# NIST Agency Report
## *2021*

*Stephen Maxwell, Sensor Science Division*

# Presentation Overview

- Updates to NIST activities/actions/achievements of interest to GSICS:
  - Lunar Calibration
  - MOBY
  - VACNT-based electrical substitution bolometry

# Lunar Calibration

## MLO-LUSI: Lunar spectral irradiance measurements from Mauna Loa

*Steve Maxwell, John Woodward*

*Goal: To collect a high spectral resolution, SI-traceable dataset of the lunar spectral irradiance in the visible, near-infrared, and short-wave infrared over a densely sampled and broad range of sun-moon-observer configurations.*

Status:
- Equipment housings on site in Hawaii
- Certified engineering drawings for wind are in hand
- Contractor to install this Spring
- *Expect to begin measurements this Fall*

## air-LUSI: Lunar spectral irradiance measurements from NASA's ER-2

*NASA: Kevin Turpie (PI), NIST: Steve Brown (co-I), John Woodward (co-I), Steve Grantham, Tom Larason, Steve Maxwell*
*USGS: Tom Stone (co-I) U Guelph: Andrew Gadsden (co-I), Andrew Newton*

*Goal: To make accurate, SI-traceable lunar spectral irradiance measurements with high spectral resolution from above about 95% the atmosphere. Target uncertainty is <0.5% (k=1).*

3 talks in tomorrow's VisNIR subgroup on Lunar Cal including overview of global efforts

Status:
Successful Demonstration Flight Campaign November 2019
- Lunar Spectral Irradiance for 5 nights at phases: 10°, 21°, 34°, 46° and 59°
- Error budget gives an uncertainty of < 1.0 % (k=1) (will be improved)
- Wrapping up data reprocessing

*air-LUSI is ready for operational use*

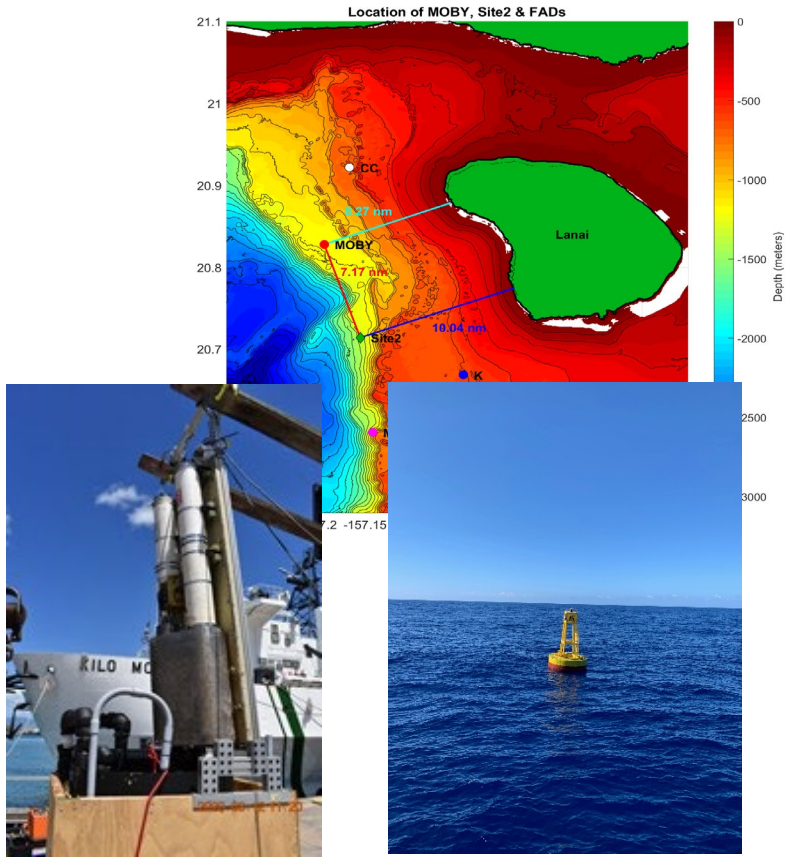
# MOBY (ocean color calibration)

*B. Carol Johnson, Thomas Larason, Heather Patrick*

MOBY Refresh (NOAA) & MarONet (NASA)
[same design, next gen MOBY]
*PI: Kenneth Voss, Physics Dept., Univ of Miami*
Second mooring site installed
- Overlapping time series w/ existing MOBY
- System to be deployed May

Characterizations on one system begun
- Temperature sensitivity & stray light

MarONet Stability System – NIST building for NASA
- Travels to mooring site and back
- Modifications underway
- Planned deployment April



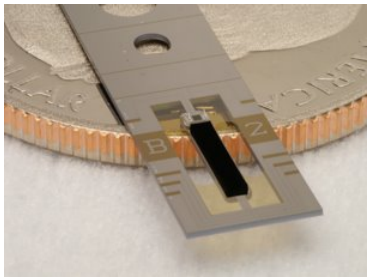

AERONET-OC publication:
Johnson et al. “Characterization and absolute calibration of an AERONET-OC radiometer,” provisional acceptance, Appl. Optics

Alexandre Castagna, B. Carol Johnson, Kenneth Voss, Heidi M. Dierssen, Heather Patrick, Thomas A. Germer, Koen Sabbe, and Wim Vyverman, "Uncertainty in global downwelling plane irradiance estimates from sintered polytetrafluoroethylene plaque radiance measurements," Appl. Opt. 58, 4497-4511 (2019)

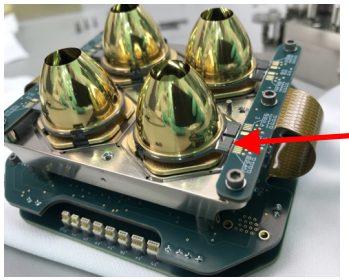
# VACNT-based electrical substitution bolometry

- **Absolute bolometers built for Compact Solar Irradiance Monitor flight demonstration (CSIM)** – *Operated and built by LASP, CU Boulder; electrical substitution bolometers fabricated by NIST Boulder. PI: Erik Richard, LASP,*
  *NIST staff Nathan Tomlin, Chris Yung, Michelle Stephens, John Lehman.*
  *Launched Dec. 2018, 6U cubesat.*
  - *Measures solar spectral irradiance from 200 -2800 nm. Operational overlap of CSIM with existing SSI measurements validates concept for maintaining critical long-term solar data records. Funding from NASA ESTO IIP and NASA ESTO INVEST.*
- **Absolute bolometers built for Compact Total Irradiance Monitor flight demonstration (CTIM) -** *Operated and built by LASP, CU Boulder; bolometers by NIST Boulder. PI: Dave Harber, LASP;*
  *NIST staff Nathan Tomlin, Chris Yung, Michelle Stephens, John Lehman.*
  *Launch early 2022, 6U cubesat*
  - *Measures total solar irradiance. Operational overlap of CSIM with existing SSI measurements validates concept for maintaining critical long-term solar data records. Funding from NASA ESTO ACT and NASA ESTO INVEST.*
- **Absolute bolometers built for Libera -** *Operated and built by LASP, CU Boulder; bolometers by NIST Boulder. PI: Peter Pilewski, LASP;*
  *NIST staff Chris Yung, John Lehman, Nathan Tomlin, Malcolm White, Bao Tran, Michelle Stephens.*
  *Launch end 2027.*
  - *Measures solar radiation reflected from Earth 0.3-5 microns, infrared radiation emitted from the Earth system from 5-50 microns, total radiation leaving Earth 0.3- 100 microns, and a split-wave channel measuring between 0.7 and 5 microns. Will maintain 40-year data record of the balance between the solar radiation entering Earth's atmosphere and the amount absorbed, reflected, and emitted. Funding from NASA Earth Venture – Continuity.*
- **Technology development of arrays of electrical substitution bolometers for Earth radiation imaging –** *Black Array of Broadband Absolute Radiometers – Earth Radiation Imaging (BABAR-ERI). Integrated by LASP, CU Boulder; electrical substitution bolometer arrays fabricated by NIST Boulder. PI: Odele Coddington, LASP;*
  *NIST staff Chris Yung, Michelle Stephens, Nathan Tomlin, Bao Tran, John Lehman.*
  - *Technology development program to enable Earth radiation imaging from 0.3 – 100 microns.*
  - *Funding from NASA ESTO ACT and IIP.*

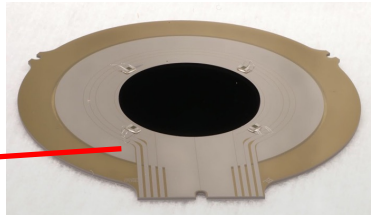
# VACNT-based electrical substitution bolometry



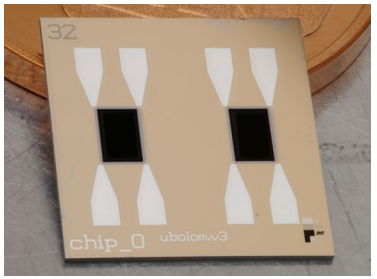
NIST ESR in CSIM
credit: N. Tomlin, NIST



4 ESR detector head
Credit: LASP



NIST ESR in CTIM
Credit: Nathan Tomlin, NIST




Libera prototype pixel
Credit: Chris Yung, NIST

Further reading:


- E. Richard, D. Harber, G. Drake, J. Rutkowsi, Z. Castleman, M. Smith, J. Sprunck, W. Zheng, P. Smith, M. Fisher, A. Sims, B. Cervelli, M. Fowle, M. Miller, M. Chambliss, T. Woods, P. Pilewskie, C. Yung, M. Stephens, N. Tomlin, M. White and J. Lehman, Proc. SPIE 11131, CubeSats and SmallSats for Remote Sensing III , 111310D5 (30 August 2019).
- D. Harber, Z. Castleman, G. Drake, S. V. Dreser, N. Farber, K. Heuerman, M. Miller, J. Rutkowski, A. Sims, J. Sprunck, C. Straatsma, I. Wanamaker, W. Zheng, G. Kopp, E. Richard, P. Pilewskie, N. Tomlin, M. Stephens, C. Yung, M. White and J. Lehman, Proc. SPIE 11131, CubeSats and SmallSats for Remote Sensing III, 111310D1 (30 August 2019).
- N. A. Tomlin, C. S. Yung, Z. Castleman, M. P. Denoual, G. Drake, N. Farber, D. Harber, K. Heuerman, G. Kopp, E. Richard, J. Rutkowski, J. Sprunck, M. Stephens, C. Straatsma, S. Van Dreser, I. Vayshenker, M. White, S. I. Woods, W. Zheng and J. H. Lehman, AIP Advances **10**, 0550101 (2020).
- C. S. Yung, N. A. Tomlin, C. Straatsma, J. Rutkowski, E. C. Richard, D. M. Harber, J. H. Lehman, and M. S. Stephens, “BABAR: Black array of broadband absolute radiometers for far infrared sensing,” Proc. SPIE 10980, 109800F (2019). https://doi.org/10.1117/12.2516047,

# Additional Slides not Presented

- Contacts for GSICS at NIST:
  - Stephen Maxwell, Agency Rep

    stephen.maxwell@nist.gov
  - NIST Calibration Services

    contacts at: https://www.nist.gov/calibrations
  - NIST Sensor Science Division

    https://www.nist.gov/pml/sensor-science
  - NIST Applied Physics Division

    https://www.nist.gov/pml/applied-physics-division

# Thank you for your attention

**WMO GSICS Portal**

**http://gsics.wmo.int**

**GSICS Coordination Centre**

**http://www.star.nesdis.noaa.gov/smcd/GCC/index.php**

**GSICS Product Catalog**

**https://www.star.nesdis.noaa.gov/smcd/GCC/ProductCatalog.php**

**GSICS Wiki**

**http://gsics.atmos.umd.edu/wiki/Home**