

EUROMET TC Photometry and Radiometry

Chairperson's Annual Report 2006-2007

1. Meetings

The Technical Committee for Photometry and Radiometry (TC-PR) met in Bucharest, Romania, on April 19-20, 2007. There were 21 attendees from 21 countries, and 3 guests. Immediately after the meeting, the Contact Persons visited the laboratories of INM. A short report on this visit is here attached.

The next PHORA meeting will be held at NPL, Teddington, United Kingdom. The tentative date, to be confirmed, is the 17th and 18th April 2008, with a possible workshop on the 16th April 2008.

2. Web-site PHORANET

The TC-PR Web site PHORANET (<http://www.metas.ch/euromet/phora/>) has been updated to contain copies of all available project forms and presentations from several TC-PR Annual Meetings.

3. PHORA Projects

	Comparison	Co-operation	Traceability	Consultation	Total
Agreed	10	3	11	2	26
Completed	7	6	-	1	24
Proposed	3	1	1	-	5
Total	20	10	12	3	45

In the transition from EUROMET to EURAMET e.V., the database of PHORA Projects will be reviewed and, possibly, the number of Projects reduced.

4. CCPR comparisons

The CCPR Working Group on Key Comparisons (WG-KC) met on October 23, 2006 at the CENAM, Mexico. For details see

<http://www.metas.ch/euromet/phora/restricted/tcm-apr-2007/Activities%202006-2007%20BIPM.pdf>

Next meeting will be held at the BIPM, in conjunction with the CCPR meeting in June 2007.

CCPR Key Comparisons

K1.b, spectral irradiance, 200-350 nm, pilot PTB: The uncertainty budgets were distributed for review in April 2007.

K2.a, spectral responsivity, 900-1600 nm, pilot NIST: Draft A-2 was distributed in October 2005 and some "major" comments were received. Draft A-3 is now under preparation and shall be available for the CCPR meeting in June 2007.

K2.c, spectral responsivity, 200-400 nm, pilot PTB: The measurements are finished except for one participant, who experienced twice problems with damaged detectors. Currently another attempt is made for this laboratory.

K5, spectral diffuse reflectance, pilot NIST: The pilot has recently changed from Jerry Franser to Yoshi Ohno. The measurements are finished and the pilot has received all results. The main issue for the data analysis is the fluorescence observed in the ceramic tiles. Two samples were measured for fluorescence at the NRC in February 2007 and the effects were found to be negligible for the K5 results. The uncertainty budgets were sent for review in October 2006, the "relative data" and NRC's fluorescence results will be send soon.

K6, spectral regular transmittance, pilot LNE: All measurements are performed. The distribution of Draft A in July 2006 was followed by discussions on the statistical treatment of the data. Some of the filters were less stable as expected. A revised Draft A2 was distributed in March 2007. Comments have been received April 2007. Draft B report is in progress and expected July 2007.

Pilot comparison on spectral responsivity, 10-20 nm, pilot PTB: The photodiodes have been ordered, tested and calibrated at the PTB. The measurements are ongoing.

CCPR supplementary comparisons

S1, spectral radiance, pilot VNIIOFI: The new pilot is Boris Khlevnoy. The data analysis has been carried out and the “relative data” have been sent to the participants for review.

S2, aperture area, NIST: This comparison is finished and has been published in the KCDB in January 2007. The final report is available as Technical Supplement to Metrologia.

S3, cryogenic radiometers: There are four bilaterals between NPL and SPRING, UME, NMIJ and CMI. The results are expected for June 2007.

5. EUROMET PR comparisons

EUROMET PR Key Comparisons

EUROMET.PR-K2.b, Spectral responsivity (IFA): In spite of the interest of the pilot laboratory and most of the participating laboratories, progress made during the last year has been short. Up to date all the laboratories have completed their measurements except for one (NMI from Ntherland), as it was reported last year. The pilot has asked this laboratory for completion several times during the last months. Eventually, detectors from NMI arrived to IFA on April, 23, 2007. The pilot laboratory has already done the final calibration of detectors received and will start to send first results in the next months. The pilot laboratory is ready to produce draft A before the end of this year if the last detector set is received within a month or if it is allowed to finish the comparison without the results of the last laboratory.

EUROMET.PR-K3.a, Luminous intensity and EUROMET.PR-K4, Luminous flux (PTB): The two key comparisons for luminous intensity and luminous flux where planned to be processed in a single campaign to reduce the effort for organization and transportation. Due to delays in getting the facilities at the PTB ready for measurements after the move in the new optics building, two separate campaigns where already planned and the procedure was started at the begin of this year.

The two link laboratories agreed to operate within the general schedule. All the NMIs, which stated their interest in this comparison in the past were contacted and will send back the first completed form sheet dealing with general information. The technical protocols for both comparisons will be send out after having got all answers of the participants.

The schedule for Luminous Intensity is:

1. Transport of lamp transfer standards to the PTB and measurements begin IV/2007
2. Results and preliminary draft A in II/2008

The schedule for Luminous flux is:

1. Transport of lamp transfer standards to the PTB and measurements begin II/2008
2. Results and preliminary draft A in IV/2008

The final draft report and any further publication is planned within half year after having got an agreed draft A report.

EUROMET.PR-K4.1, Luminous flux and luminous intensity: Bilateral LNE – INM: The aim of this comparison is to link the new realisation of the luminous intensity and the luminous flux units by the INM (Romania) to the reference value of the CCPR-K3 and CCPR-K4 comparisons. The measurements are performed. The report is in progress and is expected in July 2007

EUROMET.PR-K5, Spectral diffuse reflectance (OMH): At the CCPR-K5 comparison the measurements are finished, but the first draft output is not ready yet. last year we have agreed that we start the comparison before the CCPR K5 finalised. The pilot has proposed an agenda as well on the last meeting. Since then, the technical protocol and the agenda was accepted, the comparison samples (spectralon and CERAM ore BCR 406) were accepted and bought by the participants (the number of participants is reduced to seven countries). The samples with a month delay were sent to the organiser. Here they were measured by the organiser in 2007 January and February and sent back to the participants in March. The agenda for the future work is:

1. Measurements in the participant's Lab by the end of May 2007
2. Participants send samples and measurement results to the pilot Lab by the end of June 2007
3. Control measurements in the pilot Lab by the end of October 2007
4. Pilot Lab. sends back samples to participants where they remains: by the end of November 2007
5. First draft is planend by February 2008, depending on CCPR K5 comparison drafts.

EUROMET.PR-K6, Spectral regular transmittance (LNE): This EUROMET key comparison is closely connected with the CCPR key comparison in the same field. All the participants have performed the measurements. Draft A report will be written shortly after the CCPR-K6 Key Comparison reference value is accepted (Draft B report of CCPR-K6 available in July 2007).

EUROMET.PR-K2.a.1, Spectral responsivity. Bilateral between NMi VSL and SP: planned

EUROMET.PR-K2.a.2, Spectral responsivity. Bilateral between JV and NMi VSL: planned

EUROMET PR Supplementary Comparisons

EUROMET.PR-S1, Chromatic dispersion. Bilateral between HUT and METAS: completed

EUROMET.PR-S2, Radiant power of high power lasers (PTB): The project was agreed on in January 2005. Also in January 2005, the measurements for the two transfer detectors on the agreed laser lines and power levels started at PTB. In 2005, measurements were performed in D, S, USA, F, D, ZA, and AUS. In 2006, measurements were performed in D, J, UK, ROM, DK, in 2007 measurements were performed in D. The outstanding measurements in AUS, UA and finally D are planned in 2007. In 2006, NL withdrew from the comparison. For the second part, dealing with power levels of 100 W (Nd:YAG, CO₂) and 1000 W (CO₂), a new EUROMET project will be started. It is planned to send out the questionnaire for this intercomparison in the beginning of 2008, after finishing the measurements for the first part of the intercomparison.

6. CMCs

The CCPR Working Group on Calibration and Measurement Capabilities (WG-CMC) met on October 24, 2006 at the CENAM, Mexico. For details see

<http://www.metas.ch/euromet/phora/restricted/tcm-apr-2007/Activities%202006-2007%20BIPM.pdf>

Next WG-CMC meeting will take place in conjunction with the WG-KC meeting, scheduled on June 2007 at the BIPM. At the next working group meeting in 2007, EUROMET will take on the Chairmanship of WG-CMC.

EUROMET PR CMCs

EUROMET.PR.3: The third round of PHORA CMCs, containing data from Finland, Spain, Switzerland and Slovakia, mainly on fibre optics, has been published.

EUROMET.PR.4: All claims have been approved under inter-regional review. CMCs are from Finland, Germany, Switzerland, Turkey, and United Kingdom.

EUROMET.PR.5: Intra-regional review has been completed.

EUROMET Review of other RMOs PR CMCs

APMP.PR.4: The fourth round of APMP CMCs has been approved under inter-regional review.

SIM: No submissions to inter-regional review. But NIST submissions received have yet to be reviewed within the RMO.

SADCMET: No new submissions by SADCMET, no specific issues. South Africa withdrew all CMCs temporarily for a period because they had not received their certificate of accreditation.

Maintenance of EUROMET PR CMCs: Review of approved CMCs in the light of new comparison results.

This subject will be on the agenda of the CCPR WG-KC and WG-CMC meetings in June.

7. EMRP: Tentative Joint Research Projects

Preliminary discussion has started on possible PHORA contribution to the 4 Targeted Projects (TP) chosen by the EMRP Committee: a) SI units and fundamental constants, b) Health, c) Electromagnetism Metrology, and d) Dimensional Metrology. CPs agreed that the first two TPs are of interest to PHORA Community. In details

Proposed JRPs Related to the TP "Health"

- ✓ Traceability of optical radiation measurements for photobiological and photochemical effects
 - Radiation Protection, UV-Erythema, Blue-Light Hazards
 - Phototherapy and Ergonomics (Bilirubin, Circadian Effects)
 - UV-disinfection for water
 - Spectrophotometry (i.e for OIML R 135)
 - Colorimetry
 - Fluorometry
- ✓ Virtual human, Medical diagnostics, Imaging diagnostics and telemedicine techniques
 - Imaging spectrometry, imaging filter-radiometry
 - Appearance metrology for diagnostics (texture, colour,...)
 - THz-imaging
 - Spectrophotometry (i.e for OIML R 135)
 - Colorimetry
 - Fluorometry

JRPs Related to the TP "Great challenges on fundamental metrology"

- ✓ Quantum Candela
 - Single photon sources
 - Predictable Absolute Quantum detectors

8. EUROMET Major Investments

PTB offers the opportunity for all researchers of the PHORA-community to make use of the EUROMET Major Investments of PTB within the framework of AMPHORA (PTB's Advanced Metrology for Photometry & Applied Radiometry). The costs for guest scientists are on their own. However, little funding is possible up to a salary for two months (registration till October in the year before is necessary) (please add your invitation to the facilities of PTB).

9. Road-maps: revision and/or up-date

EUROMET PHORA road-maps served as a starting point for discussion during the supplementary meeting to brainstorm on the preparation of input of CCPR- WG-SP to Kaarls 2007 Report. CPs agreed that the revision and/or update of road-maps is not of the highest priority.

Maria Luisa Rastello

Torino, 18 May 2007

Technical Committee Chairperson for
Photometry and Radiometry

NATIONAL INSTITUTE OF METROLOGY
OPTICAL QUANTITIES LABORATORY
 Report on the PHORA 2007 visit, April 20, 2007

General

The Optical Quantities laboratory of INM-Romania (www.inm.ro) counts 6 employees, four of them being graduates of the Bucharest University and the Polytechnica University, Bucharest. The 2006 turnover was of about 190 kEur (including about 20 kEur investments in equipment).

The INM laboratory maintains and operates 5 out of the INM 23 operated national standards (luminous intensity, luminous flux, spectral responsivity, spectral transmittance factor and spectral reflectance factor). Except for the spectral responsivity national standard (consisting in a group of trap detectors traceable to LNE-INM) all other are primary realizations, based on unit definition methods.

Mainly, its activity concerns applied research (about 20 %), maintenance of the national standards including participation in CIPM-MRA relevant comparisons (20 %) and calibration services (60 %).

Currently, the laboratory is involved in several EUROMET projects concerning the key comparisons EUROMET PR K2.b, EUROMET PR K3.a, EUROMET PR K4, EUROMET PR K5 and EUROMET PR K 6. Also the INM laboratory is part in the EUROMET 741, 823 and 876 projects.

The laboratory Quality System implementation started during 2002 and was fully implemented during 2003. During the 2004 and 2005 meetings it was presented in the EUROMET QS Forum. Currently it covers the calibration activities performed with the national standards.

The first CMC-s were declared during 2001 and published in the KCDB during 2002. The last revision was submitted to the EUROMET PR TC during 2006. Currently, all declared CMC-s are covered by the implemented QS.

The visit covered all the main calibration fields dealt with by the laboratory.

PHOTOMETRY

Main facilities

Optical bench (Schmidt&Haensch, 5 m expandable to 25 m) and goniophotometer (1,5 m arm) both located in the SC 01 room (bulding basement); Temperature controlled to 23 ± 1 °C; Humidity controlled to 50 ± 10 %

Integrating sphere (Schmidt&Haensch, 3 m diameter) for lumen transfer to working standards, located in the 1 B 20 room. Temperature controlled to 23 ± 1 °C; Humidity controlled to 50 ± 10 %.

Reference standards, methods and traceability

Radiometer based candela realization, on three $V(\lambda)$ corrected photometers traceable to a group of reference radiometers calibrated by LNE-INM, France (last calibration: end of 2005).

Radiometer based lumen derived on the INM goniophotometer.

Quantity	artefact	method	range	expanded uncertainty (k=2, p=95%):
Luminous Intensity	tungsten lamps	direct comparison with reference photometers	10-1000 cd	1,2 %
Luminous intensity	tungsten lamps	substitution	100-500 cd	1,5 %.
Illuminance	luxmeters	comparison with reference photometer	A/lx	1,2 %

Illuminance	lamps	comparison with reference photometer	10-2000 lx	1,5 %
Illuminance	luxmeters	comparison with luminous intensity lamp	A/lx	2%
Luminous flux	Tungsten lamps	absolute with goniophotometer	100-2000 lm	1,5 %
Luminous flux	Tungsten lamps	substitution integrating sphere	50-5000 lm	2 %

Comparisons supporting the CMC-s: EUROMET 823
EUROMET PR K 3.a
EUROMET PR K4

Spectro-radiometry

Main facilities

Spectral comparator, monochromator based, located in an isolated enclosure in the 1 B 17 room of INM. Temperature controlled to 23 ± 0.5 °C; Humidity controlled to $50 \pm 10\%$

Reference standards, methods and traceability

Group of trap detectors traceable to LNE-INM.

Quantity	artefact	method	range	expanded uncertainty (k=2, p=95%):
Spectral responsivity	general detector	substitution	350-400 nm	6-2,5 %
			400-900 nm	2,5-0,8 %
Distribution temperature	tungsten lamp	multi filtered radiometer	2500-3500 K	30 K
Spectral irradiance	tungsten lamp	multi-filtered radiometer	0,001-0,03 W/m ² /nm 400-900 nm.	5 %

Comparisons supporting the CMC-s: EUROMET PR K2b
EUROMET 876

Spectro-photometry

Main facilities

Units transfer with dedicated spectrophotometers (Varian Cary 4000 type) for spectral transmittance and spectral reflectance calibrations.

All located in the INM rooms 1B19 and 1B20, temperature and humidity controlled to 23 ± 0.5 °C and 50 ± 10 % respectively.

Reference standards , methods and traceability

Primary standards for spectral transmittance and reflectance (SFTA 1 and SFRA 1 dedicated absolute spectrophotometers, based on the definition methods).

Quantity	artefact	method	range	expanded uncertainty (k=2, p=95%):
Spectral transmittance	filter	substitution	0,001-1,000	(0,2-0,3)(1-logT) %
			200-900 nm	
Spectral reflectance	general material		0,05-1,000	(1-0,6) %.
			400-830 nm	
Wavelength	spectrally selective material	scanning spectrophotometer and line lamps	250-900 nm	(0,05-0,1) nm

The laboratory has demonstrated the technical competence to provide a calibration and measurement service that can deliver the claimed uncertainties.