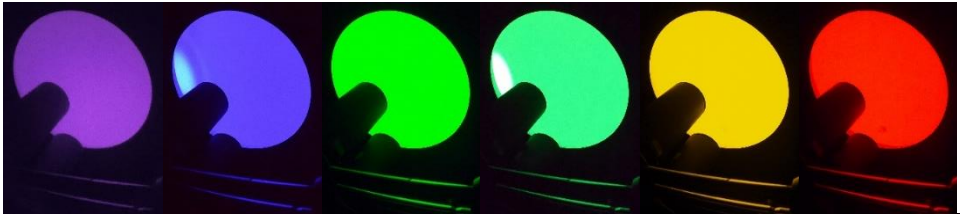


Goddard Laser for Absolute Measurement of Radiance

Surface Biology and Geology Community Workshop

Brendan McAndrew

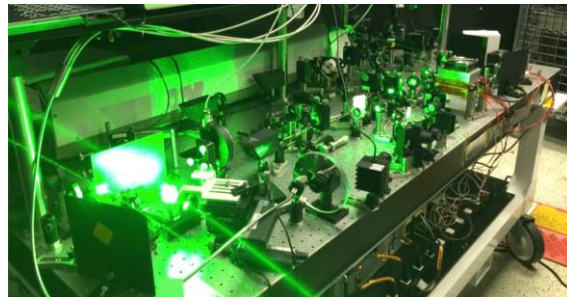
NASA Goddard Space Flight Center



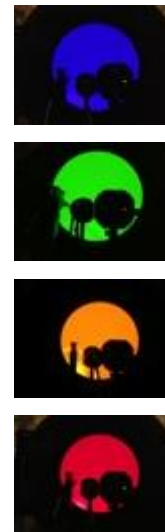
Concept

Detector based calibration using tunable, monochromatic sources

1. High accuracy achieved with temperature stabilized unfiltered trap detectors illuminated by monochromatic light
2. Tunable lasers and optical parametric oscillators provide orders of magnitude higher spectral radiance than blackbody or other broadband sources; calibrate at high signal levels



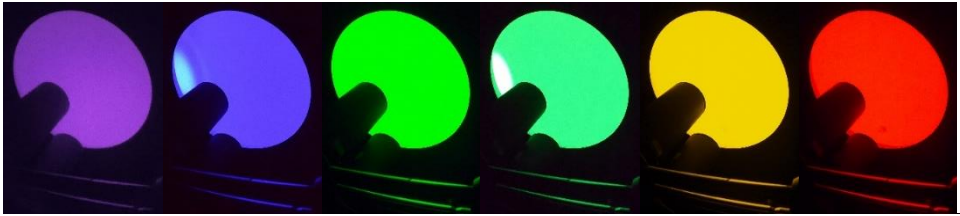
Light source



radiometry



prelaunch calibration for instruments



Absolute radiometric scale

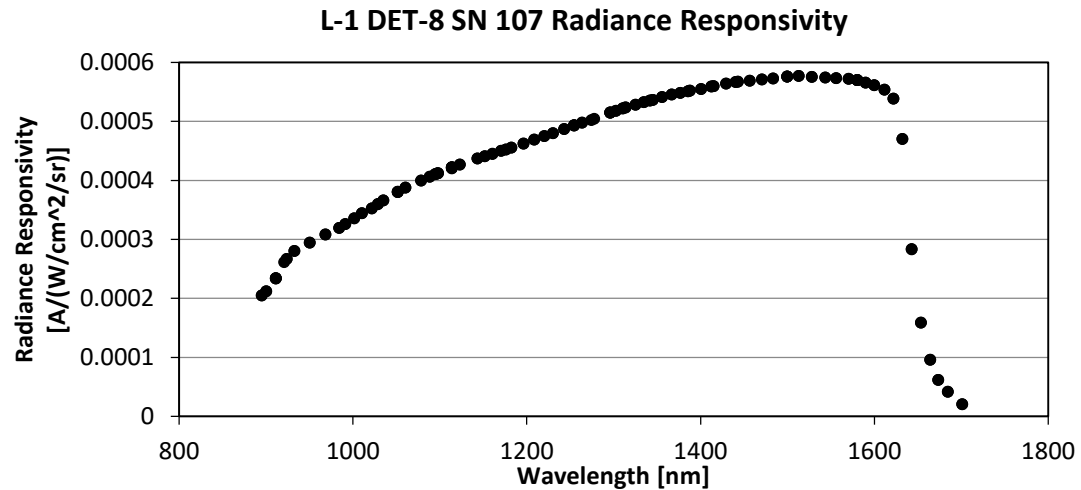
Radiance: power per unit area per unit solid angle $L = \frac{P}{A \cdot \Omega}$

Spectral radiance: radiance per unit wavelength $L_\lambda = L / \Delta\lambda$

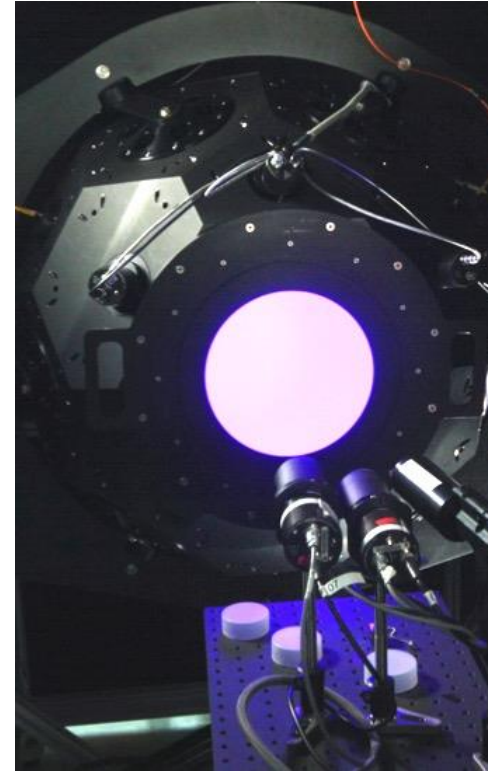
Greatest uncertainty is in optical power P

Area and solid angle are both traceable to meters

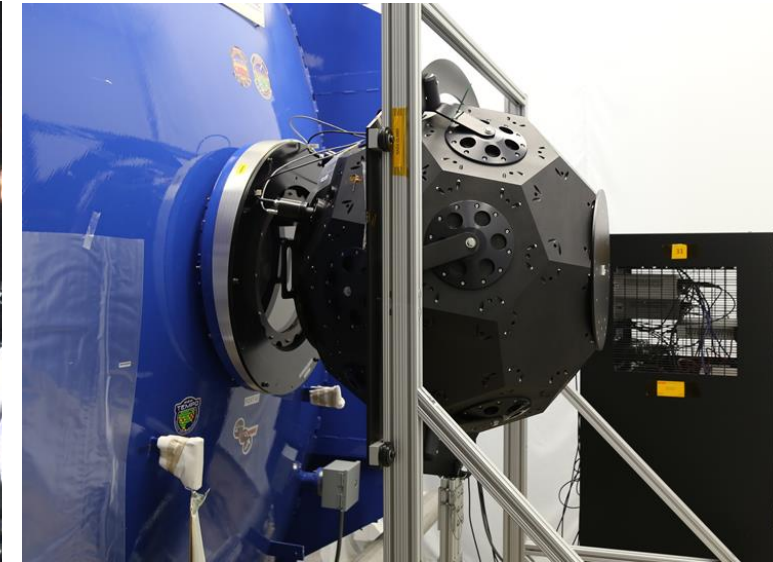
Optical power measured with electrical substitution radiometer and traceable to electrical units of measure



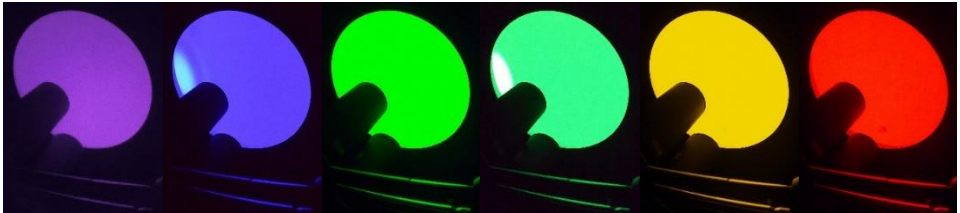
Narrow linewidth source eliminates error due to convolution of source spectrum with radiometer responsivity



Integrating sphere with transfer radiometers

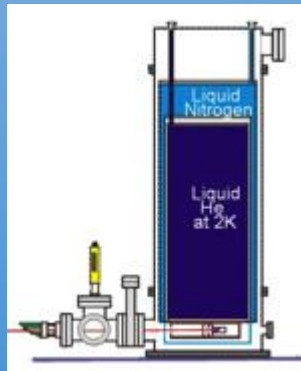


Integrating sphere outside thermal vacuum chamber

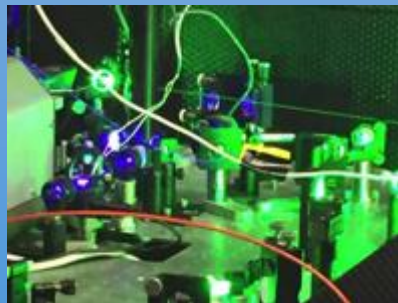


Traceability Path

NIST Facility



POWR
Primary Optical Watt Radiometer



Stabilized laser source is used to transfer radiometric scale from POWR to portable transfer radiometer via another standard radiometer



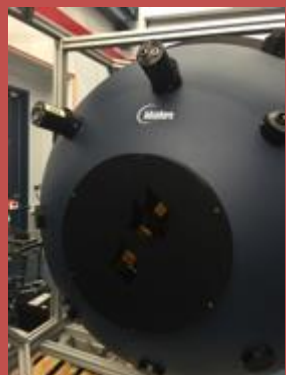
LTD-11 #107
transfer radiometer

Transfer radiometers periodically recalibrated at National Institute of Standards and Technology

Sensor vendor facility



LTD-11 #107
transfer radiometer



Sphere Monitor



Satellite/airborne sensor

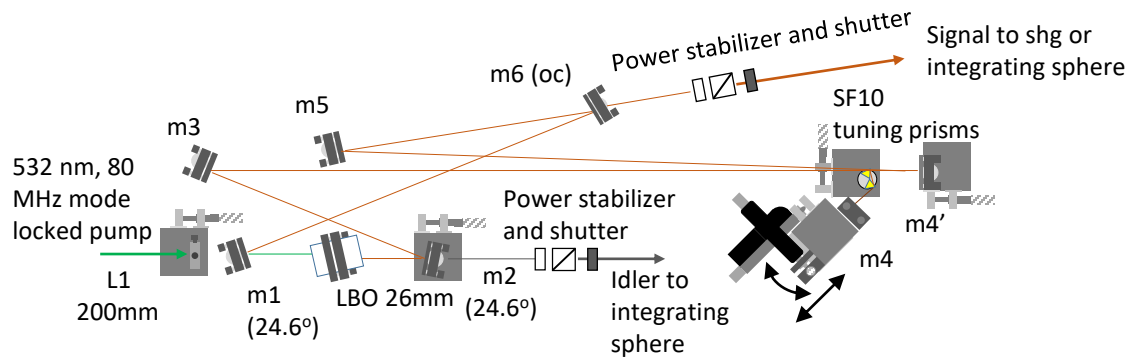
Sphere monitors periodically recalibrated with transfer radiometers at Goddard or other instrument facility



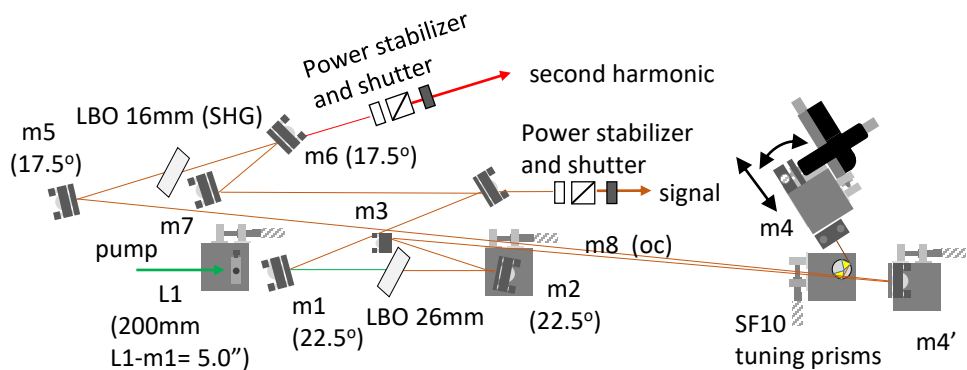


Custom LBO OPO

NIR-OPO 680-1100 nm + 1200-2200 nm



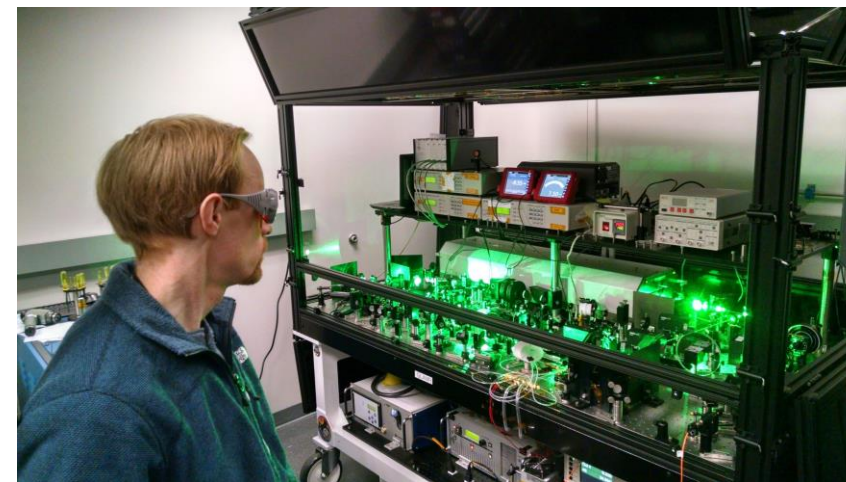
SWIR-OPO 1080-1400 nm + 540-700 nm

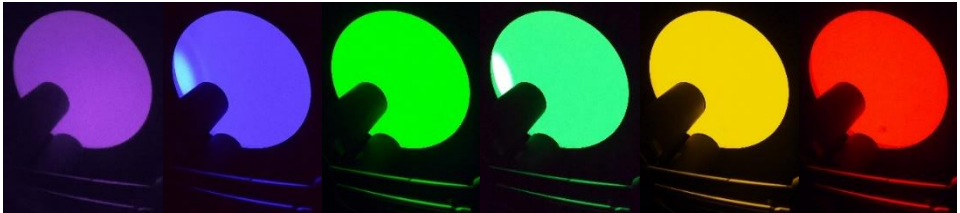


acronyms

- LBO: lithium triborate
- OPO: optical parametric oscillator
- NIR: near infrared
- SWIR: short wave infrared
- SHG: second harmonic generator

Nominal range, nm	Configuration ID
340-540	NIR SHG
540-700	SWIR SHG
680-1100	NIR Fundamental
1080-1400	SWIR Fundamental
1200-2200	NIR Idler





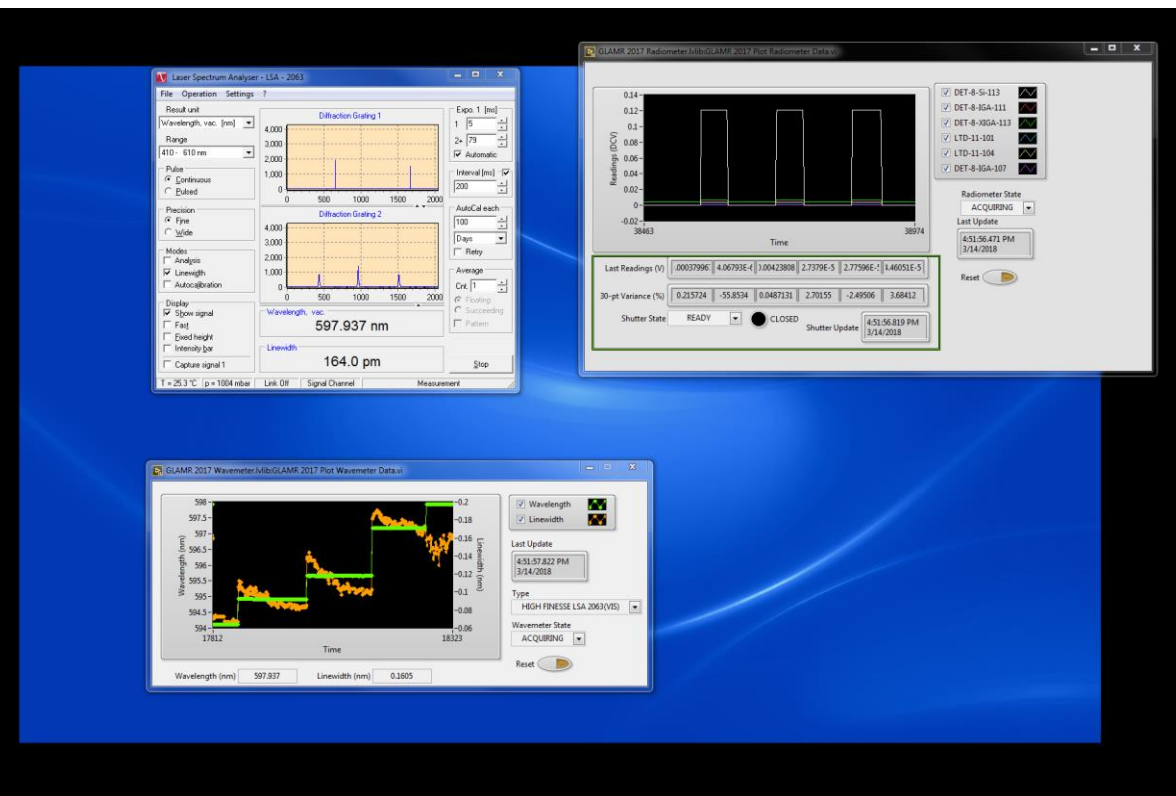
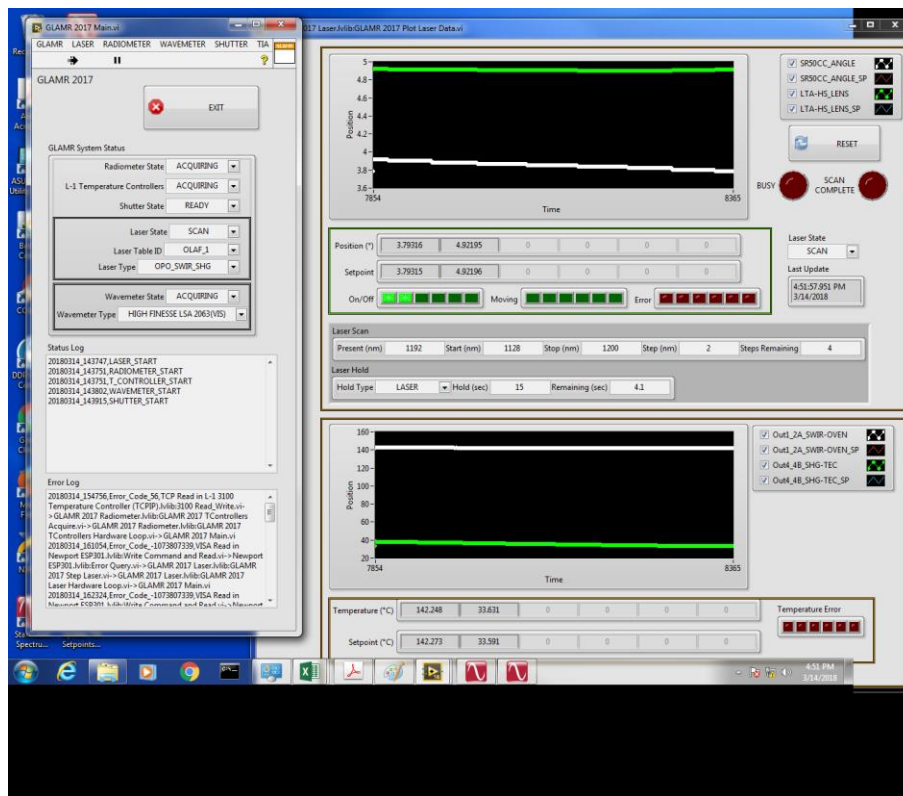
Automated scans

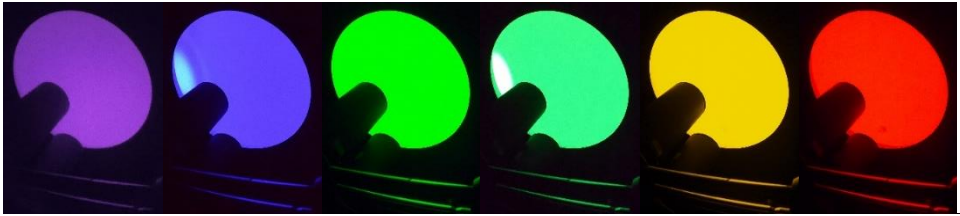
Real time display + recording of wavelength, radiance, shutter state, and OPO parameters

Light and dark dwell time

Scan wavelength interval

Automated tuning via parameter look up table

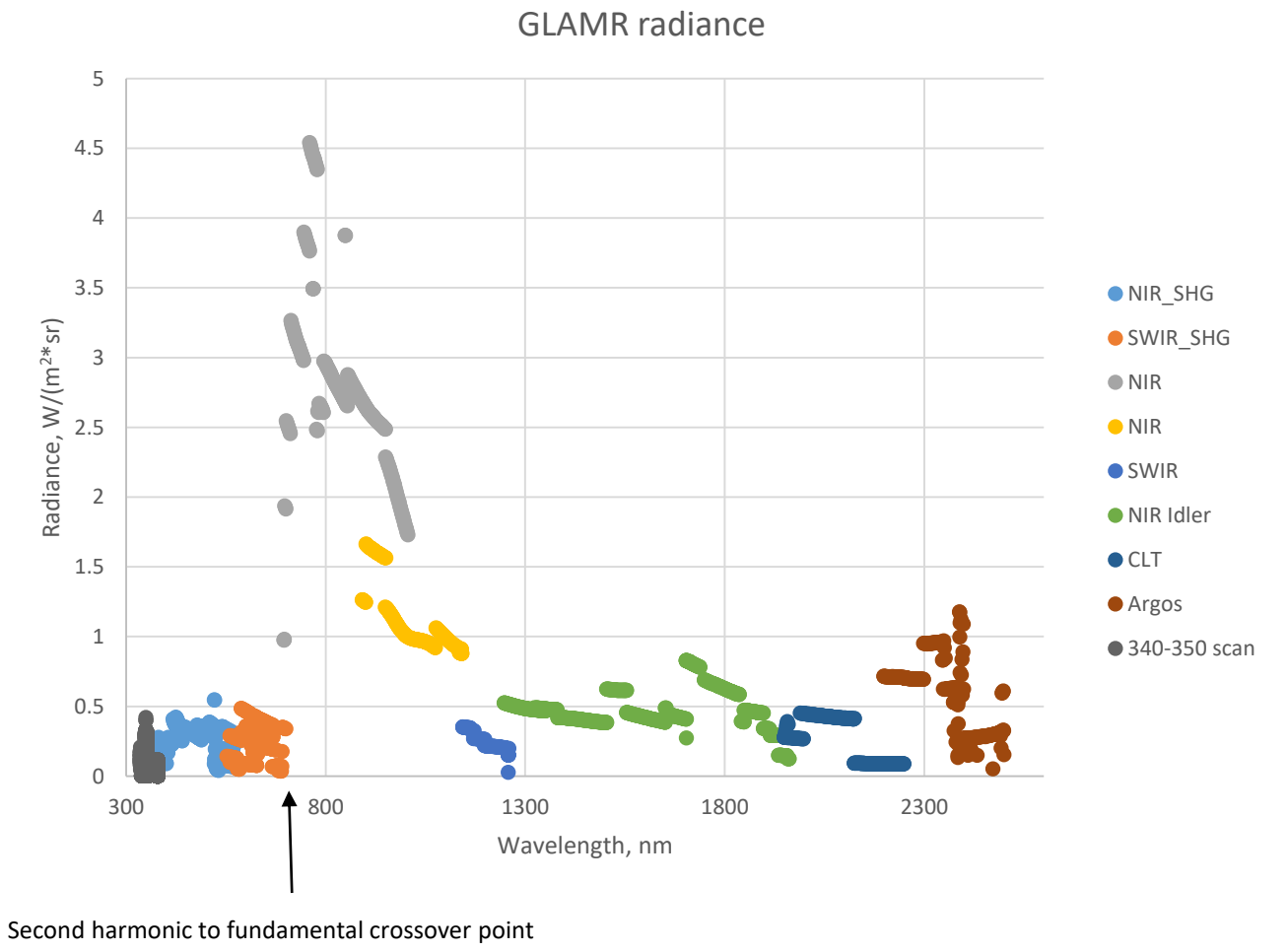
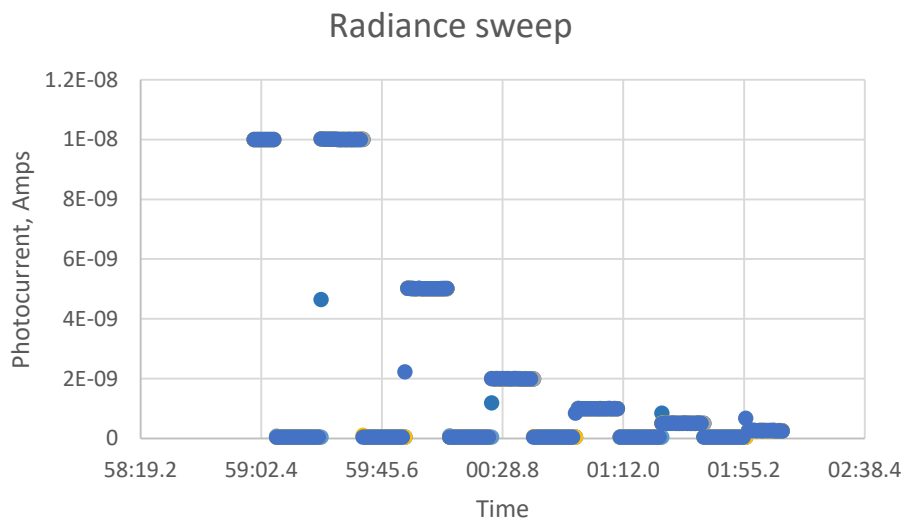


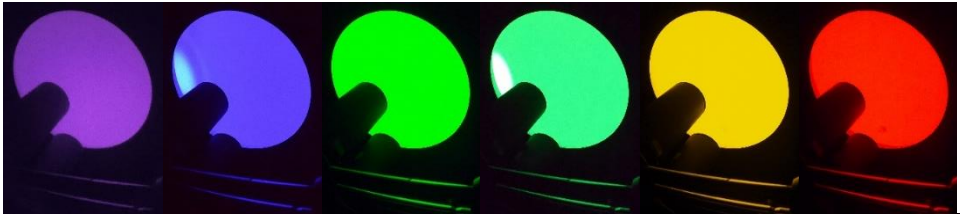


Radiance

Current spectral range 340-2500 nm

Instrument calibration over full spectral range at 1 nm resolution ~10-14 days on critical path





Acknowledgements

Program & Funding Support

GOES-R



NPP



SAGE III – ISS



Landsat



PACE Ocean Color Instrument



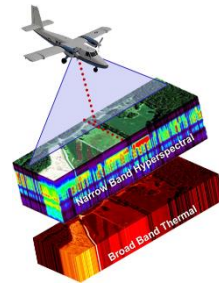
CLARREO Pathfinder



Joint Polar Satellite System



Lucy L’Ralph



G-LiHT

Team

Julia Barsi

Joel McCorkel

Jim Pharr

Tim Shuman

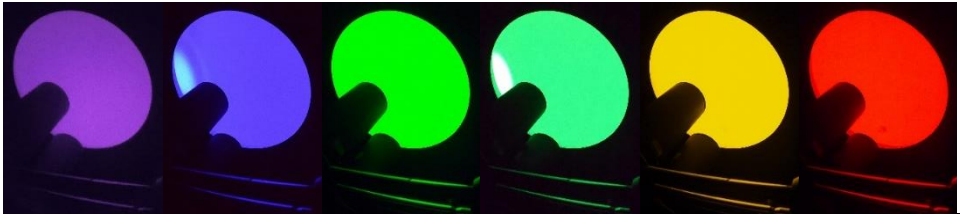
Barbara Zukowski

Brendan McAndrew

Mike Rodriguez

Andrei Sushkov





Discussion

