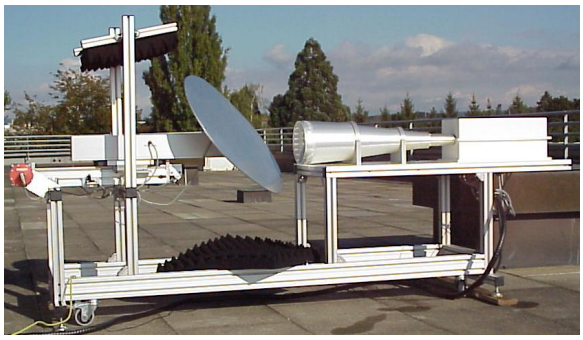
GROUND–BASED MEASUREMENTS OF MIDDLE ATMOSPHERIC WATER VAPOR USING A MICROWAVE RADIOMETER

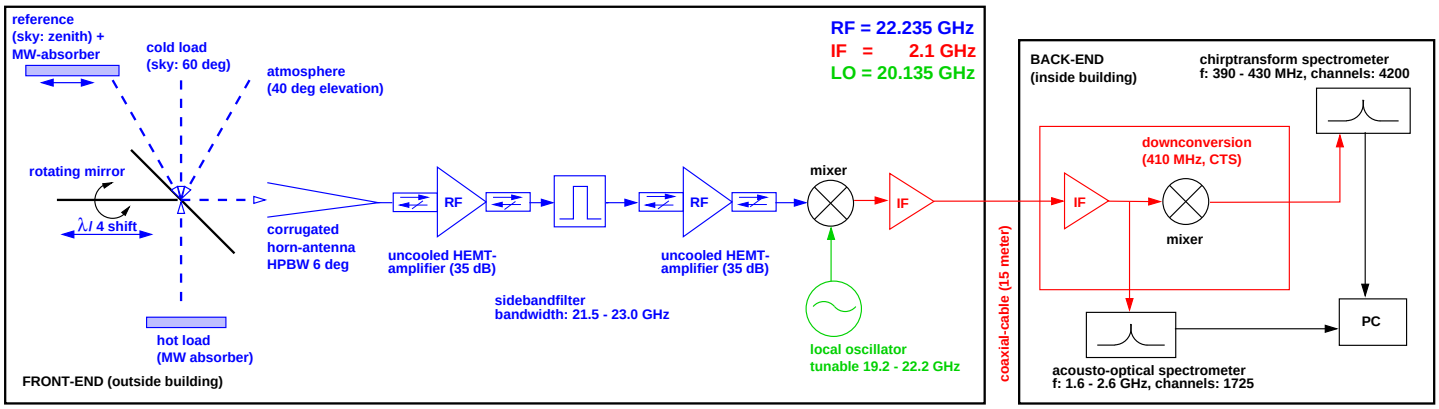
B. Deuber, D. G. Feist and N. Kämpfer
Institute of Applied Physics, University of Bern, Switzerland
e-mail: beat.deuber@mw.iap.unibe.ch

Atmospheric water vapor is a major field of the research activities at the Institute of Applied Physics (IAP) at the University of Bern. In order to enhance these activities we developed a new ground-based radiometer called MIAWARA (**MI**ddle **A**tmospheric **WA**ter Vapor **RA**diometer) which provides stratospheric and mesospheric water vapor profiles in the range of 30-70 km by measuring the microwave emission line of $H_2{}^{16}O$ at 22.235 GHz.
The instrument has started operation in Winter 2001/2002. Atmospheric spectra taken in April 2002 show promising results. We plan to derive middle atmospheric water vapor profiles from these spectra (inverse problem).
The instrument is currently operating from the roof of our institute. After this testing period we plan to operate the instrument in the frame of NDSC (Network for Detection of Stratospheric Change) and during campaigns.



The radiometer MIAWARA on the roof of the Institute of Applied Physics at Bern, Switzerland (46.95 N / 7.45 E, 550 m. above sea level).

Block scheme of the instrument



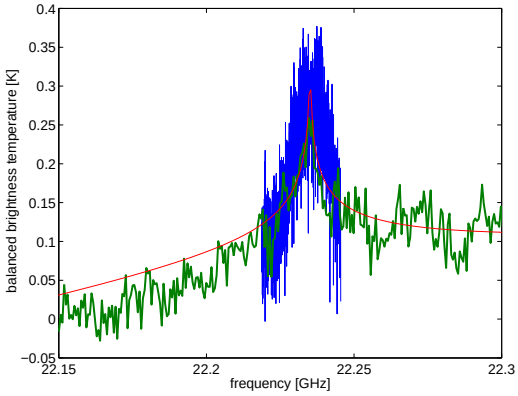
Calibration Technique

We determine the water vapor spectrum by performing a balancing-calibration using the sky as reference signal (zenith) and cold calibration target (60 deg elevation). The use of the sky as calibration target and the correction of the tropospheric attenuation on the middle atmospheric emission line require knowledge of the tropospheric properties. We determine these properties with the same instrument (tipping curve calibration). This calibration technique is validated with periodic liquid-nitrogen calibrations. The results of both calibration techniques agree within ± 1%.

Key-parameters of the instrument

Calibration technique	Balanced calibration (4 mirror positions: atmospheric signal, reference, hot load, cold load)
Operational mode	Single sideband (SSB) 50 dB sideband suppression
Mirror	Plane mirror (gaussbeam optimised shape)
Antenna	Corrugated horn (HPBW 6 deg)
Receiver noise-temperature	133 K SSB
Radio-frequency range	21.735 – 22.735 GHz
Broadband spectral analysis	Acousto-optical spectrometer (f: 1.6–2.6 GHz, Δf: 0.58 MHz)
Narrowband spectral analysis	Chirptransform spectrometer (f: 390–430 MHz, Δf: 9.5 kHz)

Acknowledgements Beat Deuber's work was supported by the Swiss National Science Foundation under grant NCCR climate. We like to thank the Institute of Meteorology and Climate Research at Forschungszentrum Karlsruhe, Germany for lending us their chirptransform spectrometer.



Measured balanced spectrum from April 2002

The measured spectra (blue: narrowband spectrometer; green: broadband spectrometer; integration-time: 1.4 hours) are corrected for tropospheric attenuation. The red line shows a spectrum calculated from a standard water vapor profile.