Consultative Committee for Photometry and Radiometry (CCPR)
23rd Meeting (22 - 23 September 2016)

Questionnaire on activities in radiometry and photometry

Reply from: VSL

Delegate: Steven van den Berg

1. Summarize the progress in your laboratory in realizing top-level standards of:

   (a) broad-band radiometric quantities
   (b) spectral radiometric quantities

   - VSL is extending its range for spectral responsivity measurements up to 2500 nm. An enhanced InGaAs based detector has been designed and built. Calibration of these detectors against the absolute cryogenic radiometer is scheduled later this year.

   (c) photometric quantities

2. What other work has taken place in your laboratory in scientific or technological areas relevant to the CCPR?

   - VSL has developed a facility for calibration of optical flicker meters. Optical flicker is generated artificially by modulating a laser with an acousto-optic modulator. The depth of the modulation relative to the DC signal is measured with a photodetector. From these data the 'flicker index' of the source is determined. Optical flicker meters are calibrated by comparison to the reference source.

   - Within the EMRP project Metrology for Safe and Efficient Lighting a climate chamber 0.8x1.0x0.85 m with temperature stability of <0.3°C and temperature uniformity <2°C has been installed at VSL for lifetime studies of SSL. The characterisation of the chamber is finished and the development of measuring setup is now ongoing. The idea is to establish a new service of traceable accelerated lifetime calibration of various SSL modules (eventually SSL lamps).

     Furthermore, the development of an electrical impedance stabilization network for reliable SSL electrical quantity measurements is ongoing but in the final stage. A prototype has being built at the moment. Validation will be done by the end of the project.

     A quick short-pulsed multispectral testing method of LED-modules for industry has been developed and first results have been obtained. Analysis and validation is ongoing. A similar method is used for determination of performance of SSL modules during the final production test.

- Within the EMRP project Photoclass, VSL is developing a facility for angle-resolved and temperature dependence spectral response calibration of solar cells (and small format mini-modules) from 420 – 2400 nm, employing a 6-DOF high precision robot arm and high power supercontinuum laser source.

- VSL has acquired a photogoniometer for near field photometric measurements. The goniometer is equipped with a CCD luminance camera and an illuminance meter and allows for luminous flux and luminous intensity distribution measurement. Calibration and validation of the instrument is ongoing.

- Within the EMRP project METEOC2 VSL has developed a filter radiometer for measuring radiance a low signal levels at 1550 nm. The filter radiometer forms the transfer standard between a primary black body source and a plate radiator. The latter will be used for calibration of so called grazing incidence p-branch spectrometers (GRIPS), which are used for measuring the temperature of the mesopause via a spectroscopic method. After an initial test at PTB Berlin in 2015, several modifications to the design have been made to reduce size-of-source effects. Recently, a second measurement round at PTB has shown that the size-of-source effects have been reduced sufficiently to reach the targeted measurement uncertainty on the scale transfer. A first calibration of the plate radiator has been performed. Further investigation on the stability of the filter radiometer and of the plate radiator is currently running.

- VSL participates in the EMRP project 'ATMOZ', on traceable measurement of atmospheric total column ozone, by developing a portable instrument for wavelength calibration of spectroradiometers under field conditions. A 'wavelength ruler', showing a wavelength-dependent transmission, serves as the reference for wavelength. The instrument is based on a Lyot filter and has been developed and optimized for spectrometers that are typically used for field measurements on atmospheric ozone. A final field campaign is held in September 2016. VSL contributes to model-development and uncertainty calculation for deriving the total column of ozone for different types of spectroradiometers that are typically used for field measurements. The work on the uncertainty budget also comprises the effects of crosscorrelation among influence parameters entering the measurement equation of total column ozone.

- VSL has integrated a spectroradiometer in the 3 m integrating sphere facility, which has been developed several years ago for spectral correction of luminous flux measurement. This allows for spectral radiant flux measurements of lamps and luminaires and determination of derived quantities (color coordinates and CCT).

3. What work in PR has been/will be terminated in your laboratory, if any, in the past /future few years? Please provide the name of the institution if it has been/will be substituted by a DI or accredited laboratory.

   - Radiation thermometry has been terminated at VSL since 2015.

4. What are present, new or emerging needs of users of your services that are not being supported sufficiently by current CCPR activities or initiatives? In the light of this information please suggest desirable changes in the future working program of the CCPR.

   - The requirements on spectral responsivity measurements are expanding into the infrared wavelength range (> 2.5 μm), e.g. for Earth observation applications, but also for characterizing of optical properties of materials. Emissivity, reflectivity and transmittivity of materials over a very wide spectral range (up to 40 μm) are relevant to e.g. energy harvesting and insulation of buildings.

5. What priorities do you suggest for new research and development programmes at NMIs in the area of Photometry and Radiometry?

   - In line with roadmaps of CCPR WG Strategic Planning and EURAMET Strategic Research Agenda

6. Are there any research projects where you might be looking for collaborators from other NMIs or are there studies that might be suitable for collaboration or coordination between NMIs?

   - Comparison of spectral responsivity measurements 1600-2500 nm

7. Have you got any other information to place before the CCPR in advance of its next meeting?

   none

8. Bibliography of radiometry and photometry papers of your laboratory since the last CCPR (September 2014)?

- O. El Gawhary, S. A. van den Berg, N. van der Leden, P. Dekker, "A Laser-Driven Light Source (LDLS) as a portable spectral irradiance calibration source in the UV range," UVNews 10, 22-24 (2014).
- P. Blattner, S.M. Foaleng, S. van den Berg, O. El Gawhary, M. Blumthaler, J. Gröbner, L. Egli, "Devices for characterizing the wavelength scale of UV spectrometers," UVNews 10, 28-29 (2014).
- P. Blattner, S.M. Foaleng, S.A. van den Berg, O. El Gawhary, M. Blumthaler, J. Gröbner, L. Egli, “Devices for characterizing the wavelength scale of UV spectrometers,” Proceedings of NEWRAD 2014, Espoo, Finland, June 24 – 27, 2014, pp. 201 – 202.

- Yoshi Ohno, Koichi Nara, Elena Revtova, Wei Zhang, Tatsuya Zama, Cameron Miller "Solid State Lighting Annex: 2013 Interlaboratory Comparison Final Report", online, IEA webpage http://ssl.iea-4e.org/files/otherfiles/0000/0067/IC2013_Final_Report_final_10.09.2014a.pdf.
- Dongsheng Zhao, Gert Rietveld, J.-P. Braun, F. Overney, T. Lippert and A. Christensen, "Traceable measurement of the electrical parameters of solid-state lighting products", Proceedings of the 2014 Conference on Precision Electromagnetic Measurements, Rio de Janeiro, Brazil, 650 – 651 (2014).
- O. El Gawhary, N. van der Leden, S.A. van den Berg, and D. Voigt, "A birefringence-based wavelength ruler for on-site wavelength scale calibration of spectroradiometers in the UV", UVNews 11, 42-45 (2016)