# 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, Lighting Research Center, Rensselaer Polytechnic Institute, 21 Union St., Troy, NY 12180. Tel: 518-687-7100 Fax: 518-687-7120 e-mail: bulloj@rpi.edu.

NUMBER 99 SPRING 2013

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# CORM 2013 Annual Technical Conference and Business Meeting

*May 7 - 9, 2013 – Gaithersburg, MD*

The CORM 2013 conference will be held in Gaithersburg, MD. All technical sessions including the NIST tour will take place at NIST. The Grum Banquet & Lecture will be held at the Holiday Inn, Gaithersburg also serving as the conference host hotel. For more information and registration visit our website at http://www.cormusa.org/

## *Tuesday, May 7th*

8:00 **REGISTRATION OPEN**
Holiday Inn, Gaithersburg, MD

9:00 **Welcome and Short Introduction by Organizing Committee**
Kathleen Muray, NIST representative

**Session I** **Display Technology and Metrology**
(Session Chair: John Bullough, Lighting Research Center, Rensselaer Poly. Inst.)

**Measuring the Luminous Effectiveness of Images**
T. Nilsson, University of Prince Edward Island

**Methods to Characterize the Reflection Properties of Handheld Display Devices for Medical Imaging Applications**
A. Badano, U.S. Food and Drug Administration

**Spectral Sensitivity in Night Driving: Dependence on Adaptation, Location, Task**
M. Flannagan, The University of Michigan Transportation Research Inst.

**Automotive Displays and New Equipment for Display Measurements**
R. Donofrio, Display Device Consultants

**FHWA Research Related to Roadway Signs and Displays**
D. Yang, Federal Highway Administration

13:00 **Lunch** (provided)

14:30

**Session II** **Measuring Instruments and Issues for Light and Human Factors**
(Session Chair: Kathleen Murray, Inphora Inc.)

**Advantages and Applications for the Use of Imaging Colorimeters**
J. Jorgen, Radiant Zemax Co.

**Outdoor Lighting and Mesopic Vision**
J. Bullough, Lighting Research Center, Rensselaer Polytech. Inst.

**Design of Mesopic Photometers Based on CIE 191**
Tatsukiyo Uchida, Panasonic/NIST

**Examples of Applying Mesopic Factors in Roadway Calculations**
Keith & Wentworth, Mindspring

**Measurement and Application of BUG Ratings**
G. Lister, Ceravision

17:30 End

***Wednesday, May 8th***

9:00

**Session III** **New SSL Measurement Standards, Metrology and Technology**
(Session Chair: Mr. Cameron Miller, NIST)

**New SSL Measurement Standards, Technology and Metrology**
Cameron Miller, NIST

**Overview of New SSL Standards under Development through the IES Testing Procedures Committee**
Cameron Miller, NIST

**The OLED Industry and Need for Standards**
T. Royster, R-Display & Lighting, LLC

**Practical Optical Measurements of OLED Panels for Lighting Applications**
T. Kawabata, Konica Minolta

**Photometric Measurements of OLEDs at PTB**
T. Gerloff, PTB

13:00 Lunch (provided)

14:30

**Session IV** **New Light Sources, General Metrology**
(Session Chair: G. Lister, Ceravision)

**Spectral Measurements of Plasma Lamps**
G. Lister, Ceravision

**LED Chromaticity Aging**
Ralph Tuttle, Cree

**Uncertainty Evaluation for Color Measurements for Solid State Lighting Sources**
Y. Ohno, NIST

**Detector Based Calibration of a Spectroradiometer using Pulse OPO Laser Systems**
Yuqin Zong, NIST

**NIST Traceable Photometric Measurements**
G. Eppeldauer, NIST

17:30 End

18:00 Reception at Gaithersburg, Hilton

19:00 **Franc Grum Memorial Dinner and Lecture**
**Headlamp Glare Through the Ages: How to Measure it; What to Do About It?**
Michael Perel, formerly with the National Highway Traffic Safety Administration

***Thursday, May 9th***

**Session V**

9:00 CORM Business Meeting, chaired by Ron Daubach
9:45 NIST Tour (Pre-registration at www.cormusa.org by April 30th is required.)
13:00 Lunch (Provided)
14:30 CORM Board of Directors' Meeting
16:00 End

Contact the conference coordinators if you have any questions about the CORM 2013 Conference:

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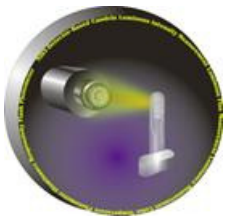
## NEWS FROM THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

### 2013 Photometry Short Course – September 2013

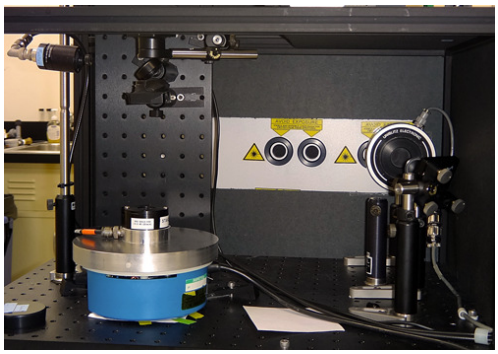


The need for education and training for photometry engineers and technicians has been stressed by the Council for Optical Radiation Measurements (CORM), Lamp Testing Engineer's Conference (LTEC), and other metrology groups within industry. In response to this need, Photometry Short Course was developed by Optical Technology Division of NIST and given since 1998.

The NIST Photometry Short Course is offered every two years and covers fundamentals in photometry, radiometry, and colorimetry and practical aspects of measurements of luminous flux, luminous intensity, illuminance, luminance, color temperature, and chromaticity of light sources. Participants will gain experience in the calibration of lamps, photometers, and colorimeters. The next course is planned for September 2013. The NIST short courses are offered every two years. http://www.nist.gov/pml/div685/sc/
*Contact: Cameron Miller (c.miller@nist.gov)*

### NIST Helping to Improve the Safety of Drinking Water

Recent changes in the Environmental Protection Agency's (EPA) Long Term 2 Enhanced Surface Water Treatment Rule (LT2) mandate more aggressive monitoring and control of various pathogens, notably including Cryptosporidium. That protozoan is highly resistant to chlorine-based disinfection. As one means of reducing the threat, the EPA has called for treating water with stronger doses of ultraviolet (UV) radiation, which also serves as a "secondary barrier" to inactivate other key pathogens such as adenovirus and other viruses, as well as bacteria and parasites such as Giardia.



*NIST "traveling SIRCUS" setup for delivering calibrated UV illumination.*

Conventional UV lamps for this purpose produce a relatively narrow spectrum centered at 254 nm. But recent advances in lamp technology have led to increased UV light output at wavelengths less than 240 nm. The effects of those wavelengths on pathogens have not been well characterized.

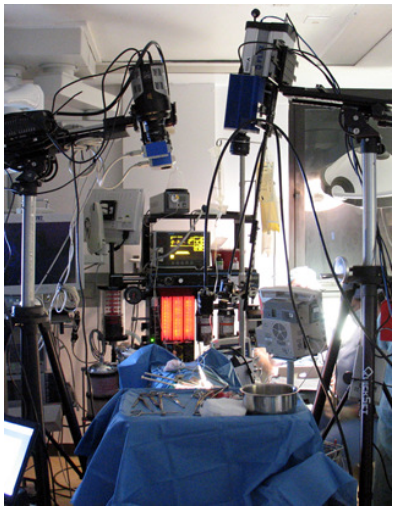
NIST scientists, working as part of an ongoing, multi-institutional project headed by researchers at the University of Colorado and funded by the Water Research Foundation, have been providing precise UV doses from NIST-calibrated devices to determine the action spectra of various bacteria and viruses. Calibration was done using a portable version of NIST's SIRCUS (Spectral Irradiance and Radiance Responsivity Calibrations Using Uniform Sources) equipment, which uses tunable lasers that emit radiation from 210 nm throughout the experimental range of interest.

Initial findings from a project site in Vermont suggest that there is a dramatic disparity in the inactivation of different microbes at different sub-250 nm wavelengths. As the project continues, and understanding of short-wavelength dose-response characteristics improves, NIST may be involved in devising calibration and validation standards for sources and sensors in the range of 200 nm to 300 nm.

*(Contact: Tom Larason, thomas.larason@nist.gov)*

**Development of Spectral Lighting Tools for Better Contrast in Surgery**

Surgery involving the bile duct is one of the most common procedures. While injuries and complications are small in proportion, estimated at 0.5% for the laparoscopic technique, the number of patients affected is still thousands annually. Analysis of the causes of human errors during such surgery points to impaired visual perception, while the error rate does not decline significantly with experience. The authors recommend, along with other changes in the technique, the addition of technological tools for visualization. Currently, the visualization technique of choice is intraoperative cholangiography, a conventional imaging technique requiring contrast agents and extra surgery time. Since lights and cameras are already routinely used by the surgeon during the procedure, improvements in these technologies can aid the surgeon at minimal cost.



*NIST-calibrated hyperspectral imager in the clinic.*

A NIST team, in collaboration with the University of Texas Southwestern Medical Center's Department of Surgery, obtained spectral reflectance images of tissues during open surgeries where the common bile duct was exposed. The images were accompanied by calibration data based on a standard reflectance plaque and a clinical hyperspectral imager. The common bile duct is typically identified by the surgeon through its bluish-green color, having higher reflectance in the 500 nm region and lower reflectance in the red region. Analysis of annotated images helps the authors explore the optimal spectral distribution of the illuminating light source to enhance contrast between the common bile duct and surrounding areas. This was done using the NIST CQS program,

substituting the tissue reflectance for standard color patches. The standard reflectance image data could then be "relighted" by convolving them with simulated lighting spectral distributions.

(*Contact: Toni Litorja, maritoni.litorja@nist.gov*)

**NIST Tests Underscore Potential Hazards of Green Laser Pointers**

Using a low-cost apparatus designed to quickly and accurately measure the properties of handheld laser devices, National Institute of Standards and Technology (NIST) researchers tested 122 laser pointers and found that nearly 90 percent of green pointers and about 44 percent of red pointers tested were out of compliance with federal safety regulations. The NIST test apparatus was designed so that it can be replicated easily by other institutions.

As NIST researchers reported at a conference on March 20, 2013, both red and green laser pointers often emitted more visible power than allowed under the Code of Federal Regulations (CFR), and green pointers often emitted unacceptable levels of infrared light as well.

Anecdotal reports of green laser hazards have previously appeared in scientific journals and the media, but the new NIST tests are the first reported precision measurements of a large number of handheld laser devices. The NIST tests point out that many red laser pointers are also—unexpectedly—out of compliance with federal regulations. "Our results raise numerous safety questions regarding laser pointers and their use," the new paper states.

The NIST tests were conducted on randomly selected commercial laser devices labeled as Class IIIa or 3R and sold as suitable for demonstration use in classrooms and other public spaces. Such lasers are limited under the CFR to 5 milliwatts maximum emission in the visible portion of the spectrum and less than 2 milliwatts in the infrared portion of the spectrum. About half the devices tested emitted power levels at least twice the CFR limit at one or more wavelengths. The highest measured power output was 66.5 milliwatts, more than 10 times the legal limit. The power measurements were accurate to within 5 percent. According to the American National Standards Institute (ANSI), laser devices that exceed 3R limits may be hazardous and should be subject to more rigorous controls such as training, to prevent injury.

NIST is a non-regulatory agency with decades of experience providing industry, research and military agencies with laser power measurements traceable to international standards. NIST also has a history of innovation in devices for making such measurements. Technical staff from NIST's Laser Radiometry Project built the laser pointer test bed and collaborated with the NIST Office of Safety, Health and Environment on the tests. NIST has provided its data on laser pointer power measurements to the Food and Drug Administration, which regulates laser product safety.

Green lasers generate green light from infrared light. Ideally, the device should be designed and manufactured to confine the infrared light within the laser housing. However, according to the new NIST results, more than 75 percent of the devices tested emitted infrared light in excess of the CFR limit.

NIST Laser Safety Officer Joshua Hadler designed the measurement test bed. The system consists of a laser power meter and two optical filters to quantify the emissions of different wavelengths of visible and infrared light. The power meter and filters were calibrated at NIST. Lens holders ensure

repeatable laser alignment, and an adjustable aperture contains the laser light around the output end of the laser.

"The measurement system is designed so that anyone can build it using off-the-shelf parts for about $2,000," Hadler says. "By relying on manufacturers' traceability to a national measurement institute such as NIST, someone could use this design to accurately measure power from a laser pointer."

(*Contact: Laura Ost , laura.ost@nist.gov*)

**NIST's 'Nanotubes on a Chip' May Simplify Optical Power Measurements**

The National Institute of Standards and Technology (NIST) has demonstrated a novel chip-scale instrument made of carbon nanotubes that may simplify absolute measurements of laser power, especially the light signals transmitted by optical fibers in telecommunications networks. The prototype device, a miniature version of an instrument called a cryogenic radiometer, is a silicon chip topped with circular mats of carbon nanotubes standing on end. The mini-radiometer builds on NIST's previous work using nanotubes, the world's darkest known substance, to make an ultraefficient, highly accurate optical power detector, and advances NIST's ability to measure laser power delivered through fiber for calibration customers.

"This is our play for leadership in laser power measurements," project leader John Lehman says. "This is arguably the coolest thing we've done with carbon nanotubes. They're not just black, but they also have the temperature properties needed to make components like electrical heaters truly multifunctional."

NIST and other national metrology institutes around the world measure laser power by tracing it to fundamental electrical units. Radiometers absorb energy from light and convert it to heat. Then the electrical power needed to cause the same temperature increase is measured. NIST researchers found that the mini-radiometer accurately measures both laser power (brought to it by an optical fiber) and the equivalent electrical power within the limitations of the imperfect experimental setup. The tests were performed at a temperature of 3.9 K, using light at the telecom wavelength of 1550 nanometers.

The tiny circular forests of tall, thin nanotubes called VANTAs ("vertically aligned nanotube arrays") have several desirable properties. Most importantly, they uniformly absorb light over a broad range of wavelengths and their electrical resistance depends on temperature. The versatile nanotubes perform three different functions in the radiometer. One VANTA mat serves as both a light absorber and an electrical heater, and a second VANTA mat serves as a thermistor (a component whose electrical resistance varies with temperature). The VANTA mats are grown on the micro-machined silicon chip, an instrument design that is easy to modify and duplicate. In this application, the individual nanotubes are about 10 nanometers in diameter and 150 micrometers long.

By contrast, ordinary cryogenic radiometers use more types of materials and are more difficult to make. They are typically hand assembled using a cavity painted with carbon as the light absorber, an electrical wire as the heater, and a semiconductor as the thermistor. Furthermore, these instruments need to be modeled and characterized extensively to adjust their sensitivity, whereas the equivalent capability in NIST's mini-radiometer is easily patterned in the silicon.

NIST plans to apply for a patent on the chip-scale radiometer. Simple changes such as improved temperature stability are expected to greatly improve device performance. Future research may also address extending the laser power range into the far infrared, and integration of the radiometer into a potential multipurpose "NIST on a chip" device.

(*Contact: Laura Ost , laura.ost@nist.gov*)

**NATIONAL RESEARCH COUNCIL OF CANADA**

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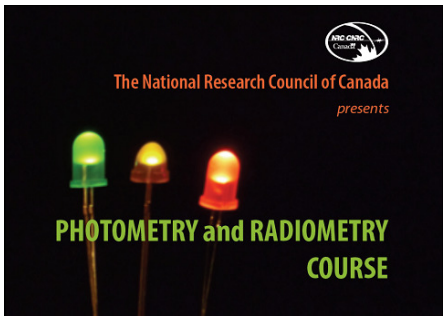
# REPORT FROM THE PHOTOMETRY, RADIOMETRY AND THERMOMETRY GROUP

## 2013 Photometry and Radiometry Measurement Course, May 2013

NRC will be offering a 2 ½ day course in Photometry and Radiometry in Ottawa, Canada, May 1-3, 2013. This course is intended for those individuals concerned with accurate and precise measurements of photometric and radiometric properties in research and development or in industrial applications. The course will include a tour of the NRC photometry and radiometry labs and an accompanying exhibition of photometric and radiometric equipment. The language of instruction will be English. Topics will include:

- Basics of photometry and radiometry (concepts, instrumentation, procedures, standards, and uncertainties)
- Basics of UV, visible and IR spectrophotometry (focus on regular spectral transmittance and specular reflectance)
- Absolute radiometry and its applications
- LED measurement issues
- ISO/IEC 17025 requirements
- Selected advanced topics:
    - Fluorescence measurements
    - Quantum based standards
    - Radiation thermometry
    - Applications of Raman spectroscopy
    - BRDF measurements




*For more information, contact Charlie Bamber, Phone: 613-990-8990 or visit:*
*www.nrc-cnrc.gc.ca/radiometry*

**Metrology Symposium 2012: Innovation in Measurements for a Better Quality of Life**

From October 8 to 12 , 2012, the Centro National de Metrología (CENAM) held its 10th Metrology Symposium, a forum summit for Latin America that allows the exchange of knowledge and experiences in metrology. The opening ceremony was introduced by Jose E. Calzada Rovirosa, Governor of the State of Queretaro and by Bruno Ferrari Garcia de Alba, Secretary of Economy on behalf of the President of the United Mexican States. Among those at the opening ceremony were Roberto Loyola Vera, Mayor of Querétaro; Manuel Valdes Rodriguez, Secretary of Agriculture; Tonatiuh Salinas Muñoz, Secretary of Labor; Seldner Eduardo Avila, Officer of the Ministry of Economy; Juan Enrique Urquidi Carrillo, Delegate of the Ministry of Economy in Queretaro; and Dr. Héctor Octavio Nava Jaimes, CEO of CENAM.

Every two years, representatives from public test and calibration laboratories, private industry research organizations, academic institutions, and national metrology institutes from other countries discussed and shared their progress and solutions for improved measurements in a time of constant challenge. The theme of the Symposium was the role of ensuring the quality of products and services for a better quality of life. The topics discussed included issues in measurement science specialties such as force and torque torsion, mass and density, hardness, pressure and vacuums, dimensions, vibration, volume, liquid and gas flow, viscosity, electromagnetism, electrical magnitudes , quantum optics, thermometry, time and frequency, nanotechnology, biology and microbiology, chemistry, health, environment, advanced materials, food safety and quality, education and training in metrology, accreditation, conformity assessment, standards, metrology infrastructure, and mathematical and statistical models.

The Symposium brought together invited foreign experts, national experts, authorities, users, providers, academics and students to share and learn about the latest developments in metrology. This event has become one of the most important of its kind in Latin America, highlighted on this occasion by having attendees from outside Mexico totaling 26% of the participants.

## UPCOMING IES MEETINGS CALENDAR

The IES is sponsoring the following meetings and conferences in 2013:

**2013 IES Street and Area Lighting Conference**
September 8-11, 2013
Marriott Phoenix Desert Ridge Hotel
Phoenix, Arizona

**2013 IES Annual Conference**
October 27-29, 2013
Hyatt Regency Huntington Beach Hotel
Huntington Beach, California

For more information, please visit http://www.ies.org/programs/meetings_calendar.cfm.

# NEWS FROM THE CIE

## CIE 100th Anniversary Conference Held in Paris

CIE is celebrating its one hundredth anniversary! A century during which our knowledge of lighting fundamentals has taken enormous leaps forward, bringing new applications of light supported by both technological advances and economic success. A century that began with the revolution of the electric light and efforts to bring both the electric light bulb and the power it required into common use ends with the need to reduce energy distribution and use, and brings a technology that promises to achieve this for lighting.

In celebration of a centenary of knowledge, and in recognition of our new challenges, CIE members gathered for a conference centered around three themes: the rhythm of life and light, intelligent lighting, and the city at night. These subjects were discussed during a two-day conference, held where the CIE was officially created and hosted.

## Standard on Color-Difference Formula Published

CIE Standard S 014/E:2013, Colorimetry – Part 6: CIEDE2000 Colour-Difference Formula, was published in 2013. The purpose of this CIE International Standard is to define the CIEDE2000 formula for color differences, based on CIE Technical Report 142-2001. The CIE International Standard has been approved by the CIE National Committees, and it is readily available through the National Committees of the CIE or via the CIE Webshop at www.cie.co.at.

Lighting Research Center

# NEWS FROM RENSSELAER'S LIGHTING RESEARCH CENTER

## New Photometry Laboratory at the LRC

The Lighting Research Center (LRC) at Rensselaer recently unveiled its new photometry laboratory with a ribbon cutting at its 25th anniversary celebration, held on March 20, 2013. The new laboratory is supported with funding from the New York State Energy Research and Development Authority (NYSERDA). Irvin "Jack" White, the past NYSERDA president who issued the 1987 request for proposals that established the LRC, cut the ribbon alongside LRC Director Mark Rea and current NYSERDA President and CEO Francis J. Murray, Jr. "This new well equipped laboratory expands the LRC's capabilities in lighting measurement and lighting product evaluation, in addition to providing tools to further the LRC's research into new lighting technologies and new metrics," said LRC Professor and Director of Research Nadarajah Narendran.

The laboratory includes an imaging type goniophotometer system, mirror type goniophotometer system, illuminance meters, luminance meter and color analyzer, spectrometers, National Institute of Standards and Technology (NIST) calibrated lamp standards, a large thermally controlled integrating sphere system, and thermal test chambers. The new equipment allows LRC researchers to conduct photometric measurements on a wider range of lighting products and systems, including luminaires. In addition, the new laboratory expands the LRC's training and education capabilities at its Photometry Institute, a three-day interactive course designed to build the knowledge and skills to establish and conduct photometric testing and evaluation of lighting products and systems. The hands-on course is geared toward engineers, technicians, managers, testing personnel, and product designers who want to learn more about photometric, colorimetric, and related evaluation of lighting products and prototypes, including the latest requirements for testing light-emitting diode (LED) and traditional lighting products—for example, understanding testing requirements for labeling programs such as ENERGY STAR® and Lighting Facts. LRC researchers will also be able to assist lighting manufacturers with a wider range of lighting measurements and evaluation services. The LRC is recognized throughout the world for objective, independent, third party testing of lighting products, and has the only university lighting laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP Lab Code: 200480-0).

## LED Lighting Institute in May 2013

The LRC has expanded its LED Lighting Institute to add new content on OLEDs (organic light emitting diodes), not included in past sessions. The Institute also includes more time for participation in hands-on sessions using LEDs and OLEDs. Institute instructors will assist in learning about these quickly evolving solid-state lighting technologies in a small-class setting. Further information can be found online at www.lrc.rpi.edu.

**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 in the April and October of 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.

# CORM Council for Optical Radiation Measurements

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Main areas of interest: ☐ Radiometry ☐ Optical Properties of Materials ☐ Spectrophotometry
☐ Other _____

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**Membership applications and dues payment checks should be sent to:**

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