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 100 FALL 2013/WINTER 2014

ARTICLE CONTENTS PAGE

NEWS FROM THE CIE

NEWS FROM THE LIGHTING RESEARCH CENTER

NEWS FROM FOGRA

CORM 2014 Annual Technical Conference and Business Meeting

Details for the 2014 CORM Annual Technical Conference and Business Meeting are being finalized. At present, the Conference is being planned for May 21-23 in Gaithersburg, MD in cooperation with the National Institute of Standards and Technology (NIST). A call for abstracts will be circulated shortly. Check the CORM website (www.cormusa.org) for updates.

Special Issue of *Journal of Modern Optics* Sponsored by CORM Published

The *Journal of Modern Optics*, a scientific journal published by Taylor & Francis, recently published a special issue is entitled "Photometry, Colorimetry and Radiometry: Issues and Applications" in cooperation with CORM. The issue was edited by John Bullough from the Rensselaer Polytechnic Institute Lighting Research Center (LRC) and Joanne Zwinkels of the National Research Council (NRC) of Canada.

In their preface for the special issue, Bullough and Zwinkels state, "The ability to make traceable, highly accurate and repeatable photometric, colorimetric and radiometric measurements is critical to improving the quality of related products and services and to their acceptance in global markets." Emphasizing their point are fourteen research articles from academia, industry and government describing new measurement techniques, lighting and display technologies, and data on human responses to light and lighting systems across many applications.

Contributions to the special issue include several papers by authors from NRC and from the National Institute of Standards and Technology (NIST), as well as by other individuals from Canada, France, Germany, Portugal, Russia, the United Kingdom and the United States.

The articles were published in Volume 60, Issue 14 of the *Journal of Modern Optics*. The paper titles and abstracts can be found online at http://www.informaworld.com/jmo. For information about CORM and its annual conferences, visit http://www.cormusa.org. The LRC website is http://www.lrc.rpi.edu.

NIST NEWS FROM THE SENSOR SCIENCE DIVISION

Dehmer to Head NIST Physical Measurement Lab

Dr. Joseph L. Dehmer, a 40-year veteran of federal science research and administration, has been named Director of the Physical Measurement Laboratory (PML) of the National Institute of Standards and Technology (NIST). Dehmer is a physicist who served most recently as director of the Division of Physics and Senior Advisor for Strategic Planning at the National Science Foundation (NSF). He took office on April 22, 2013. Dehmer is a fellow of the American Physical Society and the American Association for the Advancement of Science; has chaired, co-chaired or been a member of more than 20 committees of NSF, the National Research Council, and the U.S. Department of Energy; has served on the editorial boards of five research journals; and is presently co-chair of the National Science and Technology Council's Working Group on Physics of the Universe.

Dehmer received his Ph.D. from the University of Chicago—where his adviser was the celebrated physicist Ugo Fano, the first theoretical physicist hired on staff by the National Bureau of Standards. He was a researcher at Argonne National Laboratory before spending two years at NIST as the head of the Optical Sensor Group in what was then the Physics Laboratory. Thereafter, Dehmer went to NSF, where he served for 14 years as Director of the Division of Physics. Dehmer succeeds Katharine Gebbie, who directed the PML and its predecessor, the NIST Physics Laboratory, since the latter's inception in 1991. Gebbie is now the Senior Advisor for Interdisciplinary Technologies in the office of Willie May, NIST's Associate Director for Laboratory Programs.

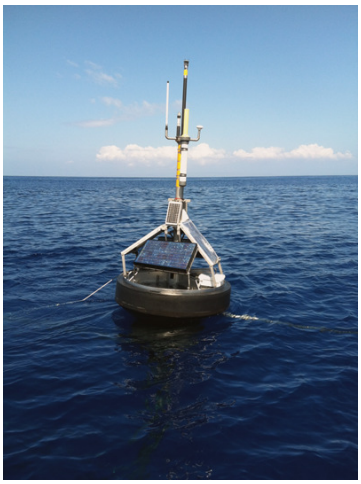
Photocurrent Traceability

Traceability of photocurrent measurements to SI units has been established at the Sensor Science Division in cooperation with the Fundamental Electrical Measurements Group of the Quantum Measurement Division (684). Wide dynamic range reference current-to-voltage converters and a new converter calibration method have been developed. The high feedback resistors of a reference converter were in-situ calibrated on high-resistivity, printed-circuit-board placed in an electrically shielded box electrically isolated from the operational amplifier using jumpers. The feedback resistors, prior to their installation, were characterized, selected, and heat treated. The circuit board was cleaned with solvents, and the in-situ resistors were calibrated using measurement systems for 10 kΩ to 10 GΩ standard resistors. It was demonstrated that DC currents from 1 nA to 100 μA can be measured with uncertainties of 55 x 10^{-6} (k=2) or less which are lower in uncertainties than any commercial device by factors of 10 to 30 at the same current setting. The internal (NIST) validations of the reference converter have been made. *Contact: George Eppeldauer (george.eppeldauer@nist.gov)*

Seeing the Oceans in Their True Colors

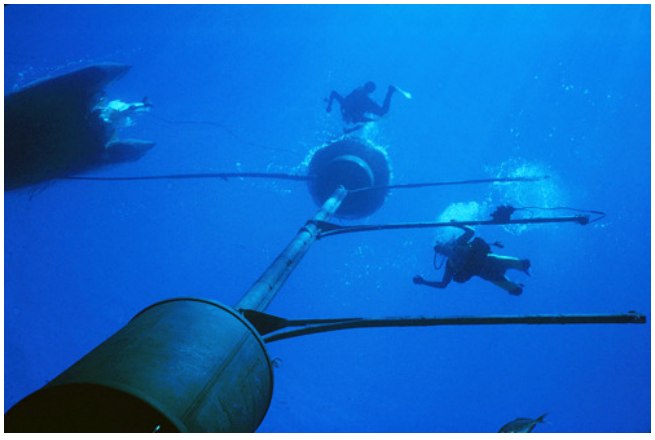
Much of what is known about the state of the Earth's oceans, and how they change over time, comes from satellite monitoring of reflected and thermally emitted light from these bodies. Thermally emitted radiation occurs in the infrared spectral region and is the basis for studies of sea surface temperature.

In the visible spectral region, the amount of sunlight absorbed or scattered by seawater varies substantially depending upon the amount and type of dissolved and suspended materials, which determine the optical properties of seawater. In particular, ocean color radiometry provides essential information about phytoplankton concentration and dissolved organic matter, and hence about primary productivity, global carbon cycling, and ultimately the effects of both on the planet's climate.



Understanding the dynamics of these variables involves analyzing datasets from multiple satellite sensors over decadal time scales. But in order to draw meaningful conclusions from the data, scientists need to know the sources of uncertainty in measurements. That is a remarkably complex and difficult problem – one that PML researchers have been addressing for years.

One method of determining the uncertainties is ground-truth validation, known as "vicarious calibration," using data from a suite of optical sensors placed in the ocean to measure the water-leaving radiance locally. Those in situ measurements are compared to what the satellite records when it is looking at the same part of the ocean at the same time. Vicarious calibration is an end-to-end calibration of the sensor and its data. The primary reference instrument for the United States and most international ocean color sensors is the Marine Optical Buoy (MOBY), an automated radiometric system operated by NOAA and deployed about 20 km offshore from Lanai, Hawaii, where the atmospheric and water conditions support utilizing this area as a ground radiometric reference standard. The water is clear (low chlorophyll) and the spatial uniformity is good and representative of most of the world's oceans; likewise the atmosphere is clear (low aerosols) so atmospheric correction is more certain. MOBY uses optical fiber-coupled collectors mounted on three long arms that stand off its central axial mast to detect both downwelling irradiance and upwelling radiance at depths of 1 m, 5 m, and 9 m, and at wavelengths from 340 nm to 950 nm. The optical fibers mate to two spectrographs (for long and short optical wavelengths) in a 2 meter-long canister at the base of the axial mast. The system also records total irradiance just above the sea surface, and upwelling radiance from directly beneath the axis.



MOBY has been in operation since 1997, and is now operated for NOAA by principal investigators Ken Voss of the University of Miami, and Mark Yarbrough of Moss Landing Marine Laboratory (part of the California State Universities). The instrument's data are used to determine on-orbit calibration factors for various satellite sensors including the long-running MODIS and recent SeaWIFS instruments. Currently, teams of researchers are using MOBY to

vicariously calibrate the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard NASA's recently launched Suomi National Polar-orbiting Partnership (Suomi NPP) spacecraft.

Of course, the instruments and data-collection system on MOBY itself have to be thoroughly characterized and calibrated – a complicated job for many reasons. To ensure robust SI traceability, a number of radiometric cross checks were implemented, and the data, which are acquired daily, are subjected to quality control analysis prior to release. Duplicate systems are rotated, in three month long deployment cycles at the Lanai site, in order to refurbish and repair the optical buoy. For each deployment, a pre- and postradiometric and wavelength calibration is performed using radiometric standards calibrated by NIST. Internal to MOBY, two LEDs and one lamp serve as on-board stability monitors for the internal optical system. The radiometric reference standards are recalibrated every 50 hours of lamp burn time, and they are tracked during operating using two NIST-designed and calibrated filter radiometers. As a final check, NIST makes independent measurements of the radiance standards at the MOBY facility on Oahu using independent radiometric artifacts.

MOBY is beyond its design life, and PML has been active in the best optical system design for the replacement sensors. Brown realized the advantage of acquiring data from all channels (e.g. depths) simultaneously by coupling the optical fibers directly to the spectrograph entrance slits. Two prototypes were built and tested, followed by an instrument that uses a prism-grating-prism design. Johnson and co-workers are midway through a NASA-funded project to examine the entire time series of MOBY data set and provide a comprehensive uncertainty analysis including identifying sources of bias, developing correction algorithms for those biases, and assessing and assigning uncertainties. The result will not only improve the accuracy of the MOBY data set, but also enhance the value of ocean-color science products to climate research and other fields. *Contact: Carol Johnson (cjohnson@nist.gov)*

New Definition for Night Vision Goggle (NVG) Gain Calibrations

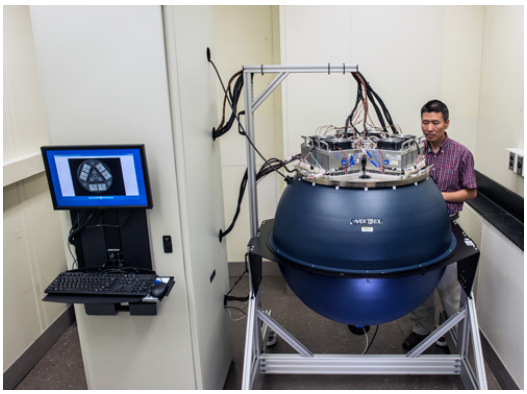
In the presently used NVG gain tests, the NVG input radiance (at 0.248 nW cm^{-2} sr^{-1}) is converted into an equivalent luminance (of 10^{-4} fL). In this conversion, a photometric unit, fL, is used for the infrared radiation of an LED (peaking at about 800 nm) in the test-sets used to calibrate the goggles. In this wavelength range, the $V(\lambda)$ photopic response function is not defined. The equivalent fL is not an SI unit and its uncertainty has not been evaluated. NIST suggested creating a new NVG gain definition based on SI traceable radiance units. In this case, the measured NVG output luminance can be converted into output radiance and the measurement geometry for both the input and the output of the NVGs will be the same for both calibrations and field applications. NIST has developed new-generation NV radiometers to transfer the detector-based radiance and luminance responsivity scales from NIST to the military-used test (Hoffman) instruments. The level of the input radiance for the NVG gain calibrations will be determined using the results of night sky (no moon) spectral distribution measurements. The U.S. Military Department of Defense funds this project to create a new military standard. *Contact: George Eppeldauer (george.eppeldauer@nist.gov)*

Infrared (Detector) Spectral Comparator Facility

IR-SCF was developed at the Sensor Science Division for the calibration of infrared detectors in both radiant power and irradiance measurement modes. This facility utilizes a high throughput monochromator with interchangeable diffraction gratings. Depending on the spectral range, either a blackbody of 1100 ^{o}C or a quartz tungsten halogen lamp can be used as a radiation source with a long-term variation in the spectral output of less than 0.1 %. In order to obtain a

full spectral coverage in the measured responsivity functions between 600 nm and 20 µm, low Noise-Equivalent-Power (NEP) pyroelectric radiometers have been developed. The detectors in these radiometers were calibrated for spectral reflectance at the IR-FT facility to obtain their relative spectral power responsivities. The relative responsivity functions were converted into absolute, using absolute tie points. These tie points were obtained using a sphere-input extended-InGaAs radiometer which was calibrated against the primary standard cryogenic radiometer. The profile of the incident beam and the positioning of the detectors were optimized. In addition to spectral responsivity calibrations, the facility allows mapping of detector area for spatial non-uniformity of response. Typical calibration uncertainties that can be achieved are about 1 % (k=2) in radiant power measurement mode and 2.5 % (k=2) in irradiance measurement modes. The spectral coverage of the IR-SCF is being extended to 25 µm. *Contact: George Eppeldauer (george.eppeldauer@nist.gov)*

LEDs Get a Life Sentence



The light-emitting diode (LED) appears on track to become the light of our lives. Switching to bright, energy-efficient, durable, and environmentally friendly LED lighting systems over 20 years could save the nation an estimated $250 billion and reduce electricity consumption for lighting by half, according to the U.S. Department of Energy (DOE). NIST is helping to make that transition possible. For nearly 10 years, NIST researchers have worked with DOE, the American National Standards Institute (ANSI), the Illuminating Engineering Society (IES), and other organizations to devise performance standards and measurement methods for LEDs, to help define the requirements for product certification in DOE programs such as ENERGY STAR (now managed by the Environmental Protection Agency), and to determine the contents of DOE-mandated laboratory accreditation programs. In 2008, NIST took the lead in developing the world's first standard for solid-state lighting final products. But the field is evolving fast, and there are still many unanswered questions. One of them is: How long, exactly, are LEDs expected to operate before failure?

Cameron Miller and colleague Yuqin Zong have sealed 480 3W white-light LEDs from four different manufacturers inside an integrating sphere to begin up to five years of fully automated continuous testing. Some will remain illuminated; some will be switched on and off. Each group will be operated at three different temperatures – 55°C, 85°C, and 115°C – using three different heat-sink configurations. A spectrometer connected to the sphere will record the data. Periodically, it will measure each individual LED's light output. The automation routine will turn them all off and then scan through the collection one at a time, providing information about how luminance changes over time. A digital camera mounted at the bottom of the sphere will constantly monitor the entire array, providing a time-stamp marker when any LED fails.

At the same time, the PML team, headed by Maria Nadal, has just completed work on the second generation of its solid-state lighting proficiency test kit, and is about to deploy the units, each the size of a medium piece of luggage, into the field. DOE's Energy Star program requires accreditation of laboratories that conduct the standard tests for solid-state lighting products, which includes measurement assurance and operator proficiency. Two years ago NIST started a measurement assurance program. NIST researched and characterized a number of LED products available on market, and then selected a set of six lamps – each chosen for distinctive properties

and subtle differences from other units – that have become the proficiency test kit. To date, NIST has worked with more than 90 laboratories. The results are within plus or minus 4 percent of each other. By comparison, it took several years for labs to get within 7 percent for compact fluorescent lamps. *Contact: Yuqin Zong (yuqin.zong@nist.gov)*

SIM Metrology School at NIST

They spanned the hemisphere – from Canada to Chile – and varied widely in age and experience. But their goal was the same: To improve and confirm their metrological abilities for the benefit of their home countries. For five extremely full days during the last week of October, 53 students from 29 countries attended the metrology school conducted by NIST in Gaithersburg, MD for the Sistema Interamericano de Metrologia (SIM), a consortium of national metrology institutes (NMIs) from all 34 member nations of the Organization of American States.

"NIST is extremely pleased and proud to be able to host this important event," said PML Deputy Director James Olthoff. "The opportunity to interact with such an impressive group of international metrologists, while also being able to utilize the extensive capabilities of the NIST calibration laboratories, will be invaluable to these young metrologists as they advance in their careers."

The students, typically scientists and engineers who have recently entered service in an NMI or nationally designated institute (DI), participated in a program featuring morning lectures (with simultaneous English-Spanish translation) on fundamental metrological topics followed by afternoon hands-on training in NIST's laboratories, many provided by PML researchers. Each day offered opportunities for introductions and networking among the students and experts in attendance. The program concluded with a final exam that confirmed the progress made by the students. Course topics covered measurement of: mass; temperature; pressure; dimension; electrical properties; chemical and biological properties; volume and flow; density, force, and torque; time and frequency; and various aspects of light. In addition, instruction was provided on legal metrology, statistics and uncertainty, and quality.

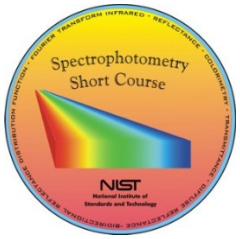
Short Courses Offered by the Sensor Science Division

The Division offers short courses in radiation thermometry, photometry, spectroradiometry, and spectrophotometry on a biennial basis. In addition, each the Division offers workshops on fixed-point cells and alternative thermometers. Attendees include NIST staff and representatives from industry, national laboratories, and other national metrology institutes.

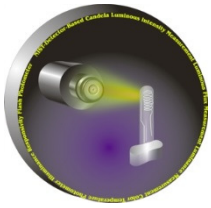
The courses consist of lectures and skill-building, problem-solving laboratory experiments. The content of the courses typically includes the following topics: practical laboratory experiences, proper uncertainty analysis, and treatment of the measurement equation. Details about recent and forthcoming courses follow and are found at http://www.nist.gov/pml/div685/sc/index.cfm.

Spectroradiometry Short Course, April 2014
This course covers the fundamentals of spectroradiometry including radiometry fundamentals, radiometric properties of sources and detectors, spectroradiometric techniques, reflectance properties of materials, and handling and determination of measurement uncertainties.

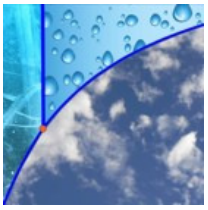
Radiation Thermometry Short Course
This course covers the fundamentals of radiation physics and instrumentation associated with determining temperature from observations of thermal radiation from materials.



Spectrophotometry Short Course, May 2015
This course covers the fundamentals of theory and practice of spectrophotometry using dispersive and Fourier-transform techniques. Evaluation of uncertainties in transmittance, reflectance, and Bidirectional Reflectance Distribution Function (BRDF) measurements is discussed.



Photometry Short Course, September 24-27, 2013
This course covers fundamentals in photometry, radiometry, and colorimetry as well as practical aspects of measurements of luminous flux, luminous intensity, illuminance, luminance, color temperature, and chromaticity of light sources.



ITS-90 Fixed-Point Cell Mini-Workshop
The workshop covers the realization of ITS-90 fixed-point cells over the range from the mercury triple point to the zinc freezing point for the calibration of SPRTs and the development of uncertainty statements for the fixed-point cells and subsequently SPRT calibrations.

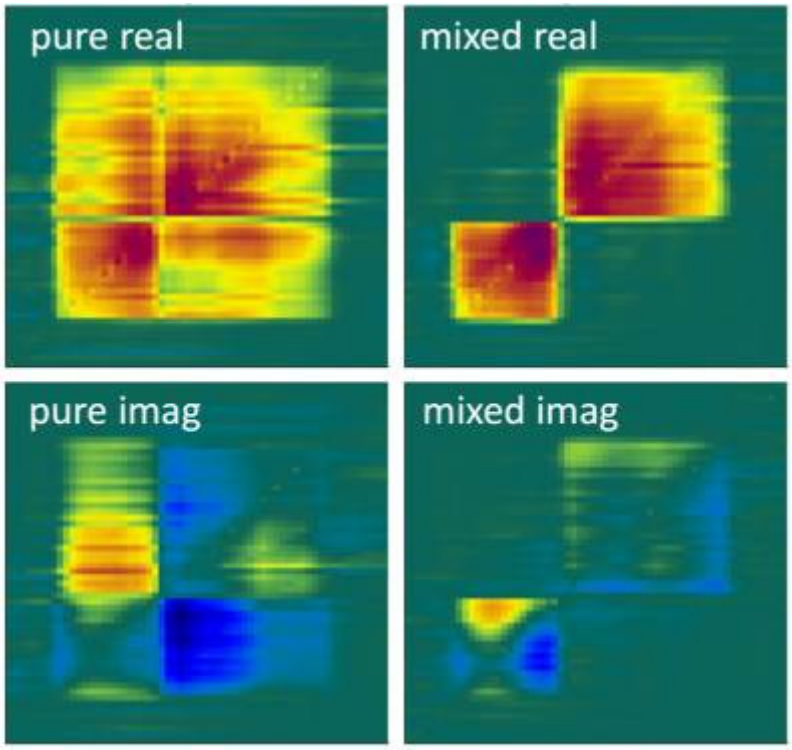
Selecting and Using Alternative Thermometers Mini-Workshop
The NIST Selecting and Using Alternative Thermometers Mini-Workshop covers different types of alternative thermometers, selecting the best alternative thermometer for your measurement application and uncertainty, calibrating alternative thermometers, and "in-the-field" validation methods.

Lunar Calibration Workshop
The Lunar Calibration Workshop covers ground-based lunar observations, atmospheric monitoring for ground-based observations, and above-the-atmosphere calibrations.

NRC LIAISON REPORT

NRC has Demonstrated the Measurement of General Quantum States

In 2011, NRC demonstrated the first direct measurement of a quantum wavefunction. This work has been extended to include the measurement of quantum systems that are not perfectly coherent. This means that, in general, any quantum system can be measured provided that it can be reproduced repeatedly. The theoretical work was published in *Physical Review Letters*, volume 108, issue 7. This was followed by the experimental result which appeared on the arXiv (arXiv:1309.1491v1).



For further information contact: Charlie Bamber, 613-990-8990.

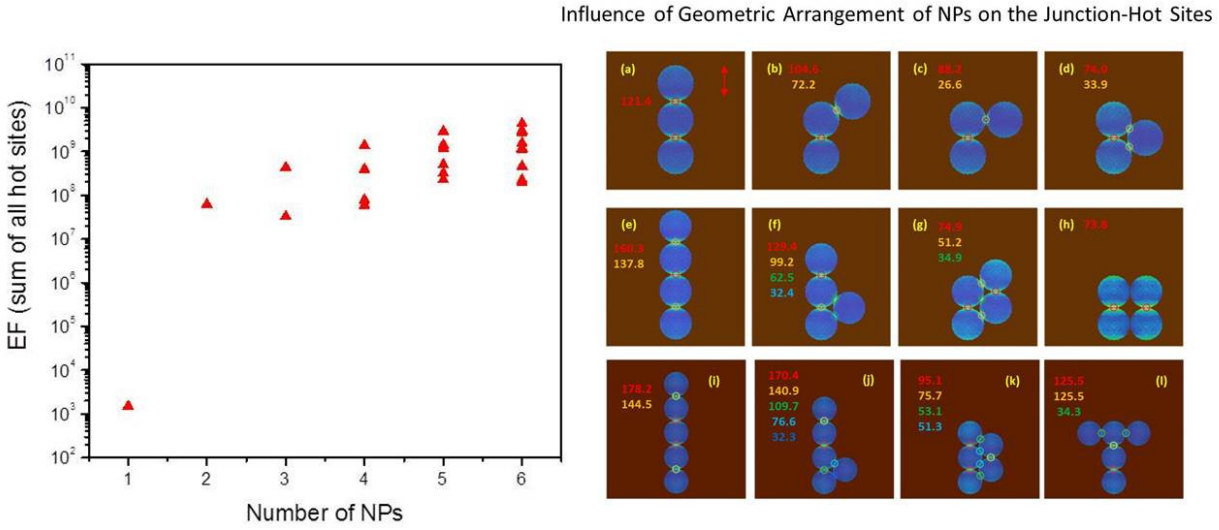
Update on NRC Radiation Thermometry Research Activities

In May and June of 2013, NRC completed its measurements of the high-temperature fixed-points of Re-C, Pt-C, Co-C, and Cu. These measurements are part of the High Temperature Fixed-point Research Plan of Working Group 5 of the Consultative Committee for Thermometry (also being run as Work Package 1 of the Euramet Project *Implementing the New Kelvin* (InK). The aim of this project is to assign thermodynamic temperatures to these fixed-point with the lowest possible uncertainties. The measurements of the fixed points were made using a radiation thermometer which had a calibration that was traceable to NRC's cryogenic radiometer via a high temperature blackbody and filter radiometers. The results of these measurements will become available after the completion of the project which is scheduled for March of 2015.

NRC has also been working two implement two new furnaces intended to realize the freezing point of copper to use as the reference point for our radiation thermometry temperature scale above 1000 ˚C. A comparison of different designs of copper fixed-points and measurements of the fixed points in three different furnaces was presented at the *Symposium on Temperature and Thermal Measurements in Industry and Science* (Tempmeko) 2013 in Madeira, Portugal 14-18 October. For further information contact: Andrew Todd, 613-993-7714.

Update on NRC Optical Spectroscopy of Nanomaterials Research Activities

Plasmonic nanoparticles (e.g. nanometer sized silver or gold particles) support extraordinary optical properties which can be tailored by their size, shape, dielectric environment and aggregation states. They are the enabling technology behind nanosensors, nanomedicine and surface enhanced spectroscopies. In summer of 2013, NRC reported detailed electromagnetic simulations, experimental surface enhanced Raman spectroscopy (SERS) and extinction data obtained from a study of more than 200 individual nanoclusters. (Tay et al., *J. Mod. Optics*, 2013, http://www.tandfonline.com/doi/abs/10.1080/09500340.2013.821535) The optical properties of each individual nanocluster are correlated to its structural geometry as elucidated by scanning electron microscopy and supported by electromagnetic simulations. The studies showed significant variations in the localized electric field intensities of the interparticle junction hot-sites in different nanocluster structures. The study explains the increase in number of interparticle junction hot-sites (from larger nanocluster aggregates) does not necessarily results in higher SERS enhancement factor. For further information contact: Li-Lin Tay, 613-993-3919.



Plot on the left shows the calculated SERS enhancement factor as a function of number of gold nanoparticles in the nanoclusters. Images on the right show the local electric field distribution are concentrated in the interparticle junction hot-sites regardless of the nanocluster morphology. The numbers in the each image depict the electric field strength normalized to the incident electric field. Note the local field strength is influenced by the number of nanoparticles as well as their geometrical arrangement that made up each nanocluster.

Extension and Application of NRC Fluorescence Measurement Capabilities to NIR

The presence of near-infrared (NIR) photoluminescence has been recently reported in some of the second series of Ceramic Color Standards (CCSII) that are widely used in the calibration and performance evaluation of color measuring instruments. The impact of this photoluminescence

effect can cause significant colorimetric errors particularly for broadband measurements using a detector with high spectral responsivity in the NIR region. The magnitude of this effect has been demonstrated for specific color standards and specific instrument systems but has not been unambiguously quantified to allow general predictions or absolute comparisons of different instrument designs or different ceramic tiles.

To quantify this effect, the spectral range of the National Research Council of Canada (NRC) Reference Spectrofluorimeter has been extended to 1000 nm. The validation for this extended spectral range was carried out by comparison of an independent method of instrument calibration using a different combination of physical standards. This extended fluorescence measurement capability was then used to measure the absolute NIR photoluminescence of three different formulations of the CCSII orange ceramic color standard. It was convincingly shown that the two different leaded formulations of this ceramic orange standard issued in 2000 and 2011 have no significant photoluminescence and thus can be used for calibration with any type of spectrophotometer design whereas the unleaded formulation issued in 2011 has significant NIR photoluminescence and should not be used for instrument calibration and validation over an extended range into the NIR for certain spectrophotometers with relatively high throughput in the NIR region, such as a spectrophotometer with polychromatic illumination mode using a xenon source or with monochromatic illumination mode using a Si detector. It was further shown that for colorimetric applications, the impact of this NIR fluorescence is only significant for the latter spectrophotometer design with broadband detection with a Si or spectrally flat detector and is negligible with a narrowband PMT detector. These calculated colorimetric results are also consistent with previously estimated colorimetric errors for this type of orange CCSII ceramic tile used to transfer calibration between these two types of detector systems. The details of this research will be published in a special issue of the Journal of Modern Optics entitled: *Photometry, Colorimetry and Radiometry: Issues and Applications*, and the eprint version of the paper is currently available on-line: (Zwinkels, Noël and Hillman, J. Mod. Opt. 2013 - http://dx.doi.org/10.1080/09500340.2013.818171). For further information contact: Joanne Zwinkels, 613-993-9363.

NRC Scientist - David Lockwood, Honoured

Dr. David Lockwood, a Principal Research Officer and member of the NRC Photometry, Radiometry and Thermometry Team, was awarded the 2013 Medal for Lifetime Achievement in Physics of the Canadian Association of Physicists (CAP) at their annual congress held in Montreal in May. David was cited “for his distinguished and sustained contributions to the elucidation of the optical properties of solids, low-dimensional semiconductor systems, and in particular light-emission from silicon, as well as his contributions to the advancement of physics in Canada and worldwide.” While many of his contributions in these fields were invaluable, his work on the optical properties of silicon made a significant global impact. In landmark papers published in Nature in 1995 and in the Physical Review Letters in 1996, Lockwood et al. convincingly demonstrated for the first time quantum confinement-induced visible light emission in a silicon nanostructure, an ultrathin Si/SiO_2 superlattice, grown at the NRC. His work has had significant impact on the applications of silicon nanostructures in photonics for use in information and communication technology. The number of applications in industry for nanoscale materials has been expanding rapidly. These applications are enabled by new methods for the preparation and measurement of materials on a nanometer scale.

The Route for Solar Radiation Measurement at CENAM

On the issue of solar radiation measurement there exist in México institutions that have historically covered this field for periods of time and even contributed to the various global databases that collect information on solar radiation at ground level for research purposes, solar resource determination and recently for energy production.

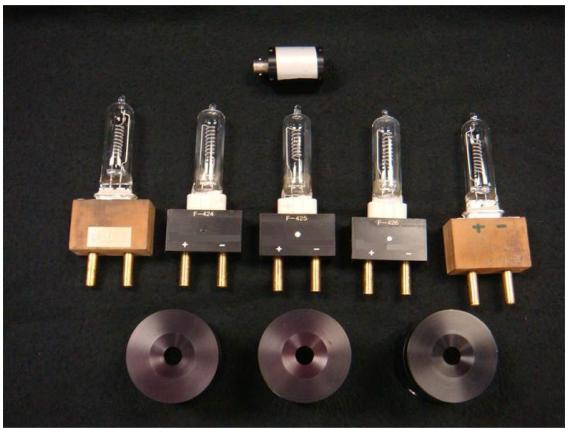
The specific aspect of the use of renewable energy for generation of electrical power from concentrated and direct solar radiation has gained growing importance in México and in the world in the last decades and national metrology laboratories have acquire an active role incorporating the traceability of measurements of various solar radiation measurement instruments and solar cells that are traditionally traceable to the World Radiometric Reference (WRR) scale maintained by the World Radiation Center (WRC) based in Davos (the World meteorological organization, dependent of the United Nations, adopted the WRR scale in 1979).
In Mexico the increase of private production of energy for self-consumption and the possibility to micro production connected to the national grid, triggered consumer panels and photovoltaic devices that require in short-term metrology support and reference measurements. According to international standard procedures and standing out above all geographical and meteorological condition of CENAM, relevant services will be developed in the short and middle time at the optical and radiometric area, comprising: the calibration of meteorology reference instruments, Calibration of UV meters for solar radiation, calibration and performance testing of reference solar panels, construction of reference solar cells, implementation of the traceability of radiometric measurements to the CENAM cryogenic radiometer and finally the construction and maintenance of a solar Simulator reference laboratory.

Improvements to Several National Standards

During the last months, various efforts have been made to update some national standards improving the realization and analyze its conditions of operation and uncertainty. A new realization for the standard of spectral responsivity and changes to the attenuation and length of optical monomode fiber, a new realization of the luminous intensity standard, is part of the developments done as far, as well as a few reference LED's for solid-state lighting have been obtained.

The new realization of the spectral responsivity standard is based on silicon trap detectors in the region of 350 nm to 1100 nm and is part of the chain of measurements for characterization of the spectral response of photometric detectors in conjunction with several flat detectors. The previous measurement chain was based on the linearity of a thermopile in the visible region of the spectrum with discrete wavelength calibrated points.

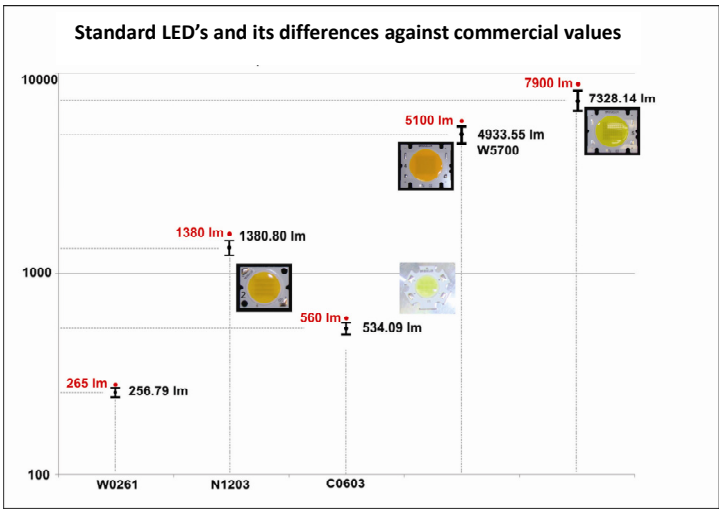
The first national standard of luminous intensity provided traceability to the country through a set of foreign calibrated lamps and detectors. This new realization provides traceability through primary standards maintained by CENAM, through a set of photometric detector calibrated with traceability through the electrical substitution radiometer (cryogenic radiometer), which is part of the national standard of radiant flux of Mexico.



Detectors and lamps for the new realization of luminous intensity standard and its dissemination.

With respect to solid-state lighting standards, a measuring system has been integrated at DOR for the characterization of solid state lighting references. The measuring system integrates several instruments and control programs to acquire and process the main physical quantities involved in the performance of the lighting references. The result of the implemented measurement system is the definition of a set of five references of lighting in the solid state for each device is considering stability in operation, luminous efficacy, spatial distribution and commercial availability.

The standard of fiber optic single mode length used for calibration of OTDR is based on a re-circulating delay line, and has been re-evaluated in uncertainty according to the history of measurements of recent years and results of comparisons with prototypes manufactured by CENAM for different secondary laboratories in the country. The standard of single-mode optical fiber attenuation is also in a revision process that will end this year.



LEDs characterized as reference standard LEDs against commercial values.

References

Overview of recent years on measurement of solar radiation in Mexico, optics, and radiometry, Hector A. Castillo, Carlos Matamoros G.

Long term view on the use of renewable energy in Mexico, energy Solar Energy Secretary, May 2005.

Report on 2012 activities CIE-UNAM México.

UPCOMING IES MEETINGS CALENDAR

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

2014 IES Research Symposium II: Light+Behavior
April 6-7-8, 2014
The Renaissance Hotel
Cleveland, OH

2014 LIGHTFAIR International
June 3-5, 2014
Las Vegas Convention Center
Las Vegas, NV

2014 IES lightFOCUS Regional Conference
July 20-22, 2014
Hyatt Tamaya Resort
New Mexico, USA

2014 IES Street and Area Lighting Conference
September 14-17, 2014
Gaylord Opryland Hotel
Nashville, TN

2014 IES Annual Conference
November 2-4, 2014
Wyndham Grand Pittsburgh Downtown Hotel
Pittsburgh, PA

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

NEWS FROM THE CIE

CIE 2014 Lighting Quality and Energy Efficiency

CIE is proud to present CIE 2014: "Lighting Quality & Energy Efficiency" as a unique forum for discovering the latest developments and results from the lighting world. The meeting will be held in Kuala Lumpur, Malaysia from April 23-26, 2014. You are invited to join colleagues there in the effort to enhance lighting quality and reduce energy consumption worldwide.

The CIE 2014 meeting will highlight topics in:

- Daylight, Lighting Systems and Energy Saving
- Light and the Visual Perception of Quality
- Photobiological Effects
- Characterizing Lighting Systems

For more information about this conference, visit http://malaysia2014.cie.co.at.

Light Emitting Diodes (LEDs) and LED Assemblies – Terms and Definitions

This Draft International Standard (CIE Draft International Standard DIS 024/E:2013) summarizes the most important terms and definitions in the field of lighting by inorganic semiconductors used in CIE documents, which are intended to become part of the International Lighting Vocabulary.

The Draft International Standard has been sent to CIE National Committees for comments and sales to interested parties. It is still subject to changes and may not yet be referred to as a CIE International Standard. When approved by the CIE NCs, it will be published as a CIE International Standard and later on get part of the International Lighting Vocabulary. The Draft International Standard is readily available at the National Committees of the CIE or via the CIE Webshop. Visit www.cie.co.at for more information.

Lighting Research Center

NEWS FROM RENSSELAER'S LIGHTING RESEARCH CENTER (LRC)

LED Lighting Institute Announced

The LRC has announced that its LED Lighting Institute session dates are May 13-15, 2014. The LRC has expanded the LED Lighting Institute to add new content on OLEDs (organic light emitting diodes), not included in past sessions. In addition, the course has been updates to add more time for participation in hands-on sessions using LEDs and OLEDs. LRC experts will help participants learn more about these quickly evolving solid-state lighting technologies in a small-class setting. Enrollment is limited to 30 students.

Participants will learn how to incorporate LED and OLED technologies into the design of architectural lighting fixtures, how to develop lighting systems that will best take advantage of the unique characteristics of LEDs and OLEDs, and how to design lighting applications using LEDs and OLEDs. Attendees will also be able to compare LED and OLED technologies and related system components from a variety of manufacturers and learn about operating characteristics, rated-life, lumen output, distribution, and other important specification factors.

For more information about the LRC's outreach education programs, visit http://www.lrc.rpi.edu/education/outreachEducation.

Lighting Research Center Launches Light and Health Alliance

The LRC has launched a new collaborative initiative—the Light and Health Alliance—to bridge the science of light and health to practical applications, and to provide objective information based on basic and applied research. The Alliance is led by Dr. Mariana Figueiro, LRC Light and Health Program director and associate professor at Rensselaer.

Light has a profound effect on health and wellbeing, including sleep, alertness, and performance. Humans need to be exposed to a sufficient amount of light of the right spectrum, for a sufficient amount of time, and at the right time, for the circadian system to remain synchronized with the 24-hour day. The LRC is researching light as a treatment for a variety of conditions, including jet lag, Alzheimer's disease, insomnia and other sleep disorders, seasonal affective disorder and depression. Light can be used to improve sleep, alertness, and performance, along with overall health and wellbeing among the general population, and in populations with rigorous work schedules, such as submariners and night shift nurses.

"Through this collaborative initiative, we will conduct evaluations, demonstrations, and research projects to develop practical devices and applications using light to improve people's lives," said Dr. Figueiro. "We will also hold seminars and present at conferences to educate key audiences and advance attention to light and health."

The Light and Health Alliance is a collaboration among manufacturers, government organizations and NGOs, codes and standards bodies, along with architects, specifiers, medical facility managers and physicians, working to enable the broad adoption of lighting for human health by producing factual information based on basic and applied research and by visualizing future applications. Acuity Brands, Ketra, OSRAM SYLVANIA, and Philips are current members. Dr. Figueiro is seeking interested organizations to join this innovative program. Please email figuem@rpi.edu for more details about the Alliance.

NLPIP Report on Plasma Lighting Systems Published

The National Lighting Product Information Program (NLPIP) at the LRC recently released its latest publication, *Lighting Answers: Plasma Lighting Systems*. Plasma lighting systems, also known as electrodeless high-intensity discharge, light-emitting plasma, high-efficiency plasma, or advanced plasma lighting are emerging in the marketplace primarily for high-bay and outdoor lighting applications. Many specifiers and others involved with lighting technologies have heard of plasma lighting systems, but would like more information on how plasma compares with other light sources, regarding performance characteristics such as light output, system efficacy, color characteristics, lumen maintenance, and rated life. *Lighting Answers: Plasma Lighting Systems* provides straightforward information on these performance characteristics and others such as operating orientation, dimming, warm-up and restrike times, electromagnetic compatibility, and ultraviolet radiation.

The report details findings from NLPIP's study of plasma lighting systems, conducted from 2012 to 2013, and responses from a survey of more than 300 lighting specifiers who provided their opinions on the application of plasma lighting systems and information on any installations they had evaluated.

Lighting Answers: Plasma Lighting Systems is available free to the public, at: http://www.lrc.rpi.edu/nlpip/publicationDetails.asp?id=936&type=2.

NEWS FROM FOGRA
(FOGRA GRAPHIC TECHNOLOGY RESEARCH ASSOCIATION)

Colour Management Symposium

Fogra's Colour Management Symposium has become one of the leading international events in the area after three successful and well attended symposia in the past years. We welcome you to register for our fourth Colour Management Symposium in Munich, to be held February 6-7 at the Holiday Inn, Munich City Centre.

Nowadays print service providers need to cope with an increasing complexity due to a large amount of channels for visual communication that is constantly growing. Furthermore we face an increasing number of additional parameters that are hard to control. This begins with the supplied artwork and extends to the different viewing conditions where both mobile devices and printed products are consumed.

The symposium is aimed at decision-makers, managers and service providers looking for ways to communication the visual information in a reliable and colour accurate way and focuses on signage printing. We will present and discuss solutions for current and future challenges of colour management for small- and large-format digital printing as well as for conventional printing in seven sessions.

The accompanying exhibition is ideal to gain important information and for networking. Based on the symposium scheme "Science meets colour", the participants can improve their skills in one of four parallel workshops (90 minutes). On the evening of the first day a colourful stage show will provide great entertainment and a pleasant atmosphere for networking. Marti Maria Saguer (HP) will be our keynote speaker.

For more information please visit:
http://www.fogra.org/en/fogra-events/colour-management-en/a-cms-en.html.

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.

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Membership applications and dues payment checks should be sent to:

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