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

Questionnaire on activities in radiometry and photometry

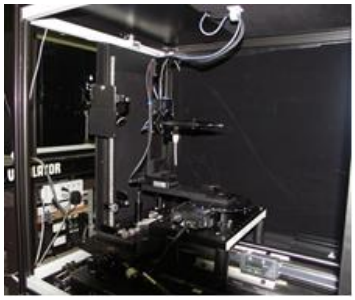
Reply from: National Metrology Institute of Japan (NMIJ)

Delegate: Tatsuya Zama

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

   (a) broad-band radiometric quantities

   - Total radiant flux (W) standard in UV wavelength region was realized by using a gonio-radiometer and a standard detector whose spectral irradiance responsivity scale was calibrated. Several kind of special UV-LED light sources equipped with a temperature stabilization device are used for the transfer standard. The center wavelengths of the transfer standard are 365 nm and 385



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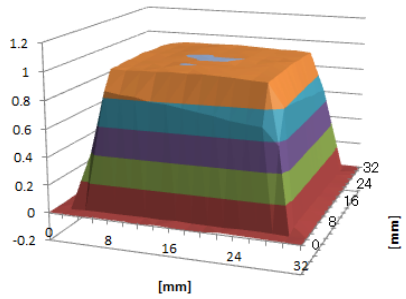
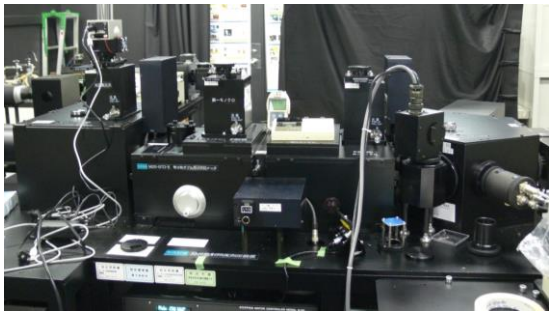
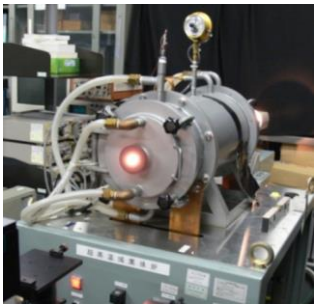
   (b) spectral radiometric quantities

   - Spectral irradiance responsivity scale (Am^2W^{-1}) was established and transferred to a standard detector. A uniform and monochromatic radiation, produced by using an optical homogenizer and a monochromator, was used for the standard detector calibration. The spectral irradiance responsivity scale of the standard detector is transferred to under-test detector from 360 nm to 830 nm.



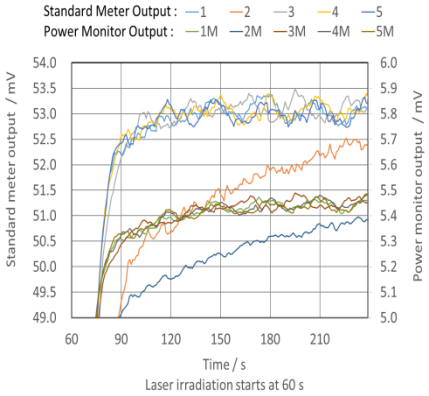
   - Radiant flux standard (W) in UV region was realized by using a blackbody radiator and a monochromator. A deuterium lamp is used for transfer standard and that radiant flux in 20 nm wavelength width can be calibrated from 180 nm to 320 nm.





- BRDF scale for white diffuser plate in a limited geometry was established. The angles of incident radiation and reflected radiation are 0 degree and 45 degree respectively. The BRDF calibration is available form 360 nm to 830 nm.

- Laser power meter responsivity scale for high power laser is established. The laser, whose wavelength and power are around 1.1 μW and 1 kW respectively, can be calibrated by the scale.



- Laser power meter responsivity scale for the laser radiation which passes through optical fiber is established. The wavelength of the laser is around 850 nm.

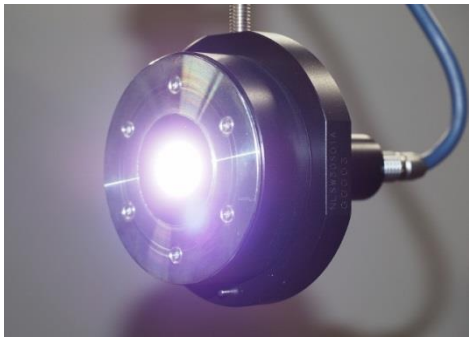
(c) photometric quantities

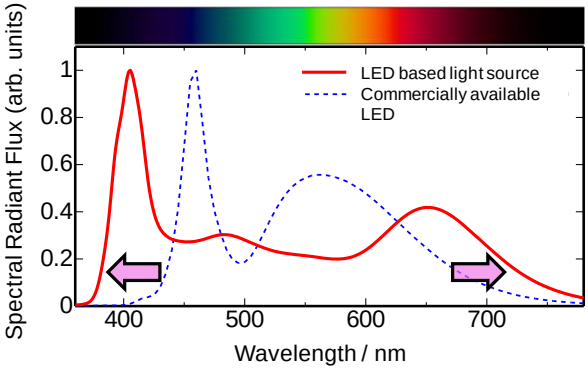
None

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

- Development of Standard LED for Total Spectral Radiant Flux calibration at 2π Geometry

  A LED-based standard light source (standard LED), which is appropriate for total spectral radiant flux (TSRF) calibration by sphere-spectroradiometer at 2π geometry, was developed. The angular distributions of the standard LED radiation and its spectrum are almost equal to Lambertian and quite uniform, respectively. The standard LED emits the radiation extending from 380 nm to 780 nm. The spectrum does not have any notches and is sufficiently flat in the wavelength range. The standard LED will be used as a transfer standard for disseminating of TSRF scale for 2π geometry. The development is based on a joint research with a Japanese LED manufacture, NICHIA .





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.

   None

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.

   Incandescent type standard lamp has been holding important positions for the scale realization and maintenance. But the manufactures have a difficulty to continue producing the standard lamps, because the standard lamps requires high technical skill, labor and time but the sales is small. In addition, most of the lighting products are shifting to LED base at present and Incandescent lamp market is shrinking. There is a possibility that we cannot get any incandescent type standard lamps in near future.
   Before the manufactures discontinue producing the incandescent type standard lamps, it would be necessary to find appropriate light source which can replace the Incandescent type standard lamp. A redefinition of candela might also be necessary if the size of the light source is not sufficiently small.

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

The lamp or luminaire based on LED are spreading market and most of manufacturers are focusing on LED products at present. However, the performance evaluation of LED products are not so easy for manufacturer's or third party's testing laboratories because the spectral distribution and the spatial distribution of the optical radiation form LED greatly differ from those of traditional light source. The research and development which can ease the performance evaluation of LED products, such as total spectral radiant flux calibration, array spectroradiometer evaluation and/or near-field goniophotometry, would be necessary for NMIs

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?

   None

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)?

   1) Kuniaki Amemiya. Hiroshi Koshikawa, Tetsuya Yamaki, Yasunari Maekawa, Hiroshi Shitomi, Takayuki Numata, Kenich Kinoshita, Minoru Tanabe and Daiji Fukuda, Fabrication of hard-coated optical absorbers with microstructured surfaces using etched ion tracks: toward broadband ultra-low reflectance, Nucl. Instrum. Meth. B., vol. 356-357, p. 154-159 (2015)
   2) Hiroshi Shitomi, Potential effect on the difference in evaluating condition for UV and IR Index of photometers according to ISO/CIE 19476, Proceedings of the 28th Session of the CIE (CIE 216:2015), vol.1, no. 1, p. 140-147 (2015)
   3) Kenji Godo, Correlation analysis of wavelength uncertainty for chromaticity measurement , Proceedings of 28th CIE session, vol. 2, p. 177-180 (2015)
   4) Kenich Kinoshita, Kenji Godo and Tatsuya Zama, Development of standard LED for UV-LEDs and establishment of calibration service for total radiant flux of UV-LED at NMIJ, Proceedings of 28th CIE Session 2015, vol. 1, no. 2, p. 1338-1342 (2015)
   5) Minoru Tanabe, Kuniaki Amemiya, Takayuki Numata and Daiji Fukuda, Spectral supralinearity prediction of silicon photodiodes in the near-infrared range, Appl. Optics, vol. 54, no. 30, p.10705-10710 (2015)
   6) Kenji Godo, Kazuki Niwa, kenich Kinoshita, Yoshiro Ichino and Tatsuya Zama, Realization of total spectral radiant flux scale at NMIJ with a goniophotometer/spectroradiometer, Metrologia, vol. 53, no. 2, p.853-859 (2016)
   7) Minoru Tanabe, Kuniaki Amemiya, Takayuki Numata and Daiji Fukuda, Spectral supralinearity of silicon photodiodes in visible light due to surface recombination , Appl. Optics, vol. 55, no. 11, p. 3084-3089 (2016)

8) Yuri nakazawa, Kenji Godo, Kazuki Niwa, Tasuya Zama, Yoshiki Yamaji and Shinya Matsuoka, Development of Standard LED for Total Spectral Radiant Flux Calibration in 2π Geometry, Proceedings of 15th International Symposium on the Science and Technology of Lighting, p. 103-108 (2016)

9) Kenji Godo, Investigation of new transfer standard for luminance by means of ray tracing simulation, Proceedings of 15th International Symposium on the Science and Technology of Lighting, p. 177-180 (2016)

10) Kazuki Niwa, Quantification of Luminescence Intensity by Photon Number Measurement to Determine Firefly Bioluminescence Quantum Yield, Methods in Molecular Biology, vol. 1461, p55-61 (2016)

11) Hiroshi Shitomi and Kenichi Siuzuki, Consideration on Safety Factors Applied to a Simplified Approach to Evaluate Blue Light Hazard of General Light Sources by Means of Photometry, Proceedings of CIE 2016 "Lighting Quality and Energy Efficiency" (CIE x042:2016), x042, p. 305-310 (2016)

12) Hiroshi Shitomi, BRDF measurement based on spectral diffuse reflectance and a gonioreflectometer, Proceedings of 4th CIE Expert Symposium on Colour and Visual Appearance (CIE x043:2016), x043, p. 167-174 (2016)