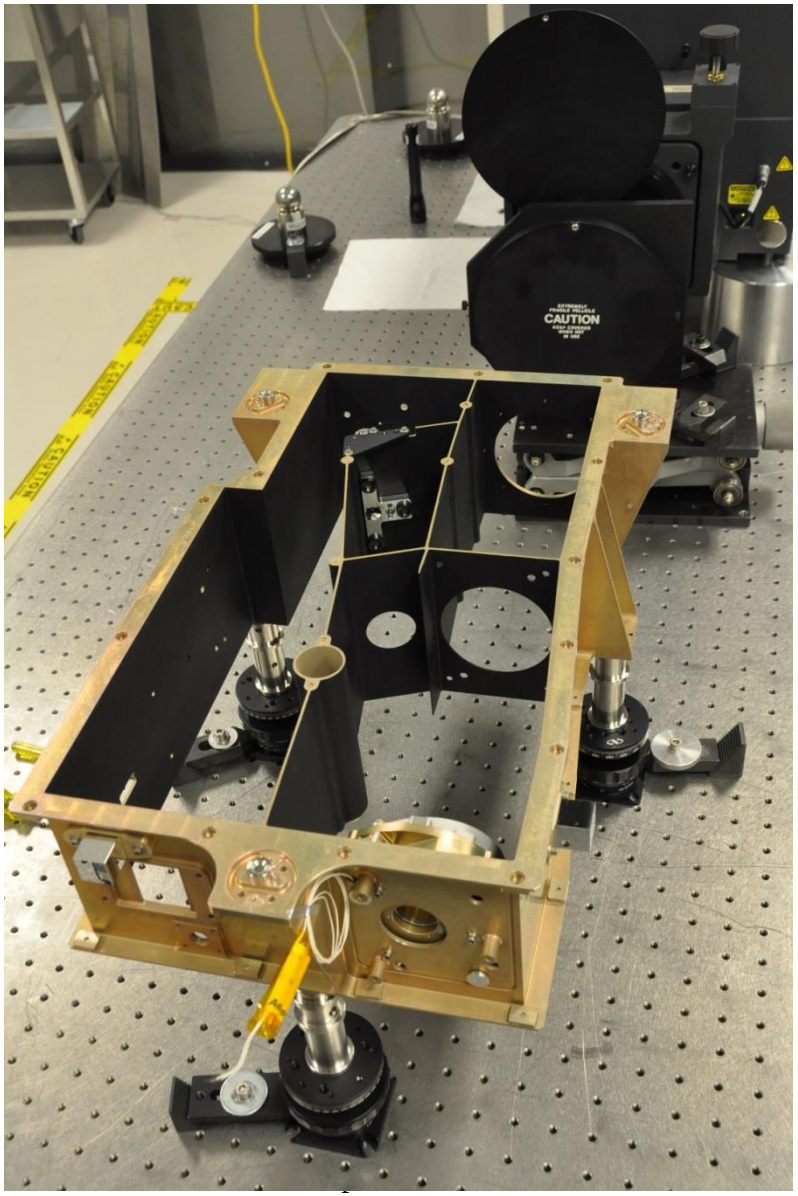
Optics Box Assembly

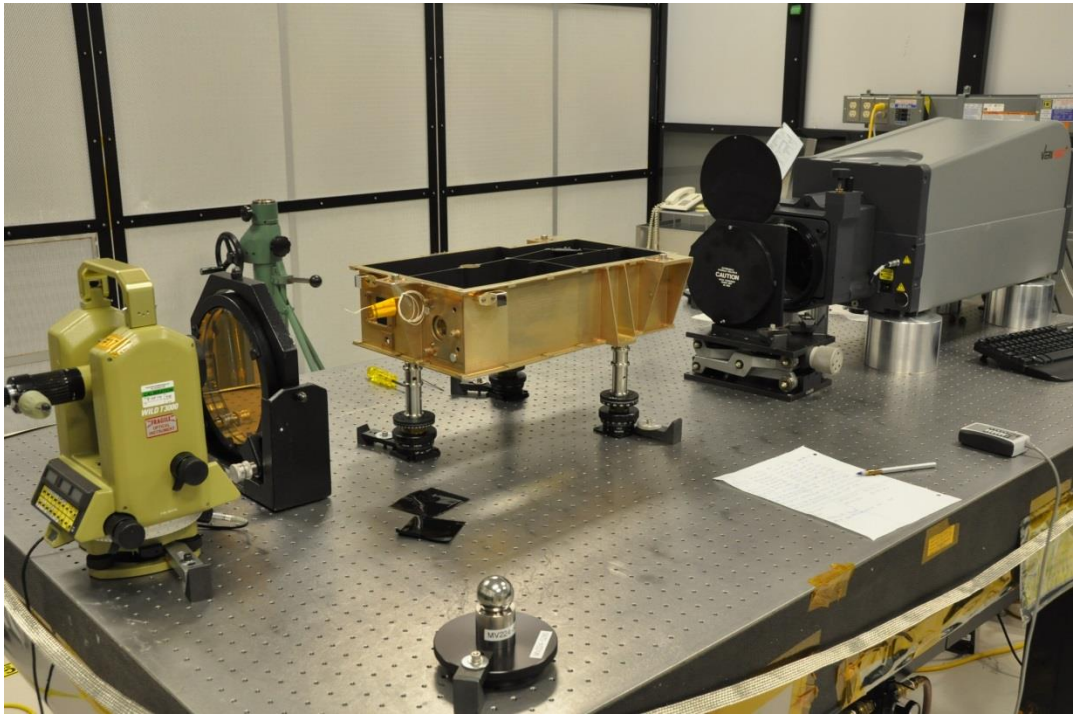
Primary and Secondary Mirror Mounting in Optics Box



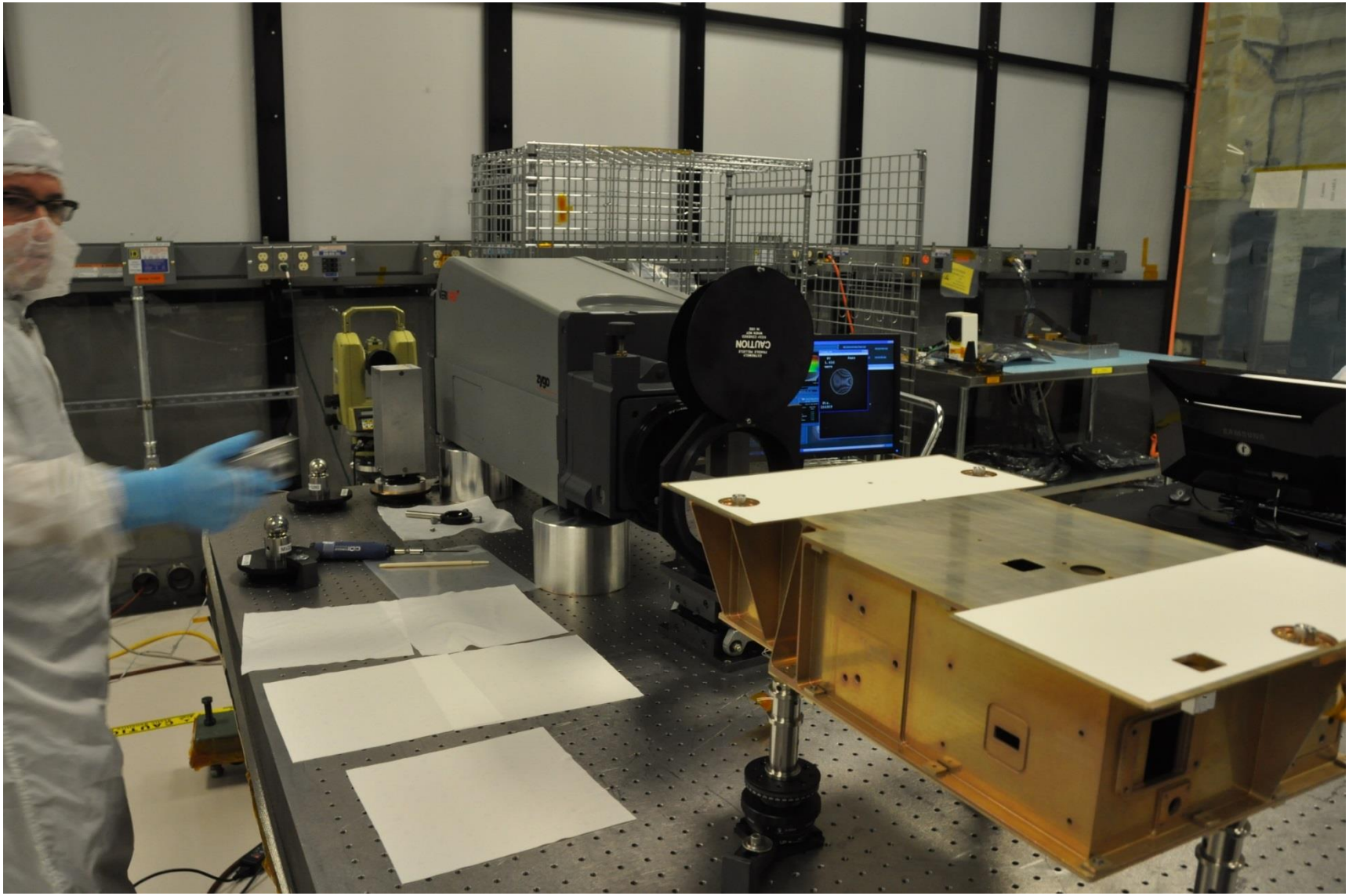


Mirror Alignment in Optics Box

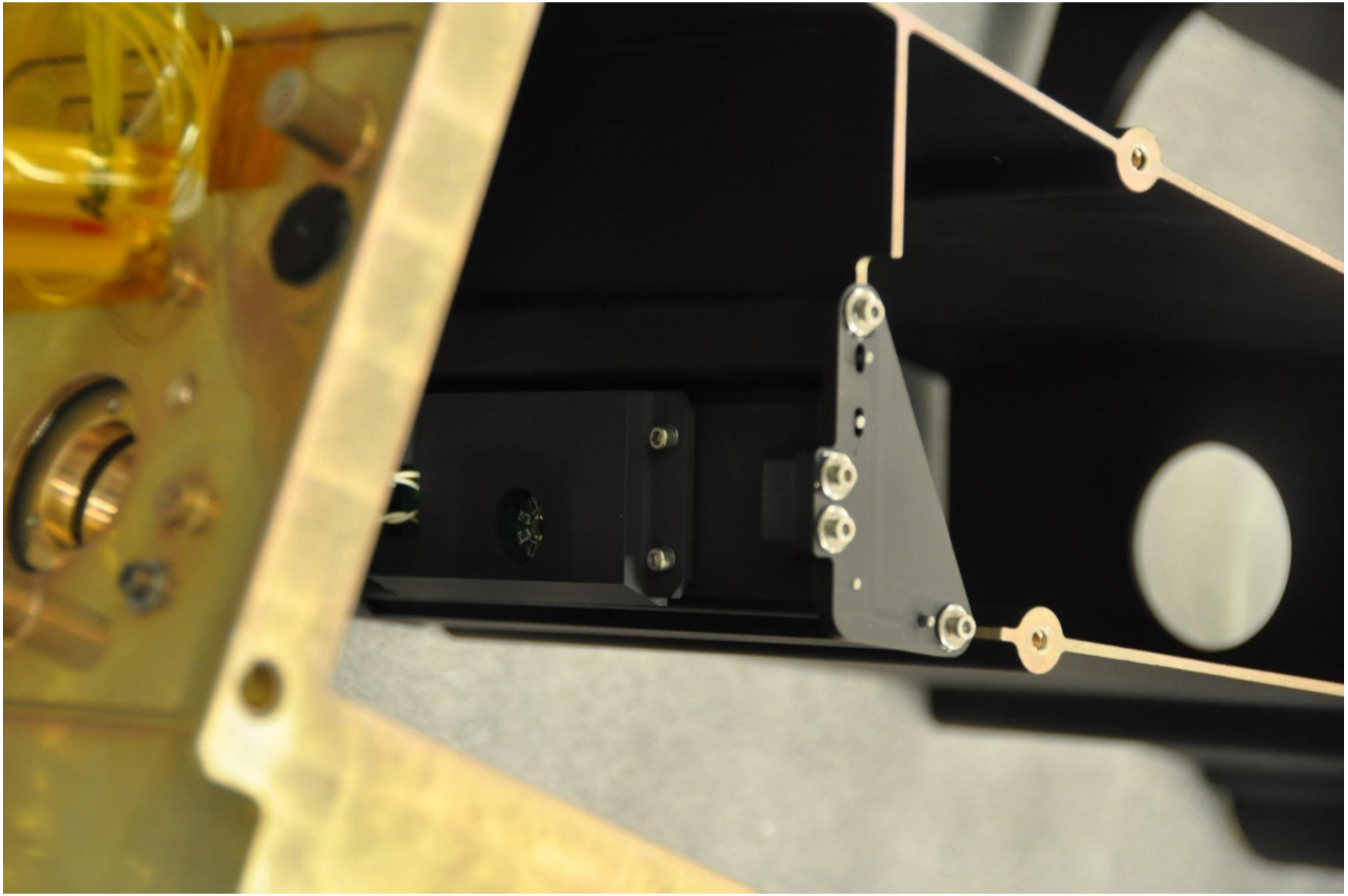




Optical System Performance Tests

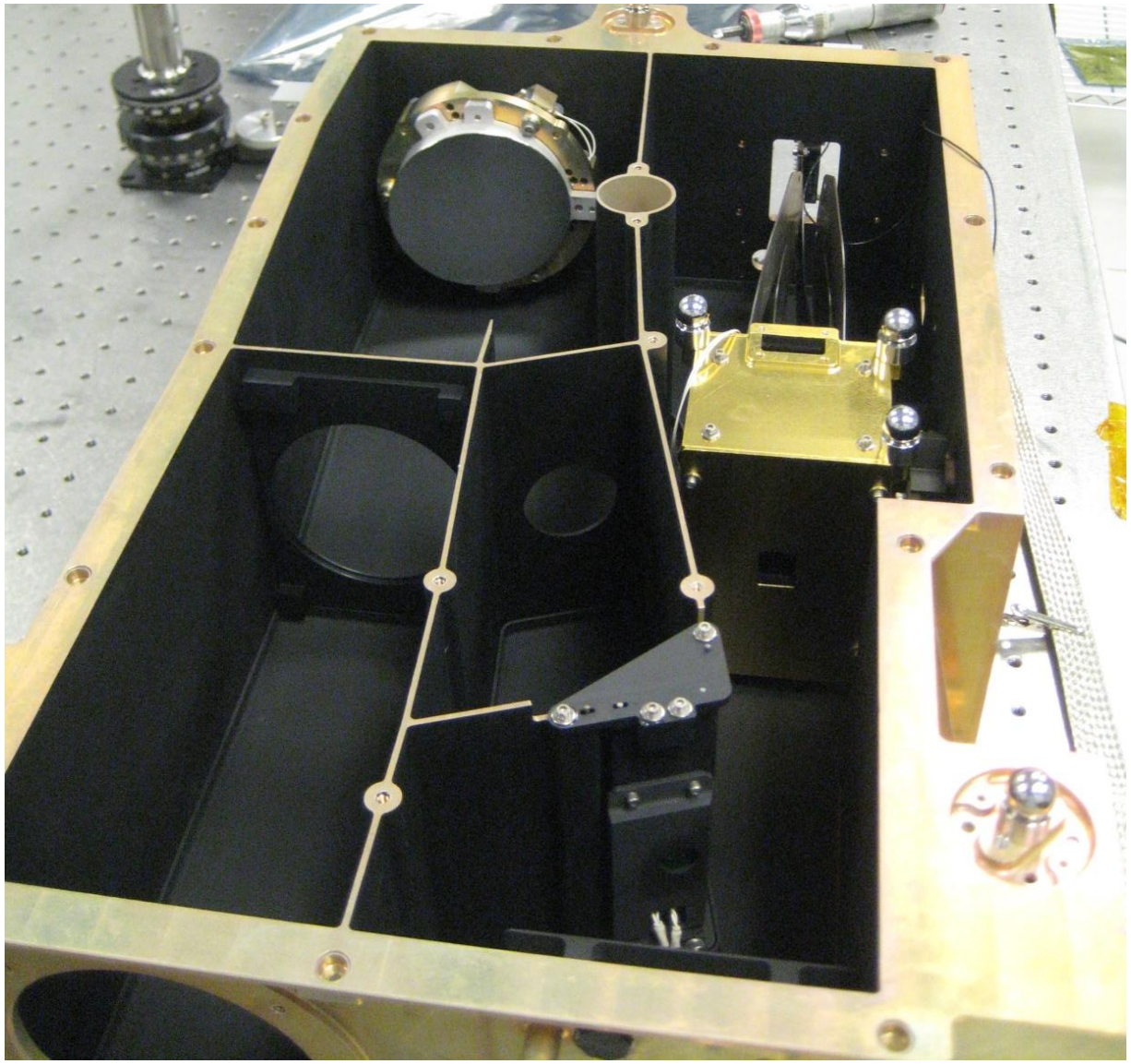


Blackbody Source Installed in Optics Box

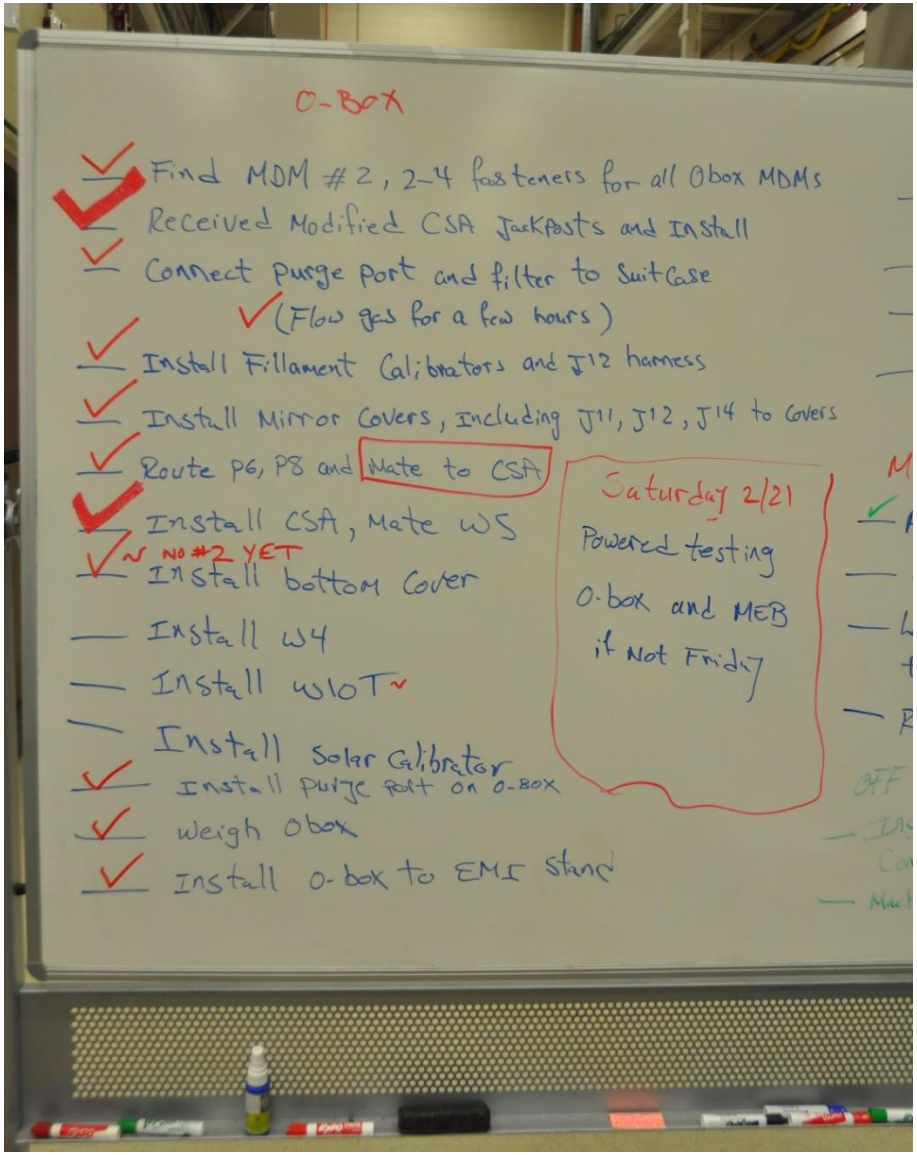


Detector Box Alignment with Optics

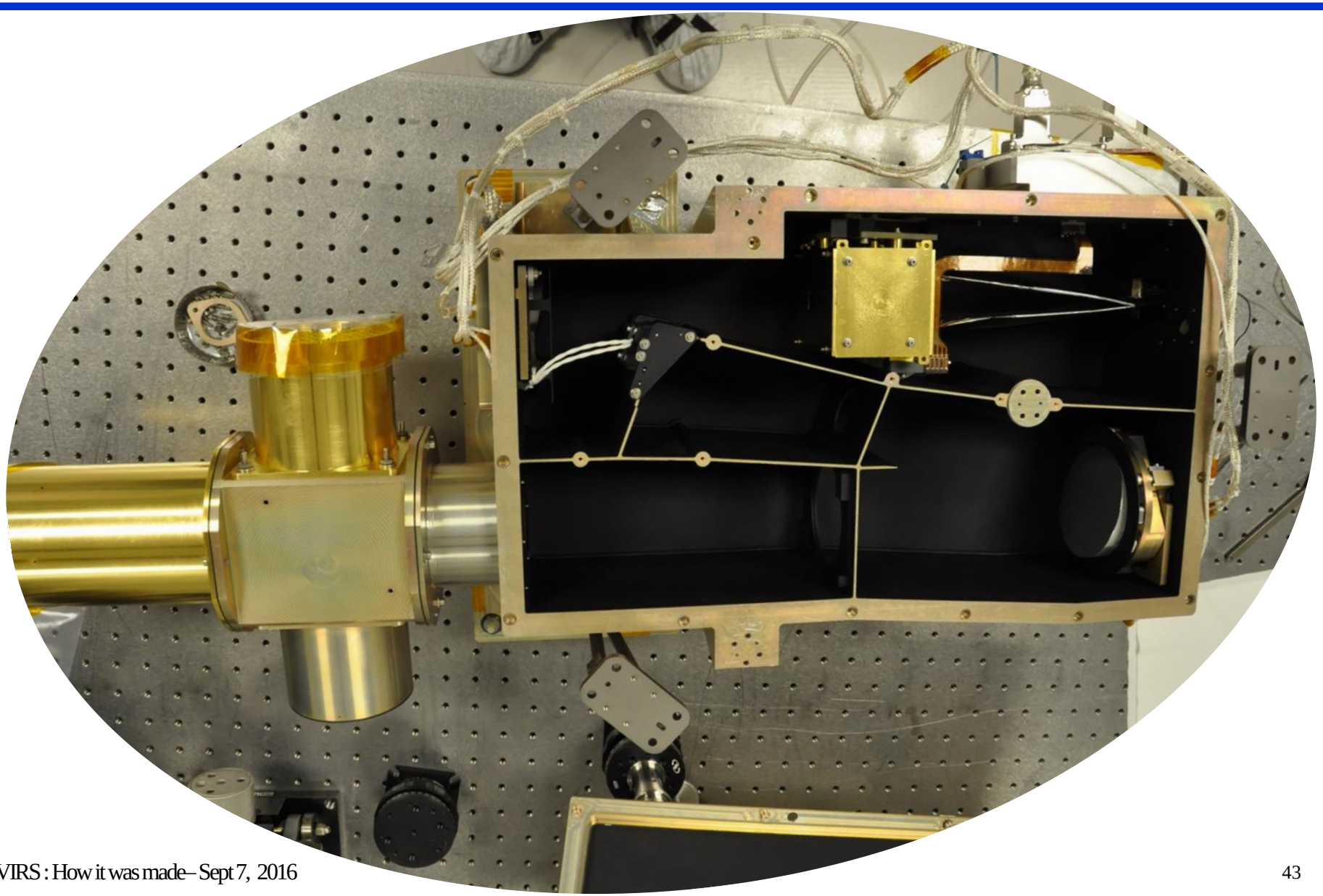
Assembled Optics and Detector Box



There might have been a few ‘to-do’ lists involved

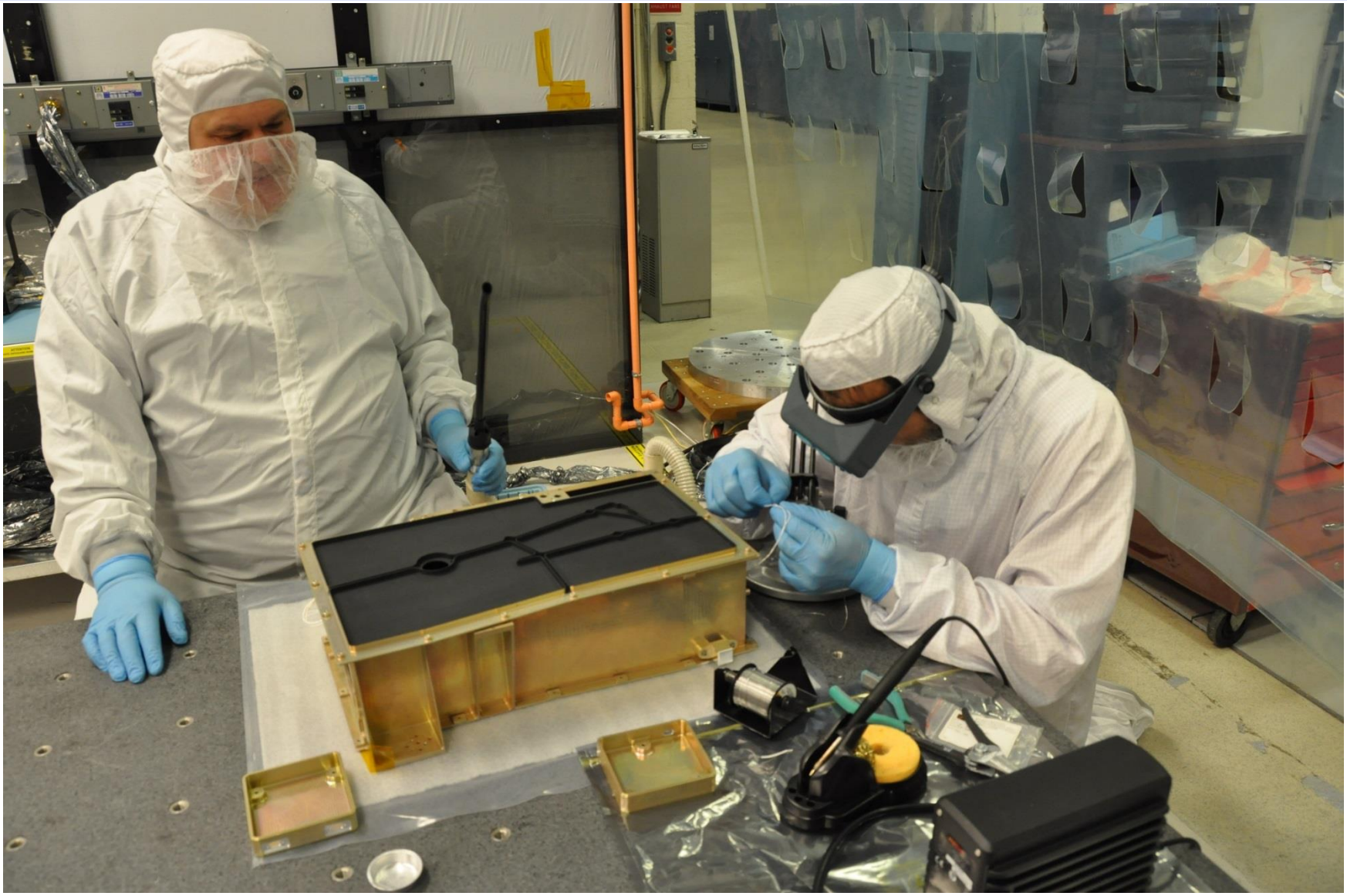


Assembled Optics Box

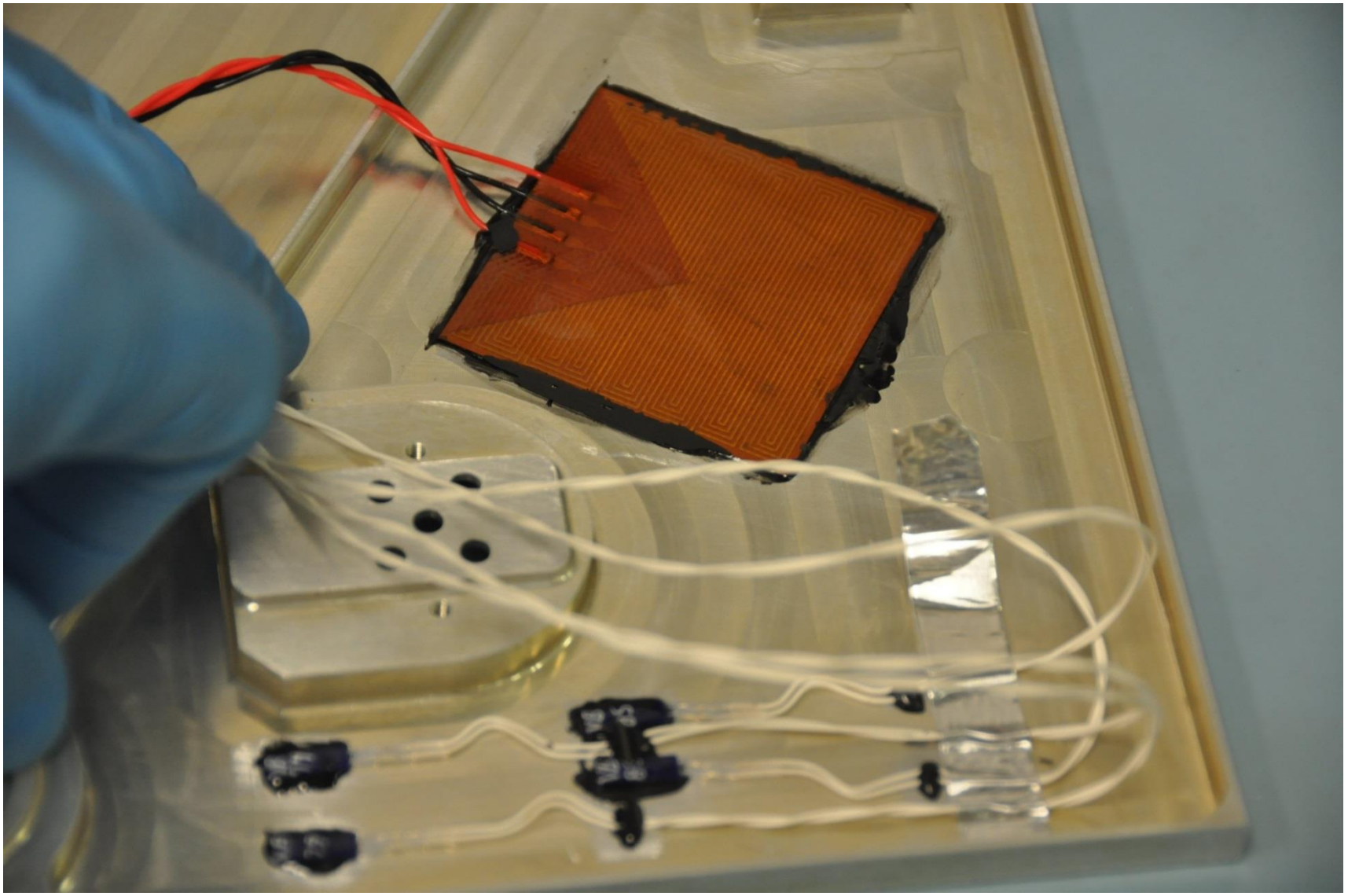


Integration

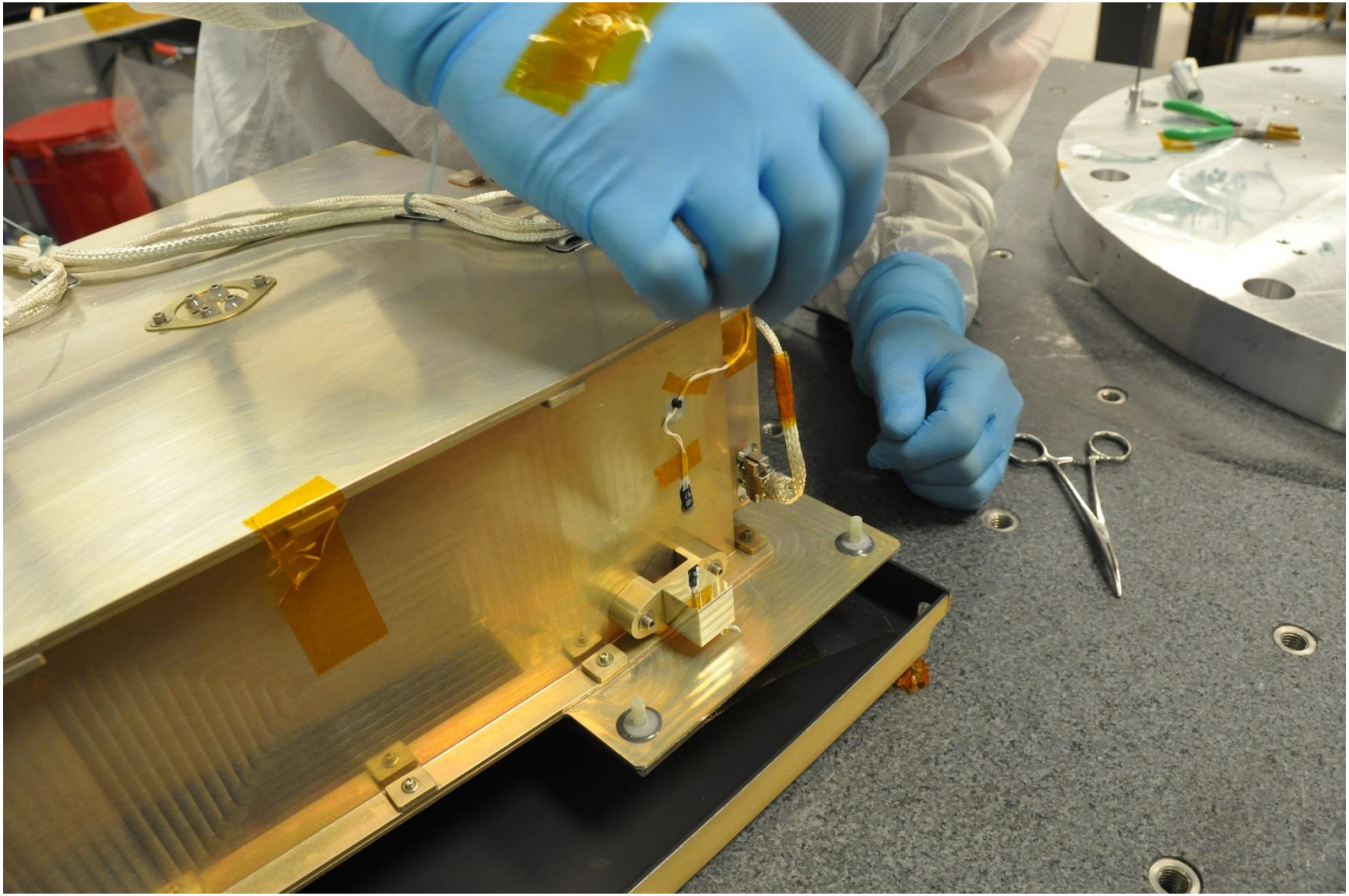
Harness Installation



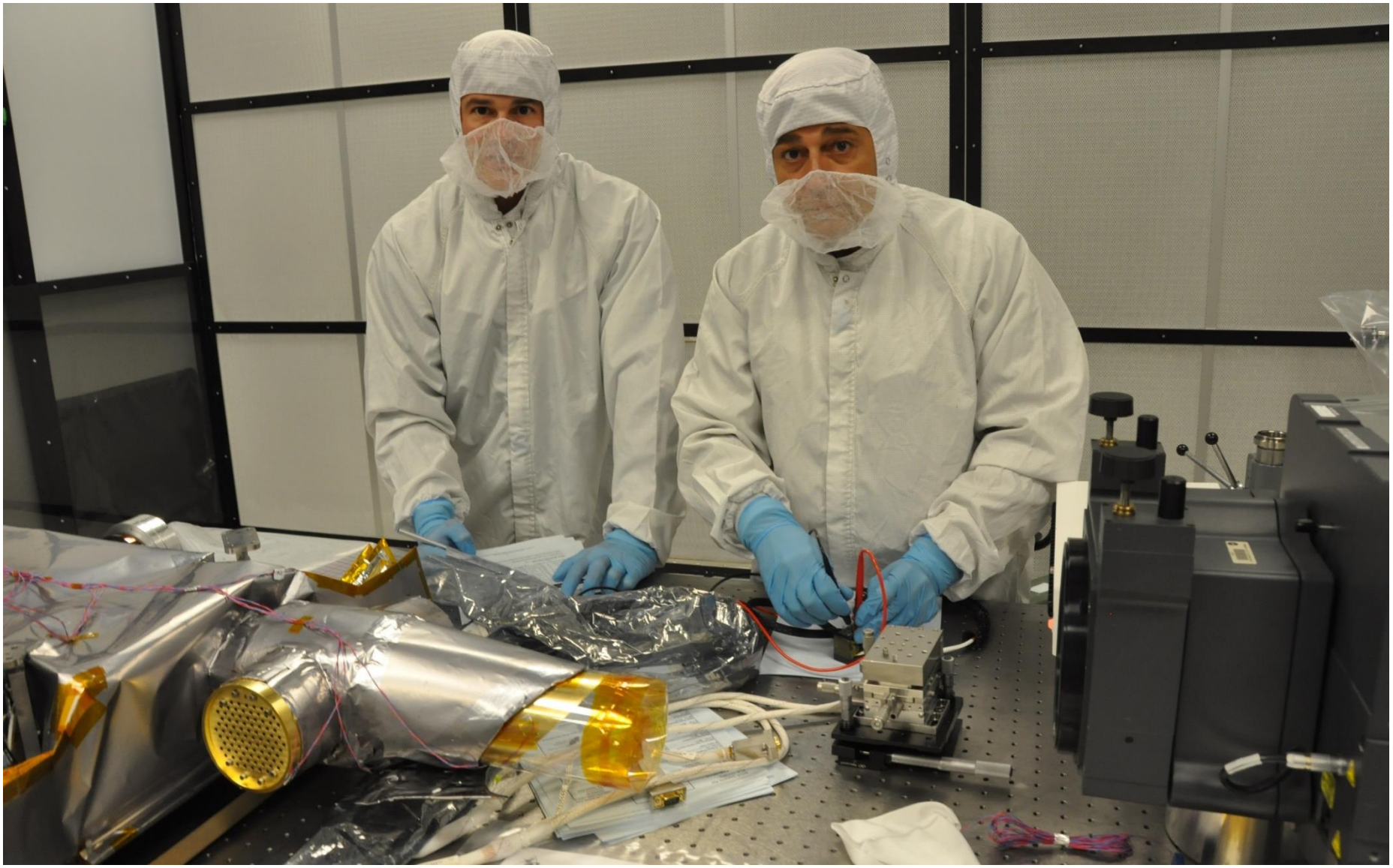
Heater and Temperature Sensor Installation



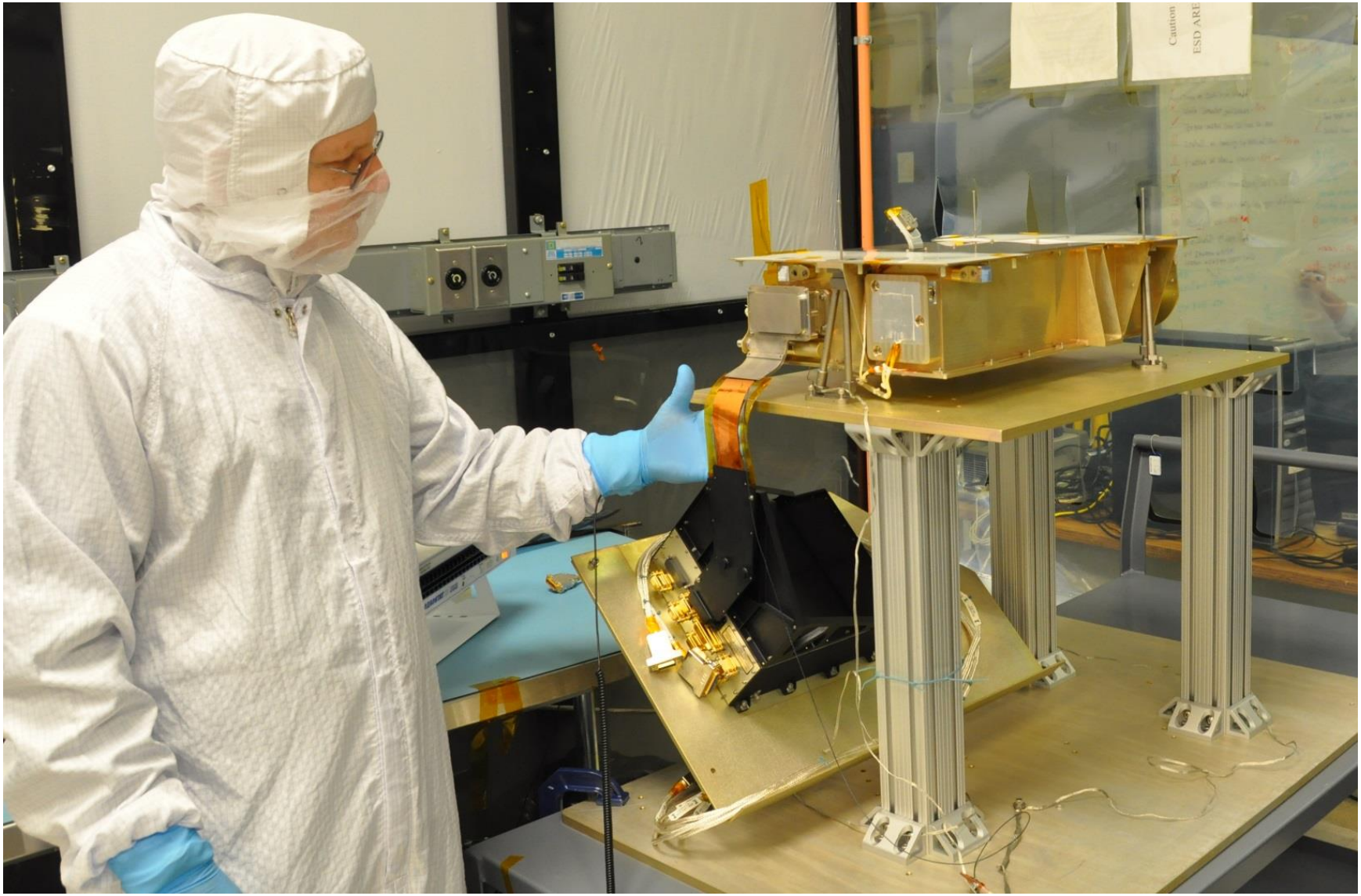
Temperature Sensor Installation and Harness Routing



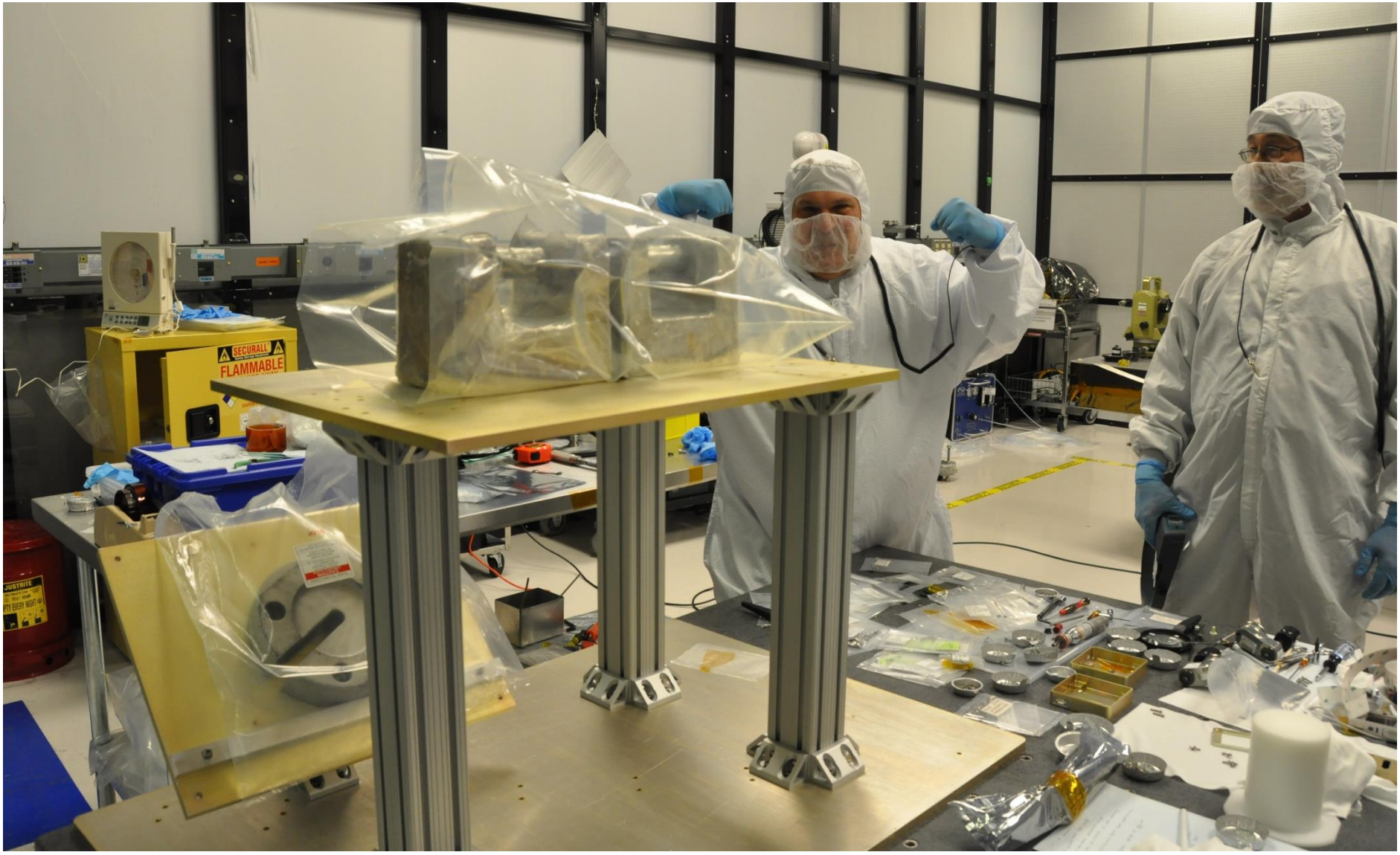
Electrical Circuit Checkouts



Optics Box and Main Electronics in the Spacecraft Configuration with Signal Harness



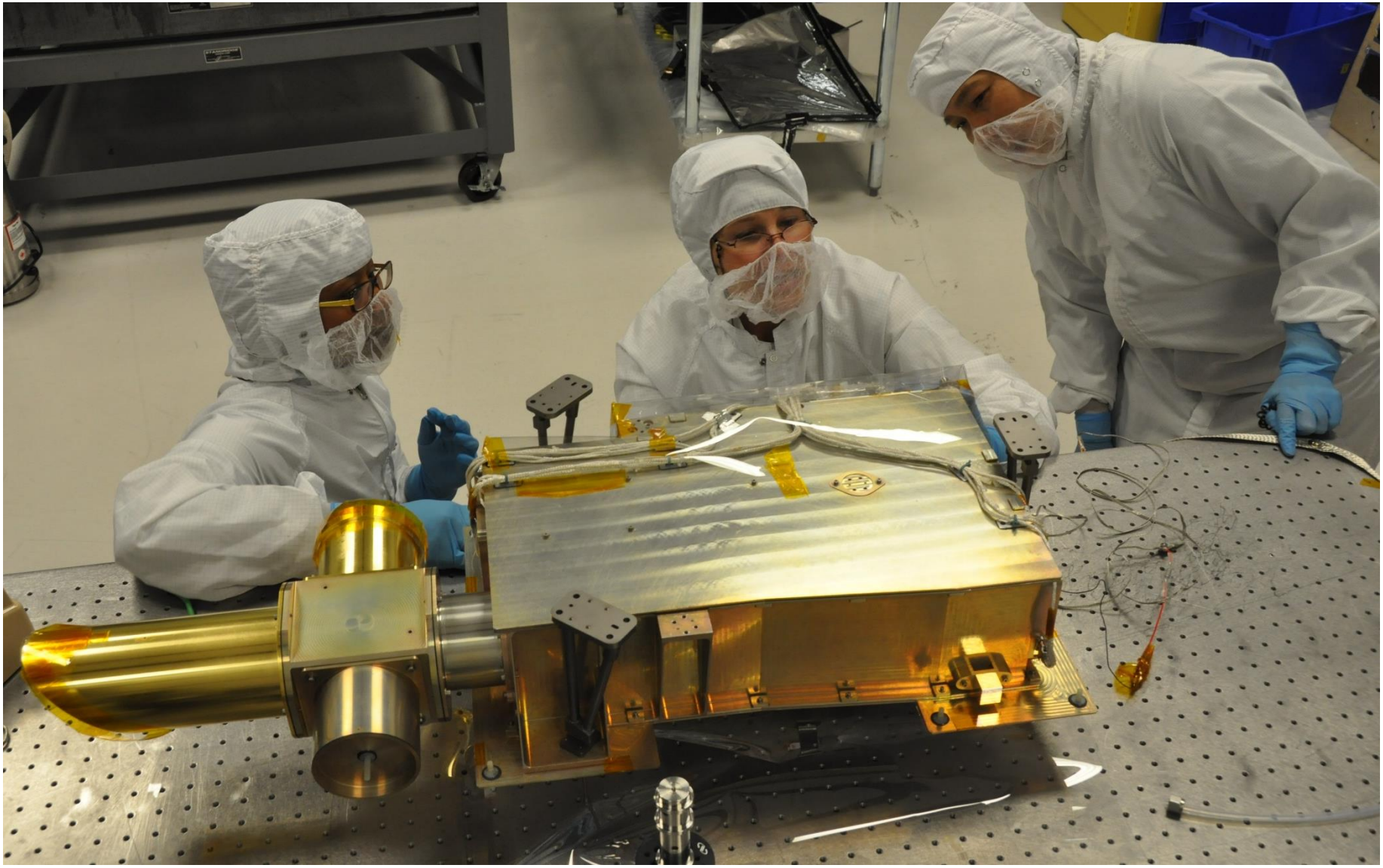
Proof Test of Support Structure



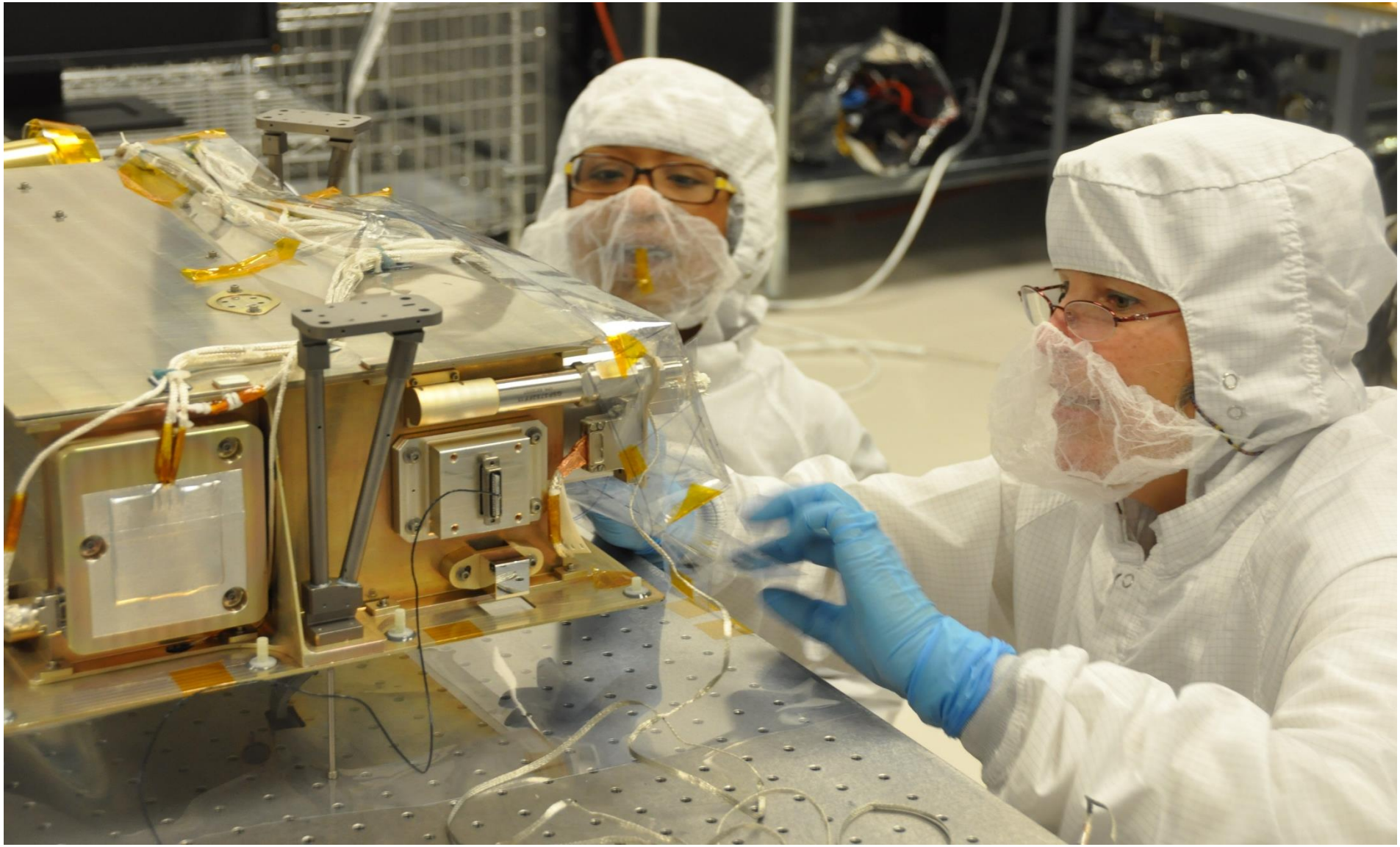
The allusive structural integrity certification tag

Thermal Blanket Design Planning

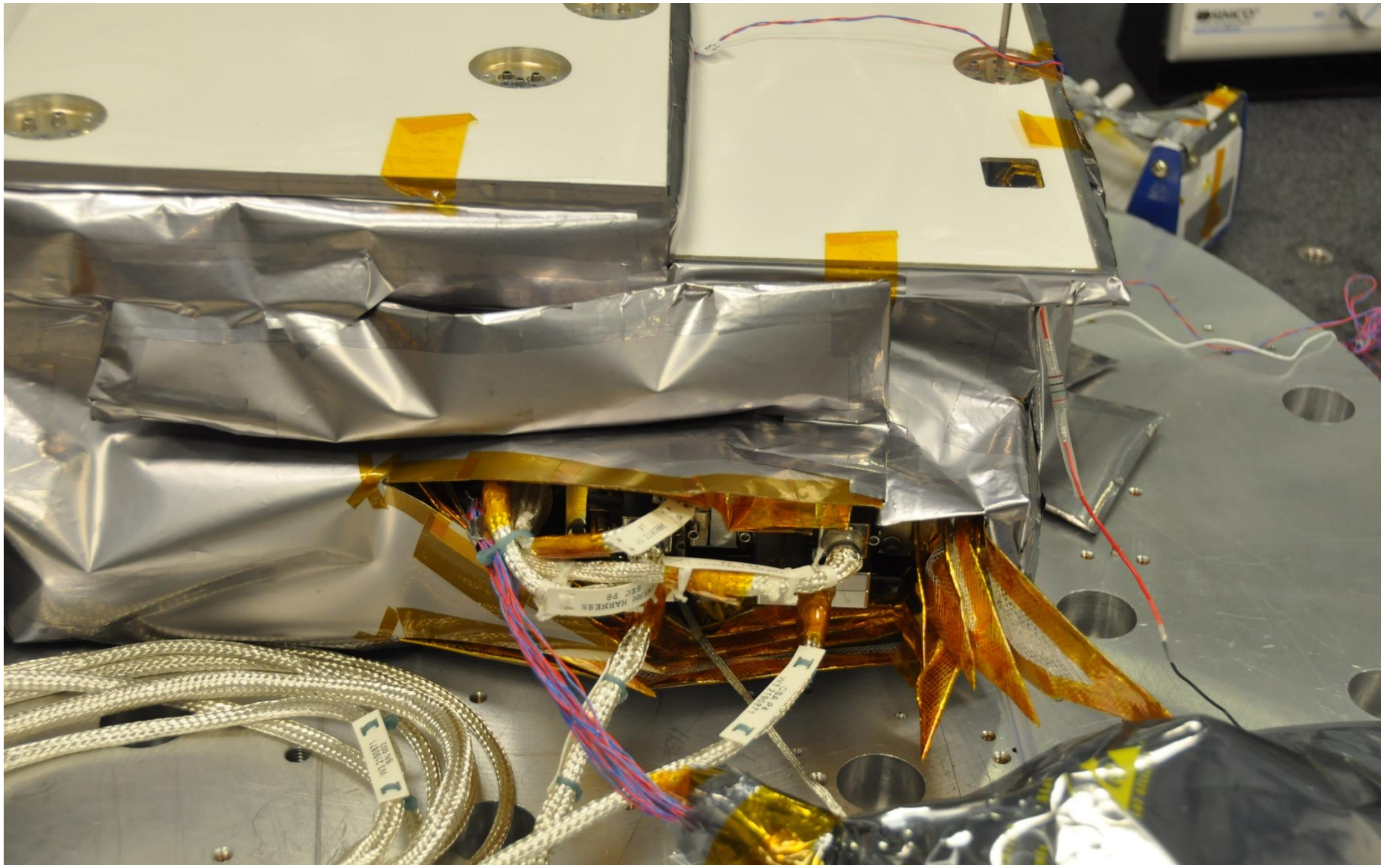
Blanket Design Templating



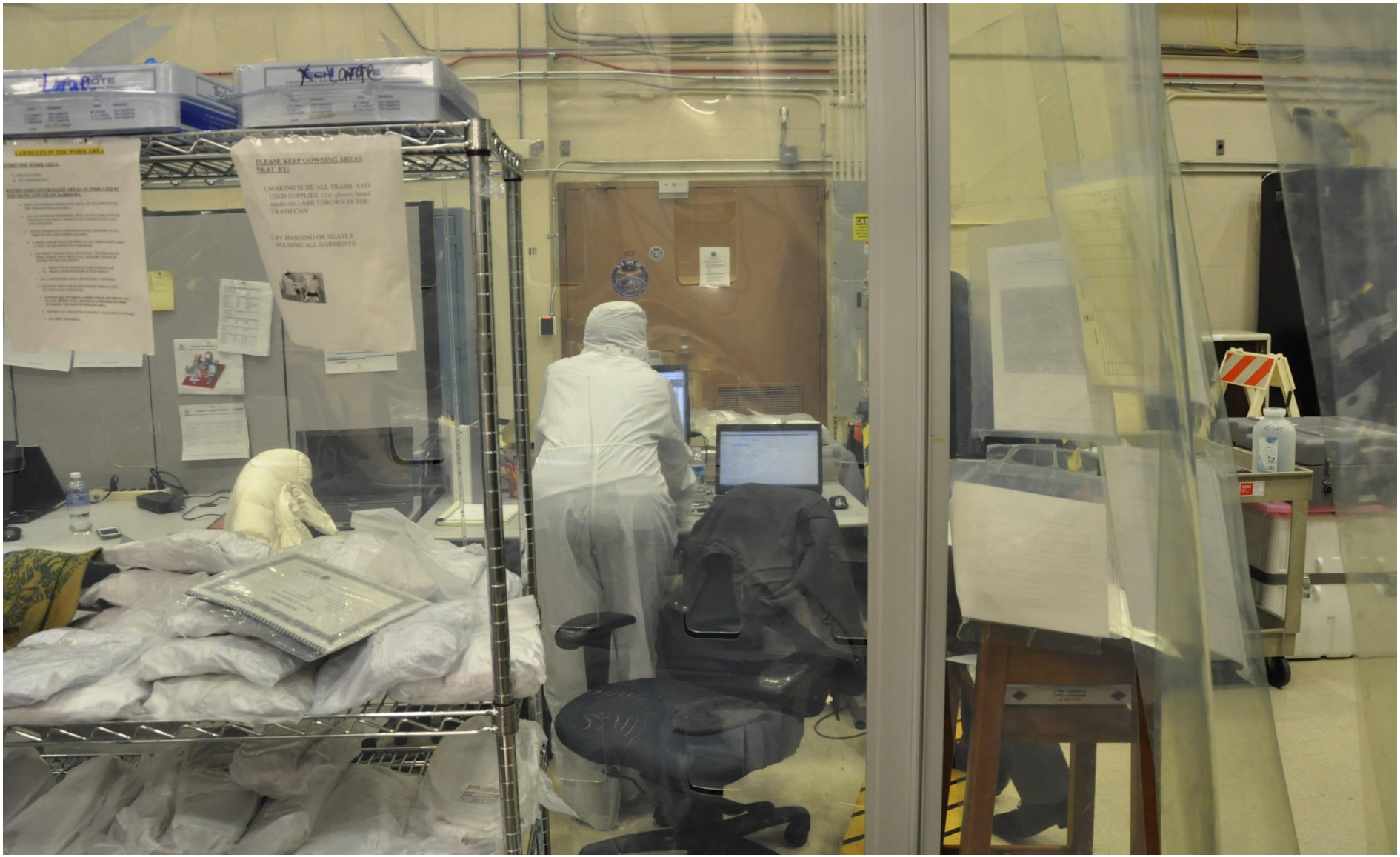
Blanket Design Templating



Complex Blanket Closeouts



Wait a minute …



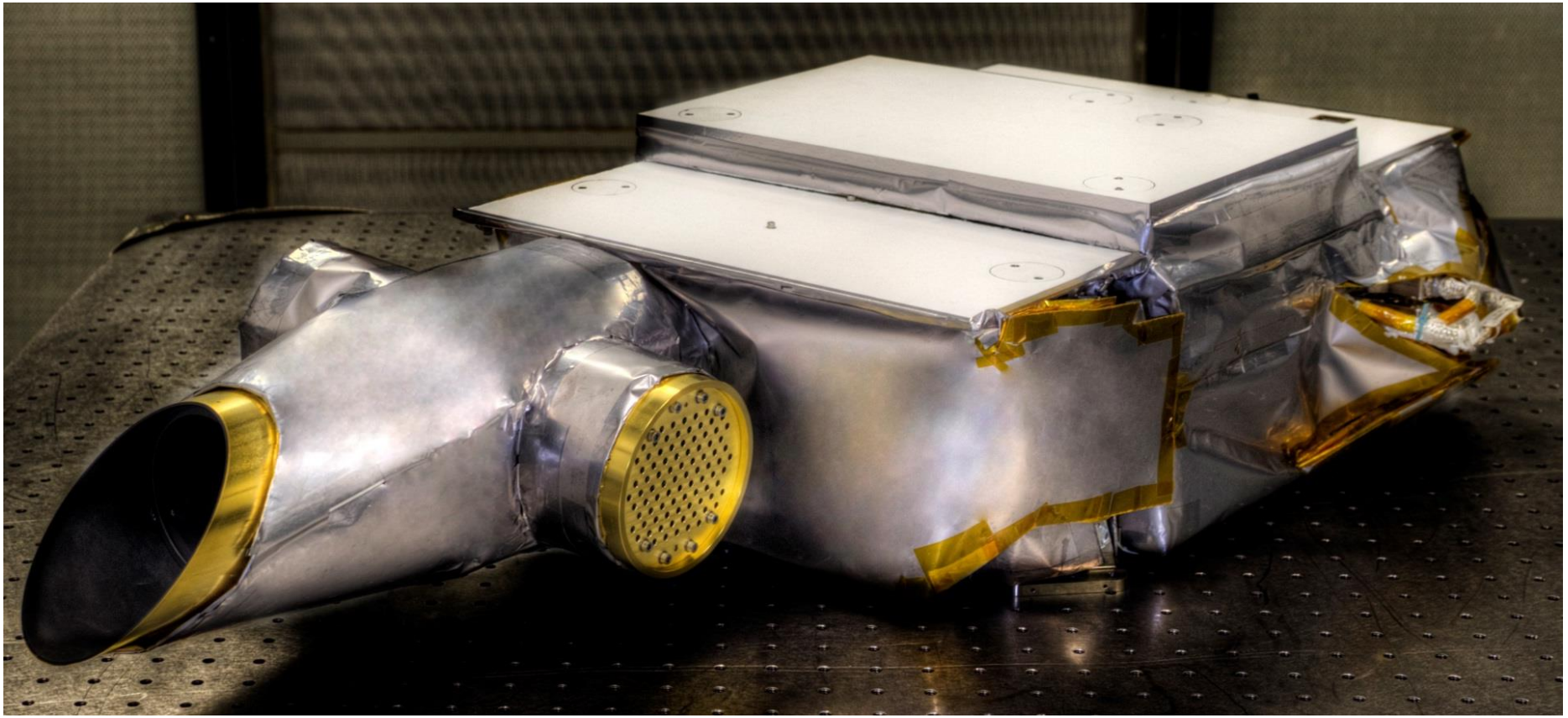
Inner Layer Blanket Installation

Thermal Blankets Near Completion, Radiators used to Cool Detectors Installed

In case you didn't recognize him …

Optics Box Gets Approval from the Optics Team

Completed Optics Box

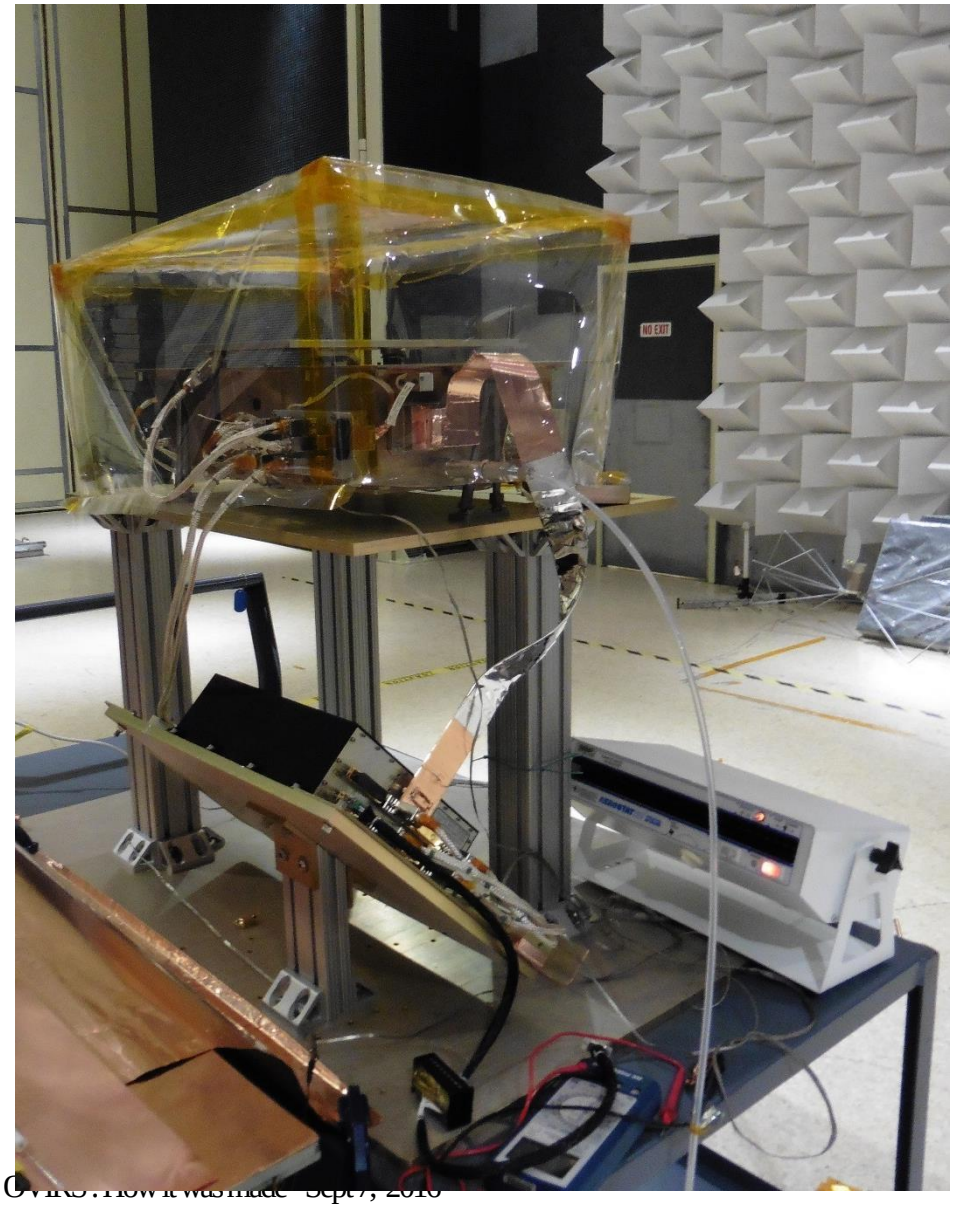


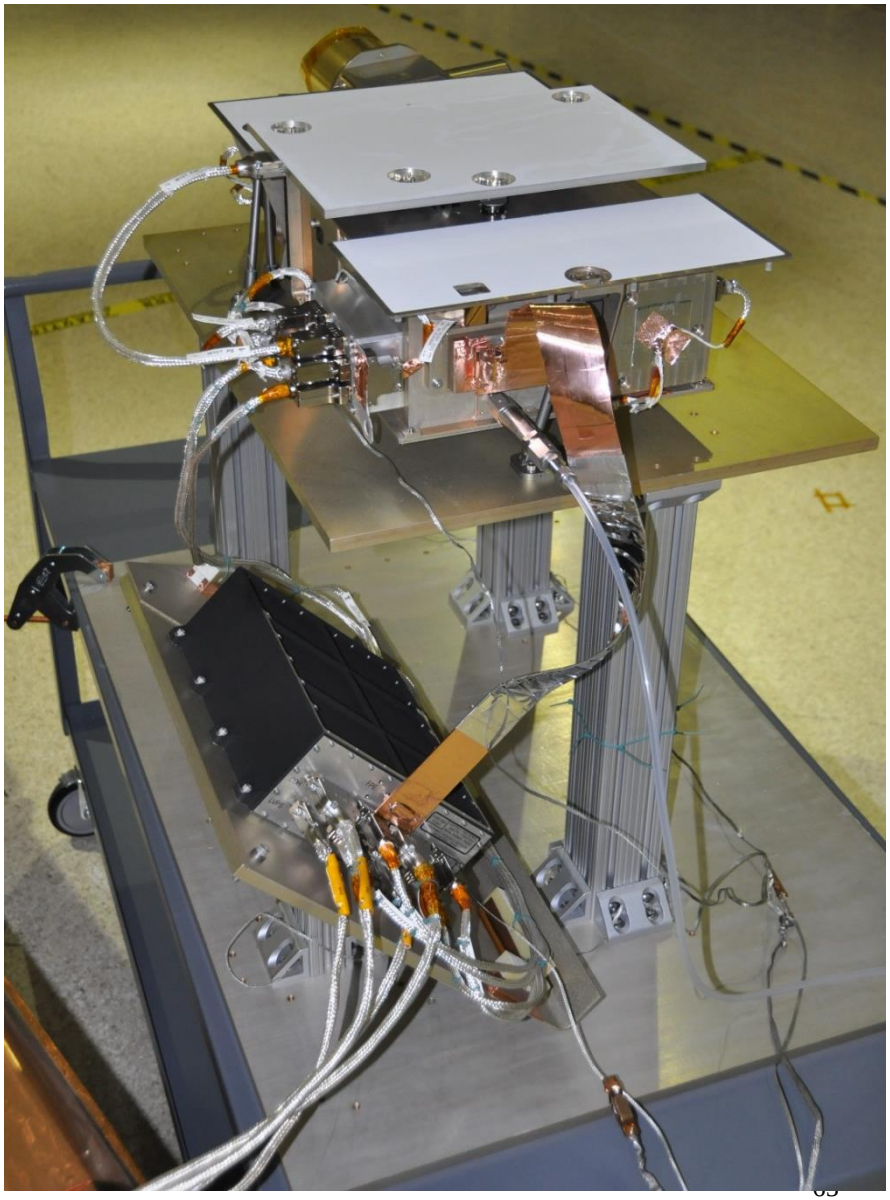
Test

OVIRS Integration Activities

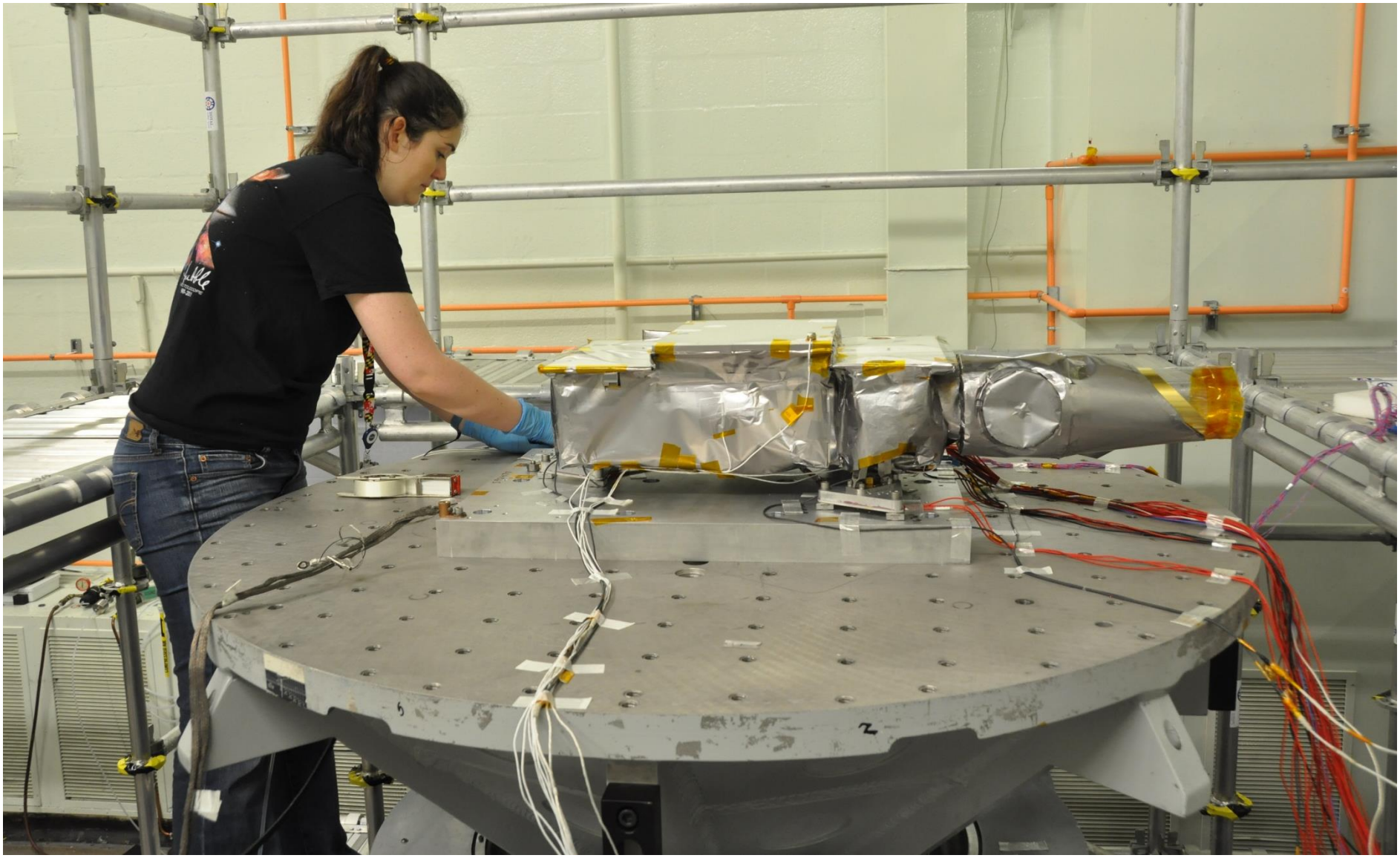
Moving OVIRS in to Electrical Interference Testing

OVIRS in Electromagnetic Interference and Compatibility Testing

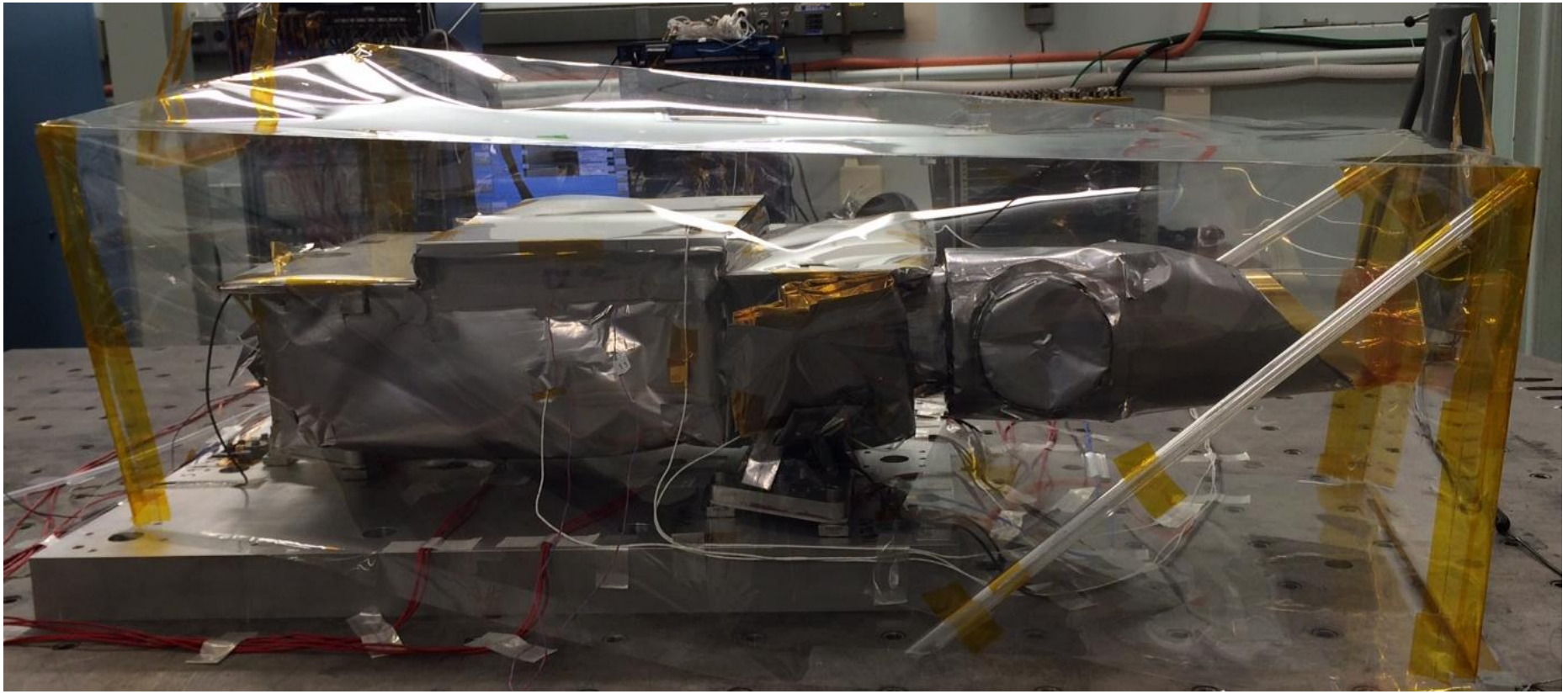




Test Sensor Installation for Optics Box Vibration Test

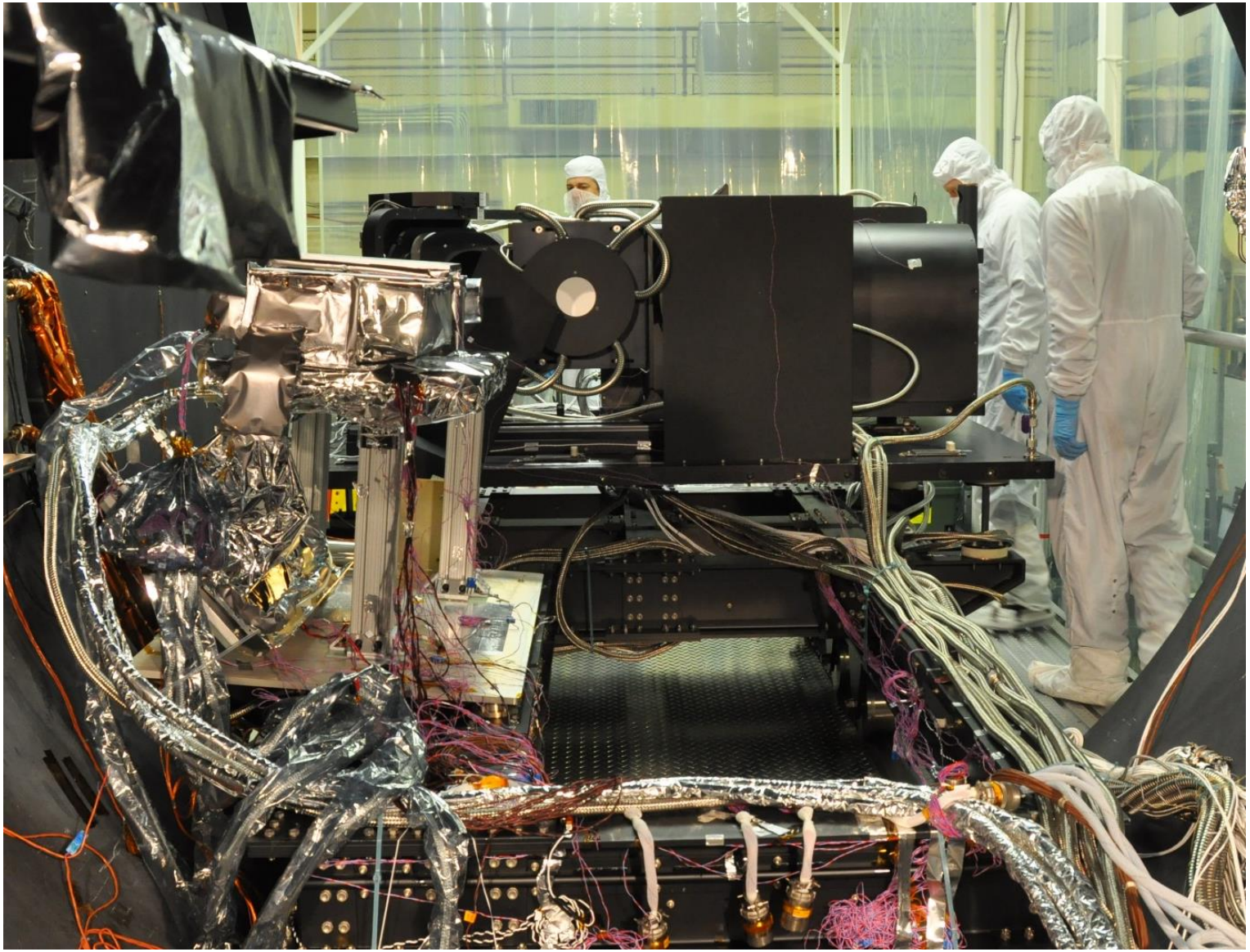


Optic Box Vibration Test

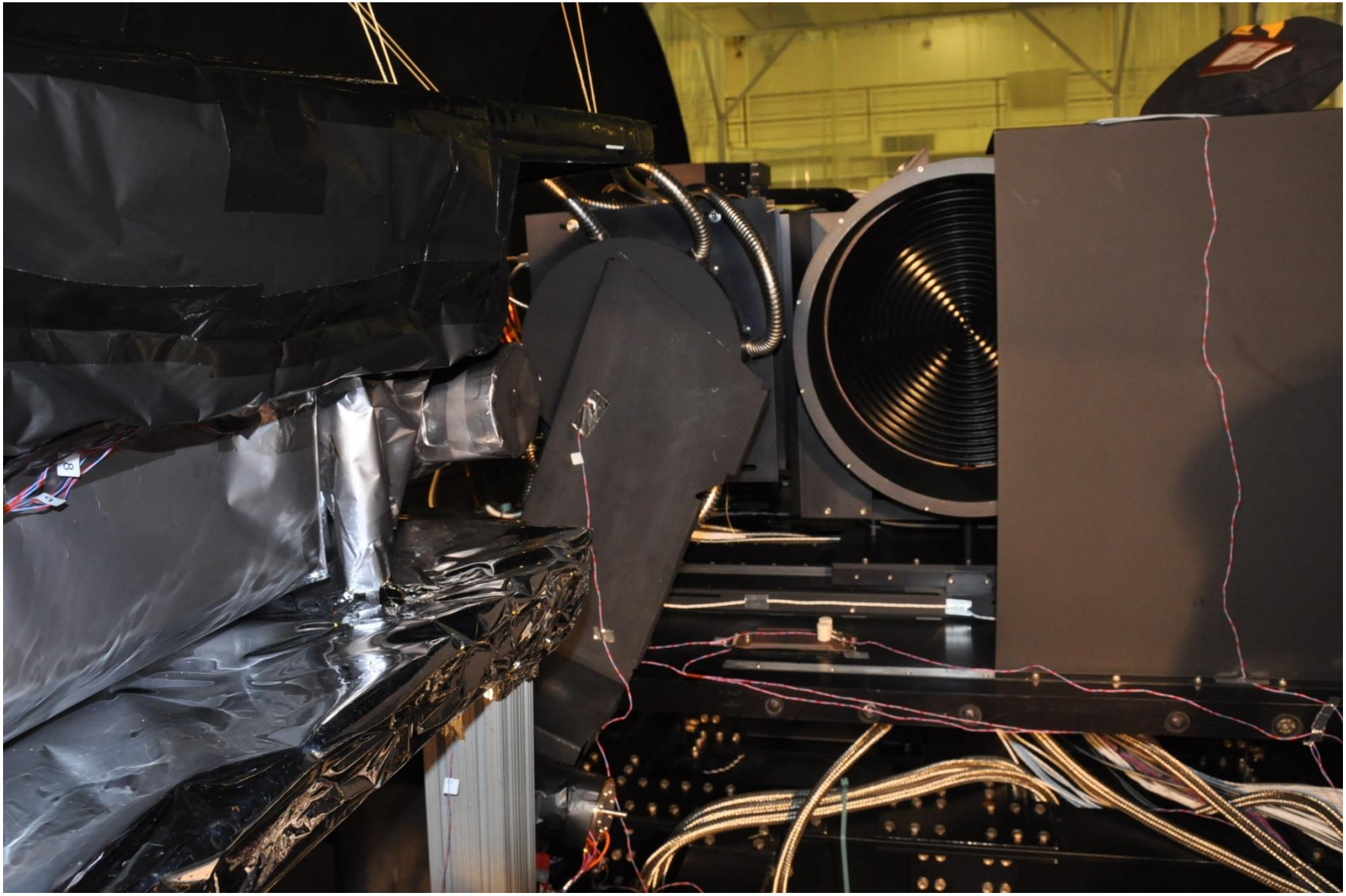


Calibration System used to Measure Performance during Thermal Vacuum Test

Calibration System Exposes OVIRS to Various Sources to Characterize Performance

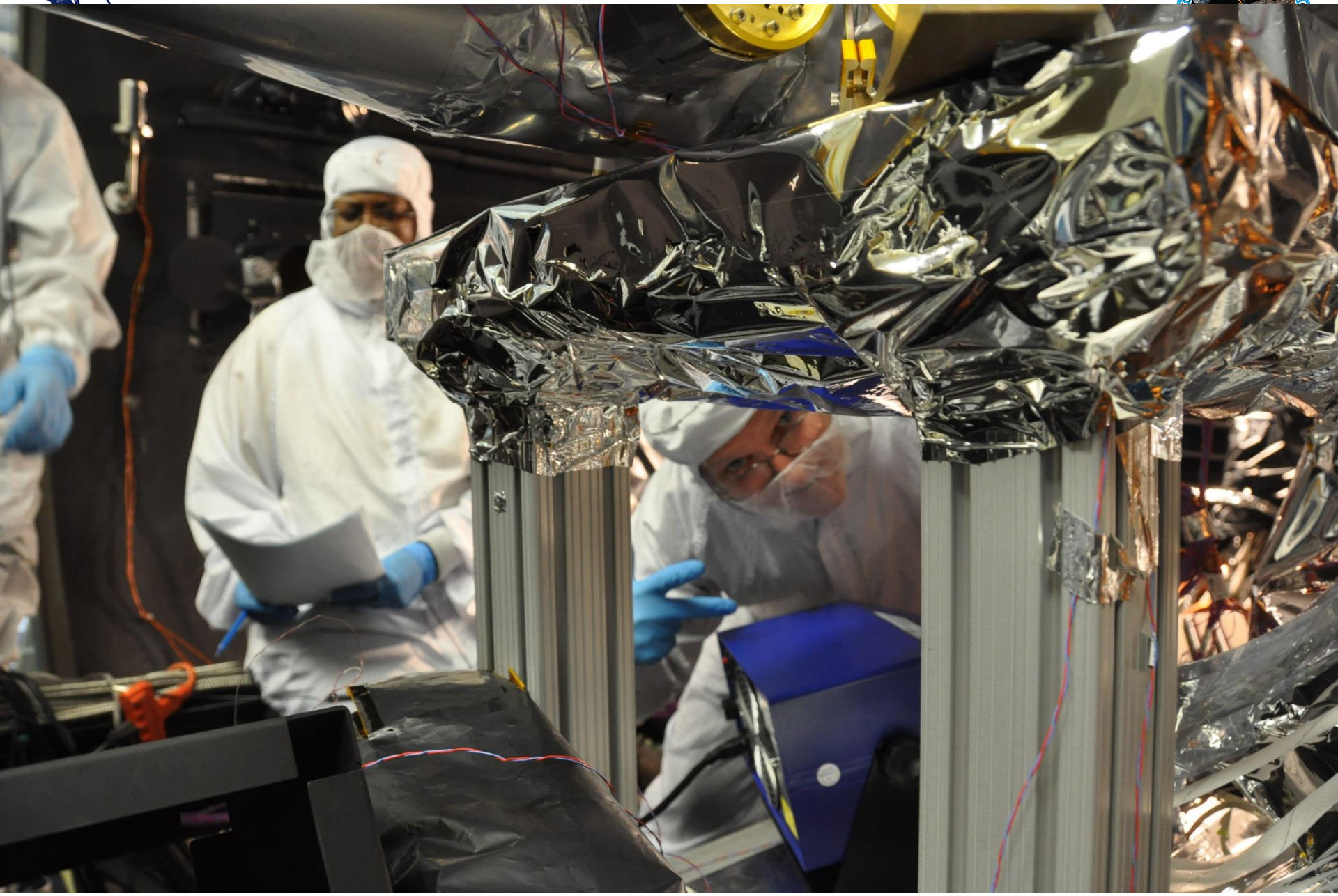


Blackbody Source used for Infrared Calibration

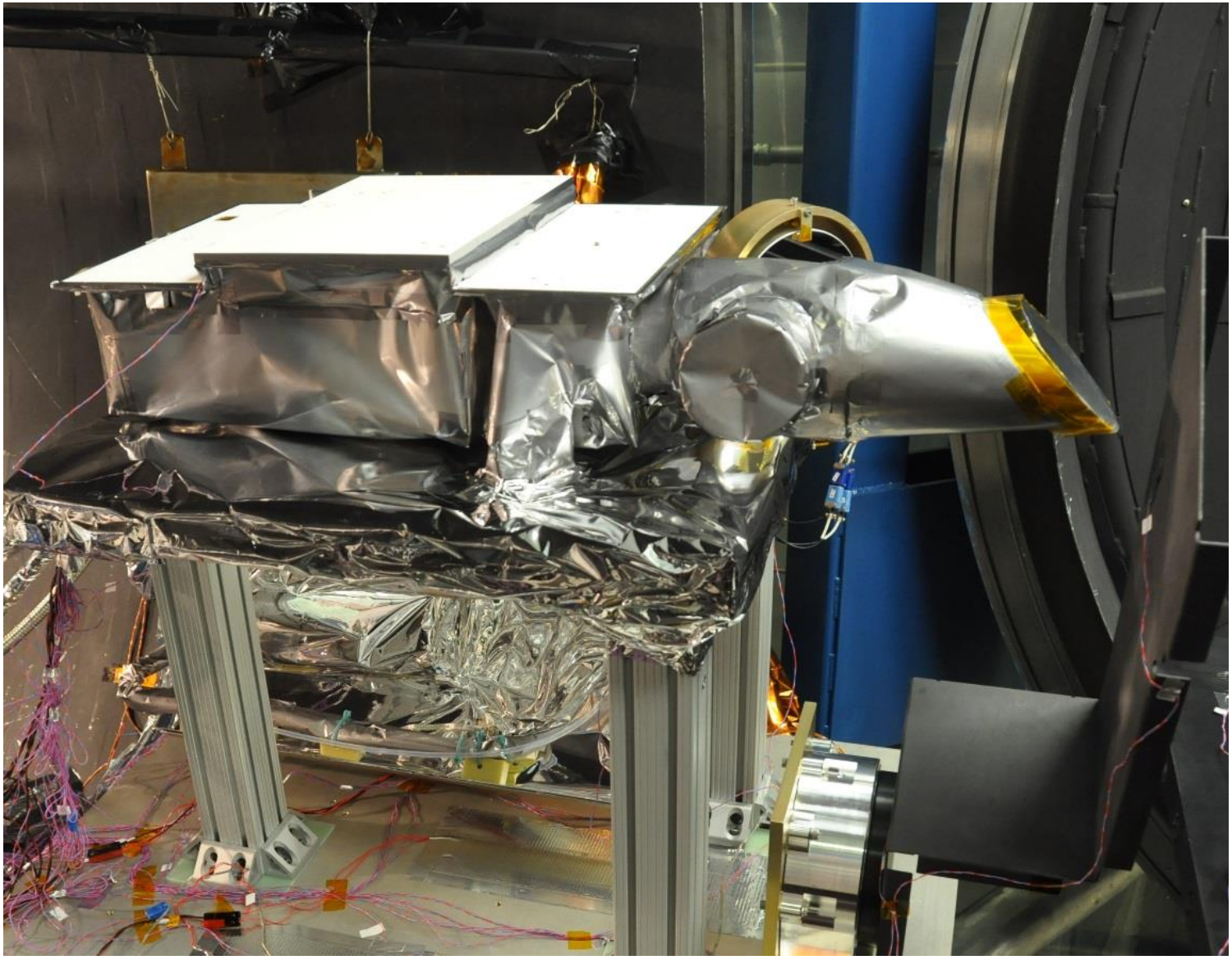


Preparing OVIRS for Thermal Vacuum Test

Blanket, Harness, and Test Sensor Closeout for Test

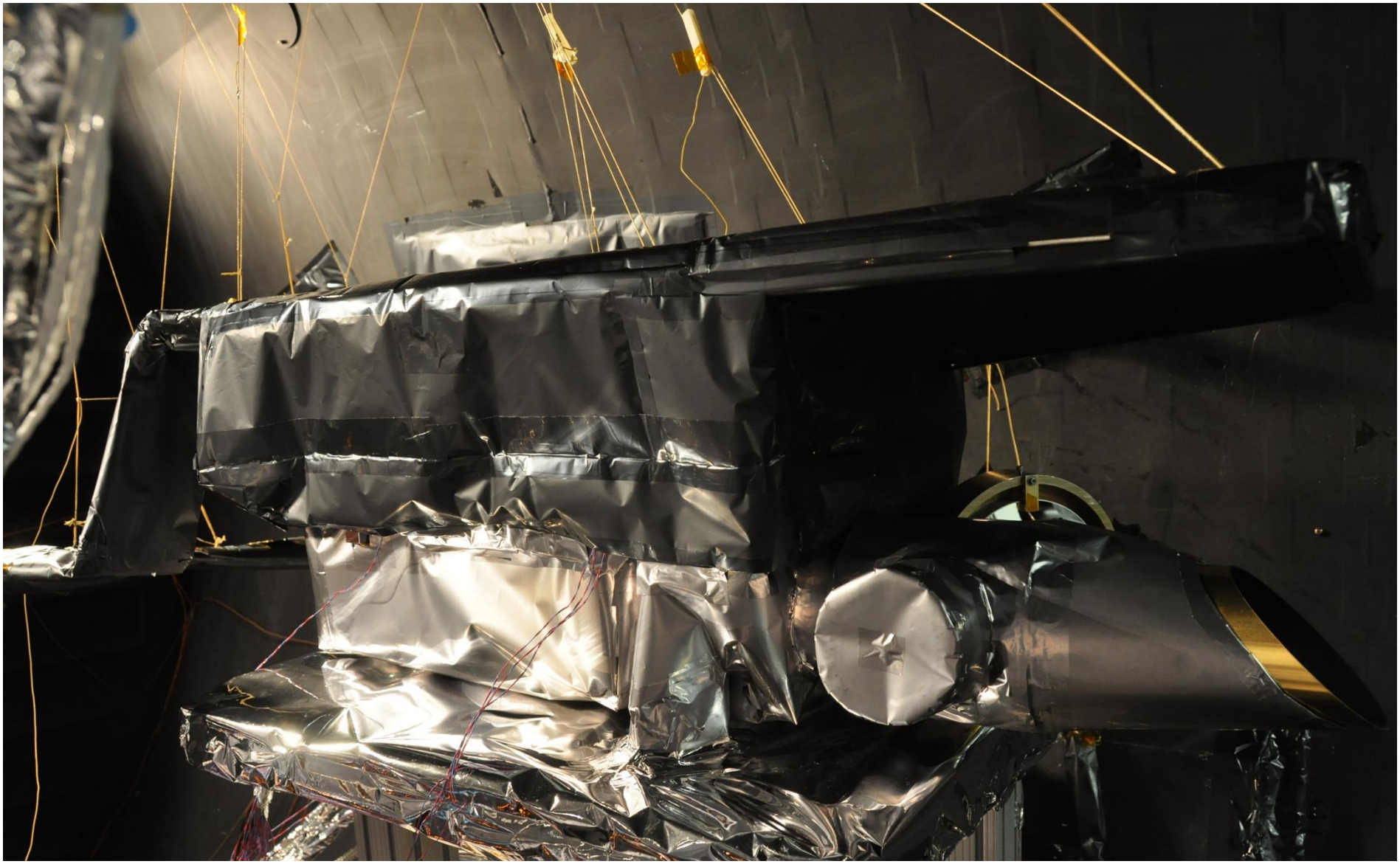


OVIRS Ready for Test



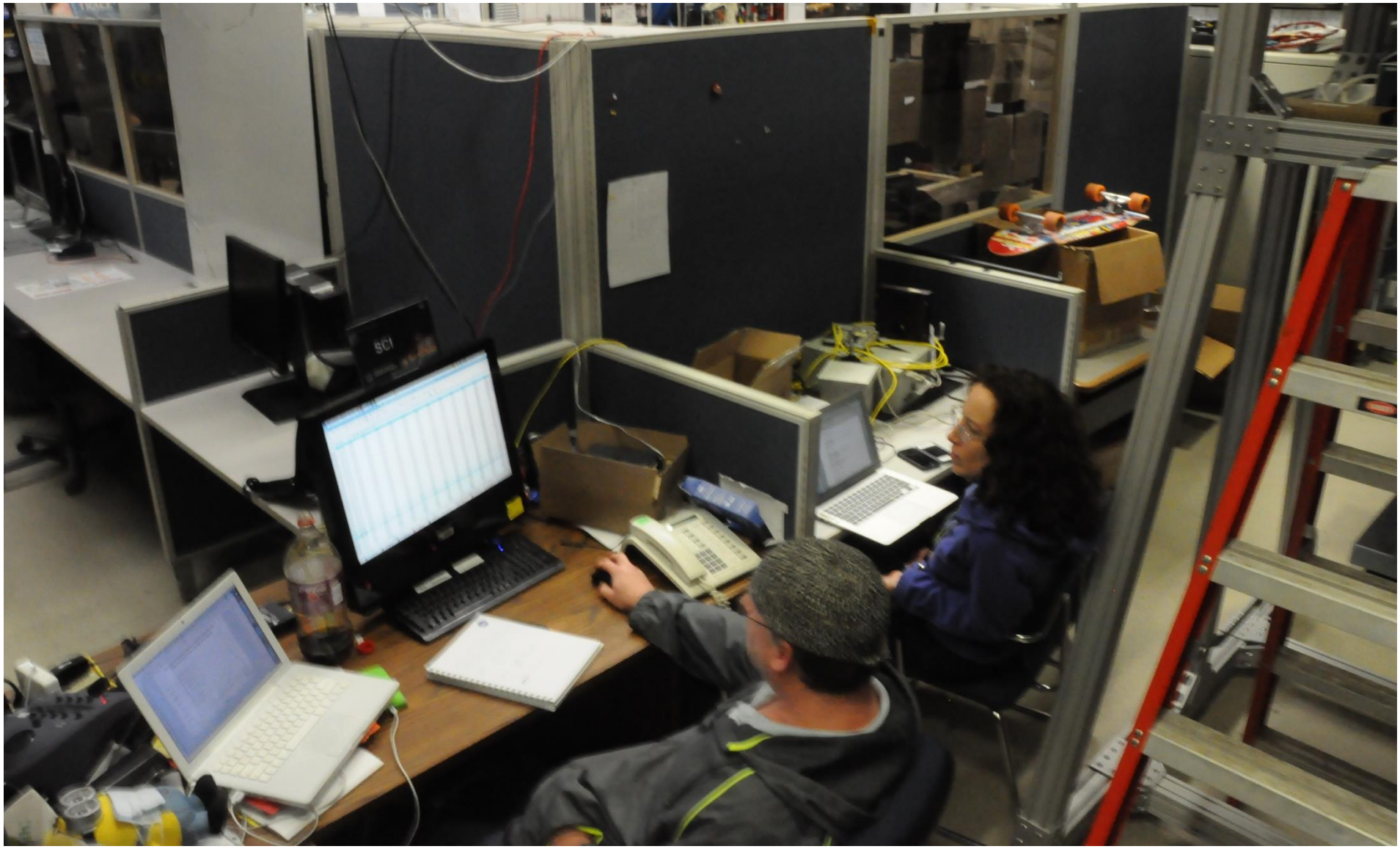
Preparing the Cold Target for the Test

Cold Target Used Over OVIRS to Cool Radiators and Detector to Cryogenic Temperature

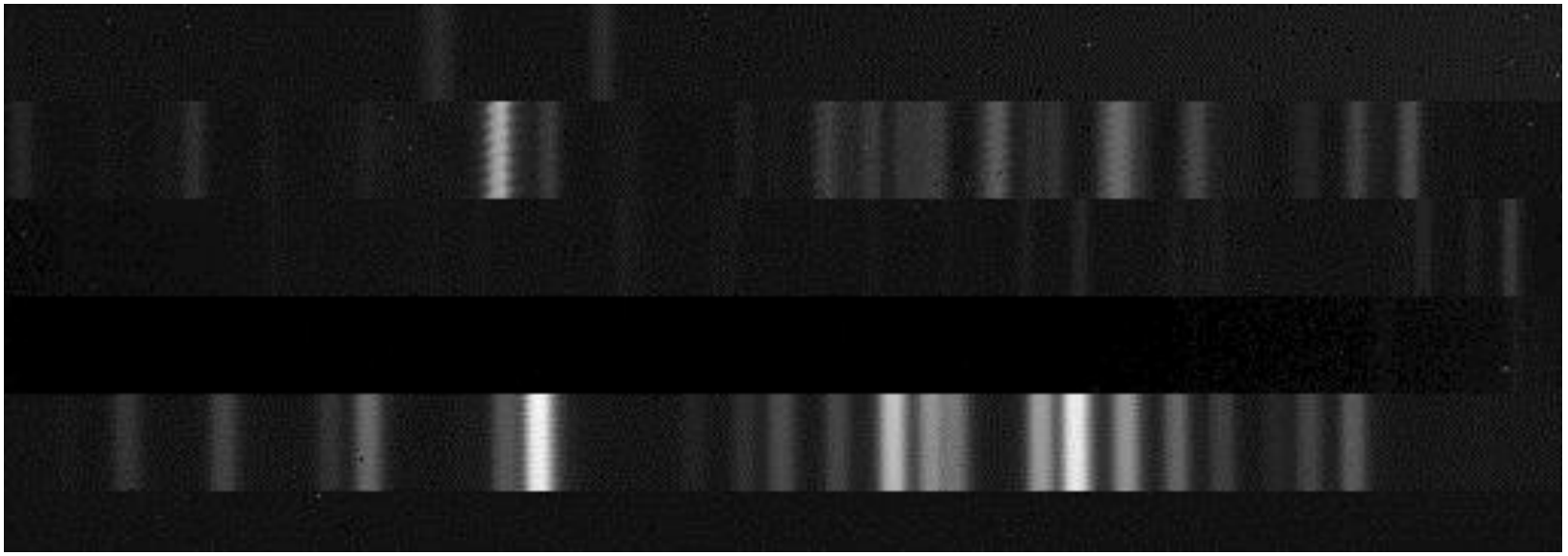


Thermal Vacuum Testing, 24 hours a day, 7 days a week for 36 days

Science Data Collection and Analysis during Thermal Vacuum Test



Example Detector Image of the Spectrum of a Mercury Lamp



Delivery and Spacecraft Integration

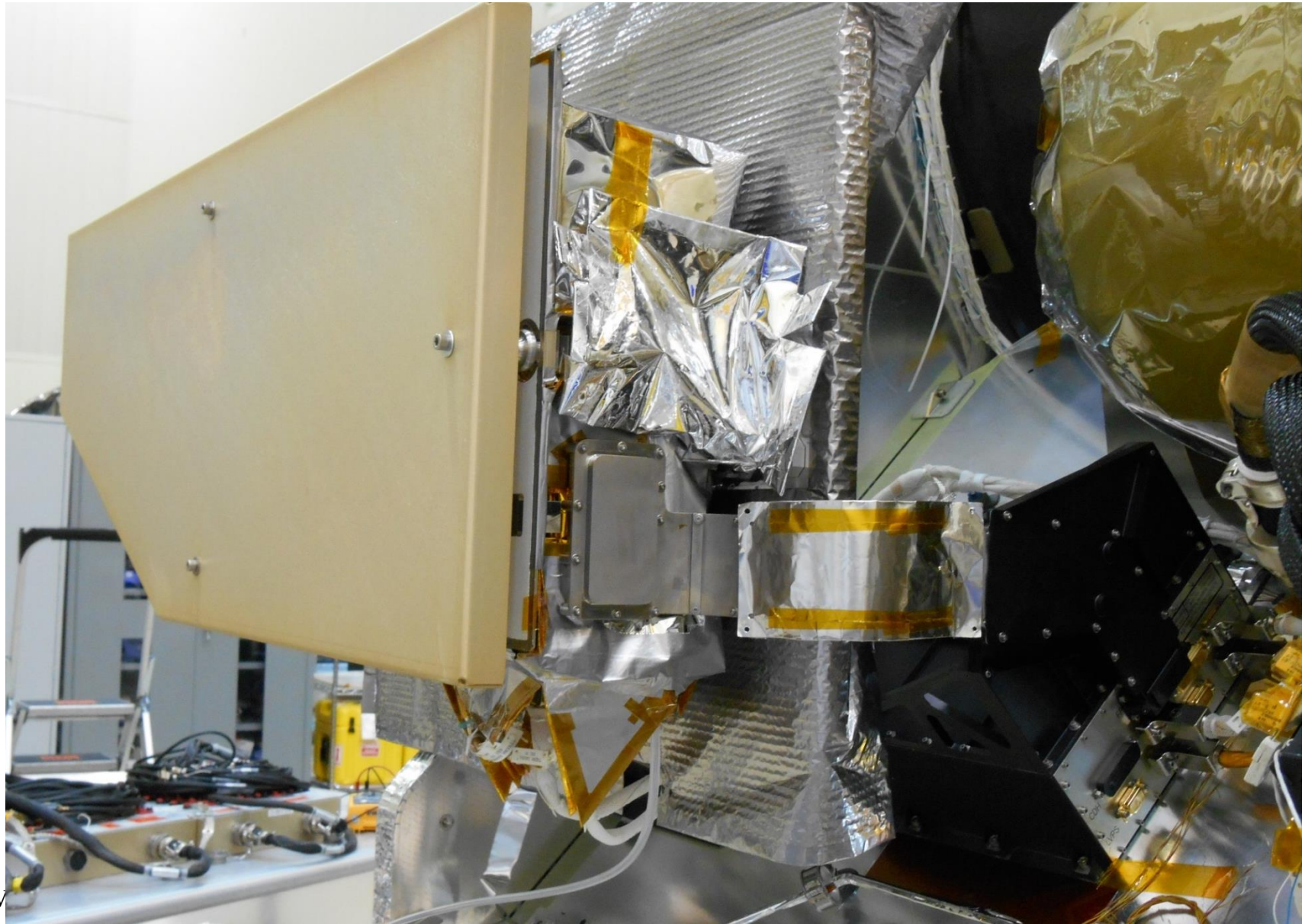
OVIRS Packed and Ready to Ship

OVIRS Arrival for Spacecraft Integration

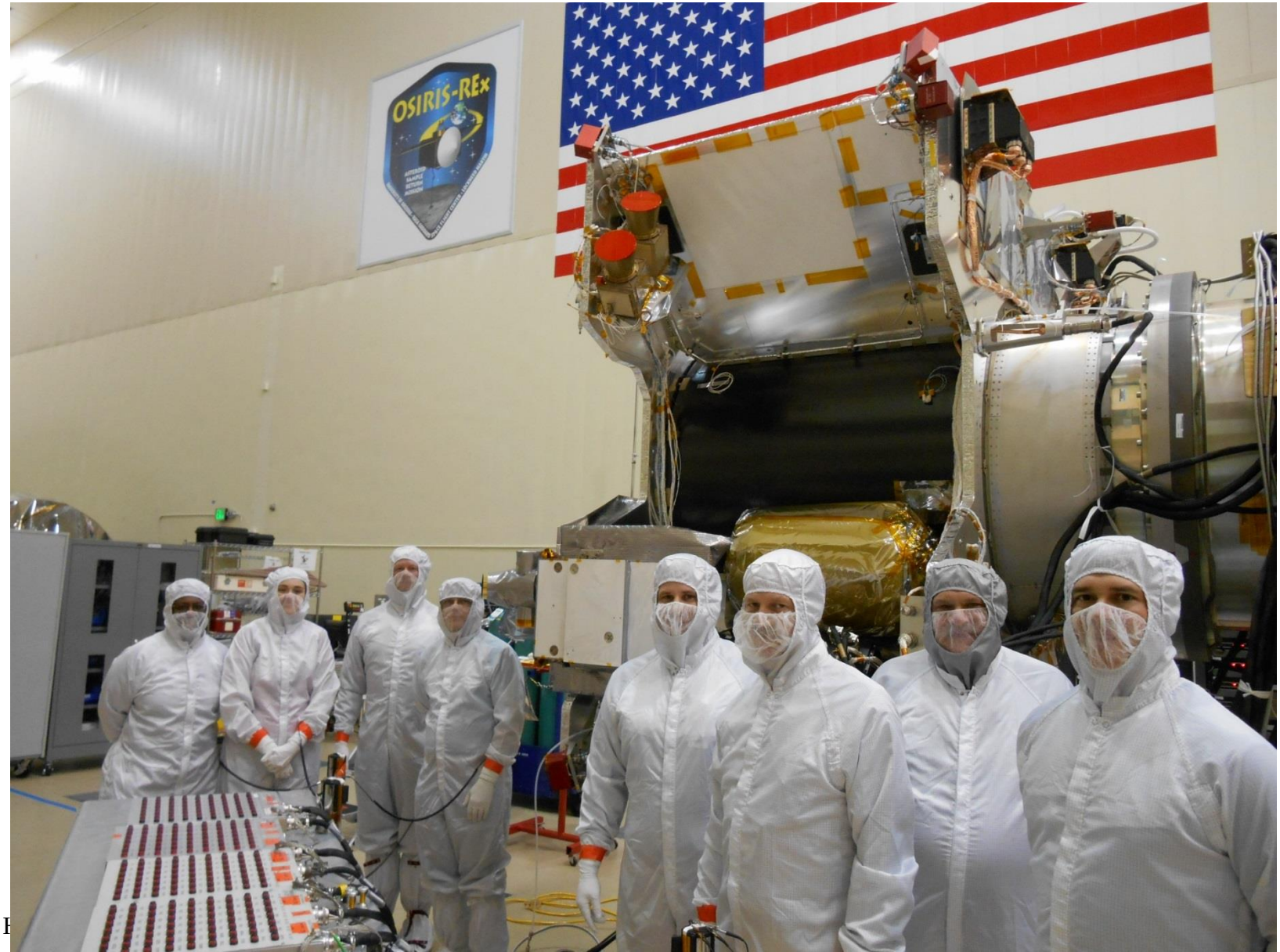
Optics Box installed the Spacecraft

Detector Signal Harness Connection between Optics Box and MEB

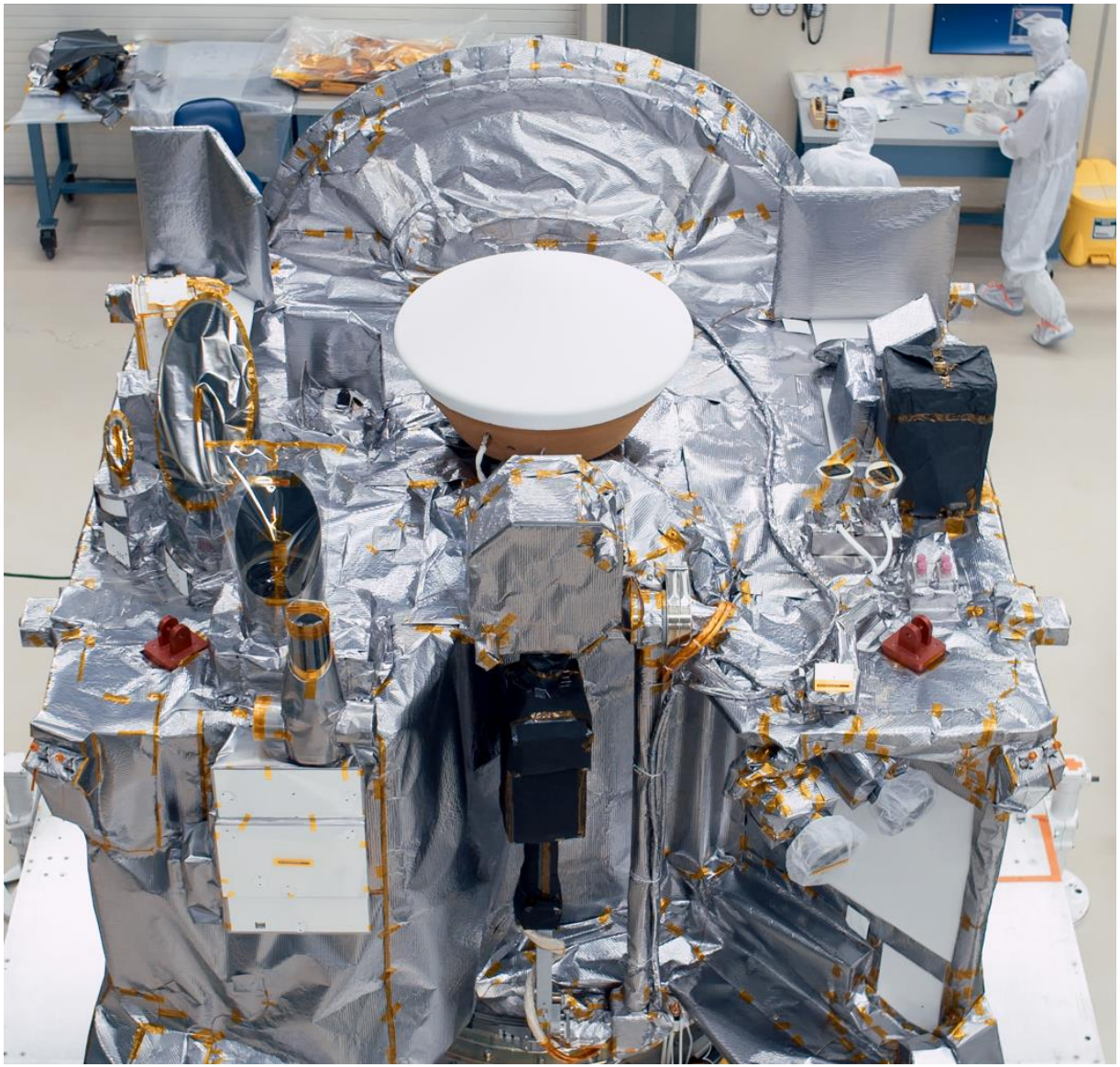
Optics Box and Main Electronics Box on the Spacecraft with Signal Harness



OVIRS Spacecraft Integration Team



OSIRIS-REx Assembled and Ready for System Level Testing



OSIRIS-REx Ready for Launch