OPTICAL TECHNOLOGY DIVISION

NIST

CEOS WGCV 29th Meeting
NIST Agency Report

Avignon, France
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SUMMARY STATEMENT

The NIST Optical Technology Division continues to support and/or partner with weather & climate related satellite programs. It maintains and improves radiometric tools, facilities and the capabilities to do so.

HIGHLIGHTED ISSUES OF CURRENT/UPCOMING IMPORTANCE

- NISTstars: SI traceability of exoatmospheric irradiance of stars
- Partnering with recently funded CLARREO Mission
- Improved capabilities for measuring BRDF over solar reflected region
- Flat plate illuminator for thermal / vacuum chambers
- Developments in Hyperspectral Imaging Projection capabilities (HIP)
- Supercontinuum Light sources
- Other items

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Absolute Flux of Standard Stars

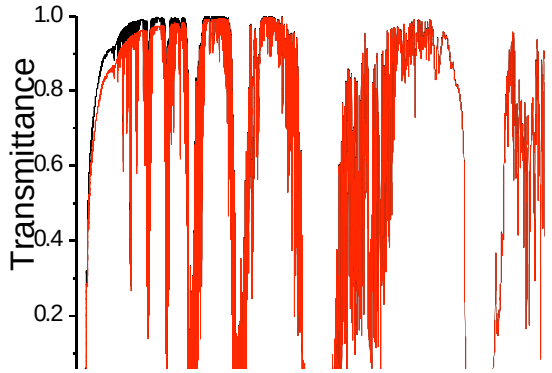
Current: 2% to 5%
Objective: 1% to 0.5%

Calibration approach:
"SIRCUS on a mountaintop"

•NIST/SIRCUS detectors calibrated for irradiance responsivity
•Laser (or SC in SLE) -illuminated sphere for irradiance standard (fixed point blackbody in 1970s work)
Si PDs w/ apertures at distances z; or
Portable telescope as transfer radiometer
•Horizonal atmospheric extinction is determined

Vertical atmospheric extinction

•Atmospheric correction – avoid known features, select site carefully; requires complete characterization (e.g. LIDAR for aerosols) for lowest uncertainty; or
•Utilize existing stellar standards to determine atmospheric correction *in situ* during actual observations from the Absolute Color Calibration Experiment for Standard Stars (ACCESS)



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NIST Stars Accomplishments

Two site visits – 42 inch telescope at Lowell Observatory; first actual calibration will be here or at Mt. Hopkins;

Site visits to PanSTARRS, Haleakala, Maui; close collaboration established with Chris Stubbs, Harvard University: a Harvard-designed near field fiber-optic fed large area source was used to acquire data;

Collaboration established with ACCESS team; NIST will participate in calibration of the rocket-borne spectrographs (4 stars, four flights);

Traveling SIRCUS deployment last May - June to JPL for calibration of the Narrow Band Imager (high resolution spectrograph at 850nm) and two broadband imagers (H and I bands) that are part of the Cosmic Infrared Background Experiment (CIBER) mission as a test of overall methodology; additional measurements planned for January 2009;

Wavelength calibration of an echelle spectrograph using a tunable ring dye laser at Mt. Hopkins' Multiple Mirror Telescope was completed; requirement was 0.0001nm uncertainty, additional measurements scheduled for November 2008.

Implemented a new NIST facility for calibration of the reference telescope for point source geometry in a 80m tunnel.

CLARREO

Climate Absolute Radiance and Refractivity Observatory

Oct 21 – 23 Community Workshop, Washington, DC. http://clarreo.larc.nasa.gov/; goal is to draft science objectives

NIST in discussion with LARC on cal/val elements

NIST participation in program elements:

LASP – NIST detector calibration support for IIP funded research on on-orbital calibration;
University of Wisconsin, Harvard – IR radiometry for climate change
LARC – far IR radiometry (blackbody sources)
JPL – NIST calibration support in a subcontractor role – “Internal Spherical Integrating Source” an ACT proposal

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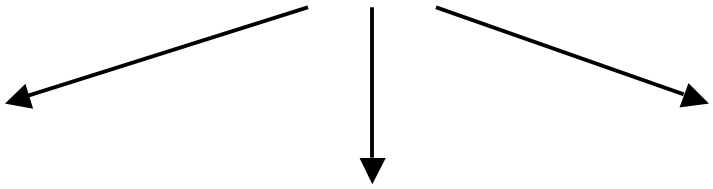
Main Components of the NIST Infrared Radiometry Program:



IR Optical Component Characterization

FTIS, including BRDF and CHILR Capabilities

IR Source Characterization

Thermal IR Ambient Background Facility (AIRI)

Thermal IR Medium Background Facility (MBIR)

Low Background Facility (LBIR)

IR Detector and Imager Characterization

IR SIRCUS

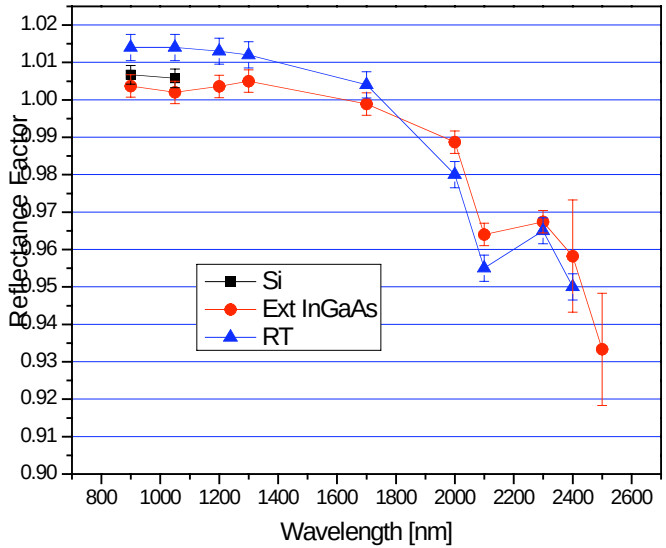
IR Spectral Scaraterization Facility (SCF)

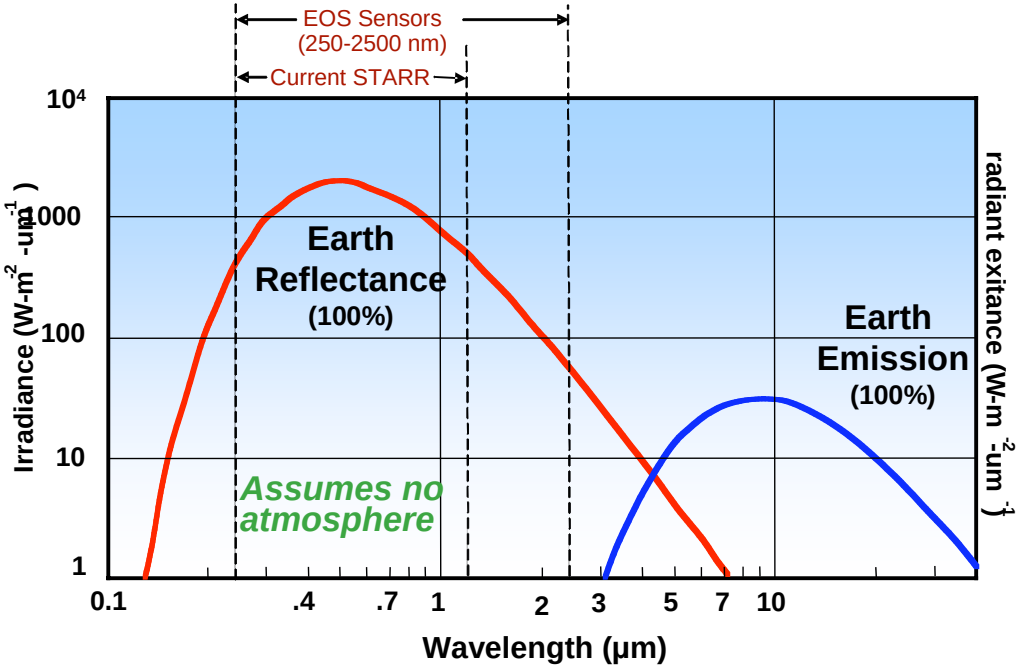
Infrared Detector Evaluation Facility (IDEF)

BRDF

Scale Realization from 1100 nm to 2500 nm

- The Spectral Tri-function Automated Reference Reflectometer (STARR) facility was modified to include an InGaAs detector
- Comparison of sample's 0/45° reflectance values from STARR to an independent irradiance (FEL lamp) / radiance (strip lamp) scale
- Impacts SWIR band calibration for sensors, as heretofore users relied on 8°/hemispherical data





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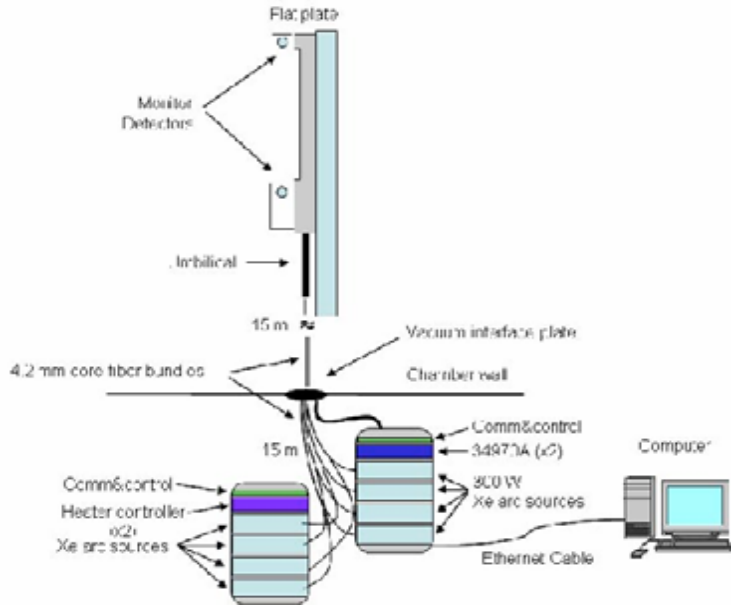
Flat Plate Illuminator

- Requirement: vacuum compatible source to test for sensor repeatability from sensor-level testing to spacecraft-level testing
  - Identify changes in VIIRS sensitivity from sensor build to S/C integration w/in 10%
- Joint project with IPO for VIIRS

- Derived Requirements
  - spectral range 0.4 to 1.8 μm
  - 25 cm square or greater
  - Moderately uniform radiance
  - Simple to operate



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Flat Plate Illuminator

- Conclusions to date:
  - Filtered diode reference monitors are key to radiometric stability and accuracy
  - Very low power dissipation in vacuum chamber
  - FPI still in testing at NIST
  - Capability of applications much broader than envisioned with initial problems
  - Best practice path identified

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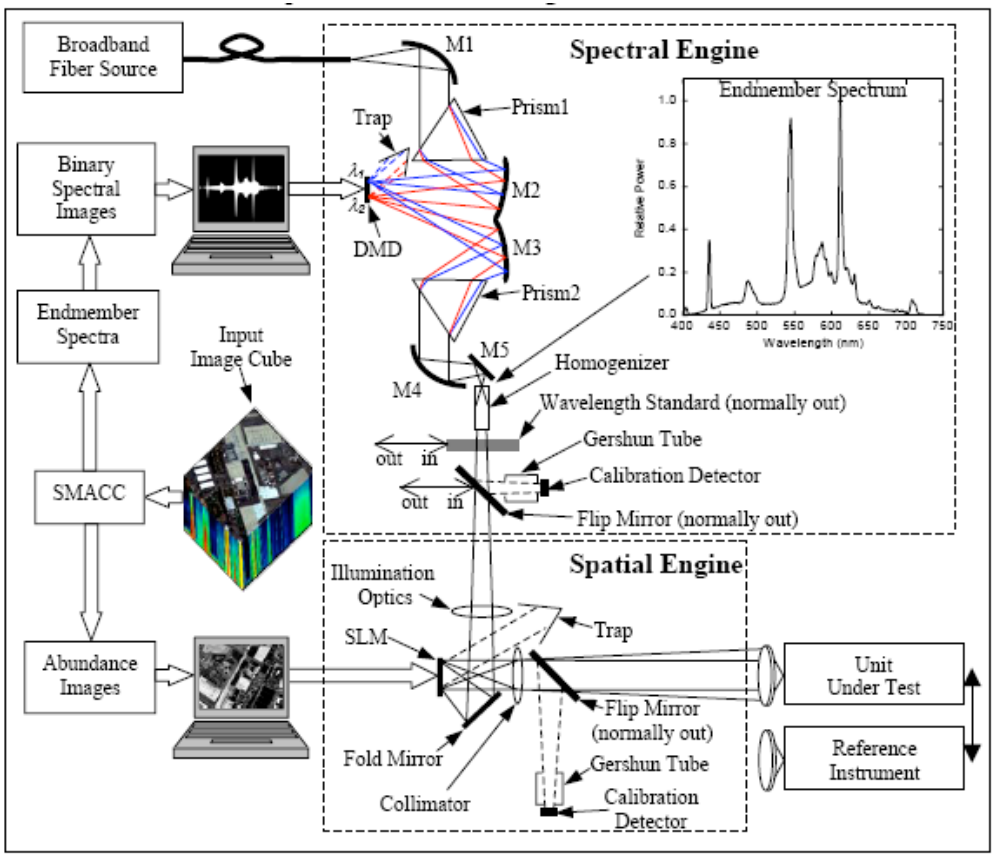
HIP

Hyperspectral Image Projector

- Resonon contract in place;
- VNIR/SWIR PDR complete and CDR in January 2009;
- “Spectral Light Engine” is “half a HIP” – digitally programmable tunable light source; fed with TQH, Xe, or supercontinuum light source



More information available at:: http://physics.nist.gov/Divisions/Div844/facilities/hip/hip.html

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Supercontinuum Light Sources

Utilizes non-linear effects in a photonic crystal optical fiber to greatly broaden the spectrum of a 1064 nm pump laser.

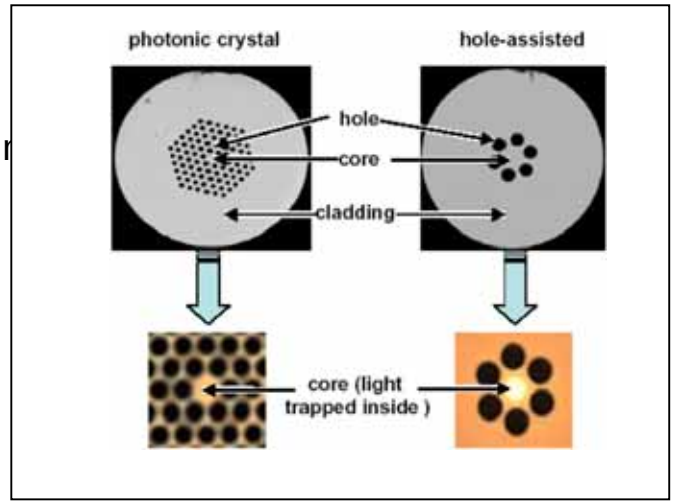
Broadband light is generated in a single-mode (5 um core diameter) photonic crystal (holey) optical fiber

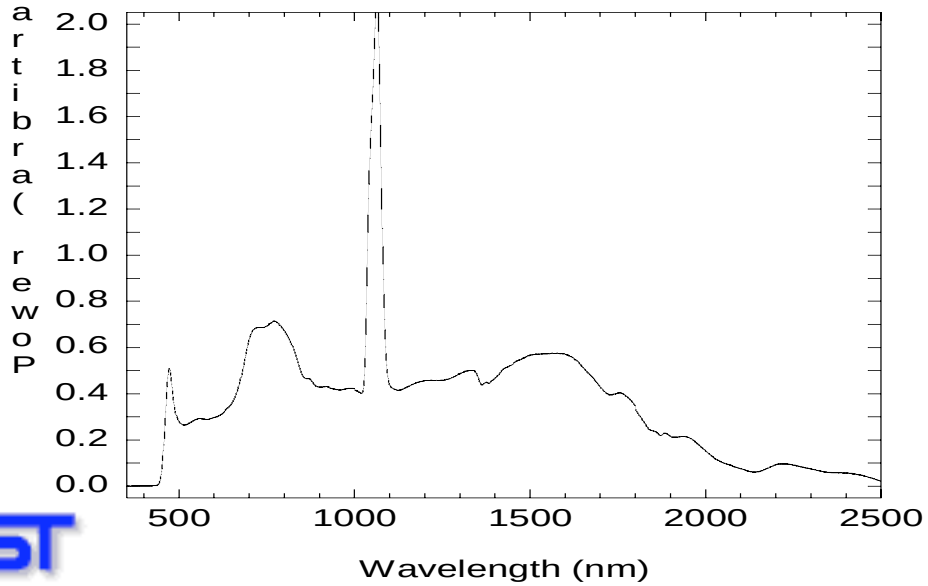
- No etendue issues as with lamps or blackbodies.
- Ideally suited for coupling to a spectral engine.

High power and high spectral resolution:

- 3mW/nm spectral power density from 450 nm to 1700 nr

Commercially available.





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Other

- TSI Workshop Report: "Sources of differences in on-orbital Total Solar Irradiance measurements and description of a proposed laboratory intercomparison," *J. Res. NIST*, 113, 187 – 203 (2008).

- A paper[1] on best practice for the IR is in preparation between NOAA (Mitch Goldberg) and NIST (Raju Datla) for GSICS; it will be expanded to include Vis/NIR.

- Preliminary laboratory comparison activities for TSI (TIM) on SIRCUS were completed.

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[1]"Best practice for pre-launch characterization and calibration of instruments for remote sensing," *Proc. SPIE* 7082, to appear (2008).

Other, Continued

- GEO/CEOS Workshop, “Quality Assurance of Calibration and Validation Processes Establishing Operational Framework,” May 6 – 8, 2008, (NOAA/NIST).

- MOU with NOAA/NESDIS for GOES-R cal/val support, current focus is on Advanced Baseline Imager (ABI). A copy VXR instrument will be built and NIST will lead in the characterization of the GSFC/NIST transfer radiometers.

- Agreement in place between NASA/GSFC and NIST for cal/val support of the Operational Land Imager (OLI).

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