

EUROMET TC Photometry and Radiometry

Chairperson's Annual Report 2005-2006

1. Meetings

The Technical Committee for Photometry and Radiometry (TC-PR) met in Prague, Czech Republic, on April 20-21, 2006, at CMI. There were 21 attendees from 21 countries, and 5 guests. Immediately after the meeting, Contact Persons visited the laboratories of CMI. Next PHORA meeting will be held at INM, Bucharest, Romania. The date will be the 19th and 20st April 2006.

2. Web-site PHORANET

The TC-PR Web site PHORANET (<http://www.metas.ch/euromet/phora/>) is used by TC-PR Members as a repository for documents and dissemination of information. It has been updated to contain copies of all available project forms and presentations from several TC-PR Annual Meetings.

3. PHORA Projects

Concerning the projects in TC-PR over the last year, in total there are 46 projects listed on the Web-site. Of these, 20 are comparisons, 10 co-operation projects, 13 projects on traceability and 3 consultations. As of 30 April 2006, 32 projects are active. As agreed in Belgrade, Progress Reports have been given also when no progress is to be reported on. As a consequence, annual reports of all PHORA projects are found in the PHORANET. The Chair sends to the General Secretary only those reports with some progress reported in.

During the meeting in Prague, a new project has been proposed by PTB on laser based radiometry for large area detectors. For the calibration of large-area filter detectors in photometry, colorimetry, UV dosimetry and spectroradiometry and for the characterisation of luminance standards and spectroradiometers, large-area, high-irradiance monochromatic radiation fields are required with narrow bandwidth tuneable over wide spectral ranges without gaps. Tuneable lasers are adequate sources if coherence effects (interferences and speckles) of the laser radiation are properly minimised and taken into account, respectively, depending on the type of the radiometric / photometric detector used. Activities in this field have been started in several NMIs. In addition, it is intended to include a comparison of different detector calibration methods based on tuneable lasers and also based on the use of conventional incoherent quasi-monochromatic radiation.

Part of the project at the PTB is one of the Pilot Special Facilities (iMERA) *TULIP (Tuneable Lasers In Photometry)* with a set of continuous wave and pulsed tuneable lasers and a special spectroradiometer used to produce wavelength-scanning high-irradiance monochromatic and uniform coherent and non-coherent radiation fields, where polarisation and speckle effects are suppressed, that can be used for the calibration of large-area filter detectors in photometry, colorimetry, UV dosimetry and spectroradiometry against trap detectors and a broad-band cryogenic radiometer. The tuneable pulsed laser setup is also used for rapid stray-light characterisation/reduction of array spectrometers.

It is expected that NPL (UK) and MIKES (FI) are also interested to cooperate. The proposer is Dr. Armin Sperling

4. CCPR comparisons

The **CCPR Working Group on Key Comparisons (WG-KC)** met on 23-24 October 2005 at the BIPM. The membership of this working group is as follows:

- Members: NMIA, KRISS, NMIJ, NIM, NIST, NPL and PTB;
- Ex-officio members: CCPR President, Executive Secretary of CCPR;
- Temporary members: pilot laboratories of on-going CCPR key comparisons: LNE;

- Observers: RMO representatives (APMP, COOMET, EUROMET, SADC MET, SIM) and all other official CCPR members and observers.

The WG-KC agreed that there will no longer be CCPR supplementary comparisons, and that none of the following comparisons

- CCPR-S1, Spectral radiance, 220 nm to 2500 nm;
- CCPR-S2, Aperture area;
- CCPR-S3, Cryogenic radiometers;

needed to be changed to a key comparison. It was proposed that future repetition of these comparisons should be classified as RMO supplementary comparisons.

As to bilateral and RMO comparison issues, the major issues raised were:

- Cost of comparisons is very expensive, particularly for the pilot laboratory;
- Time from initiation to end is long, particularly for CC key comparisons;
- Pilots of CC key comparison are often larger NMIs;
- CC key comparison must include representation of all RMOs – not to be biased to any RMO;

As to the opportunity through bilaterals to correct “error”, all NMIs must have opportunity to participate in at least an RMO comparison, and RMO comparison must happen soon after completion of CC comparison.

Some ideas were proposed for addressing these issues:

- Cost of comparison (pilot laboratories) to be shared by participants;
- Limit number of participants for key comparisons from 6 to 8 (to reduce time and workload);
- Large RMOs to consider advantages of two co-pilots for comparisons to reduce time-scales;
- Sharing of piloting responsibility within RMOs to smaller NMIs.

The WG-KC also discussed bilateral comparisons under CCPR or RMO auspices, where the distinction is not clear. The WG-KC agreed that only those bilateral comparisons that will correct errors in the measurement of the CCPR key comparisons already carried out will be designated CCPR bilateral comparisons. All other bilateral comparison (to align new NMIs to KCRV in past key comparisons) will be designated RMO bilateral comparisons.

Moreover, the same numbering is used for supplementary comparisons (S1,S2,...) of different quantities by the CCPR and some RMOs, which is confusing. Considering that there will be no further CCPR supplementary comparisons, and that these RMO comparisons are already started, it was concluded to live with this inconsistency.

It was requested to clearly label bilateral key comparisons as such on the KCDB website, and the BIPM staff has done this.

As to periodicity of key comparisons, although there was no clear consensus, the majority of respondents favoured a periodicity of about 10 years. The WG-KC can now use these inputs and proceed with making a recommendation for comparison periodicity.

The working group has published a *Guide on the preparation of CCPR comparison reports*, which is available from the CCPR web page on the BIPM web site (www.bipm.org). This closely follows the *Technical Guidelines of the MRA*, but adds an additional pre-Draft A process, during which the participants review each others’ uncertainty budgets. The process also includes the distribution of normalized data to check for clerical errors and consistent behaviour of the transfer standards. The objective is to resolve all critical issues before the Draft A is published.

Next meeting will be held at CENAM, in Queretaro, Mexico, in the last week of October, 2006.

As to current status of **CCPR comparisons**, the following reports were given by Michael Stock:

CCPR Key Comparisons

CCPR-K1.a, 250 nm – 2500 nm (NPL, contact: E. Woolliams): Draft B-2 has been approved by the CCPR in January 2006. The results for 44 wavelengths are now in the key comparison data base (KCDB).

CCPR-K1.b, 200 nm – 350 nm (PTB, contact: J. Metzdorf): All measurements are completed. The pilot lab waits for results from one laboratory. The pre-draft A process according to the *Guidelines for CCPR report preparation* is prepared.

CCPR-K2.a, 900 nm – 1600 nm (NIST, contact: S. Brown): Draft A-2 was sent to the participants in October 2005.

CCPR-K2.c, 200 nm – 400 nm (PTB, contact: L. Werner): The last of the three measurement phases is currently carried out. The Draft A report is expected for 2007.

CCPR-K5, Spectral diffuse reflectance (NIST, contact: J. Fraser): All measurements are completed and the data analysis is in progress

CCPR-K6, Spectral regular transmittance (LNE-INM, contact: J. Bastie): All measurements are completed and the pilot has received the results. The review of uncertainty budgets by the participants is under way.

CCPR-K1.a.1 (NMIA – SPRING): The review of this comparison by the CCPR key comparison working group was hold back until the approval of CCPR-K1.a. The review of K1.a.1 is currently taking place.

CCPR supplementary comparisons

CCPR-S1, Spectral radiance (VNIIOFI, contact: V. Sapritsky): There are no news for this comparison since several years. The chairman of the key comparison working group will contact the pilot to request progress.

CCPR-S2, Aperture area (NIST, Contacts: T. Litorja and J. Fowler): Draft A was distributed in May 2005 and a number of participants sent comments to the pilot. Currently Draft A-2 is under preparation.

CCPR bilateral supplementary comparisons

Two additional bilateral comparisons for CCPR-S3 (cryogenic radiometers) are prepared by NPL, with the participants SPRING and UME.

Discussion on the future of CCPR supplementary comparisons CCPR-S1 to CCPR-S3

There will no longer be CCPR supplementary comparisons. The working group discussed whether the following comparisons need to be repeated, and whether any of them should be moved to key comparisons:

- CCPR-S1, Spectral radiance, 220 nm to 2500 nm;
- CCPR-S2, Aperture area;
- CCPR-S3, Cryogenic radiometers.

The WG-KC agreed that none of these comparisons need to be changed to a key comparison. It was proposed that future repetition of these comparisons should be classified as RMO supplementary comparisons.

Proposals for new comparisons

Pilot comparisons of spectral responsivity in the vacuum ultraviolet (VUV) (10 nm – 20 nm and 110 nm – 200 nm) are being planned. The details are given in the CCPR-WG-UV report.

5. EUROMET PR comparisons

The current status of EUROMET PR comparisons is as follows.

The following comparisons have been completed since the last meeting:

EUROMET.PR-K3.b.1 on luminous responsivity (IFA), bilateral with UME. Completed bilateral with the results available in Metrologia 2005,42 Tech.Suppl.02002;

EUROMET.PR-S1, Comparison of chromatic dispersion reference fibres: Approved with results available on KCDB. A subsequent bilateral comparison between METAS (pilot) and HUT is ongoing, using a similar protocol as the actual comparison. Registration to EUROMET and BIPM of the subsequent bilateral will be made.

The following key comparisons are in progress:

EUROMET.PR-K2.b, Spectral responsivity (pilot 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.

a) Measurements: Up to date all the laboratories have completed their measurements except for one, as it was reported last year. The pilot has asked this laboratory for completion several times during the last months. The laboratory answered that they will send the measurements results and the detectors soon. But we are still waiting

b) Final calibration at pilot's laboratory: The pilot laboratory has already started the final calibration of detectors, that could be finished by summer time if the last laboratory returns the last detector set within a month.

c) Draft A: 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.

EUROMET.PR-K3.a, Luminous intensity (pilot PTB) and EUROMET.PR-K4, Luminous flux (pilot PTB): Originally, the two Key Comparisons for luminous intensity and luminous flux were planned to be processed in a single campaign for organisation and transportation. Due to severe delays in getting the facilities in the new building at the PTB ready for measurements, two separate campaigns were already planned.

General: The technical protocol will be send out October 2006

Intensity: Transport of lamps to PTB and measurements begin of 2007

Flux: Transport of lamps to PTB and measurements July of 2007

The new PTB's Photometer Bench System is now completely characterised and proofed for a correct operation and automated documentation of measurements of a large number of lamp transfer standards for luminous intensity. All relevant contributions to the measurement uncertainty for a transfer of the CCPR KCRV are investigated and known. Based on these results, the technical protocol for the EUROMET KC of luminous intensity is in preparation.

The construction of the new PTB's Robot Goniophotometer is finished now and the system will be characterised in detail. Two radiometer heads are moved on traces with variable radius and they measure simultaneously the angular distribution functions of the tristimulus values and the relative spectral distribution. The measurements for the EUROMET KC of luminous flux will start, after having finished the characterisation and the proof of a correct operation.

EUROMET.PR-K4.1, Luminous flux and luminous intensity: Bilateral between LNE-INM and INM-BRML: The aim of this comparison is to link the new realisation of the luminous intensity and luminous flux units by the INM (Romania) to the reference values of the CCPR-K3 and CCPR-K4 comparisons. For this project the protocol has been written and submitted to the CCPR working group on key comparisons and accepted.

For the luminous intensity comparison the measurement have been carried out by the INM – Romania, then the lamps were sent to the LNE-INM (France) where they were calibrated. The lamps, will be transport back soon to the INM-Romania for the second set of measurements which is expected to be finished by the end of June.

For the luminous flux measurements, a first comparison has been carried out using lamps calibrated at INM-Romania with an integrating sphere by comparison to standard lamps from BIPM. The results of this comparison intended to check the quality of transfer standard lamps were satisfactory. A second comparison using standard lamps calibrated at INM-Romania in an absolute way, using a goniophotometer is in progress. The measurement have been carried out by the INM-Romania, then the lamps were sent to the LNE-INM (France) where they were calibrated. The lamps, will be transport back soon to the INM-Romania for the second set of measurements which is expected to be finished by the end of June. The final reports for both comparisons is expected for October this year.

EUROMET.PR-K5, Spectral diffuse reflectance (pilot OMH): At the CCPR-K5 comparison the measurements are finished, but the first draft output is not ready yet. It does not need to wait with the start until the first draft comes out, but we needed some informal answer from the pilot Lab. Whether the German and Hungarian results will be included or excluded in the CCPR mean. Jerry Fraser's answer was: " *Although the analysis is not complete, I do not see any major issues with OMH or PTB.*" OMH, the EUROMET. PR-K5 pilot Lab has sent a detailed proposal for the participants about the technical protocol and recommended samples for the comparison.

The proposed agenda is as follows:

- 1./ Decision about the samples to be used: by the end of **April 2006**
- 2./ Each country buys the samples: by the end of **July 2006**
- 3./ The participants send the samples to the pilot Lab: by the end of **August 2006**
- 4./ First measurements in the pilot Lab: by the end of **December 2006**
- 5/ Pilot sends back the samples to the participants: by the end of **January 2007**
- 6./ Measurements in the participant's Lab: by the end of **April 2007**
- 7./ The participants send the samples and measurement results and their methods to the pilot Lab.: by the end of **May 2007**
- 8./ Control measurements in the pilot Lab.: by the end of **September 2007**
- 9./ The pilot Lab. sends back the samples to the participants where they remains: by the end of **October 2007**

EUROMET.PR-K6,Spectral regular transmittance (pilot LNE): The EUROMET key comparison (EUROMET-K6) on spectral regular transmittance is closely connected with the CCPR key comparison in the same field. At present time the measurements for the CCPR key comparison are completed. According to the BIPM present rules in the "Guidelines for CCPR Comparison Report Preparation", all the activities to be done before preparing the "Draft A" have been completed. A first determination of the Key Comparison Reference value have been calculated using a weighted mean with cut-off as recommended in the previous document. At present time, results are checked by a second person. The draft A is near completion and will be distributed very soon. For the EUROMET comparison, the measurements are completed. With the experience gained with the CCPR Key Comparison it has been asked to the participants to provide results in an homogenous way in order to speed up the process. As soon as the Key Comparison Reference value of the CCPR Key Comparison will be accepted the results of the "Draft A" could be circulated.

The following key comparisons are planned:

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

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

The following supplementary comparison is in progress.

EUROMET.PR-S2, Radiant power of high power lasers (pilot 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 are planned in NL, D, DK, J, UK, UA, ROM, D. 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 2007, after finishing the measurements for the first part of the intercomparison. In a letter of April 4, 2006, NMI-VSL has withdrawn its participation.

6. CMCs

The CCPR Working Group on Calibration and Measurement Capabilities (WG-CMC) met on the 24 October 2005 at the BIPM. Representatives from all five RMOs (APMP, COOMET, EUROMET, SADCMET and SIM) were present as well as 18 observers from NMIs and the BIPM, the President of CCPR and the Executive Secretary of the CCPR.

As to statistics on the inter-regional review process in the field of radiometry and photometry, there are currently 37 countries with CMCs published, over 1000 CMCs have been reviewed and a total of 846 CMCs are in the BIPM public database.

The RMO co-ordinators agreed to submit CMCs for the interregional review once a year, in March. Each region needs to define when to start the corresponding intra-regional review process. The annual meeting of WG-CMC will be used to address those issues, which could not be solved during the normal review process.

PR Cps agreed to maintain the time schedule of EUROMET CMC submissions approved in the 17th TC meeting in Belgrade, with a new strict deadline at the end of October each year.

There has been a request from COOMET to review the CMC service categories to include total irradiance. APMP feels a need to include service categories for UV irradiance and heat flux.

Next WG-CMC meeting will take place in conjunction with the WG.KC meeting, scheduled for the last week of October 2006 at CENAM, Queretaro, Mexico. At the next working group meeting in 2006, APMP will take on the Chairmanship of WG-CMC.

EUROMET PR CMCs

Inter-regional review accepted the third round of PHORA CMCs (EUROMET.PR.3), containing revised data from Finland, Spain, Switzerland and Slovakia, mainly on fibre optics.

Intra-regional review in under completion for the fourth round of PHORA CMCs (EUROMET.PR.4), containing revised data from Finland, Germany, Switzerland, Turkey, and United Kingdom. EUROMET.PR.4 will be ready to be sent for intra-regional review within March 2006

The call for submitting CMC claims in Round 5 is open. Dead-line is October 31, 2006

EUROMET Review of other RMOs PR CMCs

The third round of APMP CMCs (APMP.PR.3) has been approved.

Maintenance of EUROMET PR CMCs

CMCs already accepted onto the database need to be reviewed once the supporting KC has been completed. The Technical Committee is finally responsible that the CMCs are consistent with the results of the KC.

In addition, joint maintenance procedures (and criteria) should be agreed with other RMOs. Discussion on this topic can start at the up-coming CCPR WG-CMC meeting in October 2006.

7. The iMERA Project

The PHORA iMERA-WG met in Paris, Oct. 27, 2005. After some discussion about possible topics for road-mapping within PHORA, participants agreed to prepare three roadmaps within PHORA. Titles were tentative and have been reconsidered. Road maps are as follows:

ROADMAP A **Optical Radiation: better life**

Trigger 1: Health and environment

Keywords: medical imaging, optical radiation protection, water disinfection, medical treatment: diagnostics and therapy. Artificial tissue, climate changes, ozone problems, air - water - light pollution, bio-sensors, homeland security (IR), cultural heritage

Trigger 2: Conserving renewable energy resources

Keywords: LEDs, OLEDs, lighting efficiency, photovoltaic, thermography, hydrogen economy, lighting management, bio-lighting, light pollution, novel light sources and signals, conspicuity of light sources

ROADMAP B **Optical Radiation: better SI standards**

Trigger 1: Integrity of SI

Keywords: quantum standards, link to conventional photometry and radiometry, practical dissemination, photon standards, efficient and economic access to the base units, fundamental constants, calculable standards.

Trigger 2: Communication and information

Keywords: fibre optics, displays, photonics, multimedia, quantum communication, security, holography, cultural heritage, data storage

ROADMAP C **Optical Radiation: better colours**

Trigger 1: Quality and reliability of products: competitiveness of European industry for more efficient design and production of products that meet the increasing perceived quality demand of citizens and increasing needs of citizens according to their perception of quality reliability and desirability

Keywords: process control, colour, texture, glare, appearance, gloss, energy efficiency, colour rendering, colour reproduction, physiology and psychology aspects, fluorescence, photolithography

Several drafts were circulated by e-mail within the PHORA iMERA-WG. After a short WG meeting in Prague to finalise the drafts, Cps approved the final proposals by the WG.

8. Nominations TC Chairperson

Cps agreed the nomination of Peter Blattner; METAS, CH. His nomination will be ratified at the General Assembly during the Delegates' session.

Maria Luisa Rastello
Technical Committee Chairperson for
Photometry and Radiometry

Torino, 30 April 2006