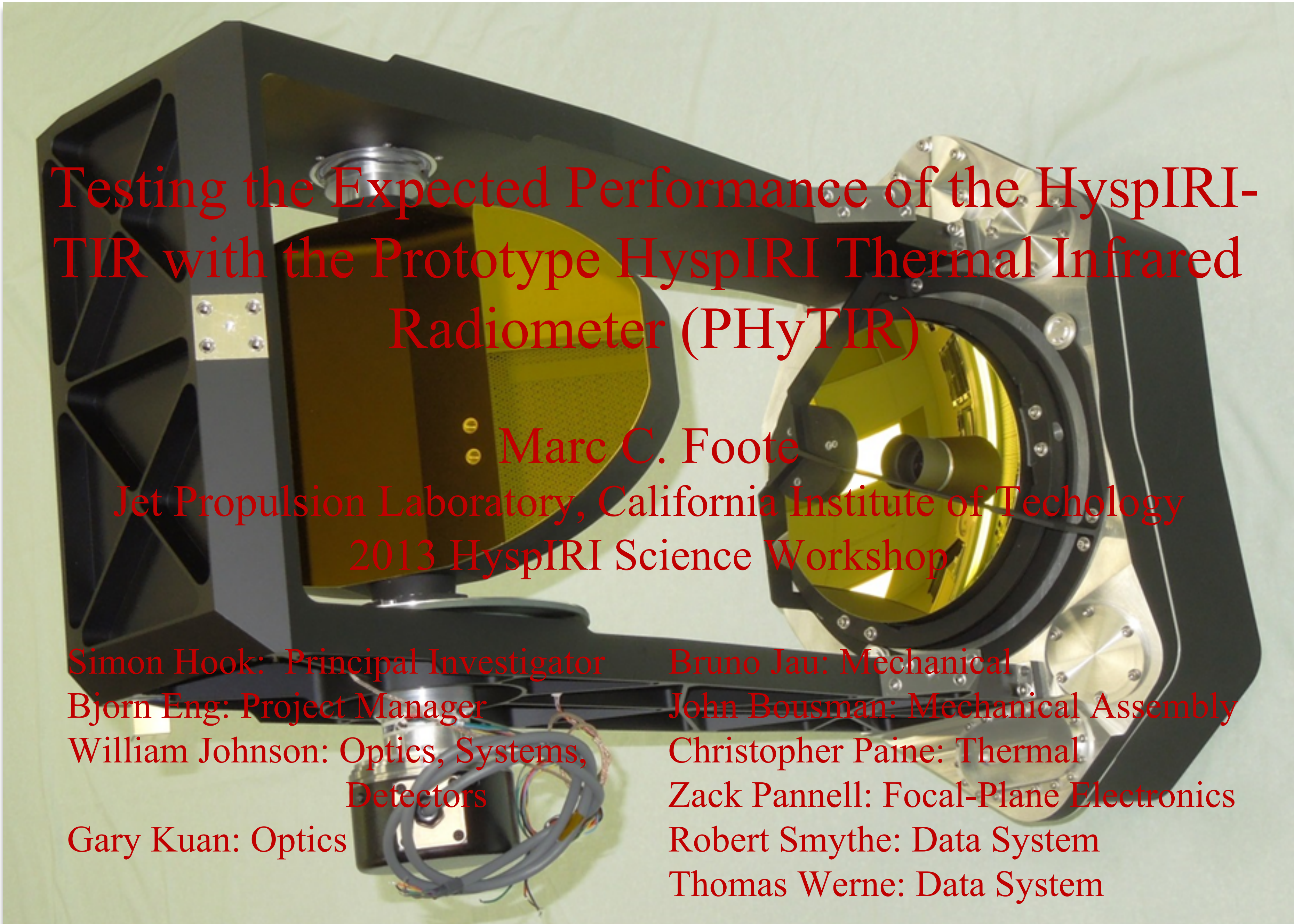

Testing the Expected Performance of the HyspIRI-TIR with the Prototype HyspIRI Thermal Infrared Radiometer (PHyTIR)

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2013 HyspIRI Science Workshop

Simon Hook: Principal Investigator

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Gary Kuan: Optics

Bruno Jau: Mechanical

John Bousman: Mechanical Assembly

Christopher Paine: Thermal

Zack Pannell: Focal-Plane Electronics

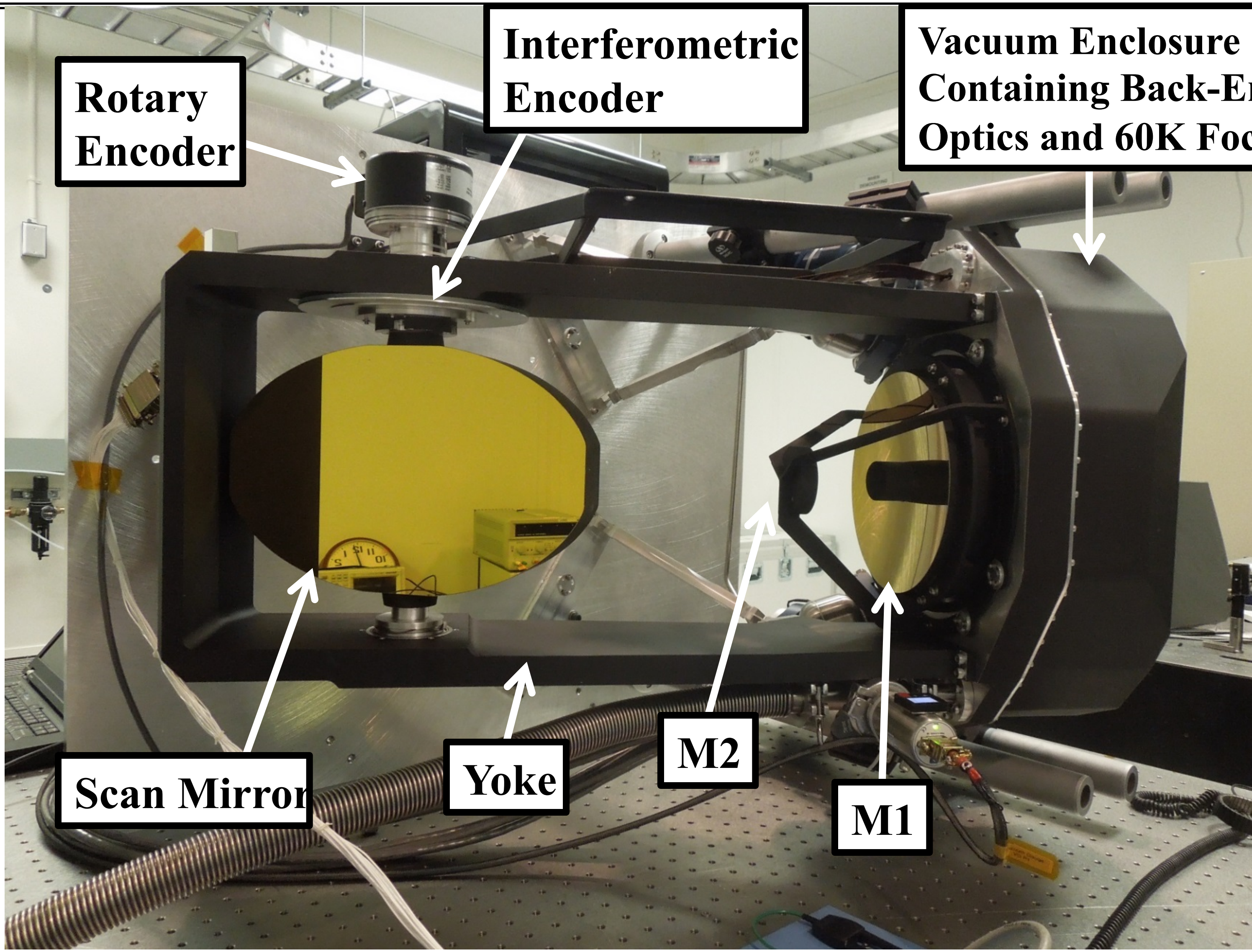
Robert Smythe: Data System

Thomas Werne: Data System

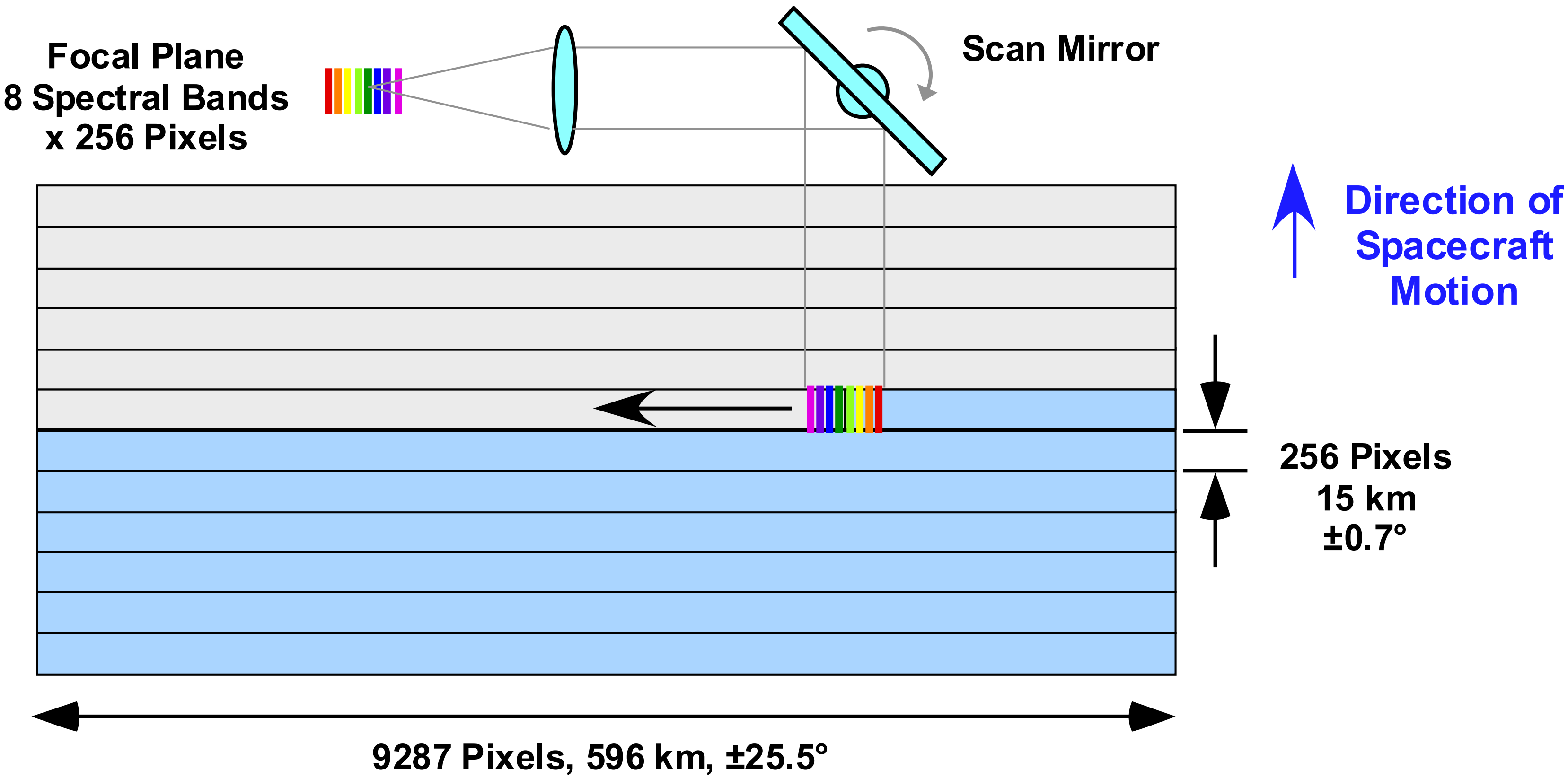
PHyTIR Project Overview

- Funded by NASA Instrument Incubator Program (IIP)
- To demonstrate a laboratory prototype of the HyspIRI TIR instrument
- Currently 2.5 years into 3-year project
- Goals are to demonstrate that:
  - The detectors and readout meet all signal-to-noise and speed specifications.
  - The scan mirror, together with the structural stability, meets the pointing knowledge requirements.
  - The long-wavelength channels do not saturate below 480 K.
  - The cold shielding allows the use of ambient temperature optics on HyspIRI without impacting instrument performance.

PHyTIR is Currently Assembled and Ready to Test

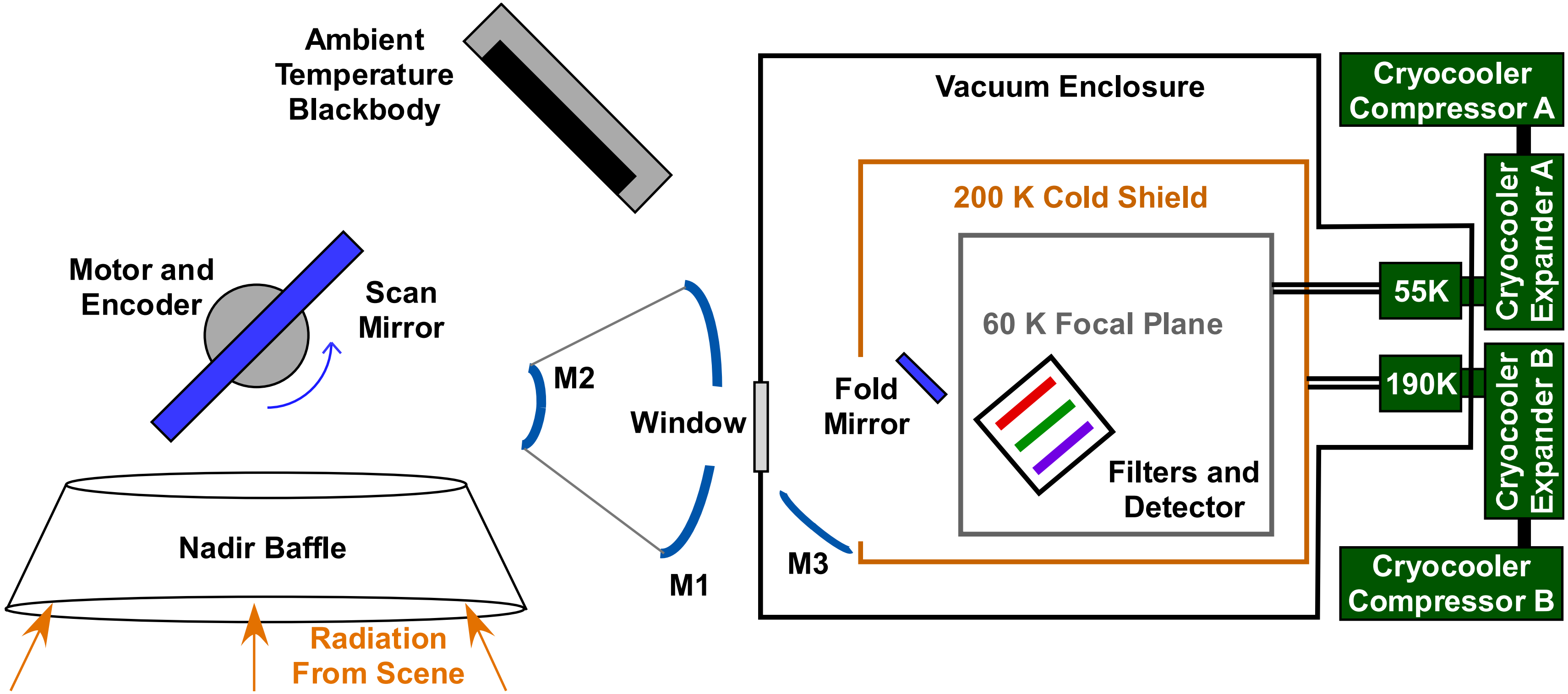


HyspIRI TIR Scan Concept



- 60 m Pixel Footprint at Nadir
- Time-Averaged Science Data Rate 0.020 Gbps
- Assuming 14 bits, 2:1 Compression, 31% Land
- Scan Mirror Rotation Rate 14.2 RPM
- Pixel Dwell Time 32 microseconds

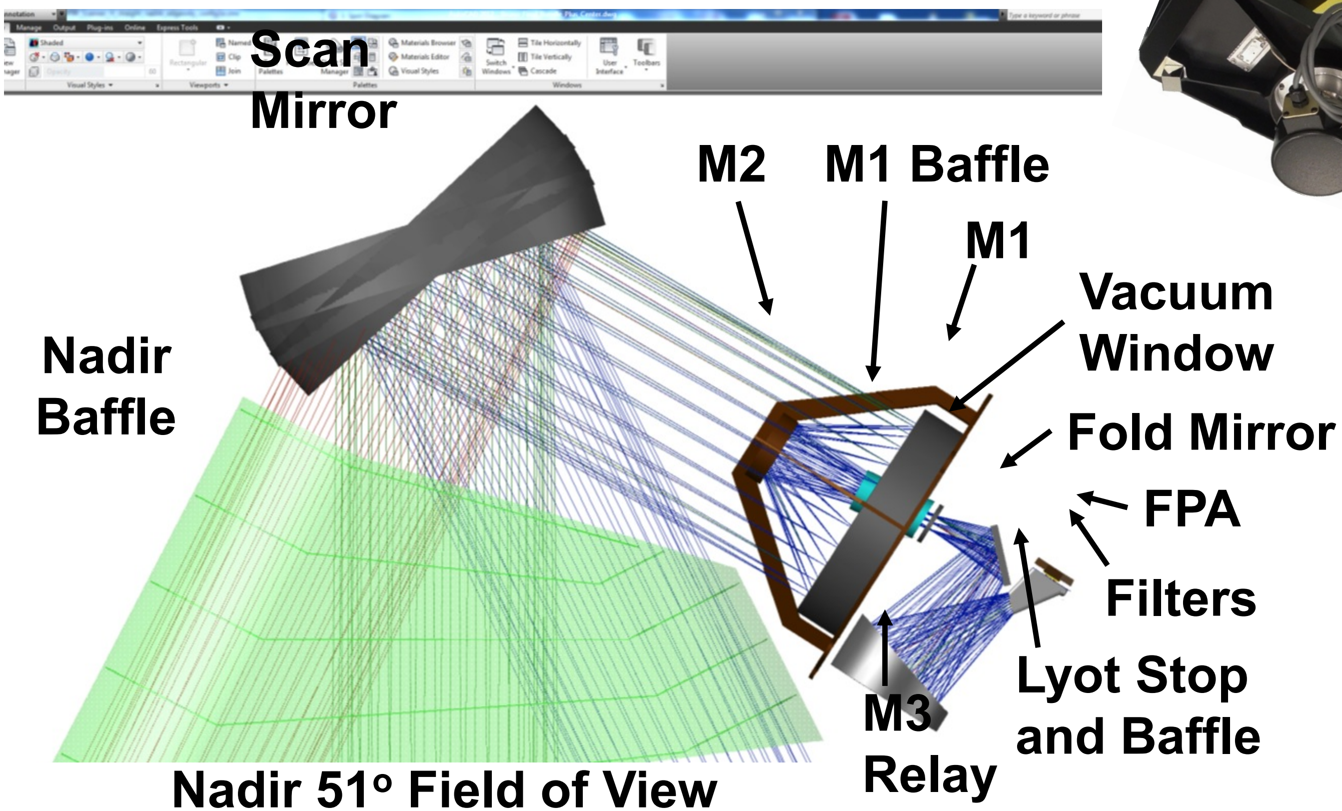
PHyTIR Block Diagram

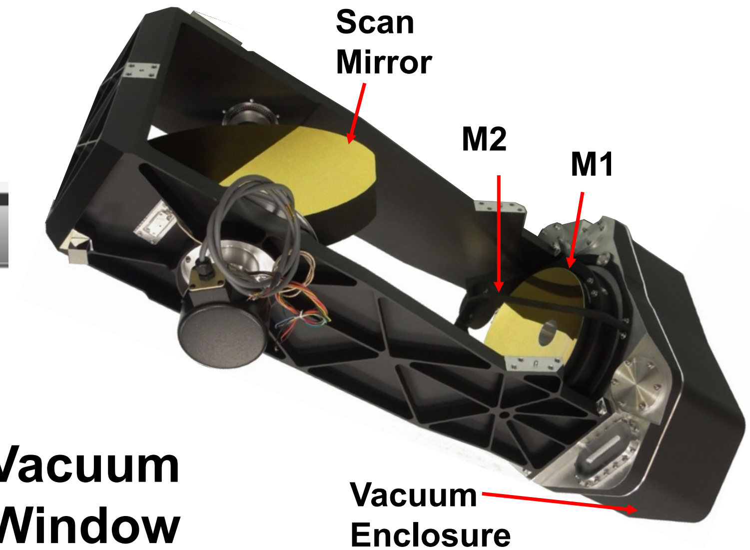


Key Differences from HyspIRI TIR Instrument

- Commercial cryocoolers used
- 3 representative spectral filters instead of 8
- Laboratory electronics used for control and data collection

PHyTIR Optics



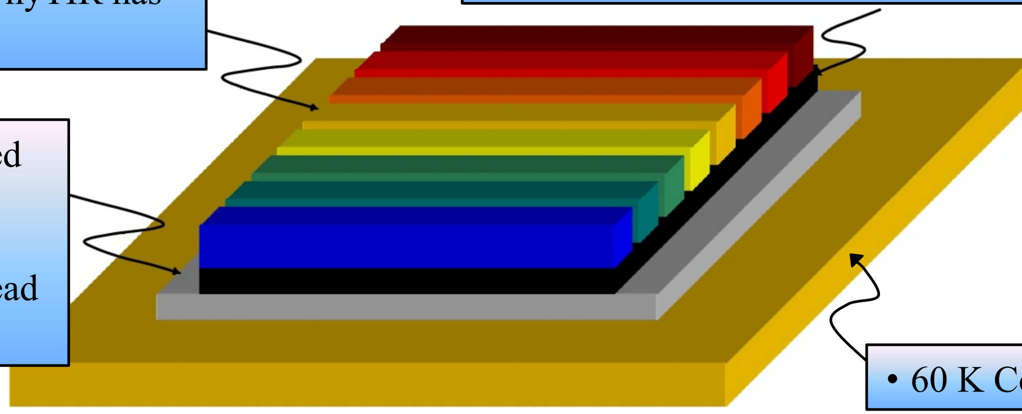


TIR Focal Plane

- Butcher-Block Filter Assembly
- Baffles to Prevent Crosstalk Between Spectral Channels
- HyspIRI will have 8 filters, PhyTIR has 3 filters

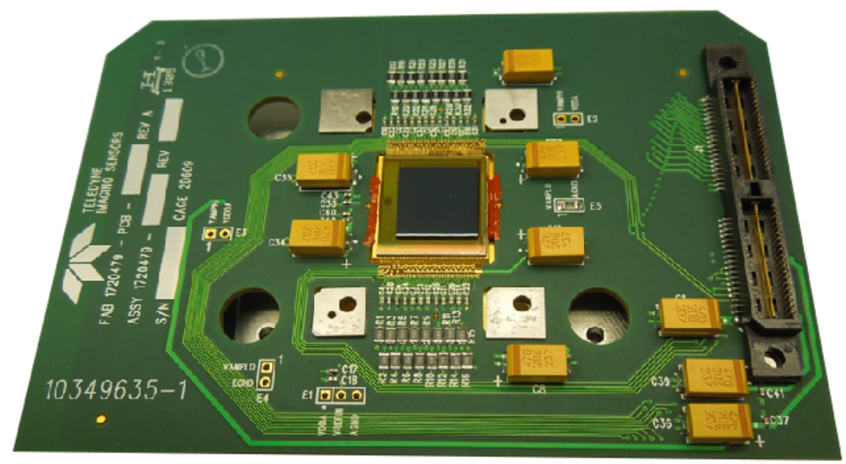
- MCT Detector Array – 256 elements cross-sweep
- 1 Bandgap to Cover Full Spectral Range
- ≥ 4 Detector Columns per Spectral Channel to Allow Time Delay and Integration (TDI)

- CMOS Read-Out Integrated Circuit (ROIC)
- 32 Analog Output Lines to Enable Necessary Pixel Read Rate

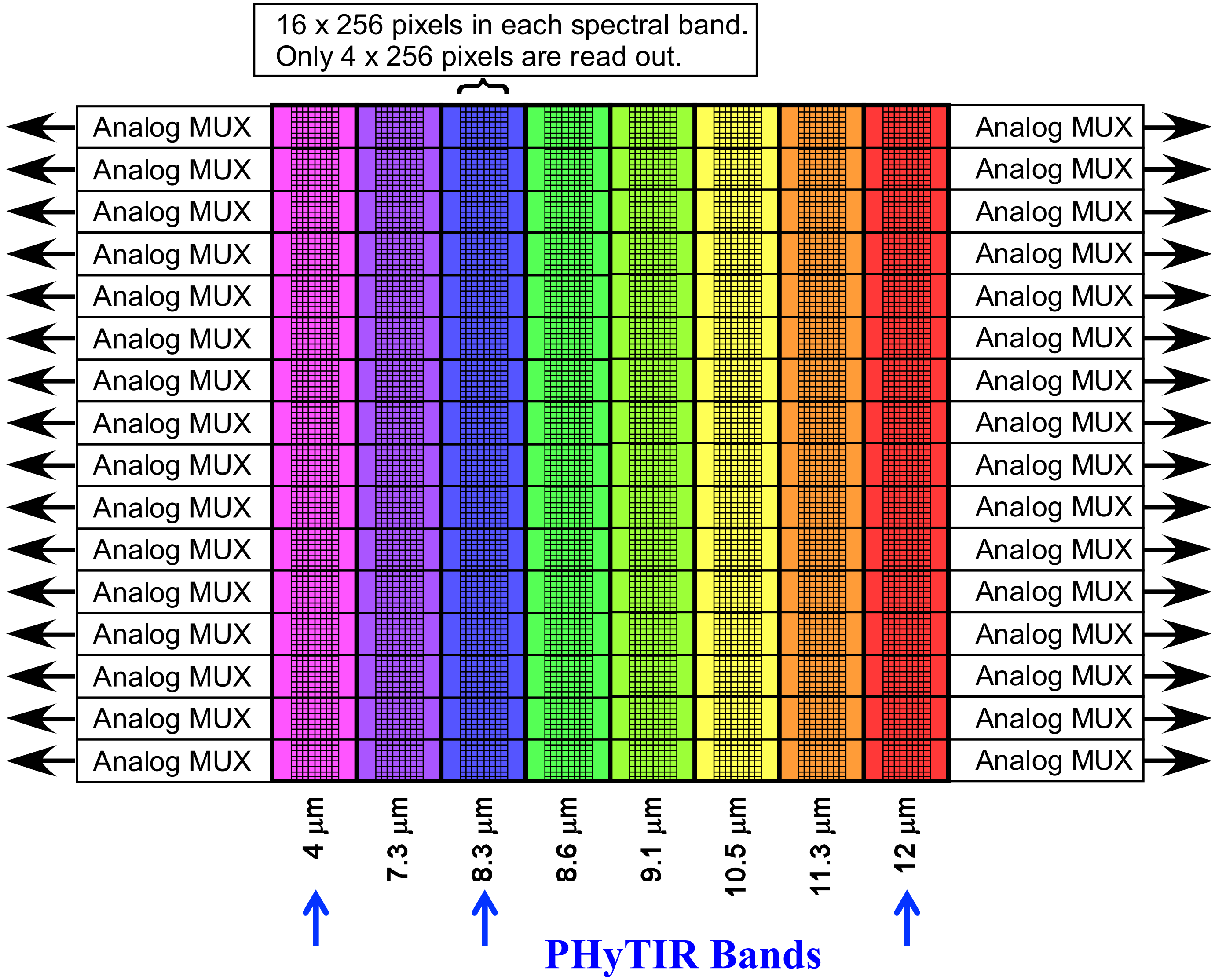


- 60 K Cold Tip of Cryocooler

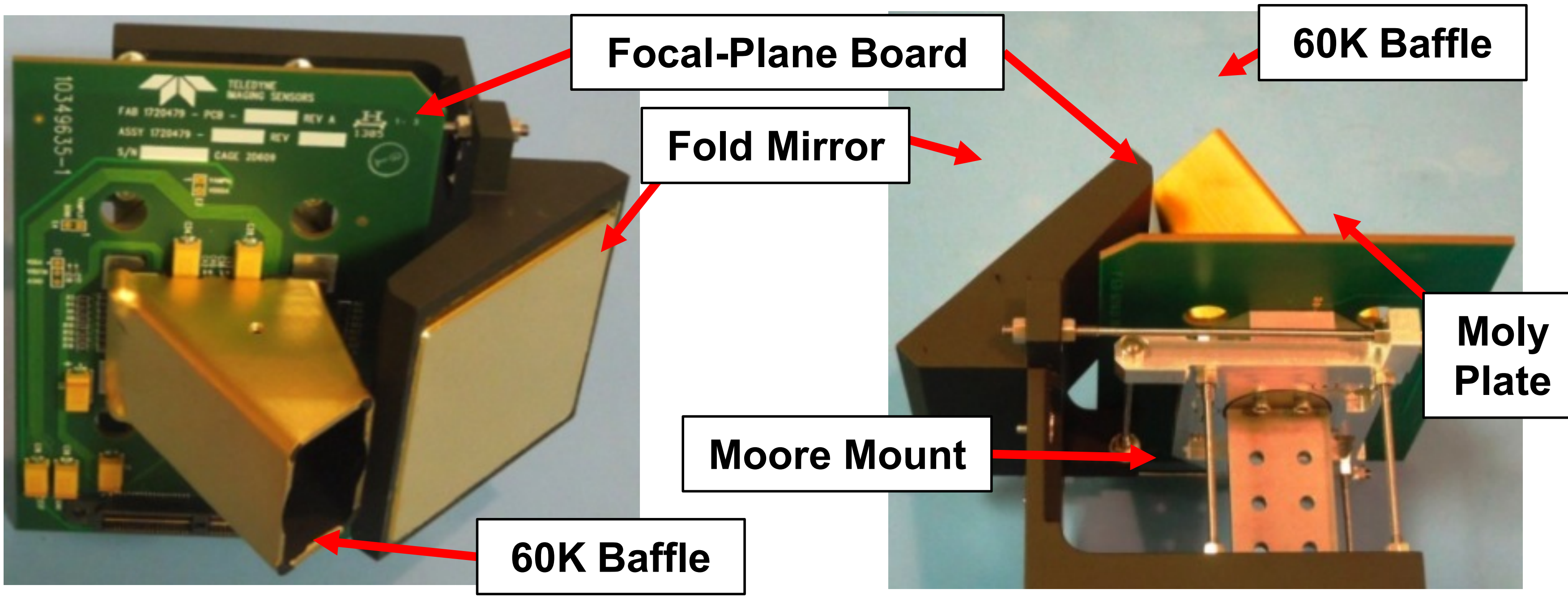
- JPL/Teledyne focal planes are in hand at JPL
- Digitization in off-chip ADCs
- TDI performed after digitization
- Cold testing shows expected performance at full readout speeds



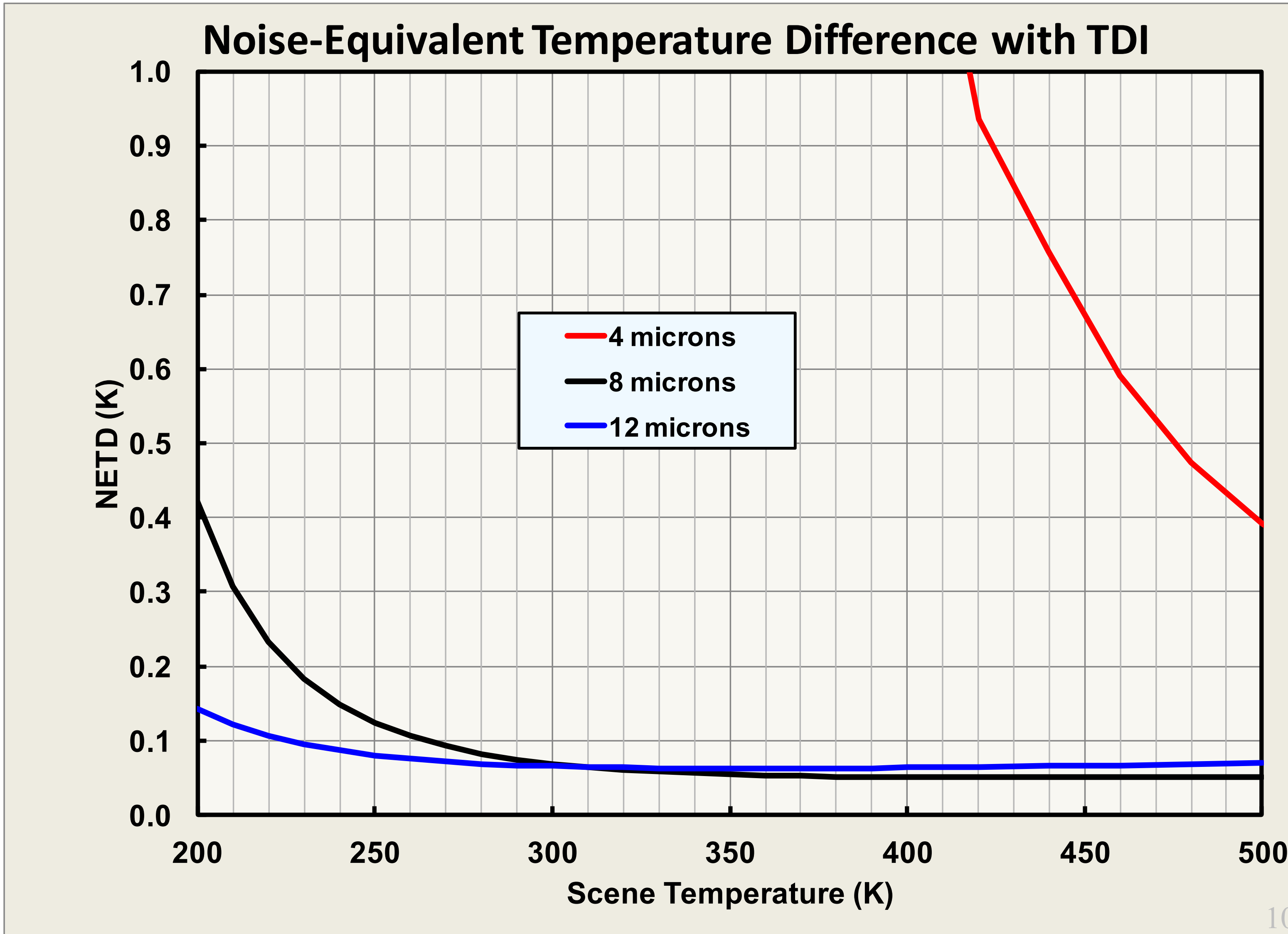
Focal Plane Readout Architecture



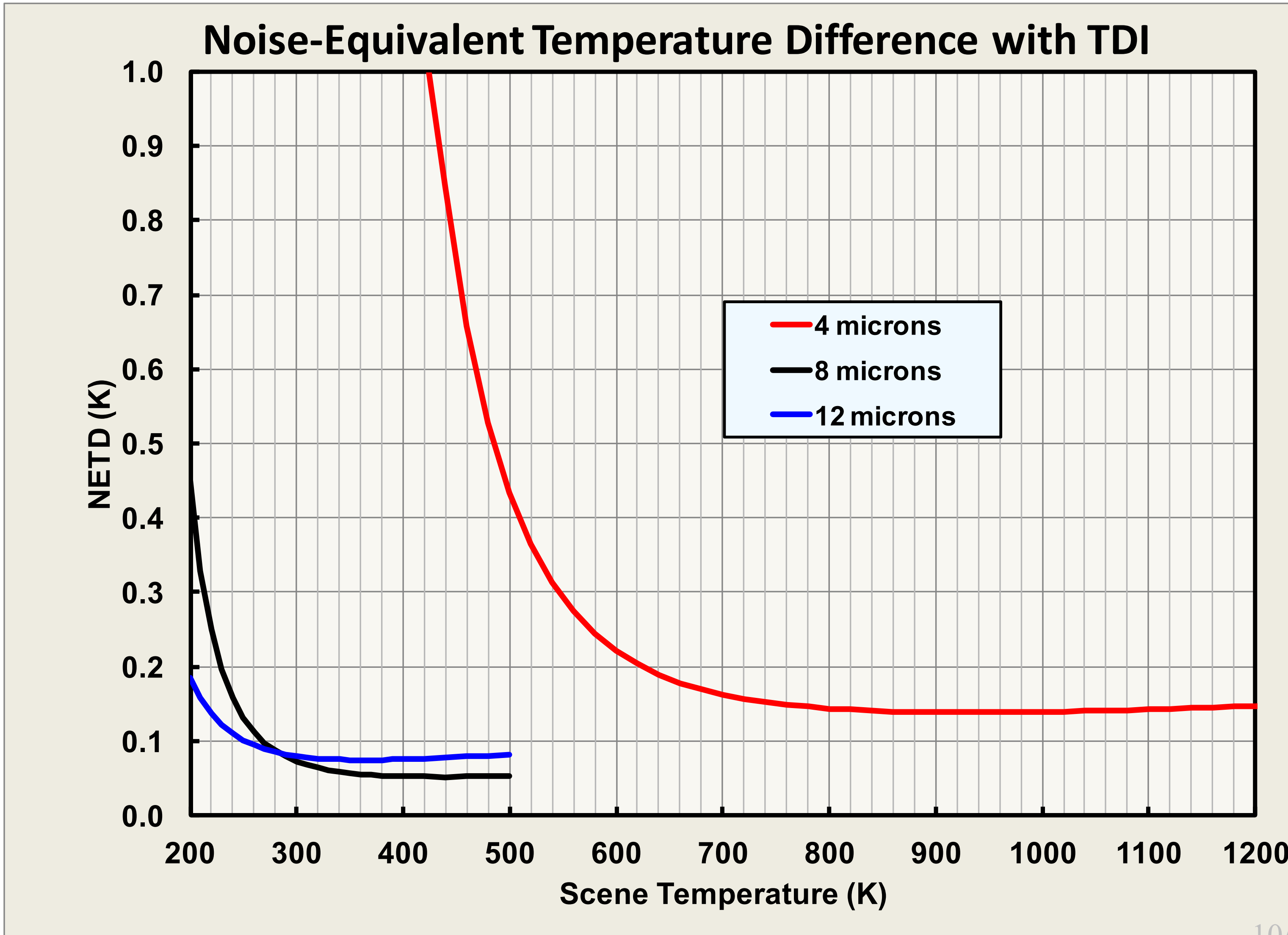
PhyTIR Focal-Plane Assembly



NETD of PhyTIR Bands



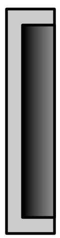
NETD of PhyTIR Bands – Full Temperature Range

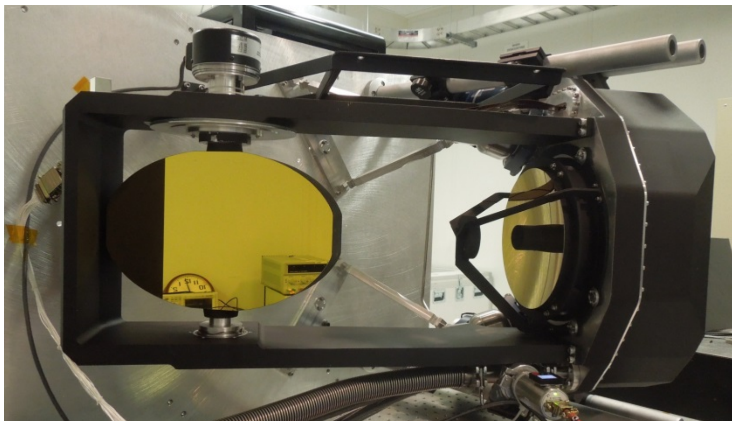


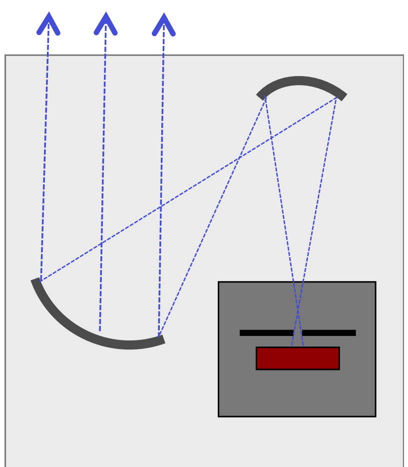
PHyTIR Testing

- Instrument is in air. Vacuum enclosure around focal-plane is evacuated Scan mirror rotating.

Room-Temperature Reference Blackbody.







Target Projector With Blackbody and Slit Source.

- Blackbody source will allow measurements of:
  - ➢ Response
  - ➢ Noise
  - ➢ Temperature Sensitivity
  - ➢ Linearity
  - ➢ Saturation Temperature
  - ➢ Limited testing of efficacy of optical design and cold baffle to minimize radiation from warm optics and baffling.

- Slit sources will allow measurements of:
  - ➢ Capability for coordinating scan mirror with focal-plane data collection
  - ➢ Detector Point Spread Functions
  - ➢ Precision of Scan Mirror Position Determination
  - ➢ Pointing Stability

Plans for Remaining PHyTIR Activities

- October Through December 2013
  - Complete Instrument Housing
  - Optimize Motor Control
  - Automate Thermal System
  - Basic Detector Testing
  - Receive Target Projector Test Source with Blackbody and Slits

- January Through March 2014
  - Blackbody Testing
  - Field-of-View and Pointing Testing
  - Write Final Report