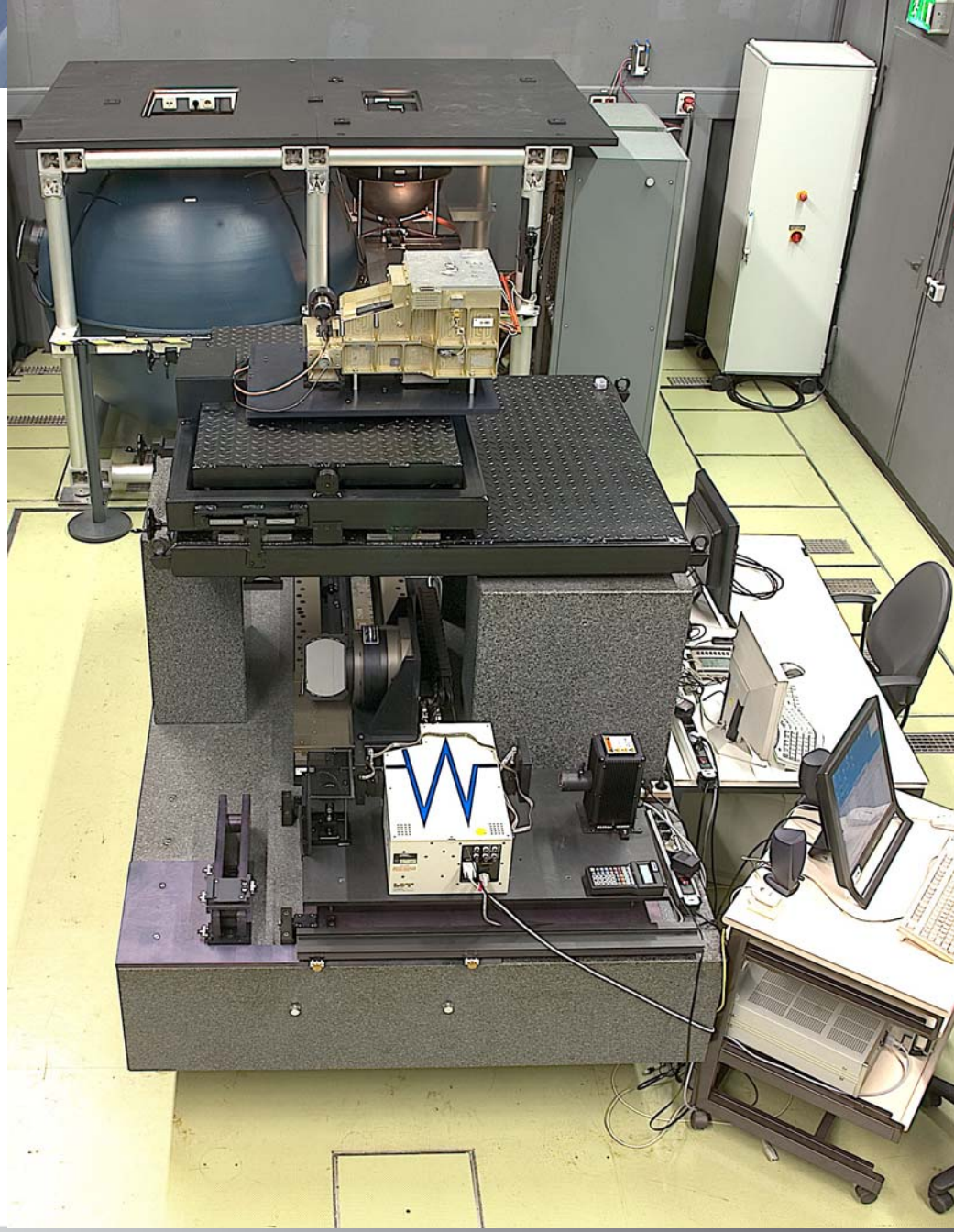
4th HYPER-I-NET Summerschool 2010

General introduction to CHB

P. Gege, DLR, 13 Sept. 2010

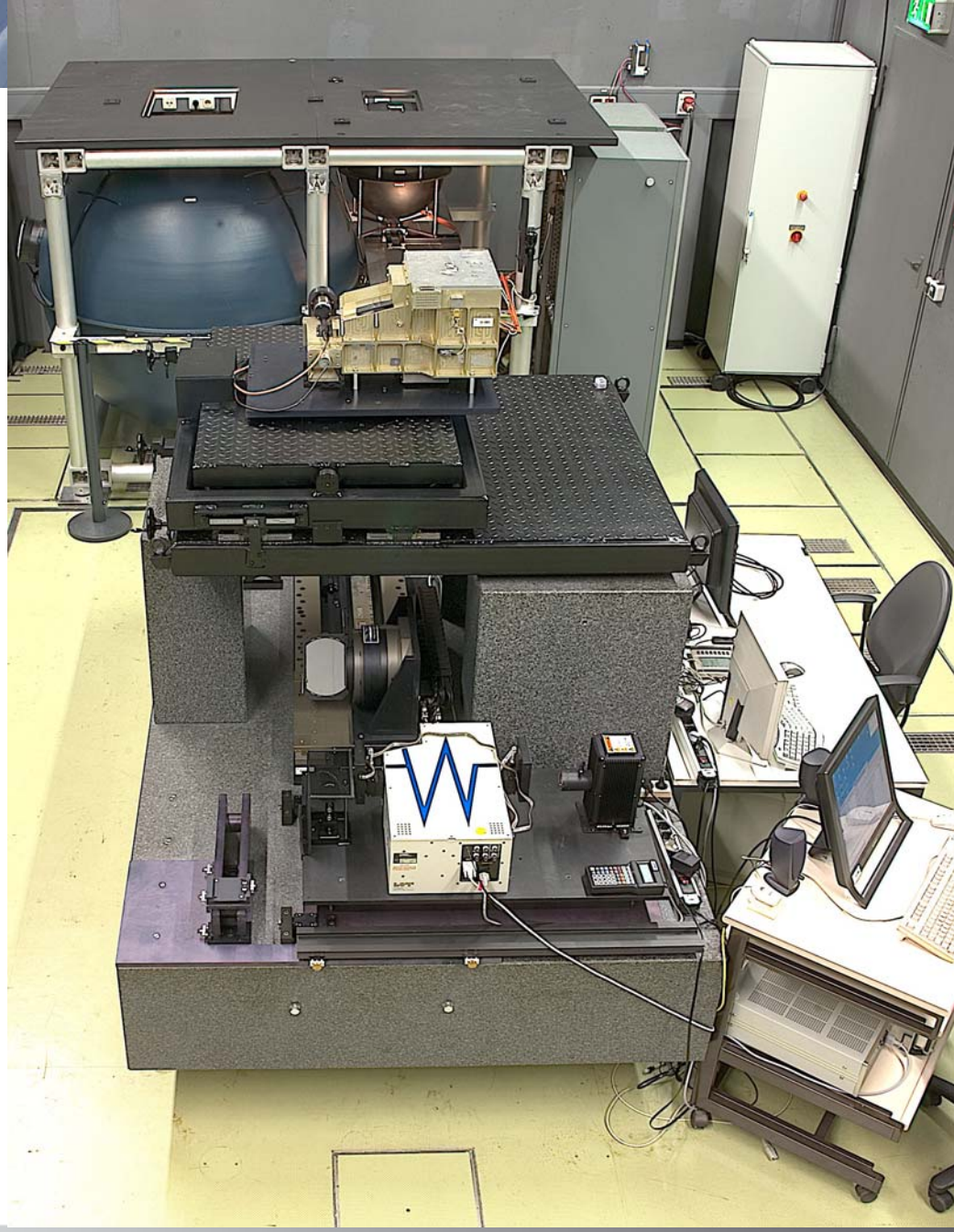
Introduction

- Funded partly by ESA to establish **Calibration Home Base (CHB)** for APEX
- Designed for hyperspectral sensors similar to APEX
  - Mass: 170 kg (excl. adapter)
  - λ-range: 380–2500 nm
  - Bandwidth: 5–10 nm
  - IFOV: 0.48 mrad
  - FOV: ±14°
- Operational since 2007.



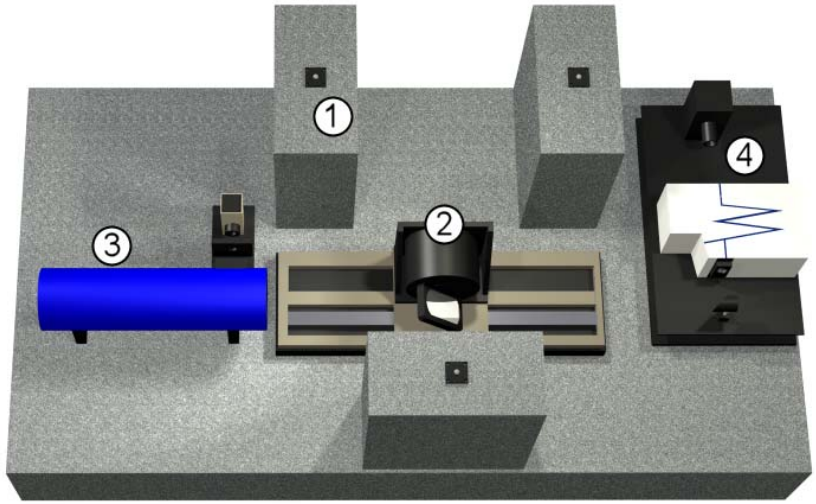
Premises

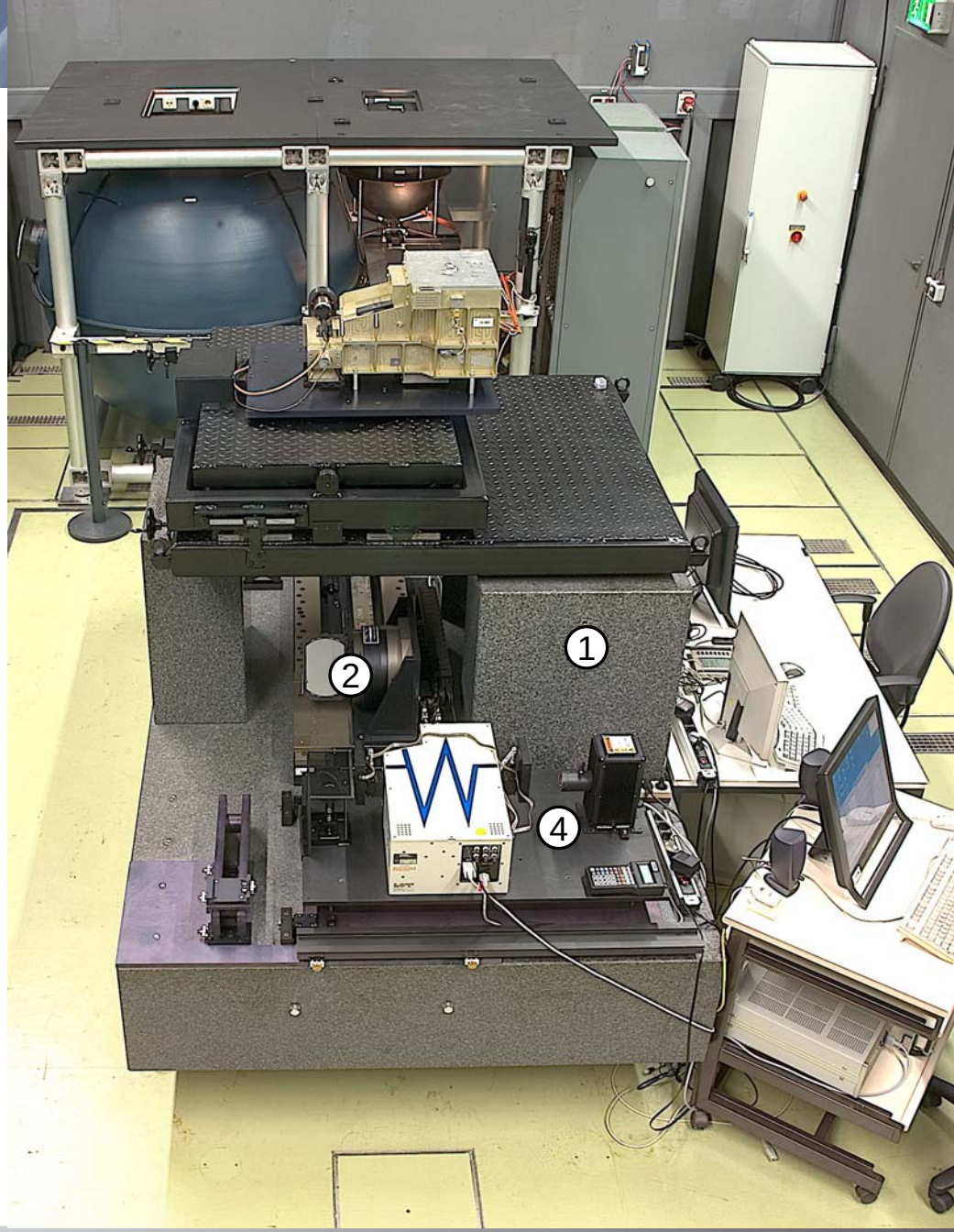
- Close to airfield of DLR Oberpfaffenhofen
- Suited for bulky and heavy instruments up to 500 kg (incl. adapter)
- Sensor in same position as in aircraft
- Sensor stable on vibrationally isolated calibration bench
  - Spectral calibration
  - Geometric calibration



Folding mirror concept

1. Pillar bearing instrument + adapter
2. Folding mirror
3. Assembly for geometric measurem.
4. Assembly for spectral measurem.

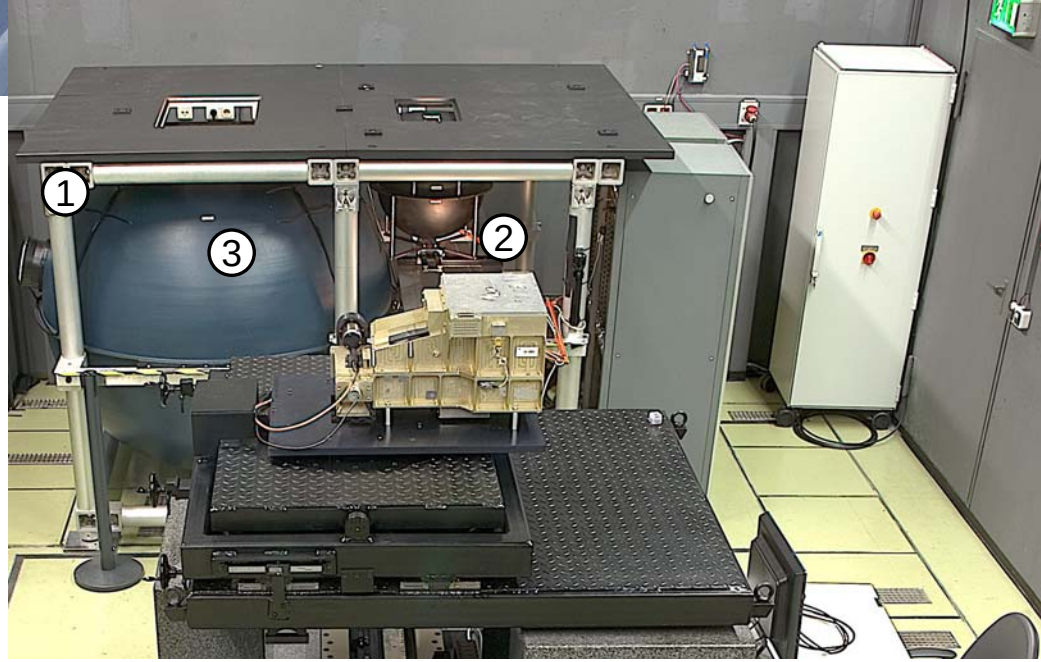


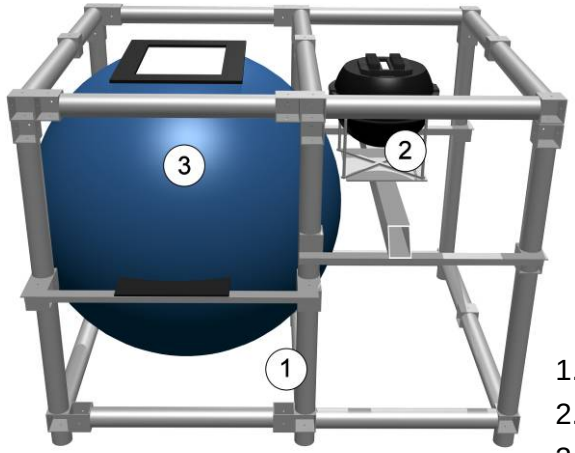


Flat-field measurements

Large integrating sphere

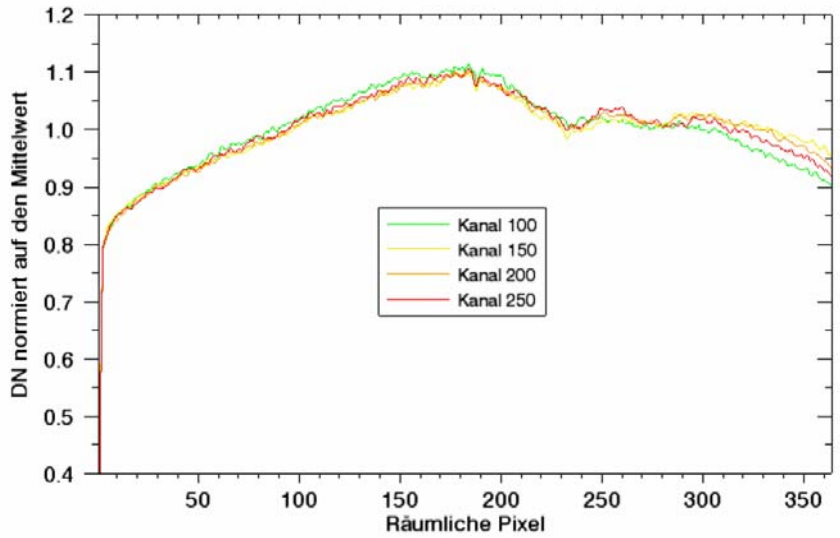
- ∅ 1.65 m
- Aperture 55 x 40 cm²
- Inhomogeneity < 0.5 % rms
- 18 lamps
- Various radiance levels (57 – 1524 W m^{-2})





1. Frame
2. Small integrating sphere
3. Large integrating sphere

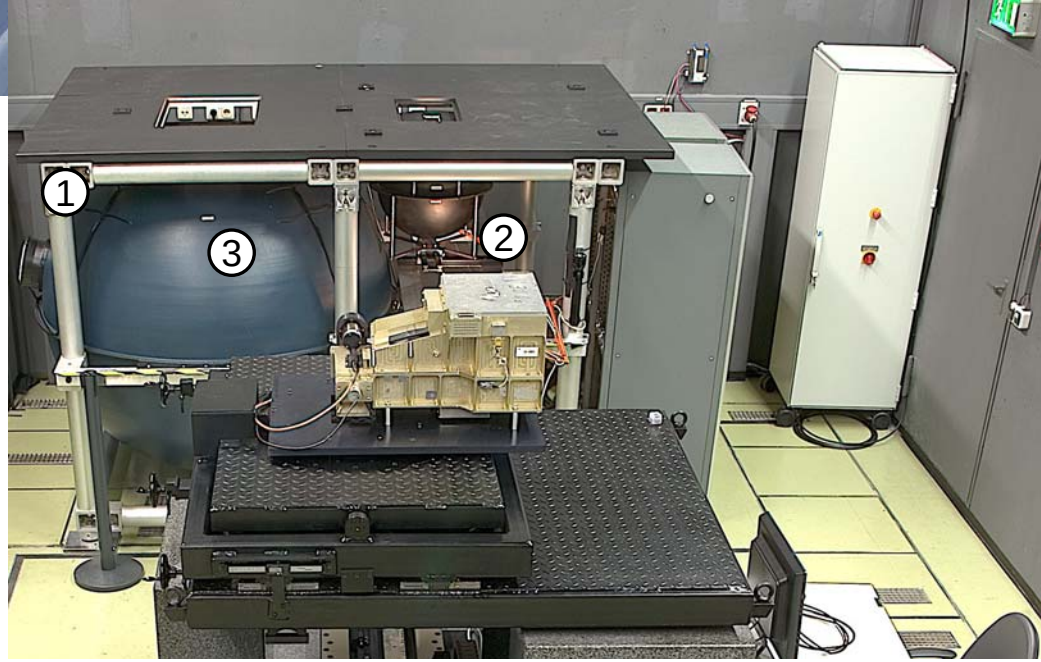
AISA (Kuhlbach 2008)

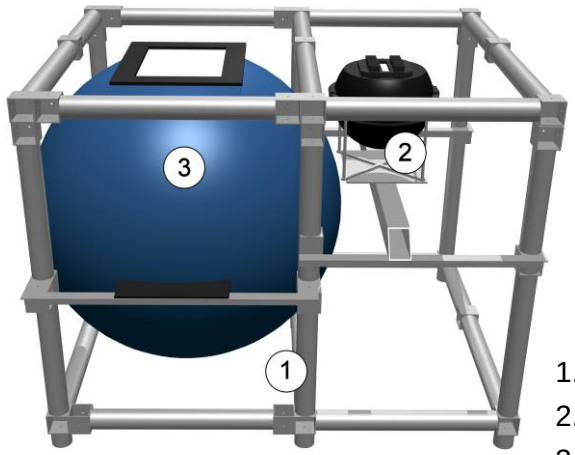


Radiometric calibration

Small integrating sphere

- ∅ 0.50 m
- Aperture 4 x 20 cm²
- Traceable to PTB
- Uncertainty (k=2) 1 % in VIS





1. Frame
2. Small integrating sphere
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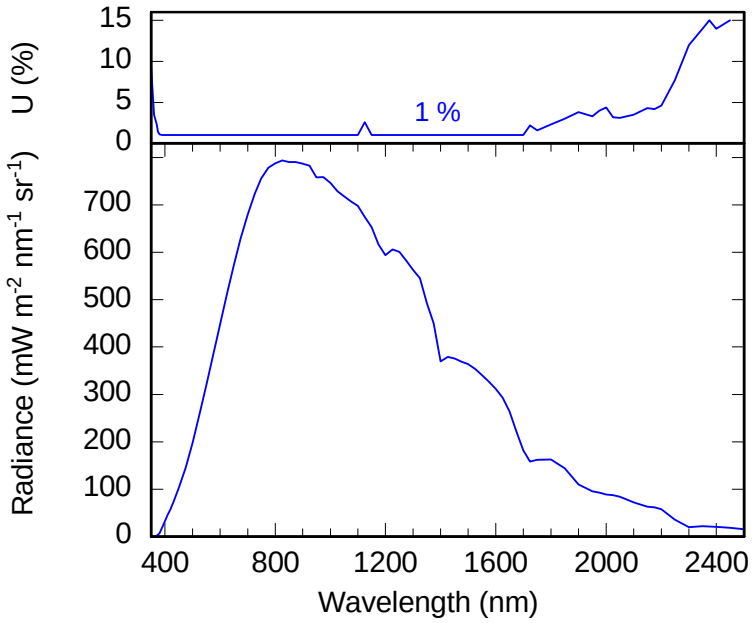
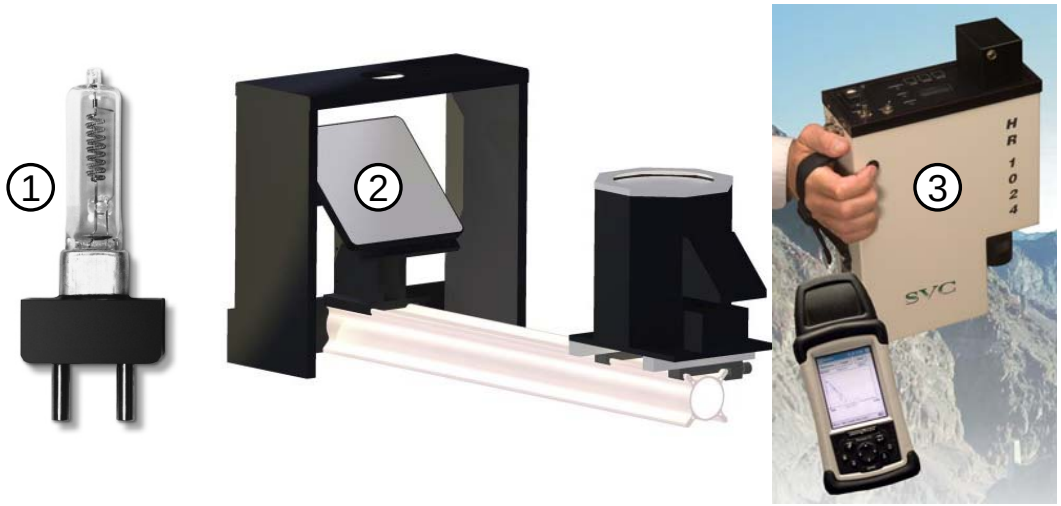


Absolute radiometric calibration of radiance sources

New



Relative radiance

1. Calibrated halogen lamp
2. Calibrated diffuser
3. Spectrometer

Absolute radiance

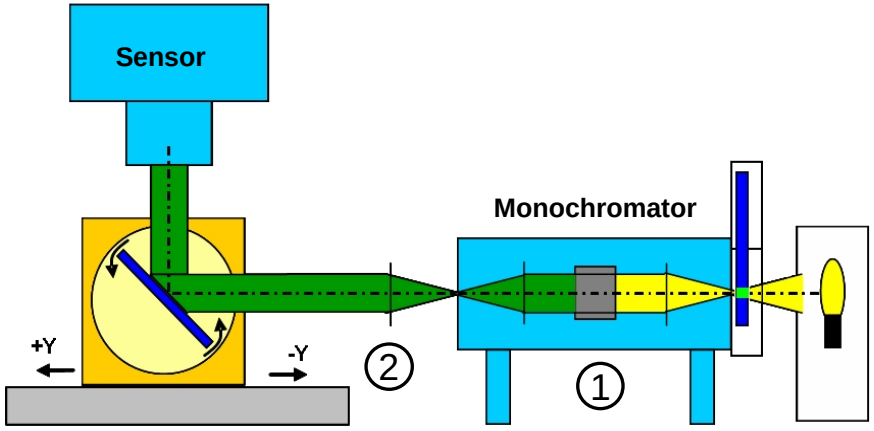
4. 5 Filter radiometers

Uncertainty (1σ)

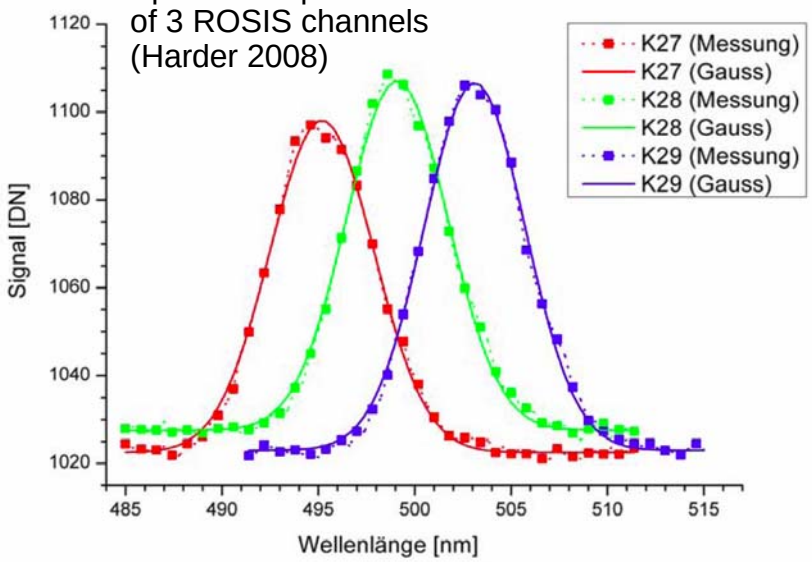
- 1.5 % at 0.35-1.7 µm (2011)
- 2.5 % at 1.7-2.5 µm (2012)

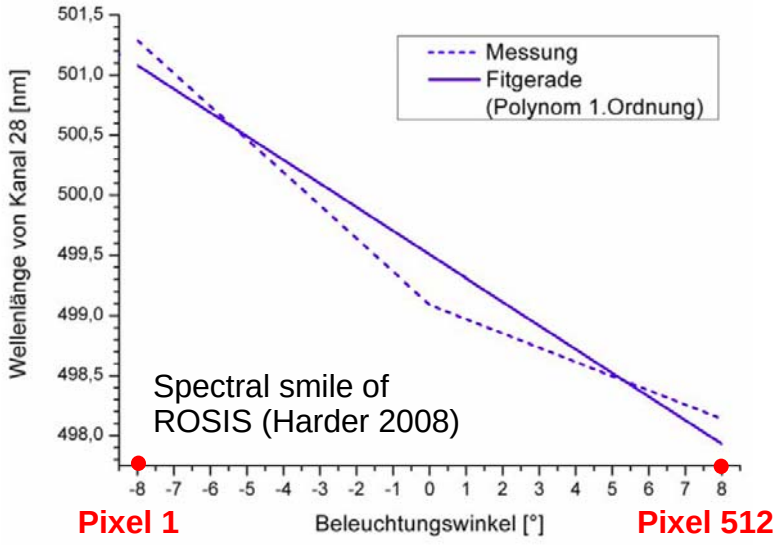
Spectral measurements

1. Monochromator Oriel MS257
   - Range: 0.38–14 µm using 7 gratings
   - Uncertainty: ± 0.1 nm
   - Spectral bandwidth: > 0.1 nm (depending on grating and slit width)
2. Parabolic mirror
   - f = 119 mm
   - Beam divergence ~ 0.8 x 8 mrad²
   - Beam cross section ~ 3 x 4 cm²



Spectral response function of 3 ROSIS channels (Harder 2008)

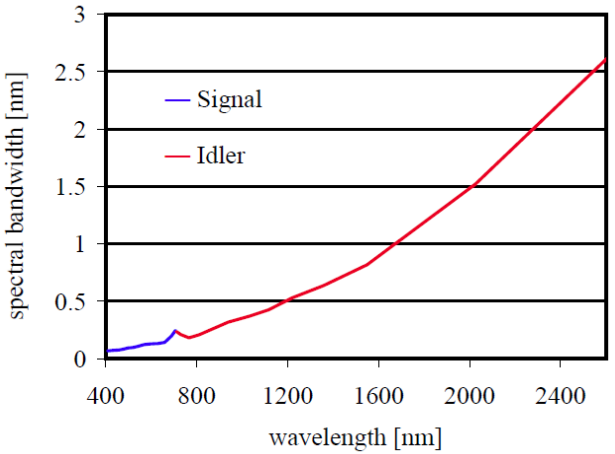




Spectral smile of ROSIS (Harder 2008)

Spectral measurements: Tunable laser

New



Specifications

- Range: 0.4 – 2.5 µm
- Resolution: 3 – 7 cm^{-1}
- Repetition rate: 10 Hz

Advantages

- High energy
- No sensor alignment
- All pixels simultaneous

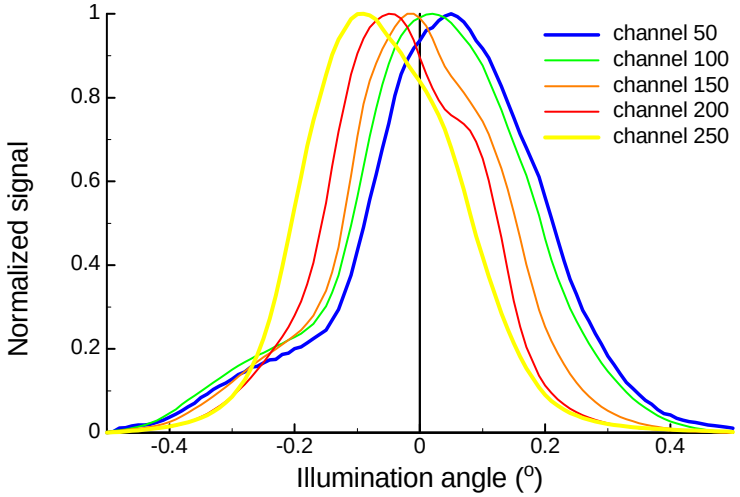
Disadvantages

- High safety requirements
- Fix bandwidth
- Pulsed (not suited for scanners)

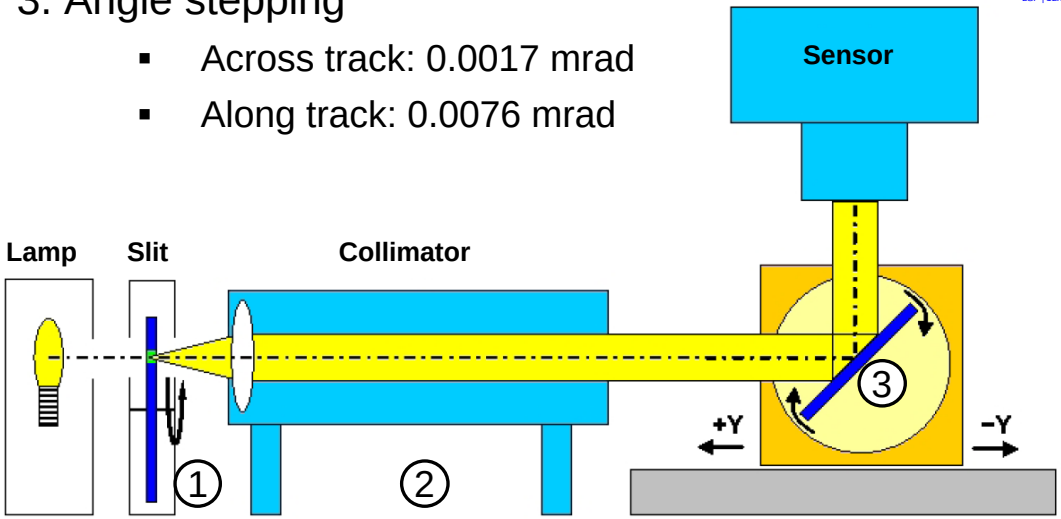
Geometric measurements

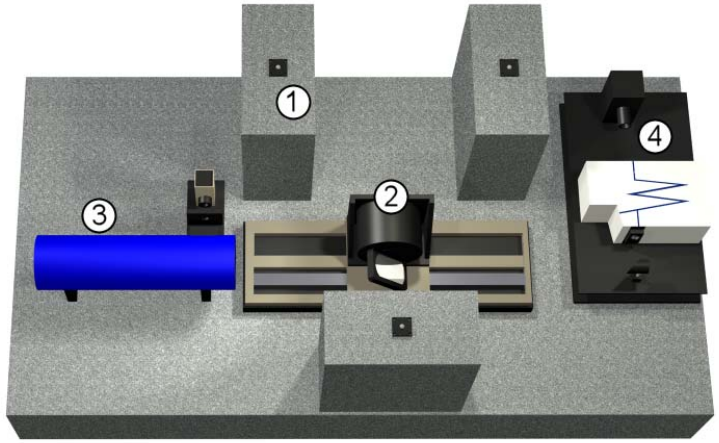
1. Slit wheel
   - 3 horizontal + 3 vertical slits
   - Widths: 50, 100, 1000 µm
2. Collimator
   - f = 750 mm
   - Divergences: 0.067, 0.13, 1.3 mrad
   - Beam cross section: ∅ 12 cm
3. Angle stepping
   - Across track: 0.0017 mrad
   - Along track: 0.0076 mrad

LSFs of AISA pixel no. 192
(adapted from Suhr 2008)



LSF | 12.3.2009

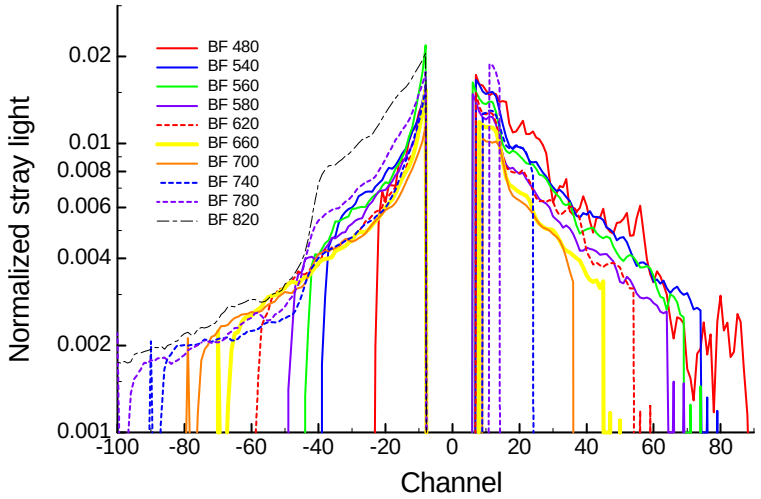




Auxiliary measurements

- Detector linearity
  - Small sphere and neutral density filters
- Spectral stray light
  - Monochromator
  - Small sphere and bandpass filters
  - New: Tunable laser
- Spatial stray light
  - From inside FOV: set-up for geometric measurements (LSF)
  - From outside FOV: large sphere and reflectance targets
- Polarisation
  - 3 linear polarisers 0.47 – 2.5 µm

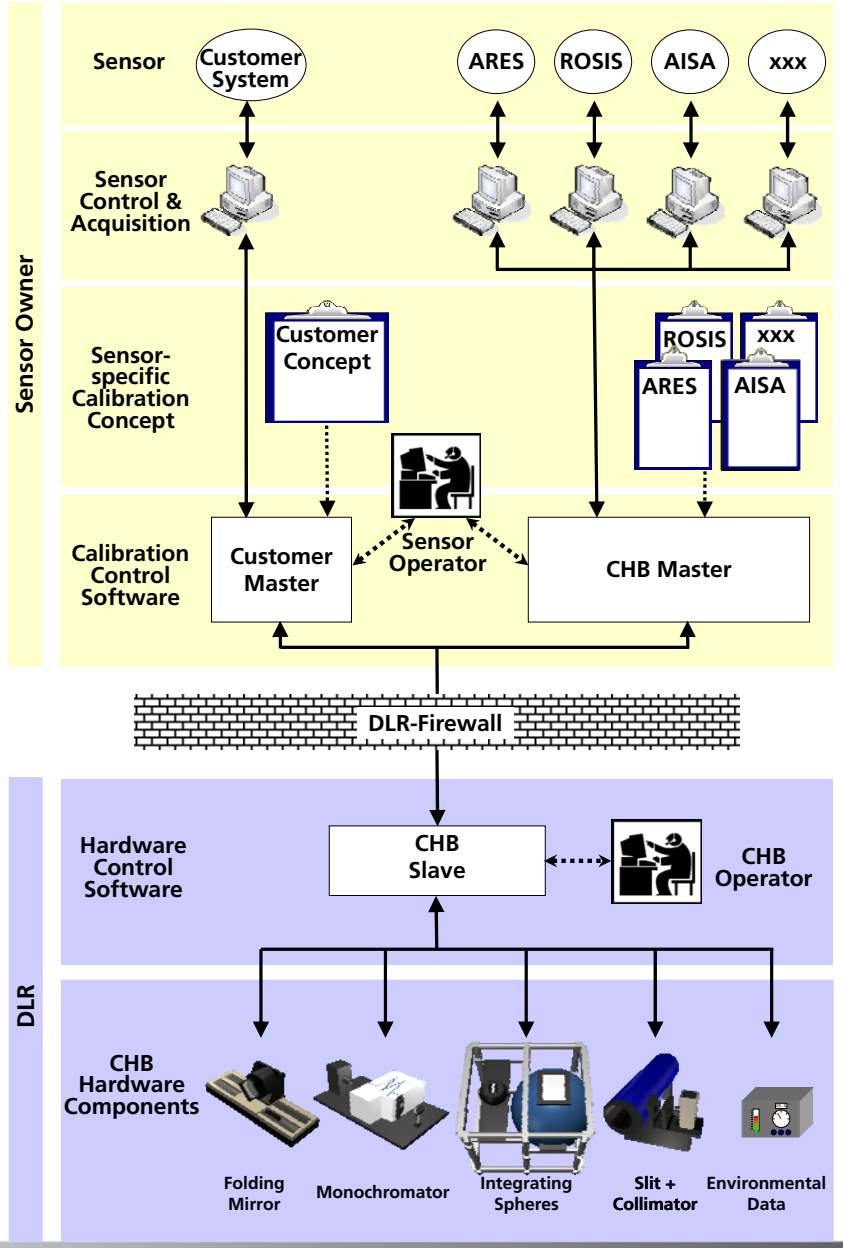
Spectral stray light in ROSIS
(Damm 2007)



STREUSTRAHLUNGSANTEILE | 11.3.2009

Computer control

- CHB Slave
  - Controls CHB hardware components
- CHB Master
  - Measurement concept
  - Commands sensor
  - Commands CHB slave



Summary and schedule

- Facility for characterisation of airborne imaging spectrometers and field spectrometers
  - Bulky and heavy instruments up to 500 kg
  - Spectral range: 380 – 2500 nm
  - Radiometry
  - Spectroscopy
  - Geometry
- Continuosly upgraded
  - Tunable laser
  - Transfer radiometer

- Visit: Today 13:00 – 14:15 h (4 groups; C. Schwarz, DLR)
- Round-robin experiment for field spectrometers: Tuesday and Wednesday (4 groups; L. Suarez, RSL + C. Schwarz, DLR)