Future Photometry Based on Solid-State Lighting Products EMPIR PhotoLED

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PhotoLED Stakeholder training

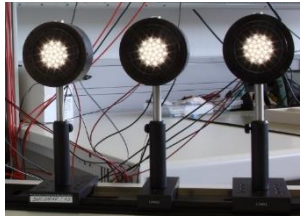
DTU, Denmark (28 August, 2019)

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

EMPIR PhotoLED (2016 – 2019)

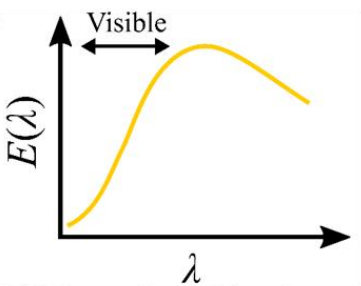
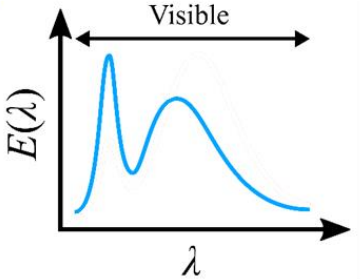
Future Photometry Based on Solid-State Lighting Products

- 3-year EU-funded project, coordinated by VTT MIKES, Finland
  - Consortium 10 NMIs, 3 Universities, 4 industrial partners
  - Official project website: http://photoled.aalto.fi
- **Investigating new photometric system based on white LED sources**
  - LED illuminants and LED reference spectrum for calibration use
  - LED standard lamps for luminous intensity and luminous flux
  - Novel measurement methods for LED standard lamps & SSL products testing



EMPIR PhotoLED (2016 – 2019)

Introducing new LED calibration spectrum and sources

Calibration spectrum	Luminous intensity [cd]	Luminous flux [lm]
Since 1931 		
CIE Standard Illuminant A	Typical standard lamp	Typical standard lamp
New in 2018! 		
LED Reference spectrum	New LED technologies	Custom LED lamps

EMPIR PhotoLED – Results

LED illuminants & Reference spectrum for photometer calibration

- PhotoLED has contributed to the technical work of CIE Divisions 1 and 2

CIE Standard Illuminants and illuminants (CIE15, 4th edition, 2018)

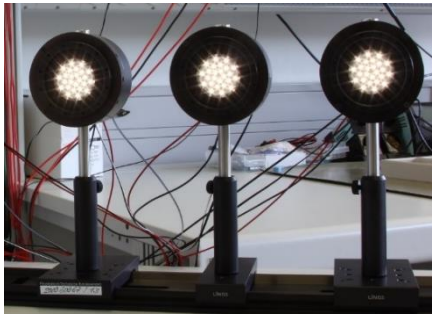
PHOTOMETRY	COLORIMETRY			
Standard Illuminant A	LED-B1	Standard Illuminant A	FL1	HP1
LED Reference spectrum	LED-B2	Standard Illuminant D65	FL2	HP2
	LED-B3	B	FL3	HP3
	...LED-B5	C	FL4	HP4
	LED-BH1	D50	FL5	HP5
	LED-RGB1/2	D55	FL6	
	LED-V1/2	D75	... FL12	

CIE TC2-90 Technical Report in preparation!

EMPIR PhotoLED – Results

LED standard lamps for luminous intensity and luminous flux

- LED standard lamps for **luminous intensity**, LIS-A
  - DC-current operated (**65 mA DC** / 75 V DC), ~245 cd, close to Wi41/G
- LED standard lamps for **luminous flux** (3 different versions)
  - E27-base, DC-voltage operated (**15-18 V DC**, built-in current source), ~800 lm
  - E27-base, AC-voltage operated (**230 V AC**, constant-power converter), ~800 lm
  - E27-base, DC-current operated (**550 mA DC**, 13.8 V DC, no electronics), ~800 lm
- LEDs selected with spectra close to the new LED reference spectrum!



Luminous intensity standards, LIS-A.

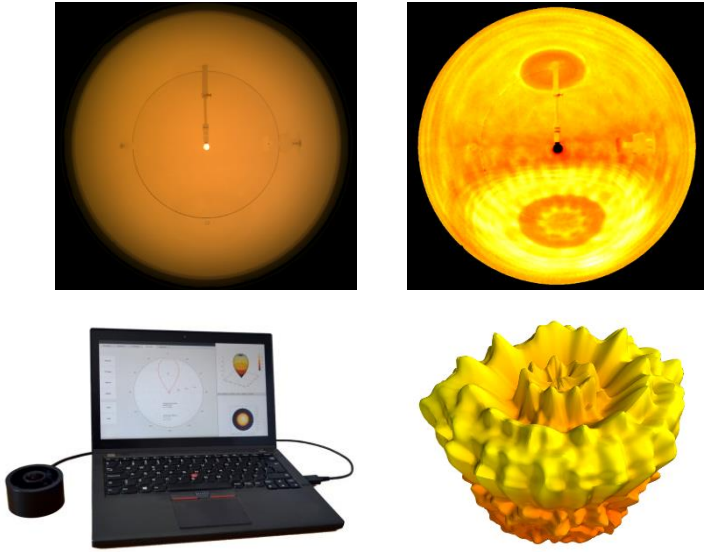
Luminous flux standards, DC-operated.

Luminous flux standards, AC-operated.

EMPIR PhotoLED – Results

New measurement methods for LED photometry

- Fisheye-camera method for angular measurements with integrating spheres
- Comparison of white LED illuminance using PQEDs <u>without</u> $V(\lambda)$-filters



Fisheye-camera method for integrating spheres.

Measuring illuminance of white LED source with unfiltered PQED.

EMPIR PhotoLED (2016 – 2019)

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Thank you!

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