Optical Radiation News

Published by the COUNCIL for OPTICAL RADIATION MEASUREMENTS (www.cormusa.org) to report items of interest in optical radiation measurements. Inquiries may be directed to the Editor, John D. Bullough, Light and Health Research Center, Icahn School of Medicine at Mount Sinai, Suite 560, Albany, NY 12205. Tel: 518-368-5418, e-mail: John.Bullough@mountsinai.org.

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CORM NEWS

CORM Tenth Survey Open

CORM regularly surveys the photometric and radiometric measurement communities to help provide national metrology institutes (NMIs) with information about pressing needs and trends for the measurement of light and optical radiation. The survey will take only a few minutes to complete, and will help NMIs define and develop programs to assist the metrology community. Your responses and contact information will not be shared with anyone. Those who complete the survey will be able to receive the results after the survey is closed, and will be entered into a drawing for a $100 Amazon gift card. To participate in the survey, visit:

https://forms.gle/nus4mVnc6rzqcf1eA

Joint CORM / U.S. / Canada CIE National Committee Conference

The 2021 USNC annual meeting will be held virtually in conjunction with the Canadian National Committee of CIE (CNC) and the Council for Optical Radiation Measurements (CORM) during the week of 15 November 2021. For more details, visit:

https://cormusa.org/news-events/

CORM Directors Elections

The 2021 CORM Election of Directors is underway. The ballot was emailed to all CORM members on Monday, October 4, 2021. Please fill in and return the ballot before October 20, 2021. If you believe you are a CORM member but did not receive a ballot, or if you have any questions, please email: secretary@cormusa.org.

Characterization and Absolute Calibration of an AERONET-OC Radiometer
B. C. Johnson, Giuseppe Zibordi, Steven W. Brown, Michael E. Feinholz, Mikhail G. Sorokin, Ilya Slutsker, John T. Woodward, and Howard W. Yoon
https://doi.org/10.1364/AO.419766

The Ocean Color component of the global Aerosol Robotic Network (AERONET-OC) utilizes CE-318 sun photometers modified for above-water radiometry from fixed structures such as oil rigs, lighthouses, and service platforms. Primarily, AERONET-OC measurements allow determination of the water-leaving radiance required for the validation of ocean color satellite data products. One instrument from the AERONET–OC network, identified as AERONET #080, was studied in this work. A laser-illuminated integrating sphere of known radiance enabled determination of the linearity with flux and absolute radiance responsivity at multiple wavelengths within seven of the AERONET #080 filter bands. We compared the results to calibrations from the AERONET facility at the Goddard Space Flight Center of the National Aeronautics and Space Administration and from the Joint Research Centre of the European Commission. These results agree within the estimated mean comparison uncertainty of 1.88 % (k=2). We also assessed these results using calibrated lamp-illuminated integrating spheres and observed a spectral dependence to the comparison results that is unexplained.

Design, Calibration, and Application of a Cryogenic Low-Background Infrared Radiometer for Spectral Irradiance and Radiance Measurements from 4- to 20-μm Wavelength
Simon G. Kaplan, Solomon I. Woods, Eric L. Shirley, Adriaan C. Carter, Timothy M. Jung, James E. Proctor, Dale R. Sears, Jinan Zeng
https://doi.org/10.1117/1.OE.60.3.034102

We have constructed, calibrated, and tested a cryogenic low-background infrared (IR) radiometer for both spectral radiance and irradiance measurements over the 4- to 20-μm wavelength range. The primary purpose of the Missile Defense Transfer Radiometer (MDXR) is to measure absolute irradiance or radiance from cryogenic IR test chamber sources using a photoconductive Si:As blocked-impurity band (BIB) detector and a set of spectral filters. The MDXR also includes an absolute cryogenic radiometer (ACR) and a Fourier-transform spectrometer (FTS). For irradiance measurements, the ACR is used to provide the primary power scale for the BIB detector in conjunction with spectral filters, whereas the FTS/BIB configuration derives its scale from an internal blackbody source. The two measurement scales show agreement for the irradiance of highly collimated (<1 mrad) IR beams from $10-13$ to $10-8$ W / μm / cm2 within the combined relative uncertainties of 2.6% (coverage factor k = 1.) We have also calibrated the radiometer for radiance measurements using a large cavity fluid bath blackbody that overfills the spatial and angular extent of the radiometer entrance pupil. The radiometric calibration uncertainty analysis of the radiometer and its maintenance and stability are discussed.

Eliminating the Middleman: Ultraviolet Scale Realization Using a Laser-Driven Plasma Light Source
Uwe Arp, Edward Hagley, and Robert Vest
https://doi.org/10.1364/AO.414700

After we replaced the argon mini-arc with a laser-driven light source in the Ultraviolet Spectral Comparator Facility at the National Institute of Standards and Technology (NIST), we realized that the optical power should be sufficient to use the comparator system for absolute-cryogenic radiometry. Calibrating working standard detectors directly against an absolute-cryogenic radiometer in the system used for calibrations would eliminate all uncertainties resulting from the use of transfer standards, which were calibrated in a separate system using a different light source and optics. The transfer standards are the middlemen we refer to in the title. Any uncertainty caused by differences in bandpass, out-off-band radiation, spectral purity, collimation, or data interpolation would be removed. In the end, we successfully set up a twin system resembling the Ultraviolet Spectral Comparator Facility and used this system to perform a primary calibration of several photodiodes, based on an absolute-cryogenic radiometer. Using this system, we were able to reduce relative standard uncertainties at wavelengths below 220 nm from above 1 % (k=1) to below 0.5%. We refer to this system as the Ultraviolet Scale Realization Facility or UV-SRF.

Spectropolarimetry of Primitive Phototrophs as Global Surface Biosignatures
William B. Sparks, Mary Niki Parenteau, Robert E. Blankenship, Thomas A. Germer, Christian Herman Lucas Patty, Kimberly M. Bott, Charles M. Telesco, and Victoria S. Meadows
https://doi.org/10.1089/ast.2020.2272

Photosynthesis is an ancient metabolic process that began on early Earth and offers plentiful energy to organisms that can utilize it such that that they achieve global significance. The potential exists for similar processes to operate on habitable exoplanets and result in observable biosignatures. Before the advent of oxygenic photosynthesis, the most primitive phototrophs, anoxygenic phototrophs, dominated surface environments on the planet. Here, we characterize surface polarization biosignatures associated with a diverse sample of anoxygenic phototrophs and cyanobacteria, examining both pure cultures and microbial communities from the natural environment. Polarimetry is a tool that can be used to measure the chiral signature of biomolecules. Chirality is considered a universal, agnostic biosignature that is independent of a planet's biochemistry, receiving considerable interest as a target biosignature for life-detection missions. In contrast to preliminary indications from earlier work, we show that there is a diversity of distinctive circular polarization signatures, including the magnitude of the polarization, associated with the variety of chiral photosynthetic pigments and pigment complexes of anoxygenic and oxygenic phototrophs. We also show that the apparent death and release of pigments from one of the phototrophs is accompanied by an elevation of the reflectance polarization signal by an order of magnitude, which may be significant for remotely detectable environmental signatures. This work and others suggest that circular polarization signals up to ∼1% may occur, significantly stronger than previously anticipated circular polarization levels. We conclude that global surface polarization biosignatures may arise from anoxygenic and oxygenic phototrophs, which have dominated nearly 80% of the history of our rocky, inhabited planet.

High-Accuracy Room Temperature Planar Absolute Radiometer Based on Vertically Aligned Carbon Nanotubes
Anna K. Vaskuri, Michelle S. Stephens, Nathan A. Tomlin, Matthew T. Spidell, Christopher S. Yung, Andrew J. Walowitz, Cameron Straatsma, David Harber, and John H. Lehman
https://doi.org/10.1364/OE.427597

We have developed a planar absolute radiometer for room temperature (PARRoT) that will replace the legacy C-series calorimeter as the free-space continuous-wave laser power detector standard at the National Institute of Standards and Technology (NIST). This instrument will lower the combined relative expanded measurement uncertainty (k = 2) from 0.84 % to 0.13 %. PARRoT's performance was validated by comparing its response against a transfer standard silicon trap detector traceable to NIST's primary standard laser optimized cryogenic radiometer (LOCR) and against the C-series calorimeter. On average, these comparisons agreed to better than 0.008 % and 0.05 %, respectively.

Optical Power Scale Realization by Laser Calorimeter after 45 Years of Operation
Matthew Spidell, Anna Vaskuri
https://doi.org/10.6028/jres.126.011

To calibrate laser power and energy meters, the National Institute of Standards and Technology (NIST) uses several detector-based realizations of the scale for optical radiant flux; these realizations are appropriate for specific laser power/energy ranges and optical coupling configurations. Calibrations from 1 µW to 2 W are currently based upon calorimeters. Validation by comparisons against other primary representations of the optical watt over the last two decades suggests the instruments operate well within their typical reported uncertainty level of 0.86 % with 95 % confidence. The dominant uncertainty contribution in the instrument is attributable to light scattered by the legacy window, which was not previously recognized. The inherent electro-optical inequivalence in the calorimeter's response was reassessed by thermal modeling to be 0.03 %. The principal contributions to the overall inequivalence were corrected, yielding a shift in scale representation under 0.2 % for typical calibrations. With updates in several uncertainty contributions resulting from this reassessment, the resulting combined expanded uncertainty (k = 2) is 0.84 %, which is essentially unchanged from the previous result provided to calibration customers.

Room Temperature Laser Power Standard Using a Microfabricated, Electrical Substitution Bolometer
M. Stephens, C. S. Yung, N. A. Tomlin, A. Vaskuri, I. Ryger, M. Spidell, M. G. White, T. Jenkins, J. Landry, T. Sereke, and J. H. Lehman
https://doi.org/10.1063/5.0032366

The design and performance of a room temperature electrical substitution radiometer for use as an absolute standard for measuring continuous-wave laser power over a wide range of wavelengths, beam diameters, and powers are described. The standard achieves an accuracy of 0.46% (k = 2) for powers from 10 mW to 100 mW and 0.83% (k = 2) for powers from 1 mW to 10 mW and can accommodate laser beam diameters (1/e 2) up to 11 mm and wavelengths from 300 nm to 2 µm. At low power levels, the uncertainty is dominated by sensitivity to fluctuations in the thermal environment. The core of the instrument is a planar, silicon microfabricated bolometer with vertically aligned carbon nanotube absorbers, commercial surface mount thermistors, and an integrated heater. Where possible, commercial electronics and components

were used. The performance was validated by comparing it to a National Institute of Standards and Technology primary standard through a transfer standard silicon trap detector and by comparing it to the legacy "C-series" standards in operation at the U.S. Air Force Metrology and Calibration Division (AFMETCAL).

Conference: 14th International Conference on New Developments and Applications in Optical Radiometry (NEWRAD 2021)
https://www.nist.gov/news-events/events/2021/06/14th-international-conference-new-developments-and-applications-optical

NEWRAD convened as a digital event June 21-24, 2021. The conference covered all aspects of optical radiation measurements and a wide range of topics were presented, including Earth remote sensing observations and Quantum optics technologies. At the time of this writing, pre-recorded talks were still available for view, with links on the conference website.

NATIONAL RESEARCH COUNCIL OF CANADA

NRC · CNRC National Research Council Canada Conseil national de recherches Canada

NRC LIAISON REPORT

Digital Calibration Certificates for UV-Vis Transmittance

We have developed prototype Digital Calibration Certificates for calibrations of transmittance in the UV-Vis range. These digital documents provide annotated calibration data and metadata in XML to support machine-readability. A human-readable version of the certificate is also generated allowing for easy integration into current workflows. Making calibration data machine-readable will support effective and efficient data management and allow for a higher degree of integration in data-driven processes. We have partially automated the generation of both machine-readable and human-readable reports, with future development to focus on streamlining the generation process and extending DCCs to other calibrations. Currently, we are following the XML Schema provided by PTB at https://www.ptb.de/dcc/v2.3.0/dcc.xsd, but we are also investigating alternative formats for the effective communication of spectral data. In order to best meet the needs of users, we encourage anyone interested to contact us with comments and use cases.

For further information, contact Dr. Matthew Beckett (Matthew.Beckett@nrc-cnrc.gc.ca) or Dr. Li-Lin Tay (Li-Lin.Tay@nrc-cnrc.gc.ca).

UPCOMING IES MEETINGS CALENDAR

The Illuminating Engineering Society (IES) is sponsoring the following meetings and conferences in the coming months (specific details are subject to change during the ongoing pandemic):

IES Street and Area Lighting Conference
Atlanta, GA
October 10-13, 2021
https://www.ies.org/events/street-area-lighting-conference/

LightFair
New York, NY
October 25-29, 2021
http://www.lightfair.com

NEWS FROM THE CIE

International Commission on Illumination
Commission Internationale de l'Eclairage
Internationale Beleuchtungskommission

Upcoming Events (subject to change; please check www.cie.co.at for latest details)

CIE NC Bulgaria 2021 Sixth Junior Hybrid Conference on Lighting (Lighting)
Gabrovo, Bulgaria and Online
September 23-25, 2021
https://cie.co.at/news/cie-nc-bulgaria-2021-sixth-junior-hybrid-conference-lighting-lighting

CIE 2021 Midterm Meeting
Online
September 27-29, 2021
http://cie.co.at/news/cie-midterm-meeting-2021

Other CIE News

CIE issued the following news items in 2021:

- CIE TC 3-59 New TC on the Integration of Daylight and Electric Lighting – Photometric, Colorimetric and Radiometric Requirements for the Spectral Design of Indoor Lighting
- CIE TC 3-60 New TC on Spectral Daylight Characteristics
- CIE TC 2-95 - New TC on the Measurement of Obtrusive Light and Sky Glow

Visit http://www.cie.co.at for additional information.

OTHER NEWS…

ISO/TS 23031:2020 Graphic Technology: Assessment and Validation of the Performance of Spectrocolorimeters and Spectrodensitometers

ISO TC 130 Graphic Technology has published a new Technical Specification (ISO/TS 23031:2020 Graphic Technology), which describes procedures for the assessment and validation of the performance of an optical spectrometer intended for use in capturing the spectral reflectance factor or the spectral radiance factor of printed areas comprised of non-fluorescent or fluorescent materials, respectively. While it does not describe the application to transmitting materials directly, many of the procedures can be applied to transmitting systems by backing them with a reflective white backing material.

This document does not address spectral measurements appropriate to other specific application needs, such as those used during the production of materials (e.g. printing paper and proofing media), which are well described by ISO standards under the jurisdiction of ISO/TC 6. It does not describe the special requirements for testing instruments that make in-process or online colour measurements. It is available now from the ANSI Publication Store.

Rensselaer's Lighting Research Center Demonstrates 3D-Printed Interior Architecture with Lighting

The 3D printing for lighting research program at Rensselaer's Lighting Research Center (LRC) revealed a prototype of a 3D-printed interior wall for building construction. The wall was printed at the LRC laboratory with functional and decorative features, including the mechanisms required for lighting, with the aim of creating a cohesive, whole system interior architecture that integrates all required electrical, mechanical, and thermal components. For more details, visit: https://www.lrc.rpi.edu/programs/solidstate/news/3DInteriorWall.asp

Light and Health Research Center at Mount Sinai Established

The Light and Health Research Center, part of the Department of Population Health Science and Policy in the Icahn School of Medicine at Mount Sinai, has been established with Dr. Mariana Figueiro as Director. The center will be based in the Riverview Center in Menands, NY, and will work in areas of Light and Human Health, Light for Energy Efficiency, Light for Transportation Safety, Light for Plant Health, and Outreach Education. For more information, visit: http://icahn.mssm.edu/lhrc

Purpose of the Council for Optical Radiation Measurements (CORM)

The Council for Optical Radiation Measurements is a non-profit organization with the following aims:

1. To establish and publish consensus among interested parties on national, industrial and academic requirements for physical standards, calibration services, and inter-laboratory collaboration programs in the fields of optical radiation measurement, including measurement of the transmittance and reflectance properties of materials, measurement of radiant sources, and characterization of optical detectors used for the measurement of these properties.
2. To establish national consensus on the priorities for these requirements.
3. To maintain liaison with the National Institute of Standards and Technology (NIST) and The National Research Council Canada (NRC) and to advise the Institute(s) of requirements and priorities.
4. To cooperate with other organizations, both public and private, to accomplish these objectives for the direct and indirect benefit of the public at large.
5. To assure that information on existing or proposed standards, calibration services, collaboration programs, and its own activities is widely disseminated to interested parties.
6. To answer inquiries about such standards activities or to forward such inquiries to the appropriate agencies.

Optical Radiation News Editorial Policy

Optical Radiation News (ORN) is published semi-annually each year. ORN reports upcoming technical meetings and news from NIST and other national metrology laboratories. News relating to the status and progress in optical radiation metrology from affiliated organizations, including, but not limited to, the *Commission International De Éclairage* (International Commission on Illumination, CIE), Inter-Society Color Council (ISCC), Lamp Testing Engineers Conference (LTEC), etc., is welcome. No commercial advertising, endorsements, or contributions with commercial content are included in ORN. Unsolicited contributions are subject to review and approval by the editor, CORM publications committee, and /or executive board prior to publication. Anonymous contributions will not be accepted. Contact information for a submission is required and will be published. ORN is included free with CORM membership.

Instructions for Contributing Authors

ORN is published in English. Deadlines for submission of News items and announcements concerning optical radiation metrology are 1 March and 1 September. Items may be submitted to the editor in via fax or e-mail attachments in plain ASCII text or common electronic word processing file formats, preferably Microsoft Word® or Corel WordPerfect®. Contributions should be in 12 point Times New Roman font with simple formatting, e.g., the "Normal" style and template in Word. *Use of complex style templates and formatting is strongly discouraged*. Submissions with high quality pertinent electronic graphics are welcome, however digital photographs and graphics will be reproduced in black-and-white or grayscale. Graphics included in hardcopy submissions via fax will not be reproduced. Submissions are credited to organizations, rather than individuals.

Policy on Commercial Activities at CORM Conferences

The Council for Optical Radiation Measurements (CORM) does not permit commercial activities in conjunction with technical sessions of CORM conferences and CORM workshops. Commercial activities include, but are not limited to, product exhibition and dissemination or display of advertising in any format. Speakers at CORM conferences and workshops may not use talks for overt commercialization of products. Commercial activities as defined above are permitted for a fee for defined periods prior to social activities associated with the conference or workshop at the discretion of the CORM Board of Directors. Registration requirements, details of the structure of the allowed activities and fees are (event and site) specific.

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