Consultative Committee for Photometry and Radiometry (CCPR)

24th Meeting (19 - 20 September 2019)

Questionnaire on activities in radiometry and photometry

## Reply from: METAS

## Delegate: Dr. Peter Blattner

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

* METAS has built up a calibration facility for Si-SPAD detectors at photon rates between 10 kHz to 200 kHz. The automatic system is based on several sets of fully characterized neutral density filters. With the system uniformity mapping of the detectors surface is possible in the wavelength range from 700 nm to 1000 nm. The new facility is used in the CCPR pilot study (WG-SP TG 11 Single-photon radiometry).
* METAS has built four new set-ups in the field of appearance: A fully automatic BRDF setup covering the spectral range from 390 nm to 800 nm. For the detection, a camera used allowing the definition of irregular shaped regions of interest of the sample in the range 50 m to 30 mm. The second systems allows the determination of spectral radiance factors at specific angles (10 detection angles and 3 illumination angles). The wavelength range and sample sizes are similar to the full BRDF system. Furthermore a spatial resolved diffuse reflectance system (geometries: de/8° and di/8°) has been built with similar wavelength and sample size specifications than the BRDF system. Finally a primary gloss measurement system has been built according the requirements of different national and international measurement standards (ANSI, CIE,DIN).
* The optics laboratories have contributed to different EMPIR projects (SolarUV, photoLED, SURFACE, PhotInd, MIQC2, BiRD, BxDiff)
* A fully traceable system for the calibration of the Encircled Angular Flux (EAF) in step index multimode fibers was successfully developed, jointly with the industry partner Arden Photonics in the frame of the EMPIR 14 IND3 PhotInd project. A first Inter-comparison was already performed and further contributions to the normalization effort in this field will be carried out, depending on the industrial needs.
* A series of new artefacts for the calibration of the distance and of the attenuation scales, as well as for the reflectance scale of high-resolution reflectometers have been successfully developed and some of them are already now available for customer services.
* An optical frequency standard based on a stabilized compact femtosecond MIXSEL laser was successfully built and its application to the calibration of FTIR and of grating spectrometers was demonstrated.
* Different measurement techniques for the characterization of the optical properties of critical components and systems used in quantum communication systems have been developed in the frame of the EMPIR 14IN05 MIQC2 project and are now available for calibration services.

1. 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.

none

1. 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.

We observe an increased demand in calibration of spectroradiometers. In addition, there are requests for LED-based standards in photometry.

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

The topics are outlined in different roadmaps and research strategy (including EURAMET's Strategic Research Agenda for Metrology in Europe). Due to changes in the political agendas but also because of the real needs, the topic of Climate and Environment has become a priority for many research program. Several essential climate variables are related to photometry & radiometry but there are also new topics like light pollution.

1. 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?

We are seeking for in informal intercomparisons the field of appearance, including BRDF, diffuse reflectance, multi-angle reflectance and gloss.

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

none

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

### Manuel Spitschan, Oliver Stefani, Peter Blattner, Claude Gronfier, Steven W. Lockley, Robert J. Lucas: How to Report Light Exposure in Human Chronobiology and Sleep Research Experiments. 06/2019; 1(3):280-289., DOI:10.3390/clockssleep1030024

### Alexander Kokka, Tuomas Poikonen, Peter Blattner, Sophie Jost, Alejandro Ferrero, Tomi Pulli, Mathias Ngo, Anders Thorseth, Thorsten Gerloff, Paul Dekker, Florian Stuker, Adam Klej, Klaus Ludwig, Markus Schneider, Thomas Reiners, Erkki Ikonen: Development of white LED illuminants for colorimetry and recommendation of white LED reference spectrum for photometry. Metrologia 08/2018; 55(4):526-534., DOI:10.1088/1681-7575/aacae7

### Armin Sperling, Maic Meyer, Stefan Pendsa, Werner Jordan, Elena Revtova, Tuomas Poikonen, Dominique Renoux, Peter Blattner: Multiple transfer standard for calibration and characterization of test setups for LED lamps and luminaires in industry. Metrologia 12/2017; 55(2)., DOI:10.1088/1681-7575/aaa173

### Luca Mari, Peter Blattner, Franco Pavese: Improving the understandability of the next edition of the International System of Units (SI) by focusing on its conceptual structure. Measurement 01/2017; 101., DOI:10.1016/j.measurement.2017.01.039

### Alexander Kokka, Tomi Pulli, Tuomas Poikonen, Tobias Schneider, Alejandro Ferrero, Florian Stuker, Peter Blattner, Alicia Pons, Erkki Ikonen: DEFINITION OF A SPECTRAL MISMATCH INDEX FOR SPECTRAL POWER DISTRIBUTIONS. Proceedings of the 29th Quadrennial Session of the CIE; 06/2019, DOI:10.25039/x46.2019.OP15

### Nina Basic, Peter Blattner, Marcel Pastuschek: SPATIALLY RESOLVED MEASUREMENTS OF DIFFUSE REFLECTANCE. Proceedings of the 29th Quadrennial Session of the CIE; 06/2019, DOI:10.25039/x46.2019.PO063

### Tobias Schneider, Paul Dekker, Richard Young, Peter Blattner, Tuomas Poikonen: EXTRAPOLATION OF PHOSPHOR CONVERTED WHITE LED SPECTRA BEYOND THE VISIBLE WAVELENGTH RANGE. Proceedings of the 29th Quadrennial Session of the CIE; 06/2019, DOI:10.25039/x46.2019.PO105

### Florian Stuker, Peter Blattner, Fabio Rinderer: NOVEL METHOD FOR ANGULAR CHARACTERISATION OF GONIOPHOTOMETERS WITH A PATTERN GENERATING ARTEFACT. CIE 2017 Midterm Meetings and Conference on Smarter Lighting for Better Life; 01/2018, DOI:10.25039/x44.2017.PP34

### Sophie Jost, Peter Blattner, Anders Thorseth, Tomi Pulli, Tuomas Poikonen, Alejandro Ferrero, Mathias Ngo: DETERMINATION OF ILLUMINANTS REPRESENTING TYPICAL WHITE LIGHT EMITTING DIODES SOURCES. CIE 2017 Midterm Meetings and Conference on Smarter Lighting for Better Life; 01/2018, DOI:10.25039/x44.2017.WP01

### [Modelling of standard and specialty fibre-based systems using finite element methods](http://intranet.metas.admin.ch/de/dokumentation/publikationen/?tx_bib_pi1%5Bsearch%5D%5Btext%5D=test&tx_bib_pi1%5Bsearch%5D%5Brule%5D=AND&tx_bib_pi1%5Bsearch%5D%5Bextra_b%5D=1&tx_bib_pi1%5Bsearch%5D%5Bextra%5D=1&tx_bib_pi1%5Bsearch%5D%5Babstracts%5D=1&tx_bib_pi1%5Bsearch%5D%5Bfull_text%5D=1&tx_bib_pi1%5Bsearch%5D%5Bsep%5D=space&tx_bib_pi1%5Bshow_uid%5D=82&cHash=9de95e6d72c0a5f9195c7f6392c12a38#c82), Castagna, N., Morel, J., Testa, L., Burger, S. Proc. SPIE, 10683, 2018 , DOI: [10.1117/12.2307372](http://dx.doi.org/10.1117/12.2307372)

### [Traceable instruments for Encircled Angular Flux measurements](http://intranet.metas.admin.ch/de/dokumentation/publikationen/?tx_bib_pi1%5Bsearch%5D%5Btext%5D=morel&tx_bib_pi1%5Bsearch%5D%5Brule%5D=AND&tx_bib_pi1%5Bsearch%5D%5Bextra_b%5D=1&tx_bib_pi1%5Bsearch%5D%5Bextra%5D=1&tx_bib_pi1%5Bsearch%5D%5Babstracts%5D=1&tx_bib_pi1%5Bsearch%5D%5Bfull_text%5D=1&tx_bib_pi1%5Bsearch%5D%5Bsep%5D=space&tx_bib_pi1%5Bshow_uid%5D=81&cHash=d2801473883c2251b5cc3dac047c5104#c81), Castagna, N., Morel, J., Robinson, E., Yang, H., Proc. SPIE, 10683 , 2018 , DOI: [10.1117/12.2306430](http://dx.doi.org/10.1117/12.2306430)