



IR Absolute Radiance Interferometer (ARI) with On-orbit Verification and Test System (OVTS) prototype demonstrates 0.1 K capability

(UW-Harvard project, NASA Instrument Incubator Program)

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IIP Material presented to the CLARREO Science Team

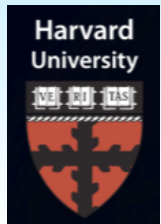


Absolute Radiance Interferometer (ARI): Definitions of key components

- **Calibrated Fourier Transform Spectrometer (FTS):**
 - FTS with strong flight heritage
 - 3 Spectral bands covering 3-50 μm
 - 2 Cavity Blackbody References for Calibration
- **On-orbit Verification and Test System (OVTS):**
 - ❶ On-orbit Absolute Radiance Standard (OARS) cavity blackbody using three miniature phase change cells to establish an accurate temperature scale from -40, to +30 C
 - ❷ On-orbit Cavity Emissivity Module (OC EM) using a Heated Halo source that allows the FTS to measure the broadband spectral emissivity of the OARS to better than 0.001
 - ❸ OC EM-QCL* using a quantum cascade laser source to monitor changes in the mono-chromatic cavity emissivity of the OARS
 - ❹ On-orbit Spectral Response Module* (OSRM) using the same QCL to measure the FTS instrument line shape

*Not fully implemented in prototype—demonstrated separately

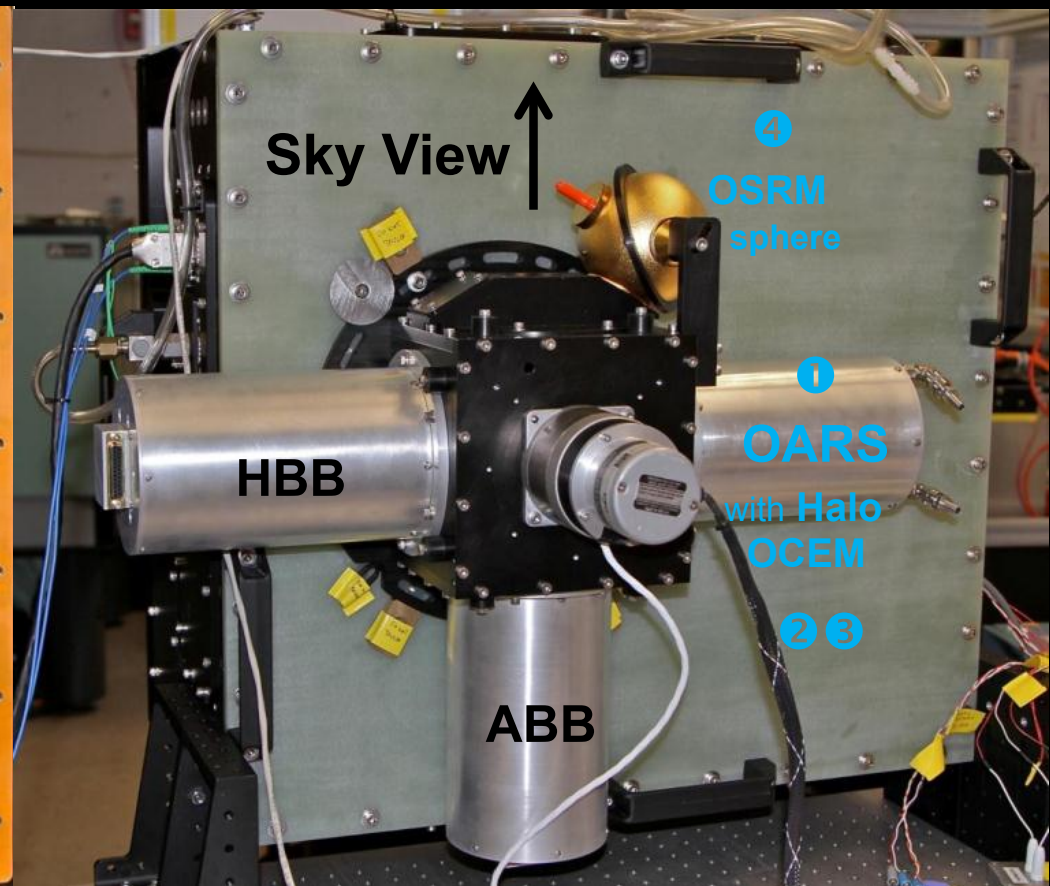
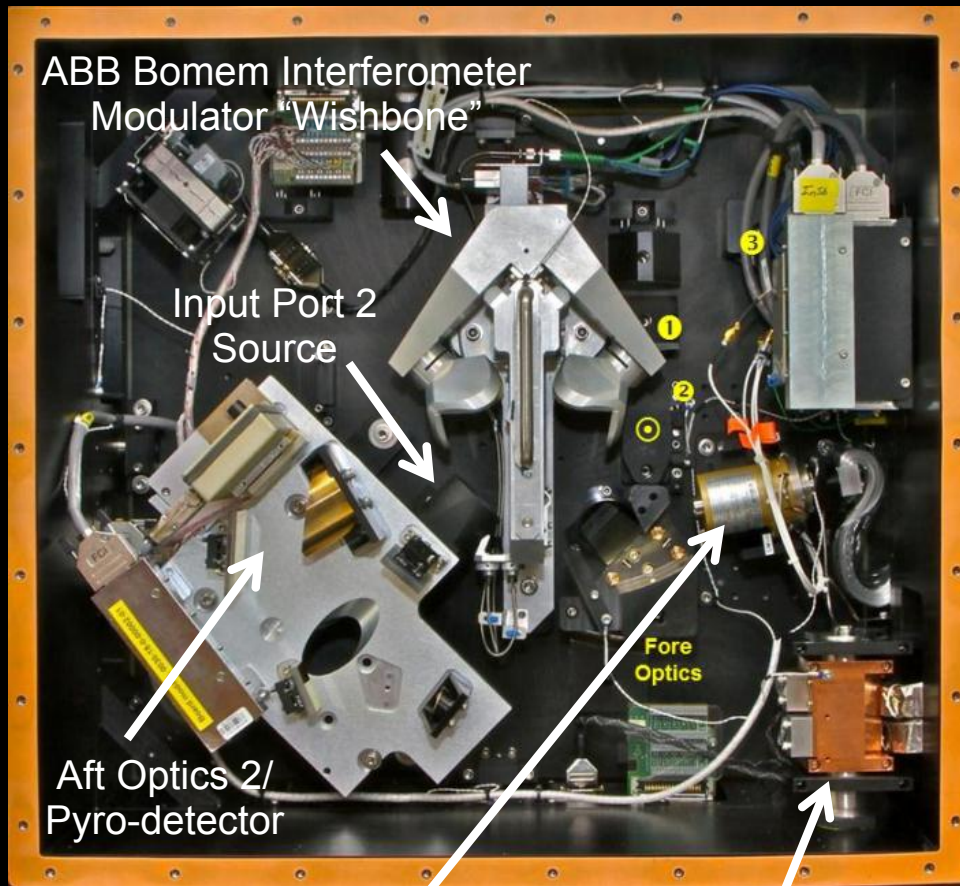
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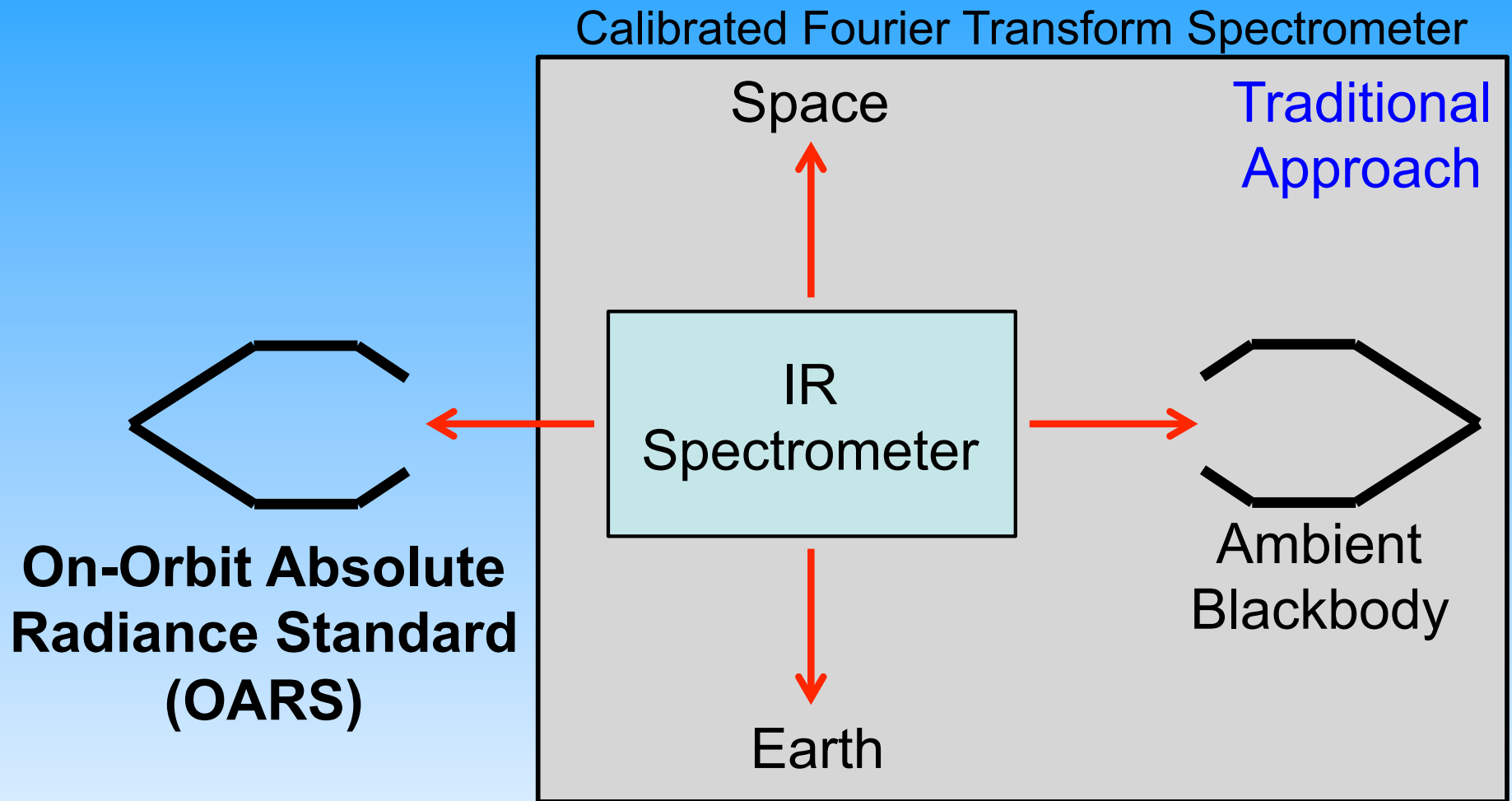
UW Absolute Radiance Interferometer (ARI) Prototype

components of **Calibrated FTS**

On-orbit Verification & Test Sources &
Calibrated FTS Blackbodies (HBB & ABB)



On-Orbit Calibration Verification

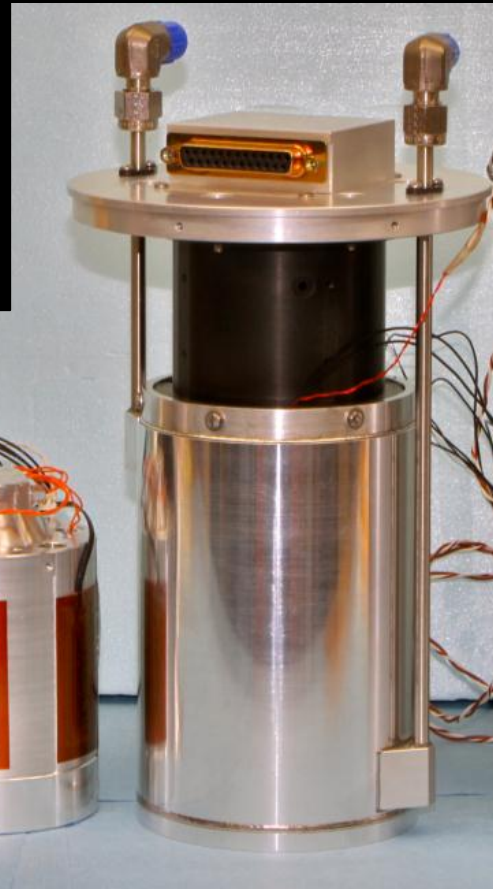


OARS Provides End-to-End Calibration Verification On-Orbit
Traceable to Recognized SI Standards

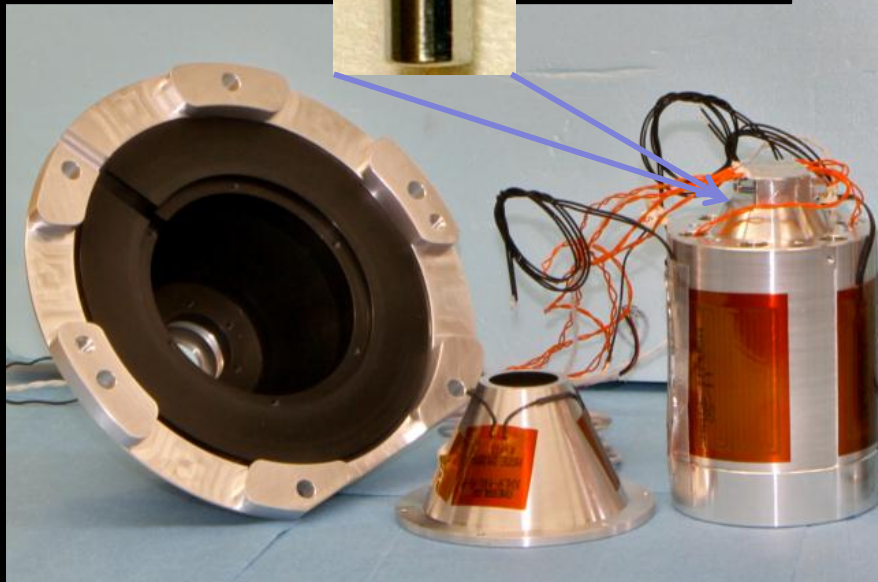
On-orbit Absolute Radiance Standard OARS



Phase Change Cell



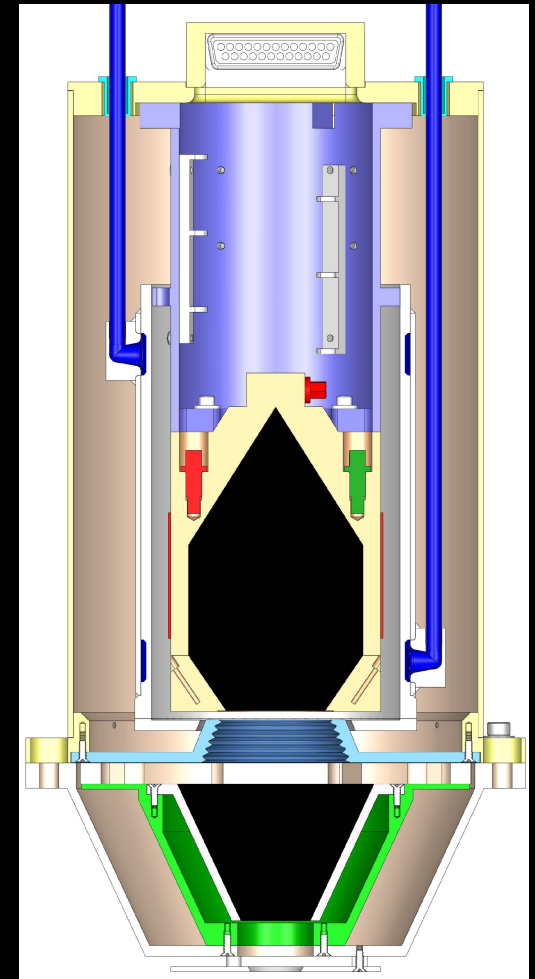
Inner Shield & Isolator



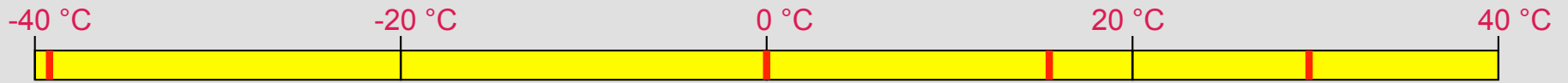
Heated Halo & Halo Insulator

Cavity

Assembly Diagram



Melt Signatures Provide Temperature Calibration



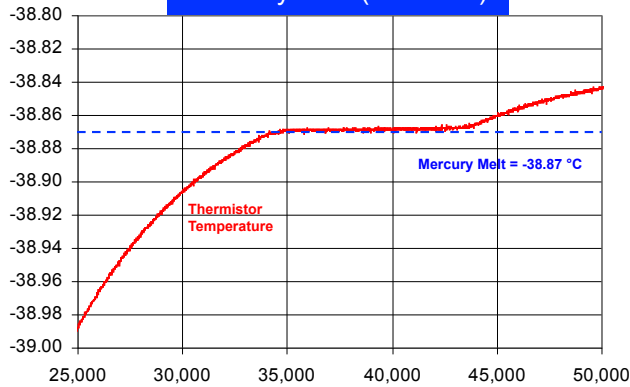
-38.87 °C
Mercury

0.00 °C
Water

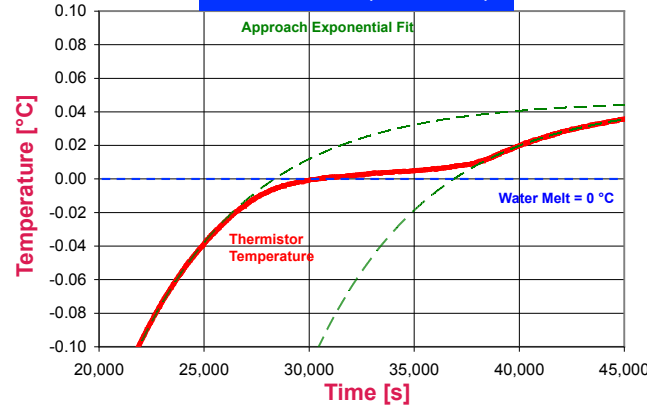
Ga-In

29.77 °C
Gallium

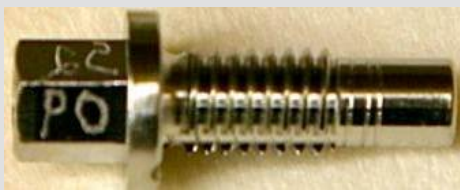
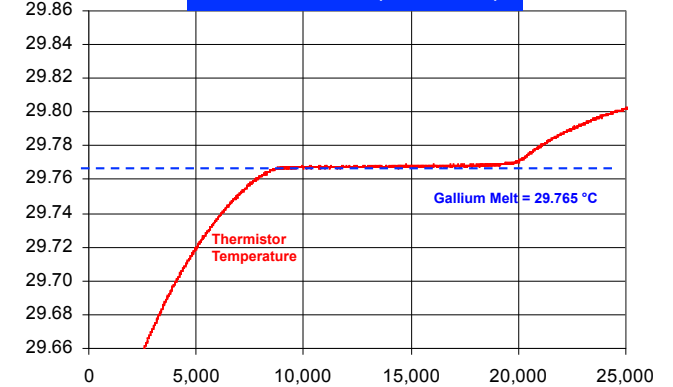
Mercury Melt (test data)



Water Melt (test data)

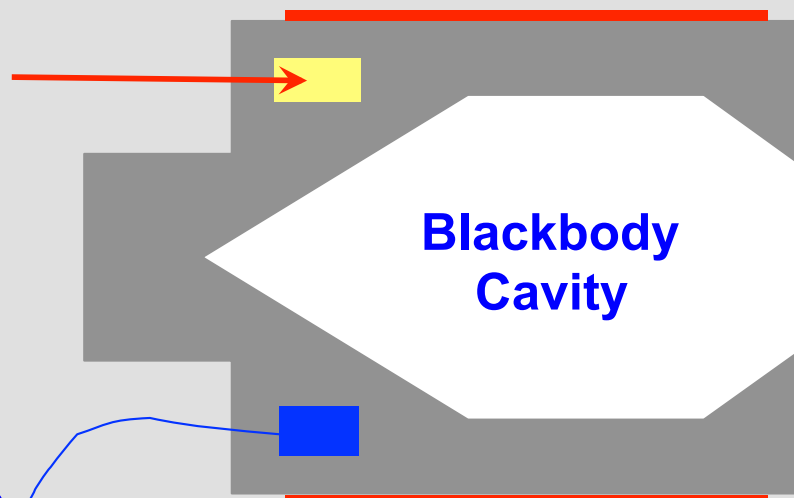


Gallium Melt (test data)



Phase Change Cell
(Ga, H₂O, or Hg)

Thermistor
(plotted above)

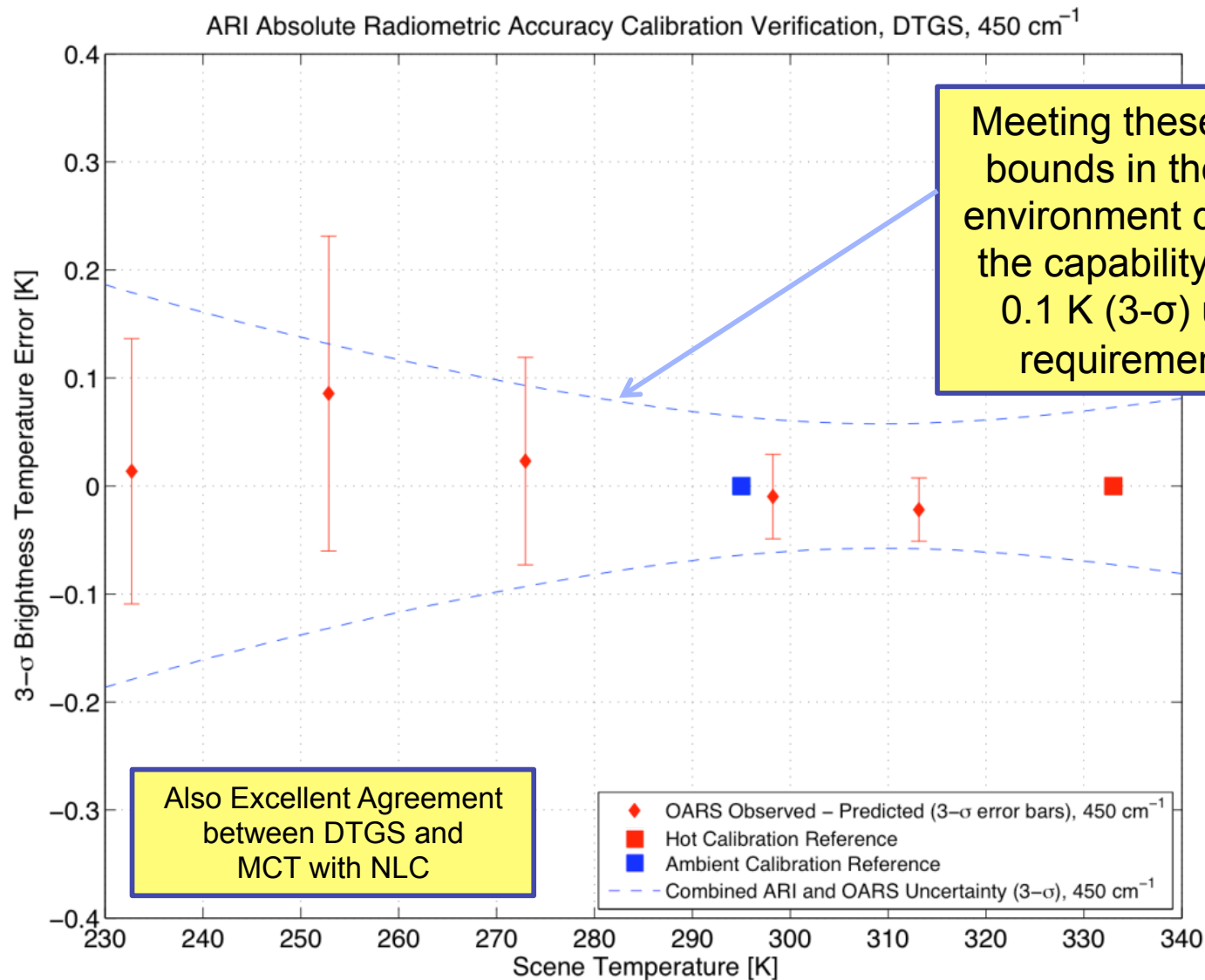


Blackbody
Cavity

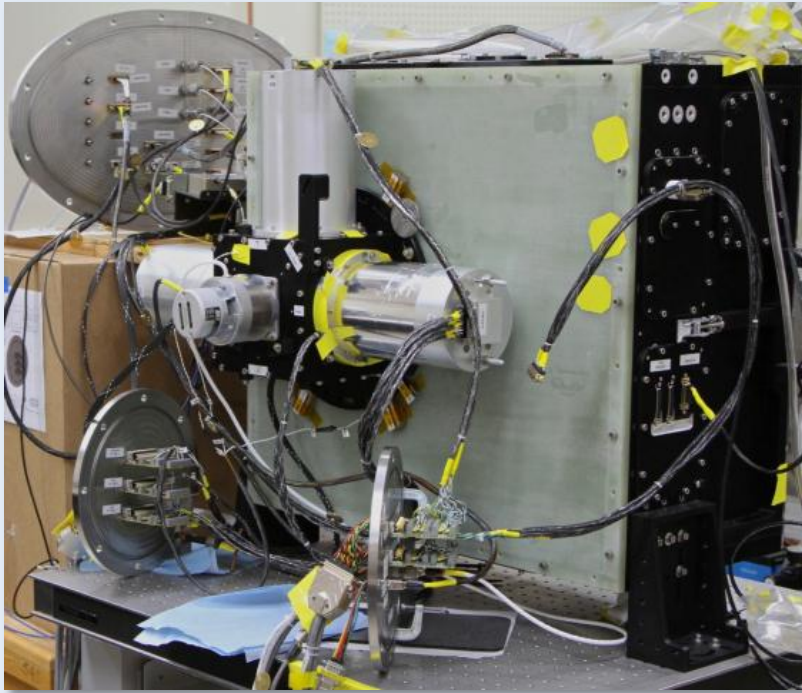
Plateaus (shown in plots)
provide known
temperatures to
better than 10 mK

Sample Radiometric Calibration Verification

DTGS (450 cm⁻¹)



NASA ESTO currently supporting additional ARI testing in vacuum



- While all new technology components achieved TRL 6, NASA ESTO considered the rolled up ARI to be just under 6
- Therefore, NASA ESTO made funding available to bring the ARI to TRL 6, by verifying operation and performance in a vacuum environment.

- Bringing the ARI to TRL 6 is a huge step because it provides the US with a **flight-like IR prototype instrument ready to support CLARREO or other Climate Benchmark Missions**, a high priority of the NRC.
(final testing to be performed in March/April).

