Bundesministerium
für Wirtschaft
und Technologie

Transferability of stray light corrections among array spectroradiometers

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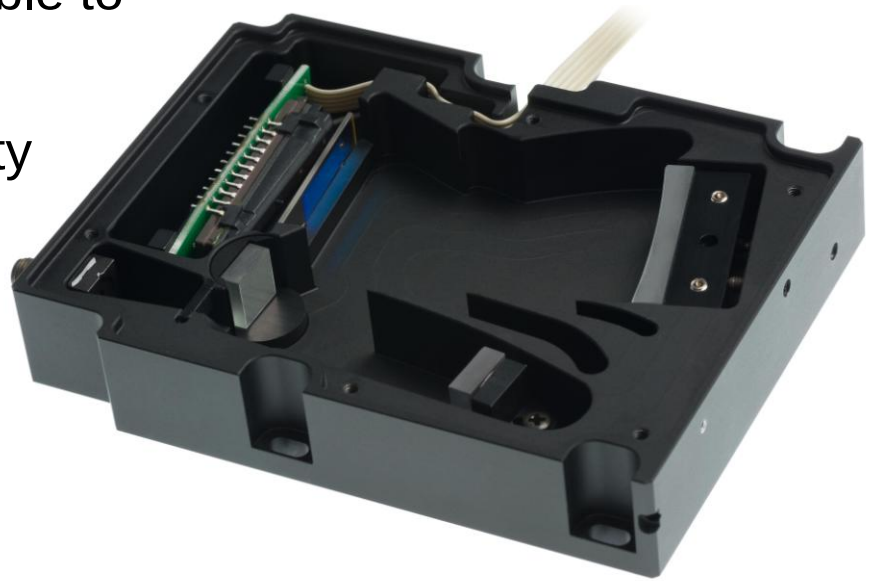
Outline

- Motivation
- Stray light characterisation and correction using tuneable lasers
- Stability of stray light properties
- Transferability of stray light corrections among devices
- Conclusions

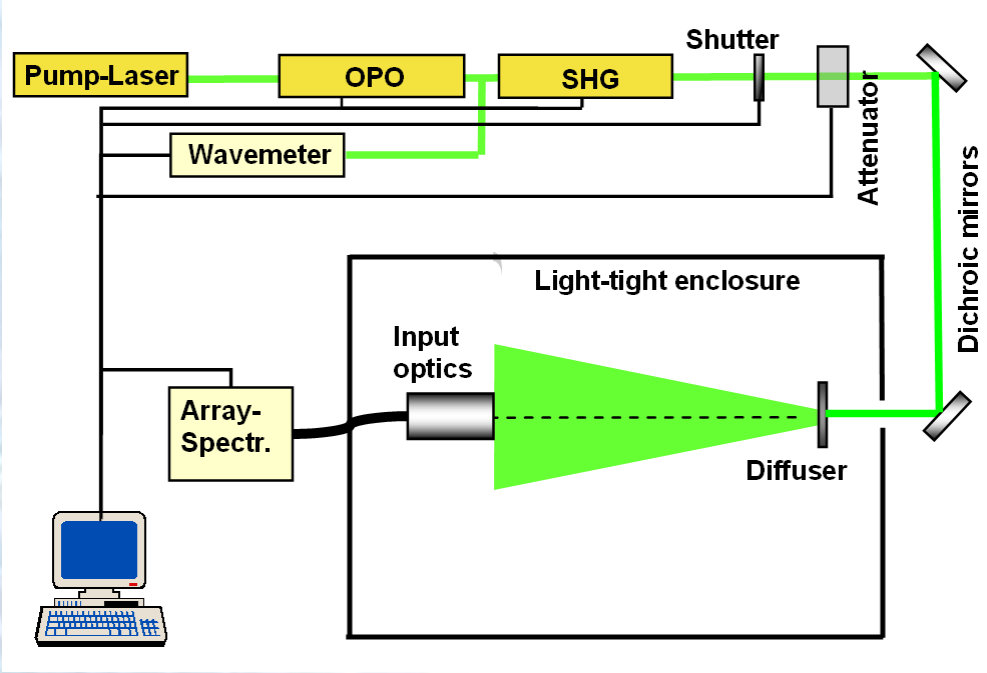
Motivation

- Array spectroradiometers: fast, compact, affordable
- Spectral stray light suppression limited, especially in UV
- Improvement of stray light properties by technical (talk by L. Egli et al.) or/and numerical means (e.g. Zong's matrix)
- Numerical correction based on characterisation using tuneable lasers enables stray light reduction by 1-2 orders of magnitude
- Is the correction valid and applicable to the instruments of same type?
- Requirements for the transferability of the stray light correction:
  - stable over time and
  - identical stray light signatures

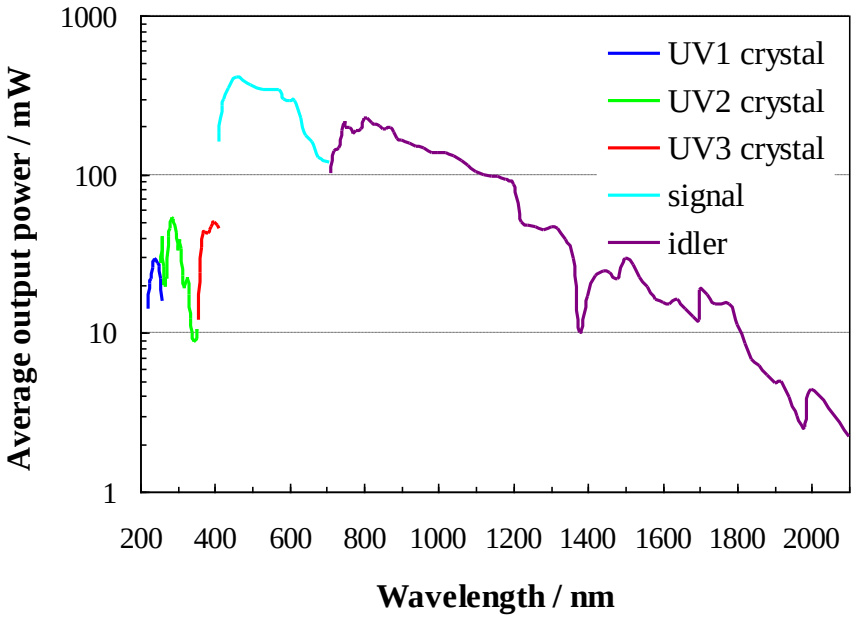


Stray light characterisation

- Stray light characterisation using PLACOS setup at PTB:
  (Pulsed Laser for Advanced Characterisation of Spectroradiometers)



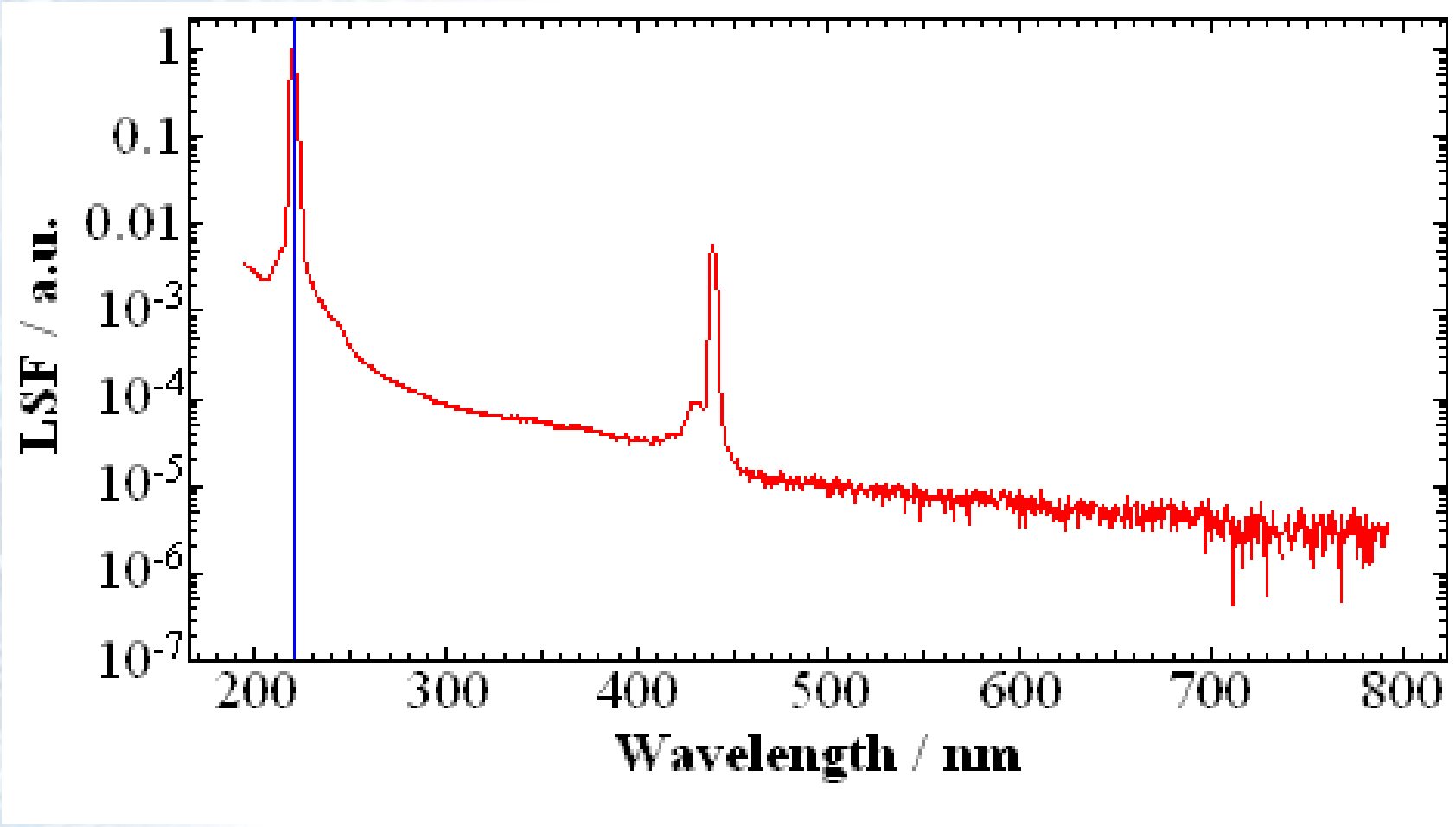
- pulsed operation (20 Hz, 5 ns)
- automatic change of wavelength
- easy to handle



OPO, optical parametric oscillator
SHG, second harmonic generator

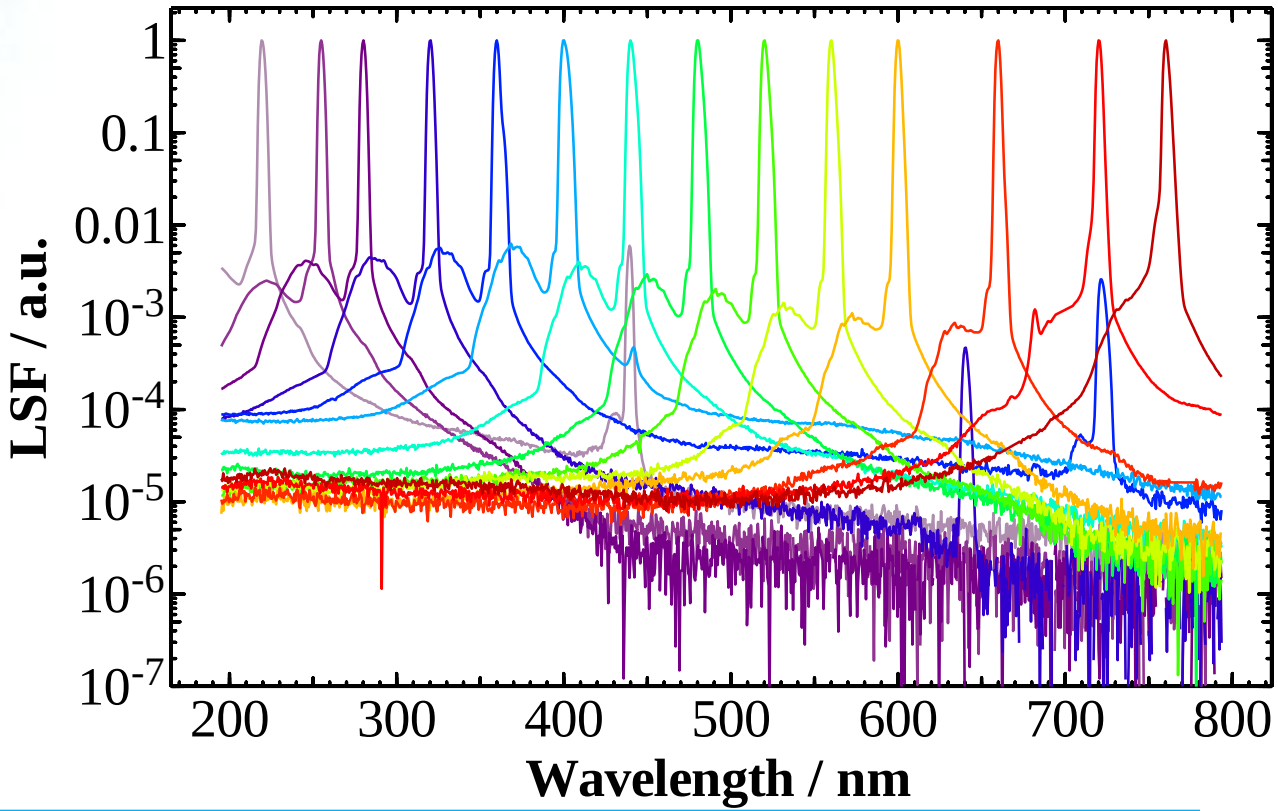
* S. Nevas, M. Lindemann, A. Sperling, A. Teuber, R. Maass, "Colorimetry of LEDs with Array Spectroradiometers", *MAPAN - Journal of Metrology Society of India* **24**, 153-162 (2009).

Stray light characterisation



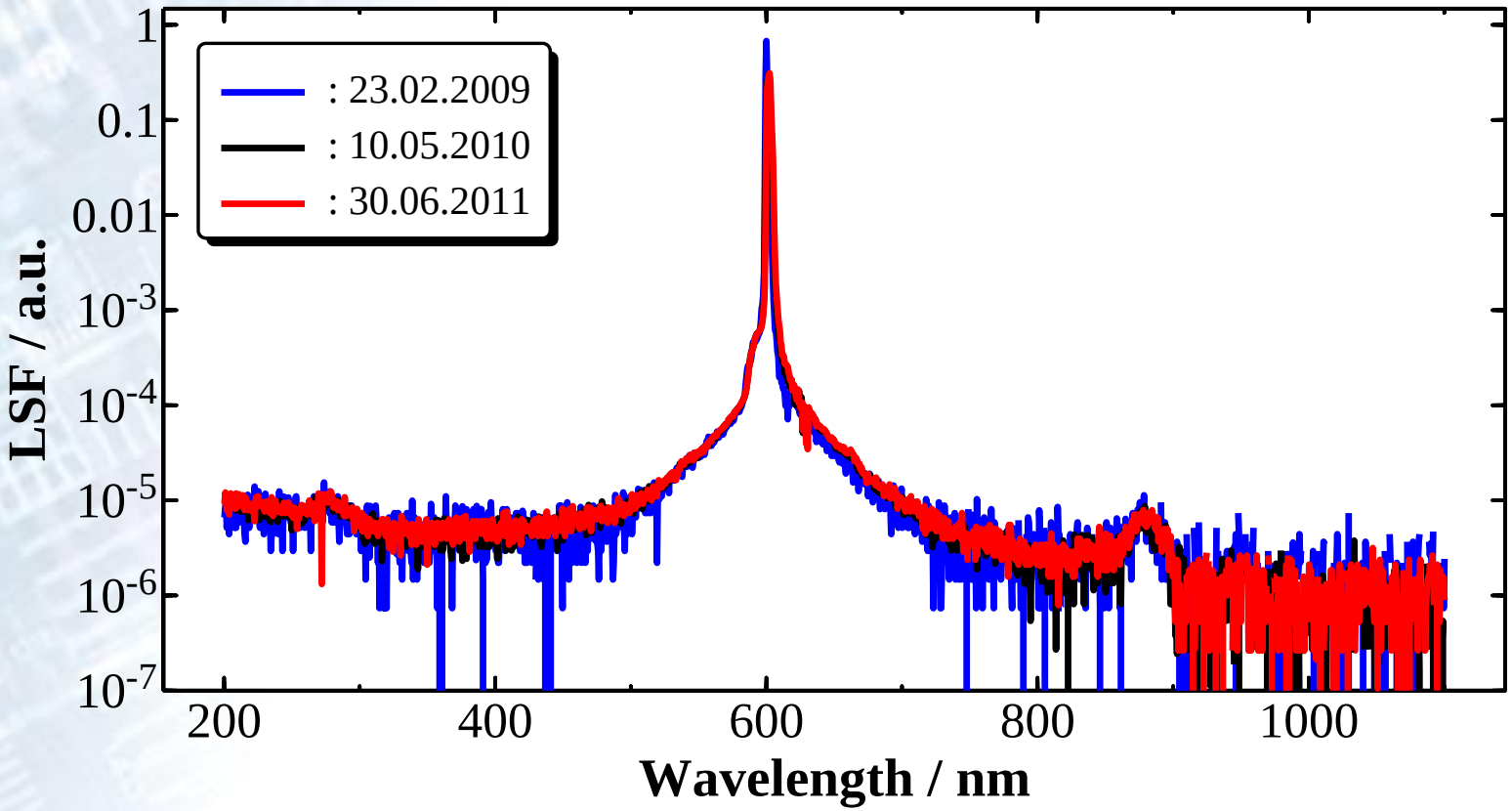
Stray light characterisation

- Stray light “fingerprint” of an array spectroradiometer:
  - scattering from optical components
  - zeroth diffraction order
  - double diffraction
  - higher orders
  - grating ghosts
  - interreflections
  - fluorescence



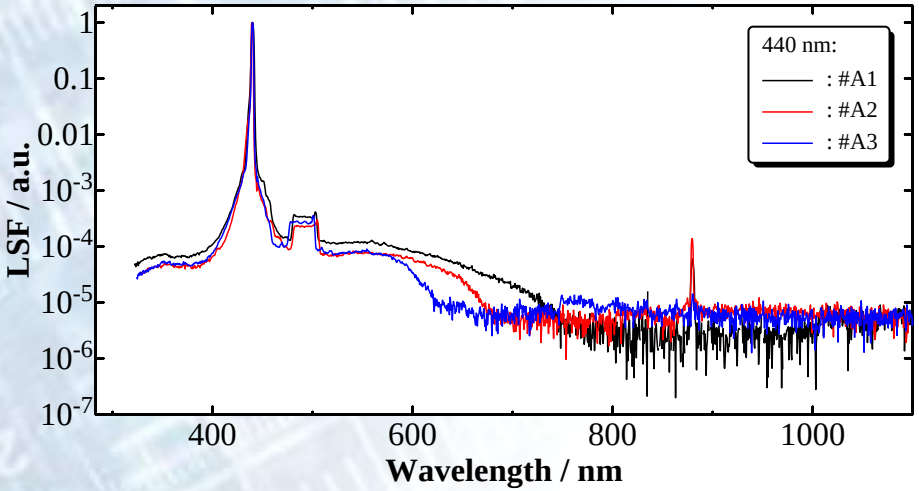
Stability of stray light properties

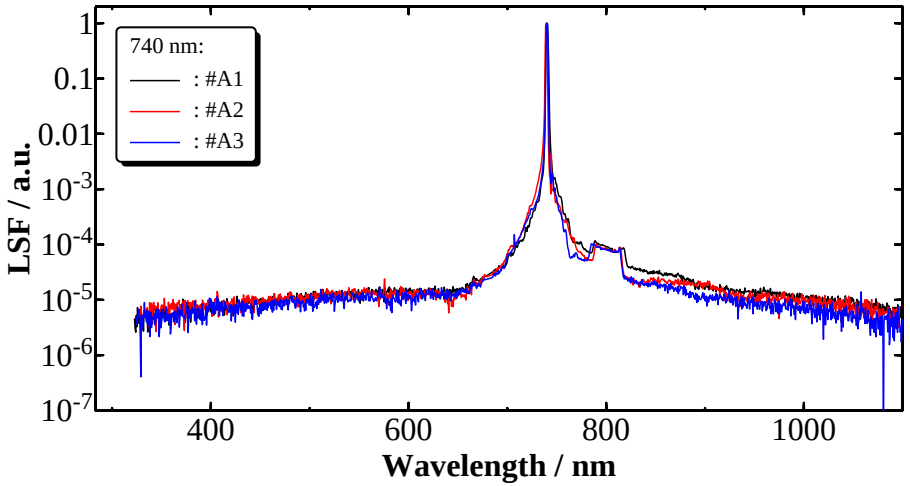
- Stray light characteristics under normal operating conditions are stable
- Example: LSF of an array spectroradiometer over 3 years

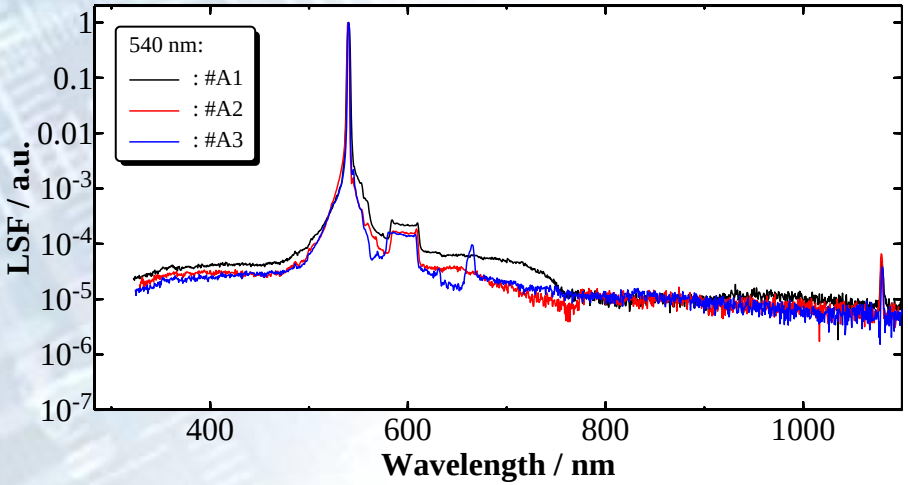


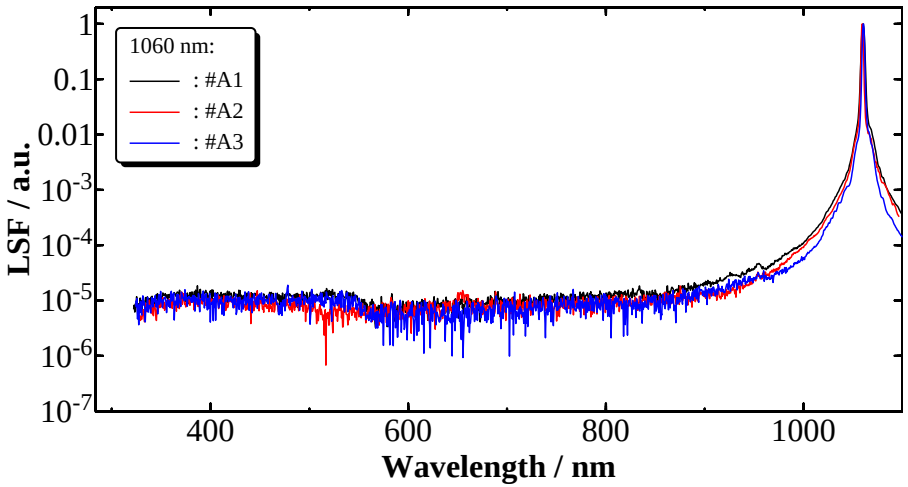
Transferability of stray light correction

- LSFs of three instruments from one batch









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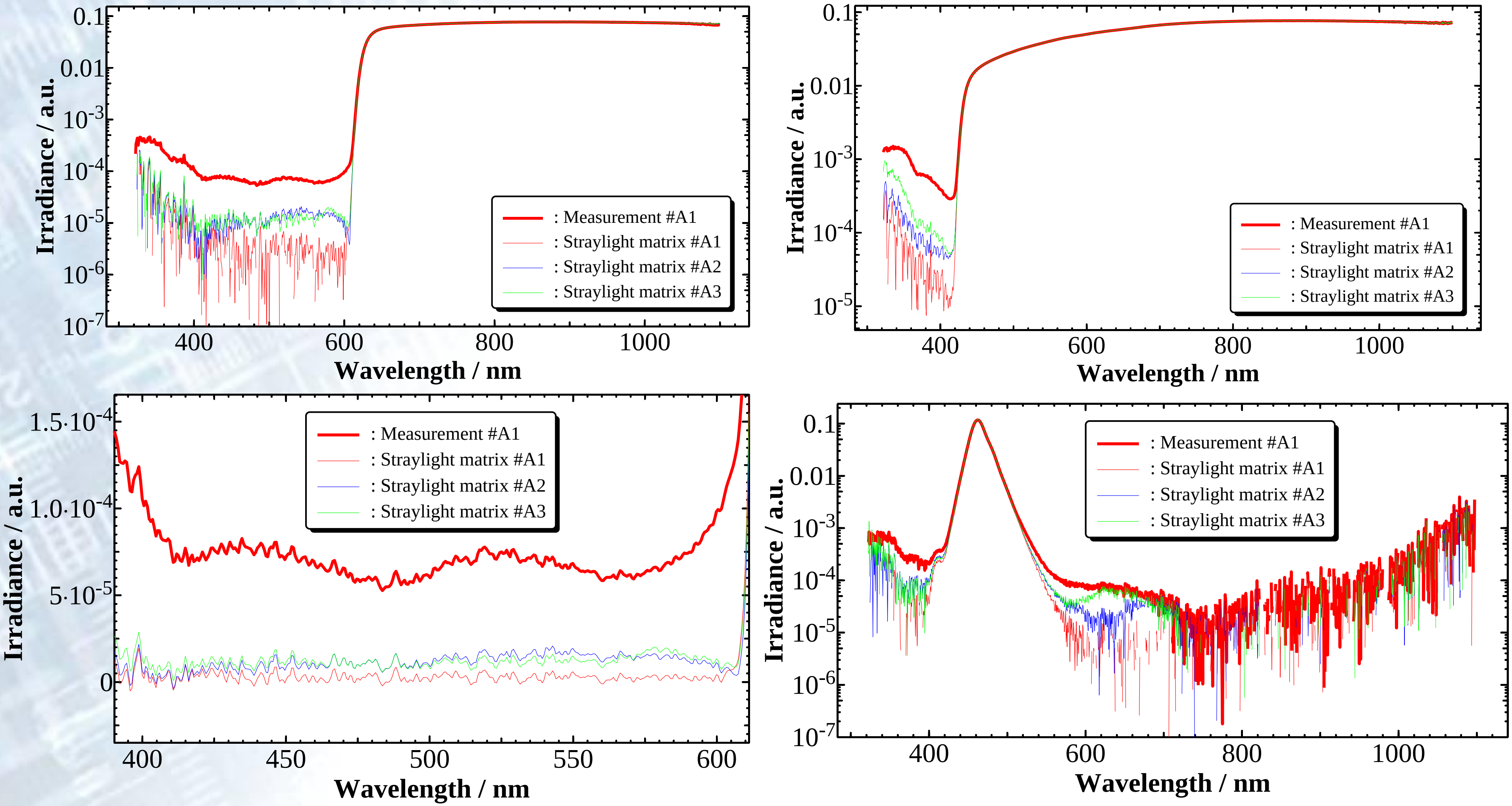
Transferability of stray light correction

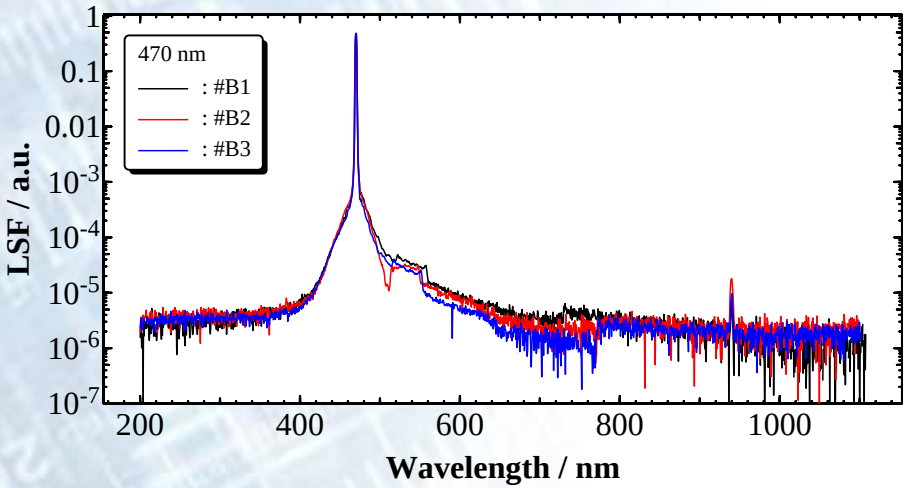
PTB

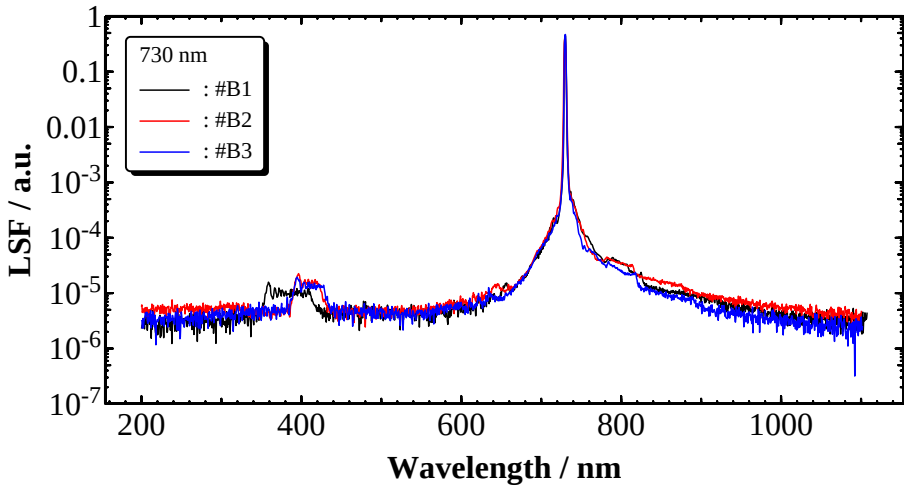
- Results of stray light correction by applying matrices of different instruments

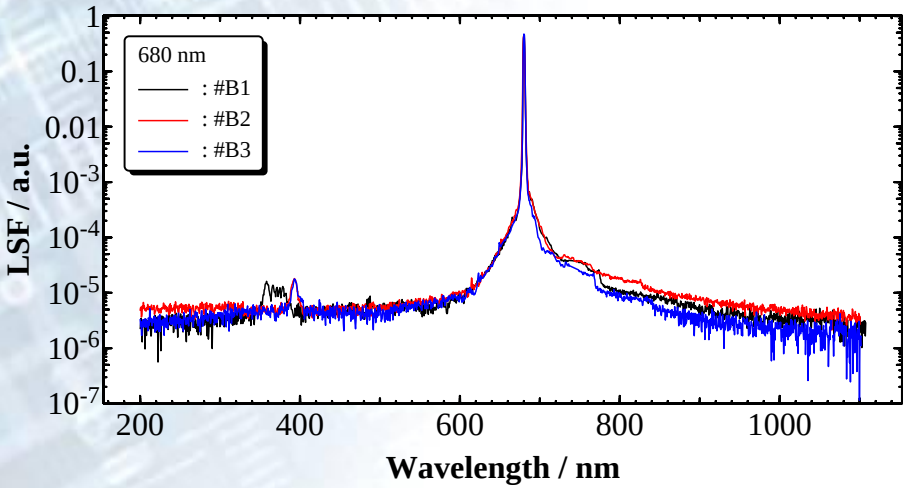


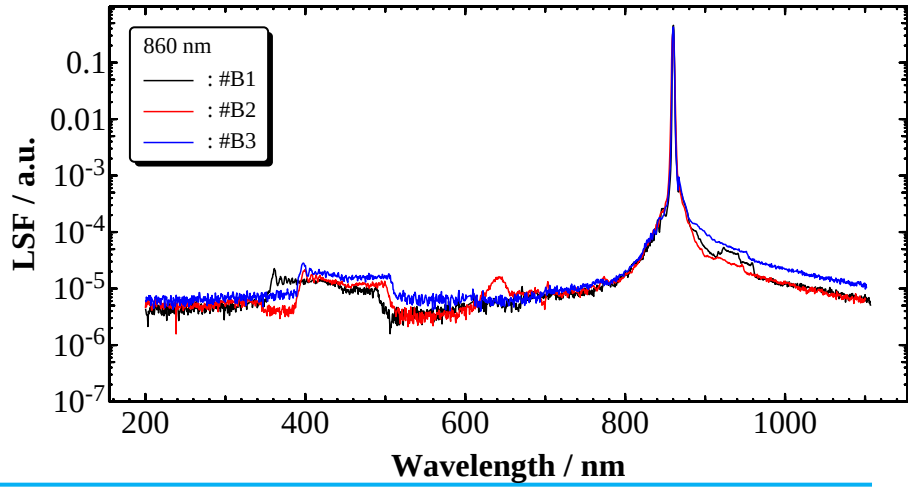
Transferability of stray light correction

- LSFs of three other array spectroradiometers









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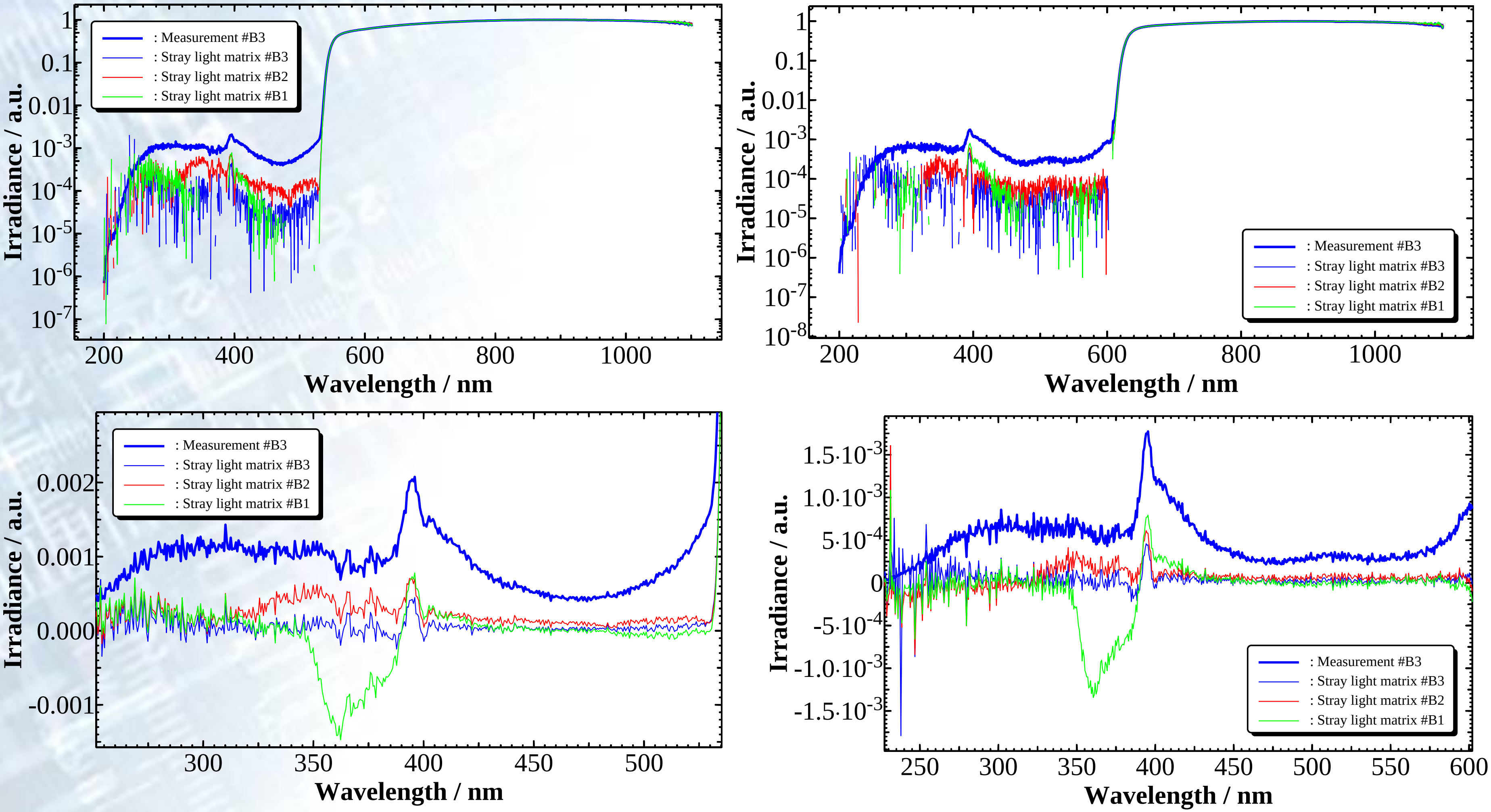
Transferability of stray light correction

PTB

- Results of stray light correction: one instrument, three correction matrices



Conclusions

- A single stray light correction matrix can be effective on a class of instruments provided the spectrometers have stable and identical characteristics
- Under normal operation conditions stray light signatures of array spectrometers remain stable
- Stray light properties and their similarity among different instruments depend on the optical components used and procedures for their assembly/alignment in the spectrometers
- The richer in spectral features the LSFs of the instruments are, the less likely they are to be identical among instruments of even the same model and batch, unless the devices are intentionally optimised
- Discrepancies in the LSFs of the instruments will define the effectiveness of the stray light corrections using a single matrix or can even lead to spurious corrections at the specific spectral regions