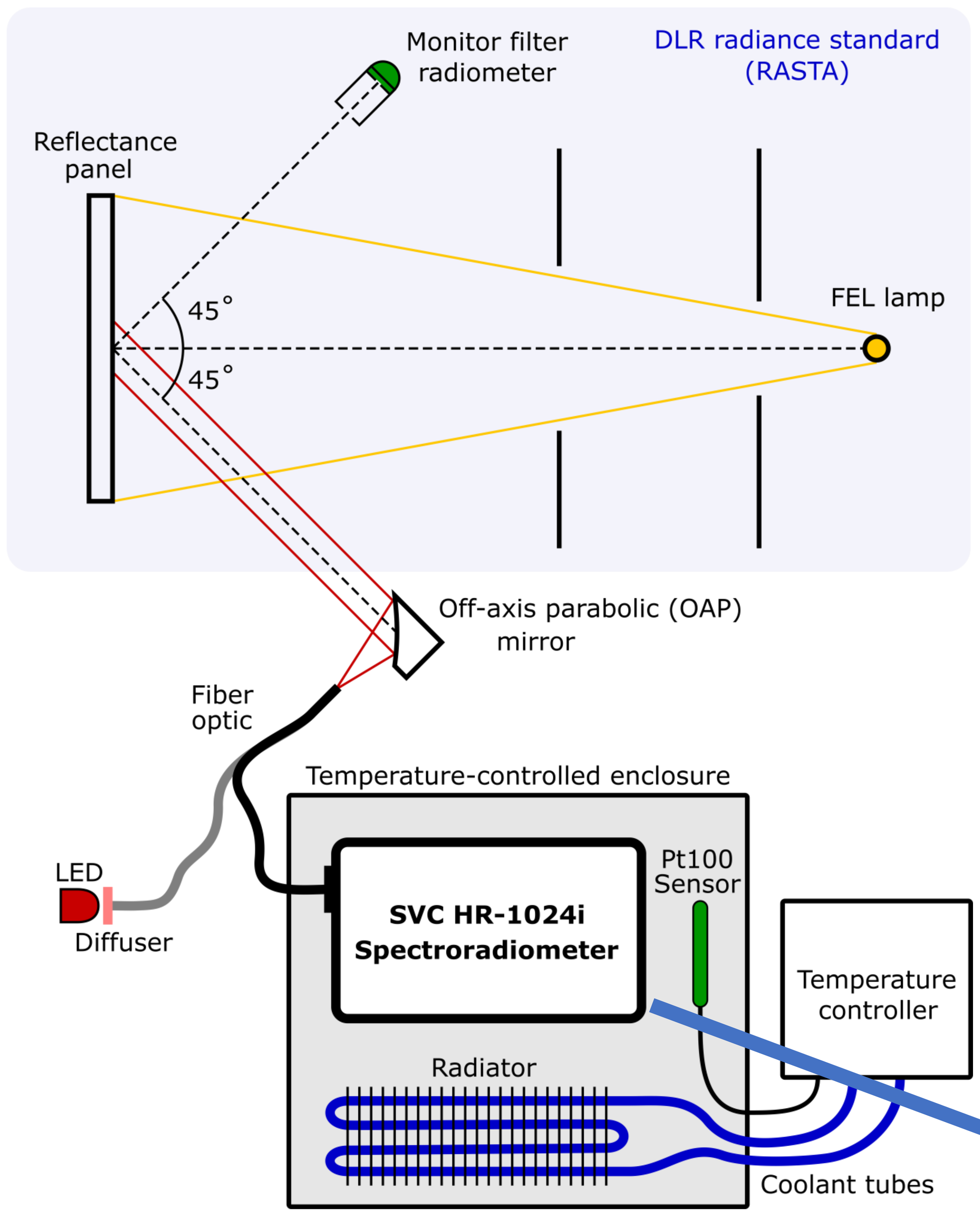
Spectroradiometer Calibration for Radiance Transfer Measurements

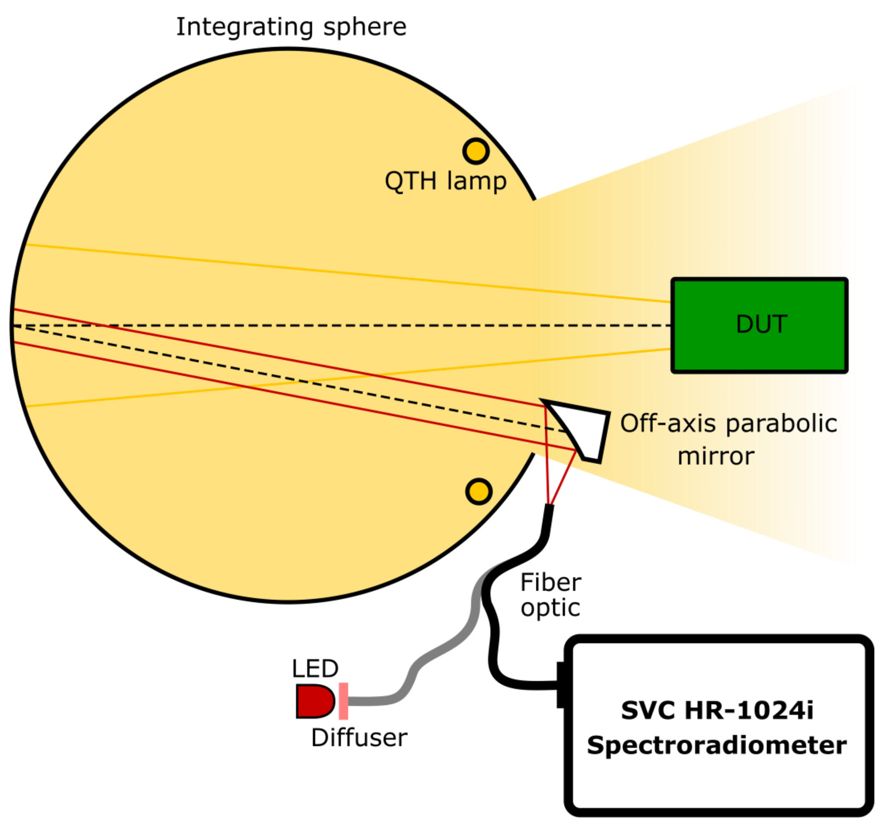
Clemens Rammeloo[1*], Andreas Baumgartner[1†]

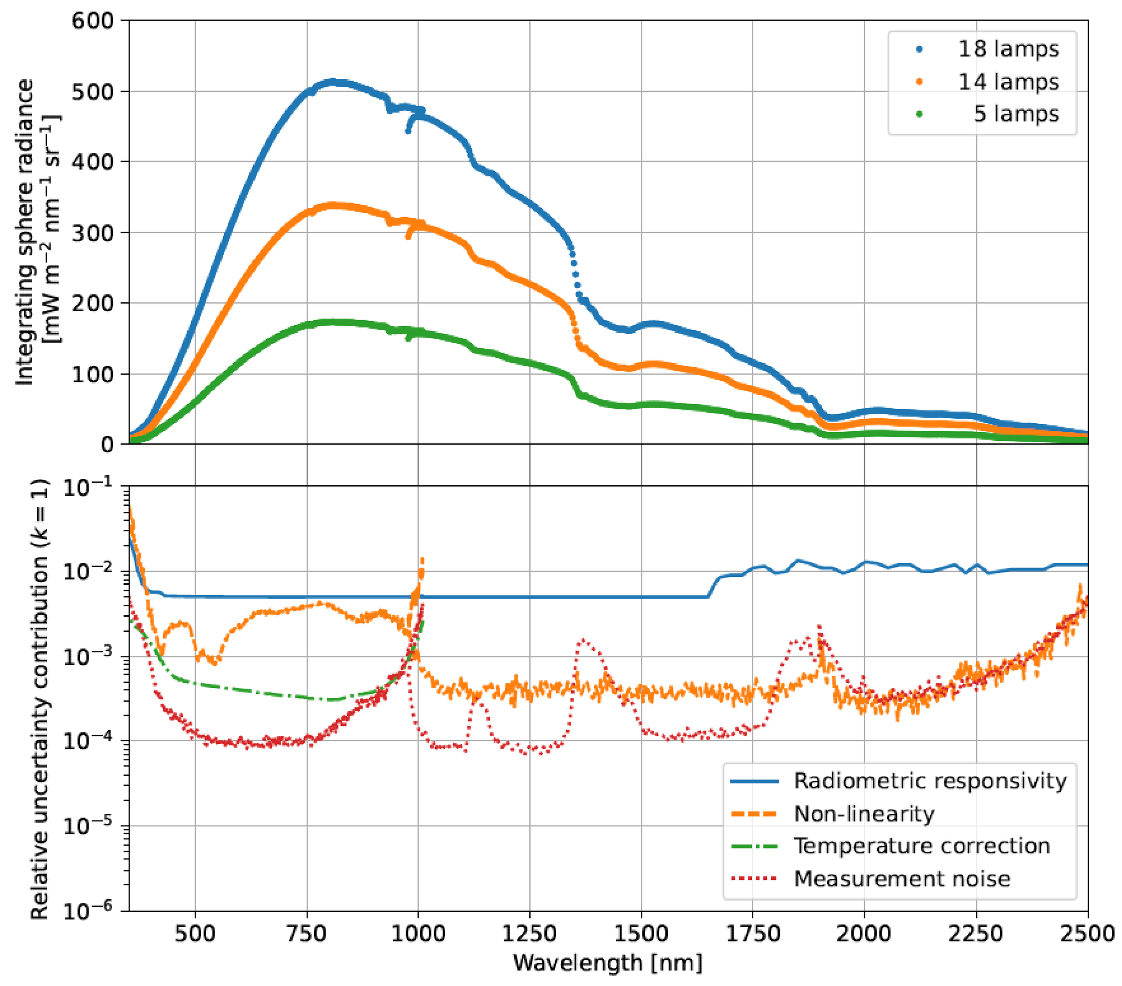
[1]German Aerospace Center (DLR), Remote Sensing Technology Institute
*Now at National Physical Laboratory, Teddington, UK, clemens.rammeloo@npl.co.uk
† andreas.baumgartner@dlr.de

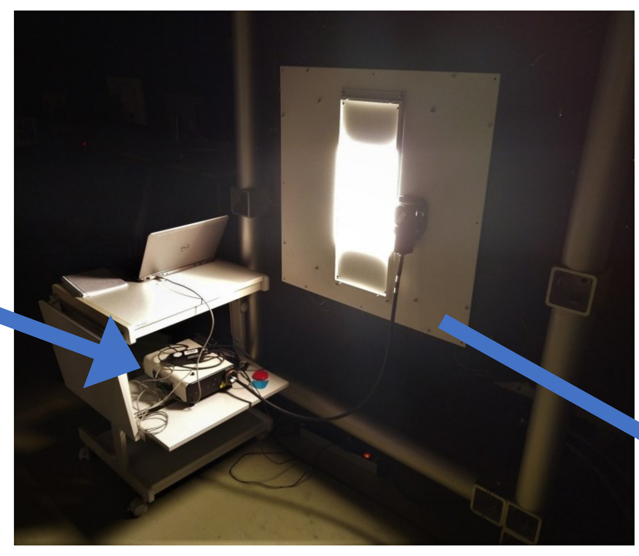
The SI-traceable spectral radiance from the DLR Radiance Standard (RASTA) [1] is transferred to a large integrating sphere with a spectroradiometer (SpectraVista Corp. HR-1024i) [2].



Integrating sphere radiance determined with calibrated spectroradiometer







Relative uncertainty in radiance measurements limited by spectral radiance standard to 1% - 3% ($k = 2$).

Traceable radiance from the integrating sphere of the Calibration Homebase [3] is applied in radiometric calibrations of imaging spectrometers, such as:

- APEX [4]
- EnMAP [5]
- specMACS [6]

Spectroradiometer Measurement Equation

$$S = R\, t_{int,d}\left[1 + C_T(T_d - T_{ref})\right]\int_0^{\infty} G(\lambda - \lambda_c) L_\lambda(\lambda)\,\mathrm{d}\lambda$$

Signal $[DN]$

Integration time $[ms]$

Detector temperature $[°C]$

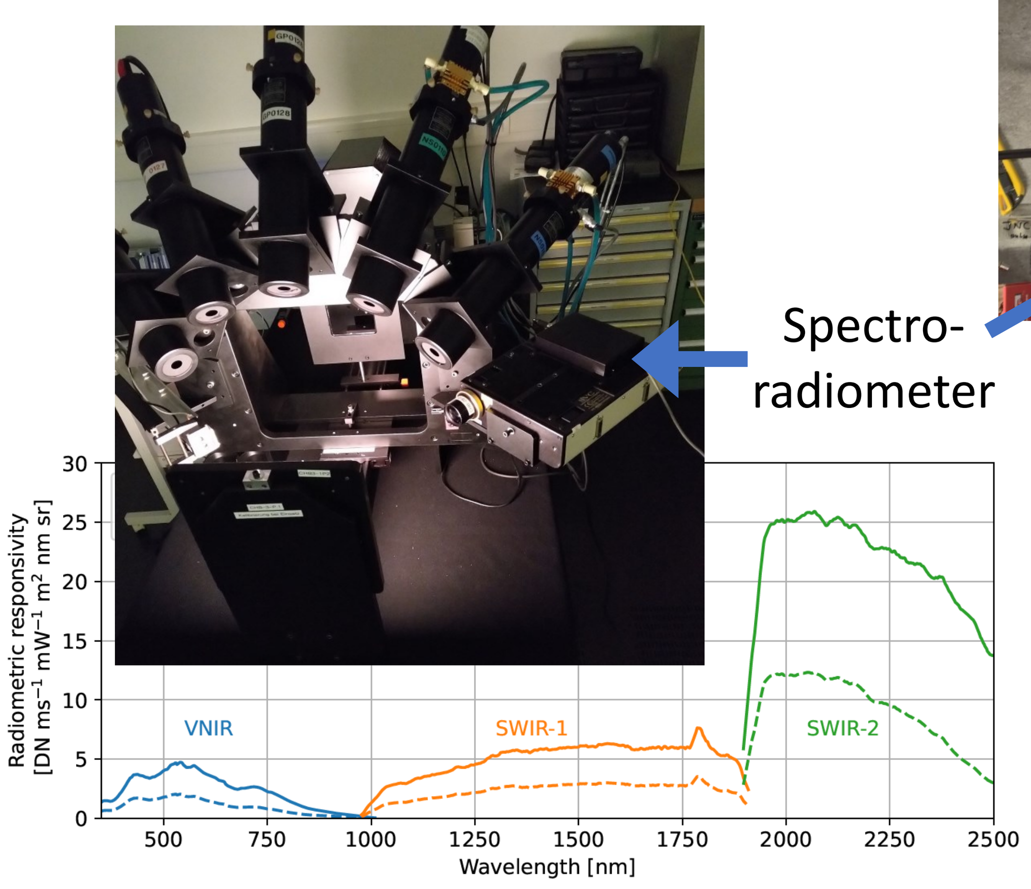
Spectral radiance $\left[\frac{mW}{m^2\ nm\ sr}\right]$

Radiometric responsivity $\left[\frac{DN\ m^2\ nm\ sr}{mW\ ms}\right]$

Temperature coefficient $[1/°C]$

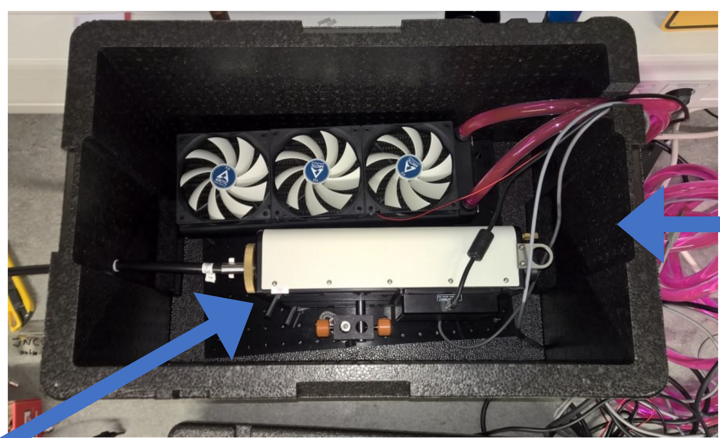
Normalised spectral response function (SRF) $[1/nm]$

Radiometric calibration with RASTA

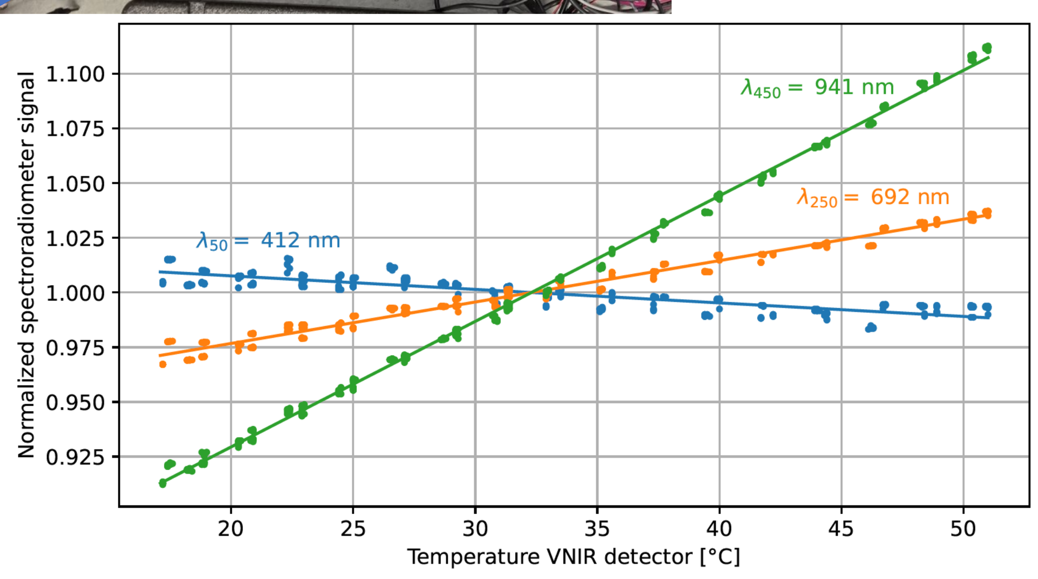


Spectro-radiometer

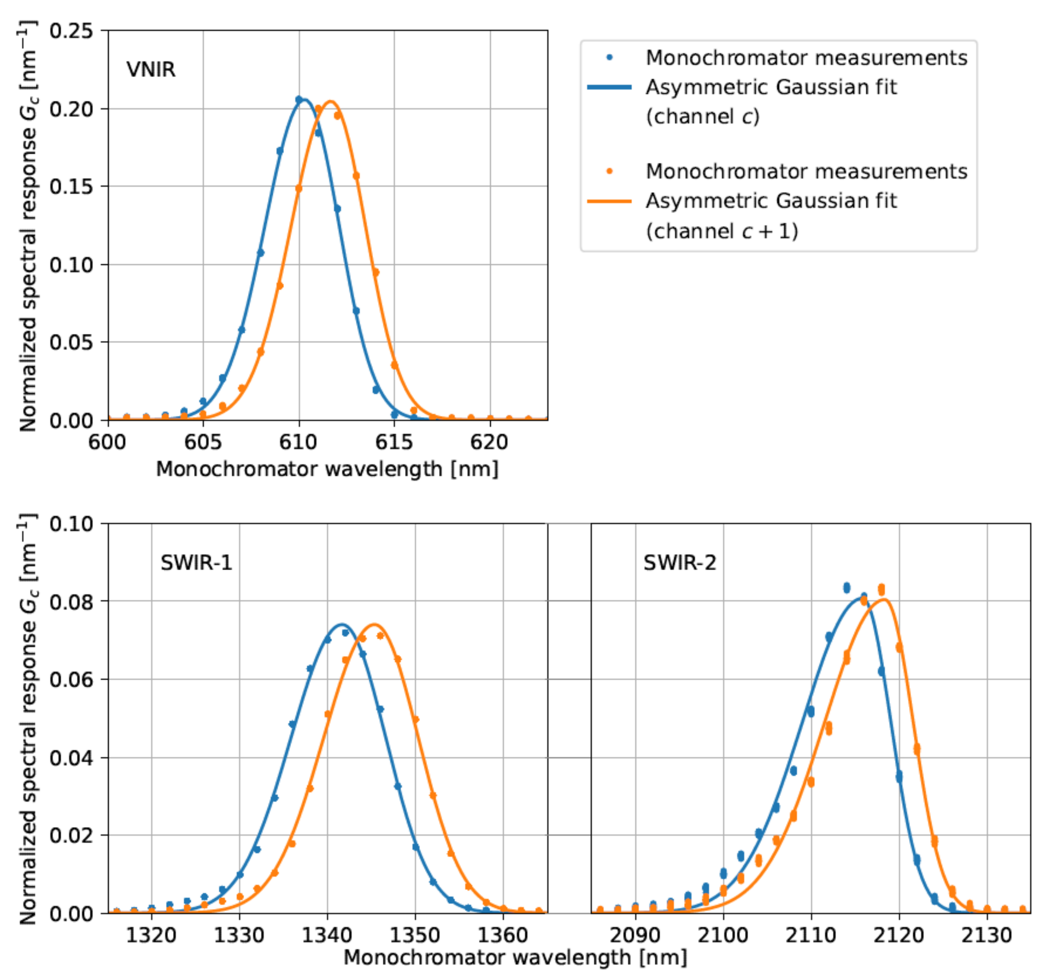
Temperature dependence measurements



Enclosure with controlled air-temperature



Spectal response calibration with monochromator measurements



[1] Taubert, D.R.; et al. "Providing radiometric traceability for the calibration home base of DLR by PTB". Proc. AIP Conf. 1531, 376 (2013). DOI: 10.1063/1.4804785
[2] Rammeloo, C.; Baumgartner, A. "Spectroradiometer Calibration for Radiance Transfer Measurements". Sensors 23, 2339 (2023). DOI: 10.3390/s23042339
[3] DLR Remote Sensing Technology Institute. "The Calibration Home Base for Imaging Spectrometers". Journal of large-scale research facilities, 2, A82 (2016). DOI: 10.17815/jlsrf-2-137
[4] Schaepman, M.E.; et al. "Advanced radiometry measurements and Earth science applications with the Airborne Prism Experiment (APEX)". Remote Sens. Environ. 158, 207 (2015). DOI: 10.1016/j.rse.2014.11.014
[5] Polz, L.; et al. "Setups for alignment and on-ground calibration of the EnMAP hyperspectral imager". Proc. ICSO Conf. (2020). DOI: 10.1117/12.2600240
[6] Ewald, F.; et al. "Design and characterization of specMACS, a multipurpose hyperspectral cloud and sky imager". Atmos. Meas. Tech. 9, 2015 (2016). DOI: 10.5194/amt-9-2015-2016