



National Aeronautics and  
Space Administration

Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California

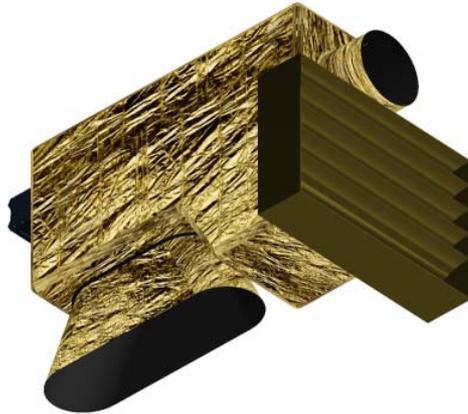
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# HyspIRI Thermal Infrared Radiometer (TIR) Instrument Conceptual Design

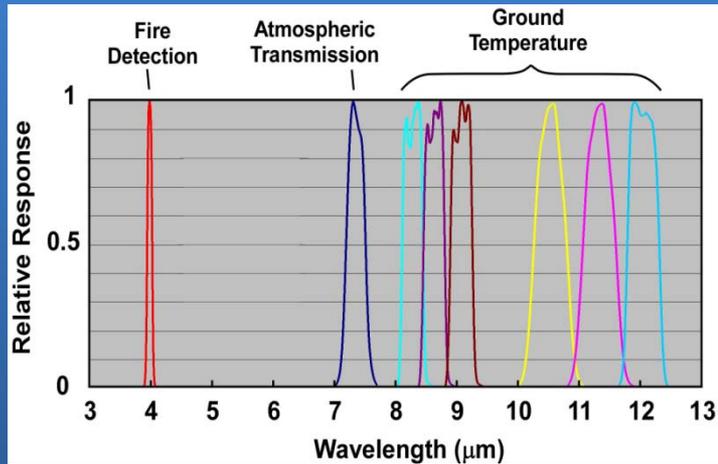
Marc Foote, William Johnson, Simon Hook  
Jet Propulsion Laboratory  
California Institute of Technology  
HyspIRI Workshop August 24, 2010



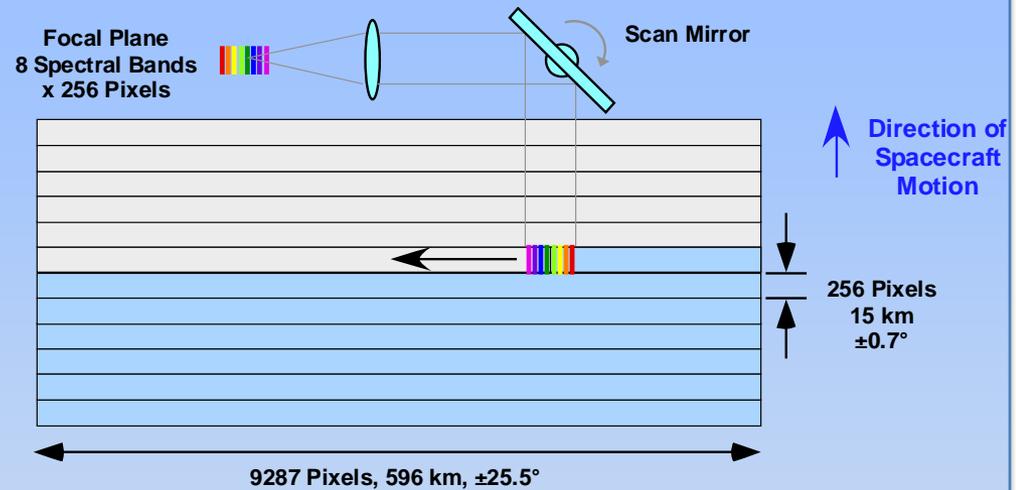
# TIR Instrument Concept



## Spectral Bands



## Scanning and Data Rate

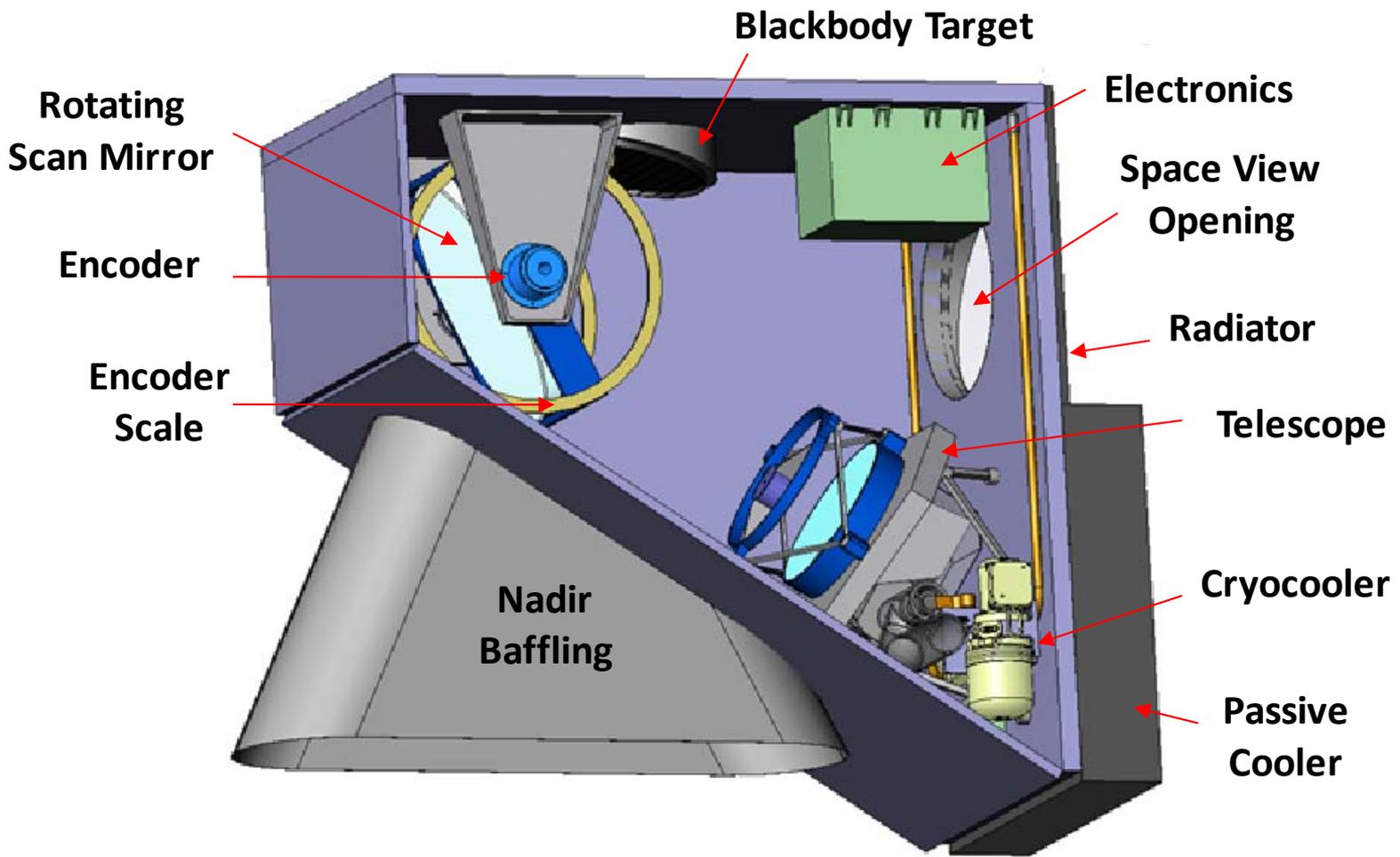


- 60 m Pixel Footprint at Nadir
- Time-Averaged Science Data Rate 0.024 Gbps
- Assuming 14 bits, 2:1 Compression, 40% Land
- Scan Mirror Rotation Rate 14.2 RPM
- Pixel Dwell Time 32 microseconds

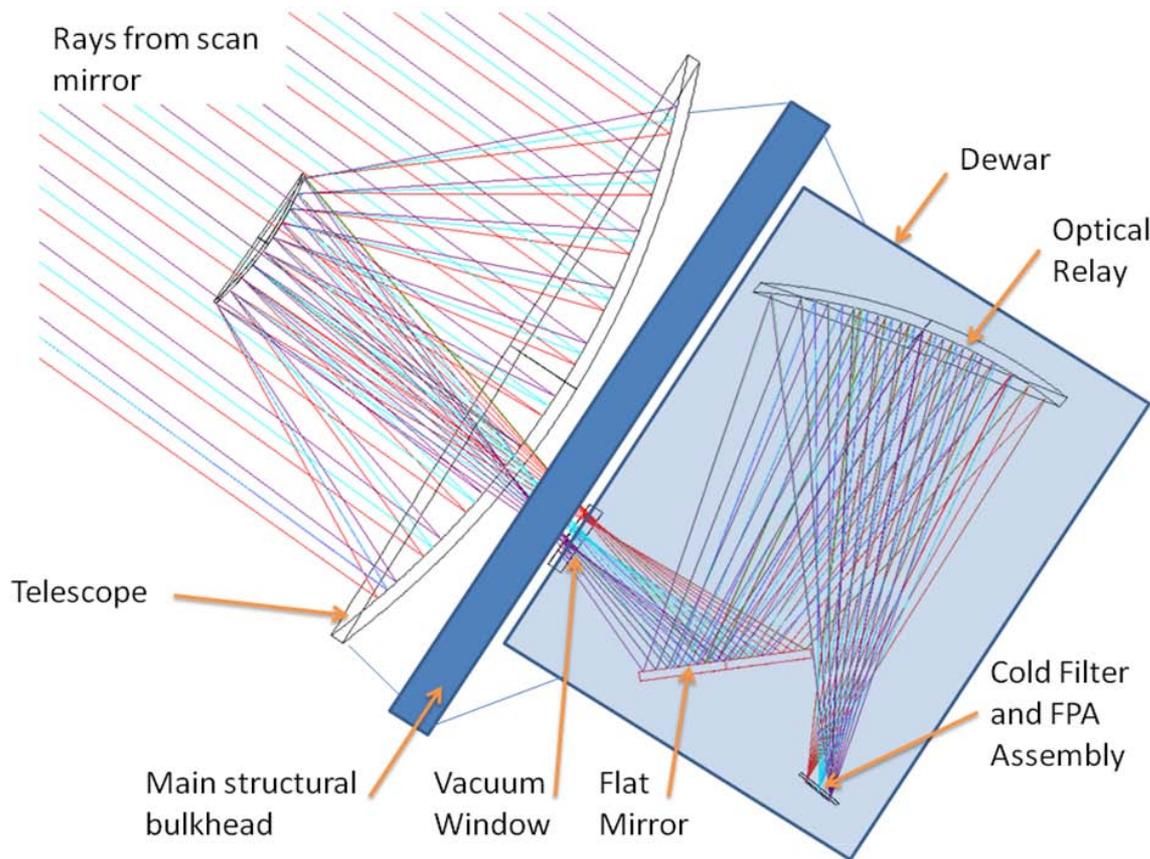
## Mass and Power (JPL Team X)

- Mass CBE 60 kg
- Power CBE 109 W

# Conceptual TIR Layout



# Conceptual TIR Telescope

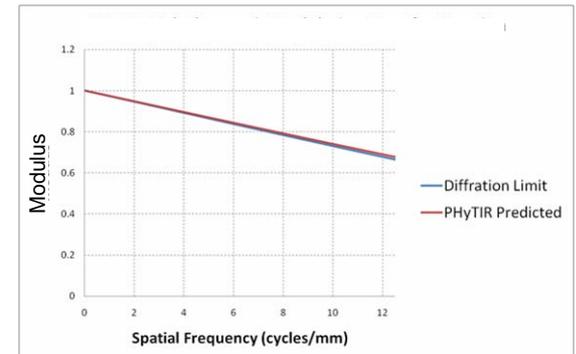


HypsIRI-TIR optics consists of a 3-mirror off axis Cassegrain.

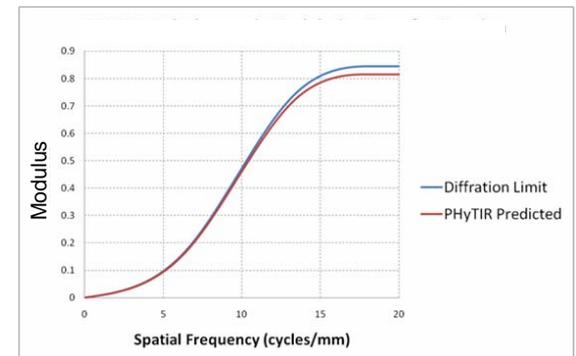
## Optical Parameters

Parameter	Value
Aperture Size	208 mm
f/#	2.0
Focal Length	416 mm

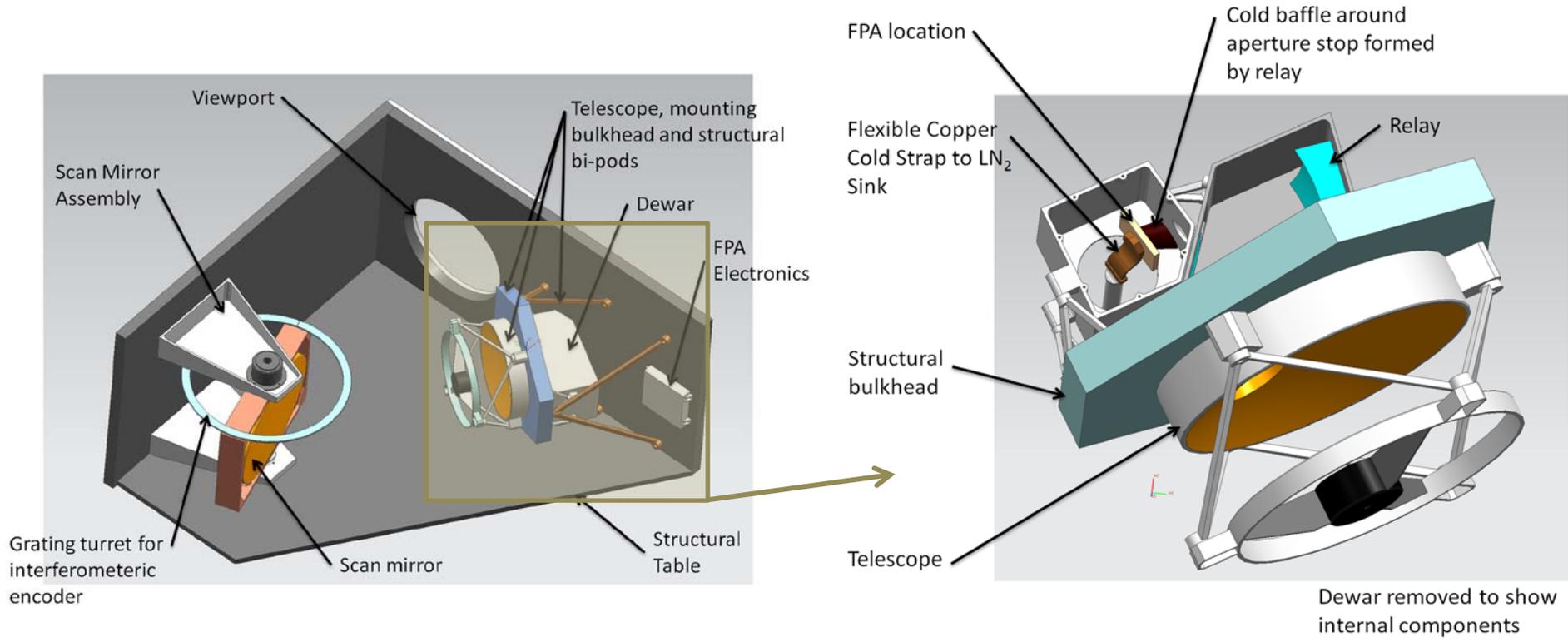
HypsIRI-TIR Polychromatic Modulation Transfer Function



HypsIRI-TIR Polychromatic Ensquared Energy Function



# Conceptual TIR Layout

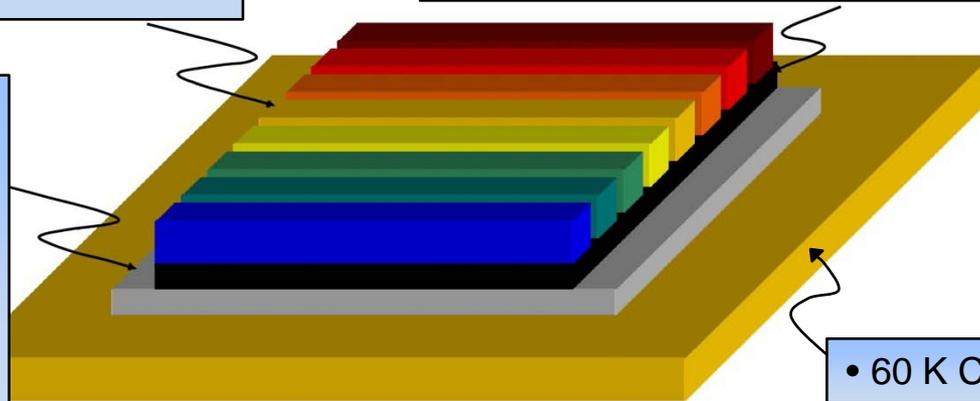


# TIR Focal Plane Concept

- Butcher-Block Filter Assembly
- Baffles to Prevent Crosstalk Between Spectral Channels

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

- CMOS Read-Out Integrated Circuit (ROIC)
- Multiple Output Signals to Enable Necessary Pixel Read Rate
- On-Chip Digitization Under Study

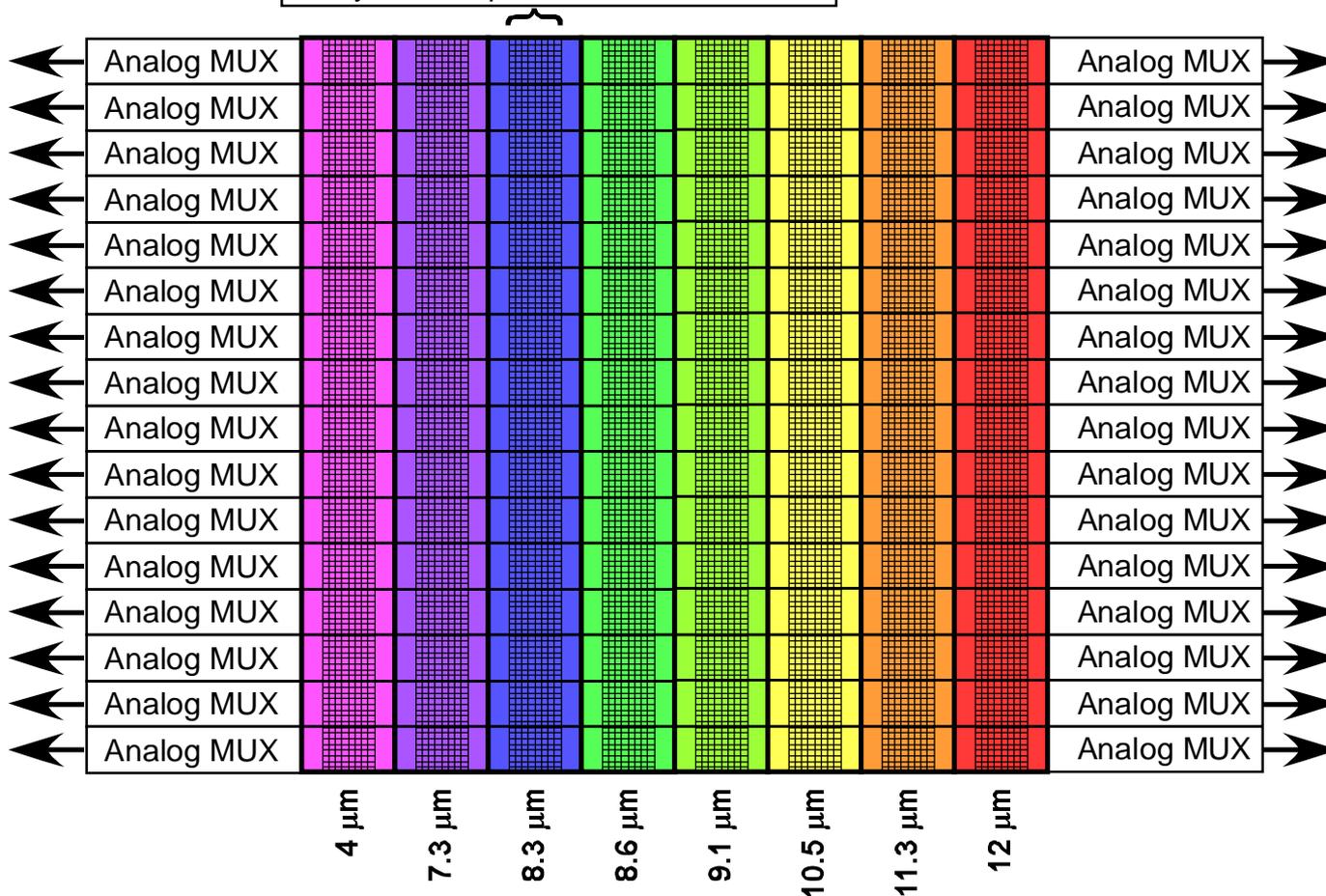


- 60 K Cold Tip of Cryocooler

- Peak Data Rate = 256 Mpixels/sec (256 detectors cross-sweep, x4 for TDI, x8 spectral bands every 32  $\mu$ s).
  - 32 analog output lines, each operating at  $>10$  MHz
  - Digitization in off-chip ADCs – for example, 4 Teledyne ADP 14x8 ASICs (standard Teledyne product)
  - TDI performed by FPGA after digitization

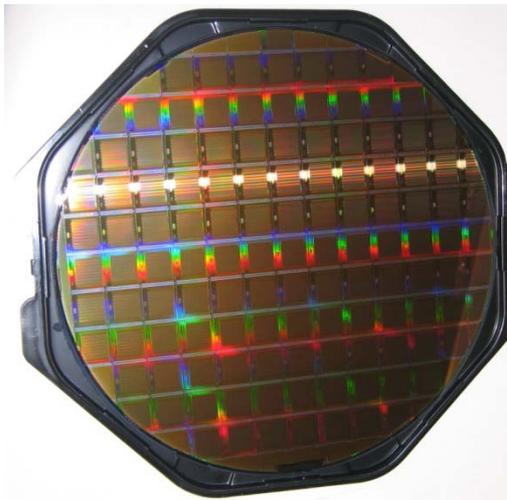
# Teledyne Focal Plane Readout Architecture

16 x 256 pixels in each spectral band.  
Only 4 x 256 pixels are read out.

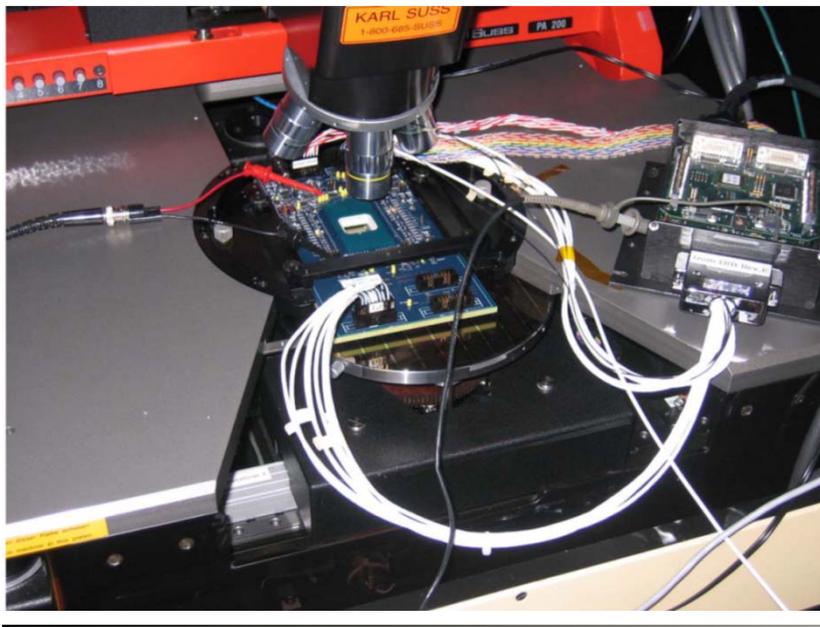




# Teledyne ROIC Warm Probe Testing

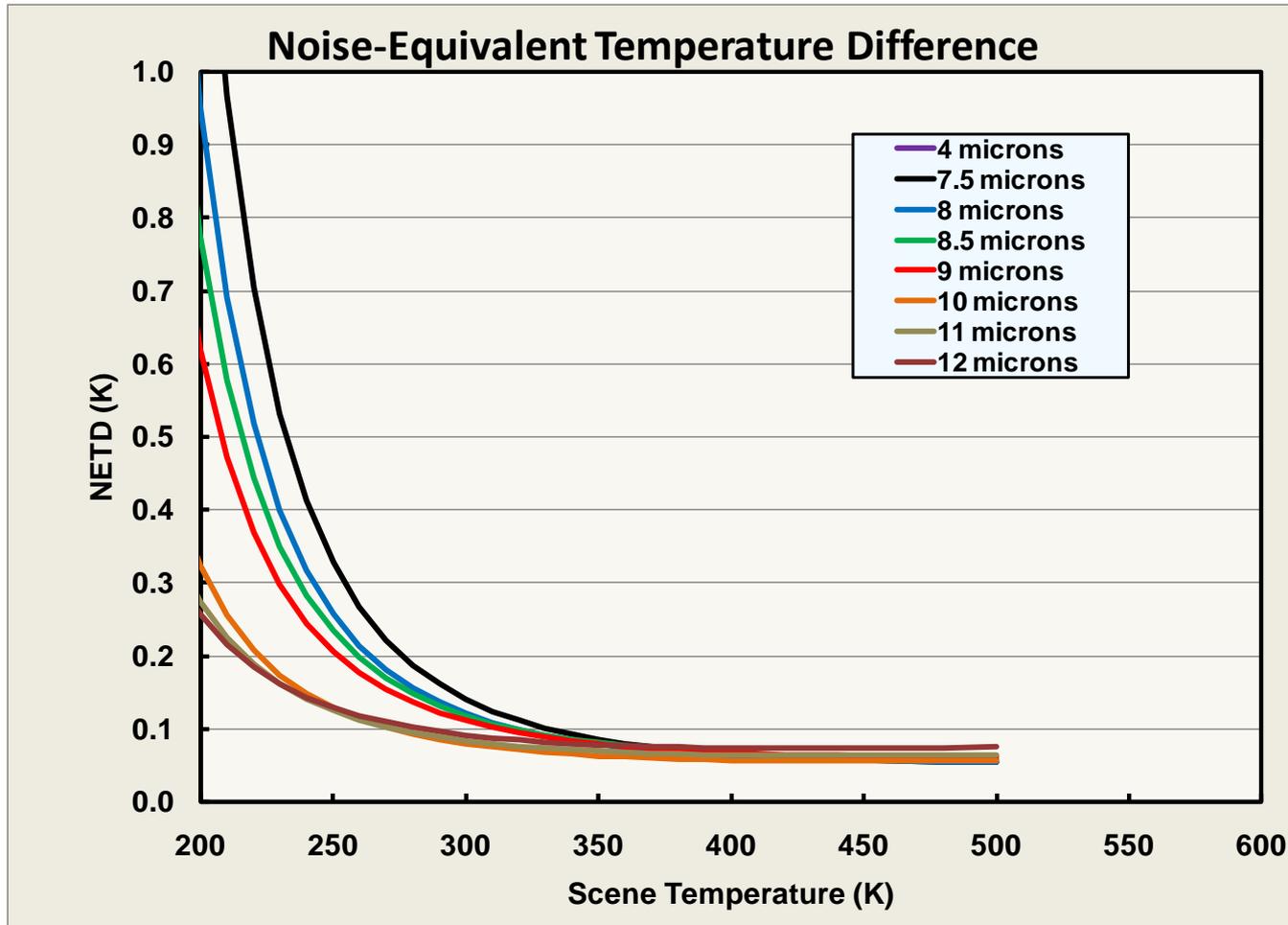


HyspIRI-TIR eight inch wafer with over 100 dies.  
6 wafers are at the vendor.



Wafer probe station. Wafer is currently being  
testing at nearly the required readout speed and  
shows as-expected noise and power  
performance as well as register functionality.

# TIR Estimated Performance





# Baseline TIR Cryocooler

- Baseline is NGST HEC (High-Efficiency Compressor)
- Compressor space qualified for MIRI on JWST
- Compressor with two cold heads is being qualified for Advanced Baseline Imager (ABI) on GOES-R. This configuration could be used build-to-print for HypSIRI TIR instrument.
- Other vendors have appropriate coolers that have similar maturity

## NGST ABI (GOES-R) Cooler

