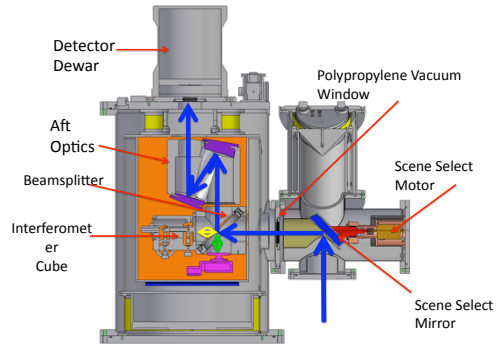


FIRST Observations of Far-Infrared Spectra During the RHUBC-II Campaign

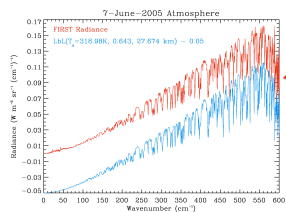
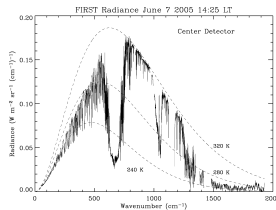
M. Mlynczak, R. Cageao, D. Johnson, A. Alford, D. Kratz, J. Lee, G. Farnsworth
 NASA Langley Research Center, Hampton, VA

FIRST Instrument Description



Instrument Parameters

- Michelson Interferometer
- 6 to 100 μm on a single focal plane
- 0.625 cm^{-1} unapodized (0.8 cm OPD)
- $0.47 \text{ cm}^2\text{sr}$ optical throughput (realized)
- 10 discrete detector focal plane (sized for 100 @ 10×10)
- Germanium on polypropylene beamsplitter
- Bolometer (COTS) detectors @ 4 Kelvin
- NE Δ T – Realized 0.2 K over most of wavelength range
- Demonstrated on high-altitude balloon flight June 7 2006
- Second balloon flight September 18 2006

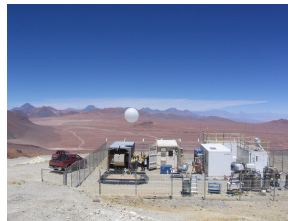


Excellent representation of spectral features relative to theory

RHUBC-II Campaign Overview

Location: Cerro Toco, Atacama Desert, Chile
 Altitude: 17,600 Feet
 Surface pressure: 520 hPa
 Typical PWV: 0.1 to 0.5 mm
 Typical Temperature: 0°C at surface

Science Goal: Radiative Closure in Far-IR



On site at Cerro Toco
 Radiosonde launch
 Sky on typical good day

FIRST Calibration and Measurements

- FFT of double-sided interferogram (no zero-padding, sampled once per He-Ne laser fringe, or 6x over-sampling of IR fringes) trimmed and centered for 0.643 cm^{-1} unapodized resolution.
- Two temperature reference blackbody calibration (ambient $\sim 280\text{K}$ and warm $\sim 320\text{K}$). Complex responsivity and offset determined for each detector.
- Phase correct each interferogram, minimizing complex imaginary part in transformed spectra to correct for sampling, beamsplitter dispersion, and other linear and non-linear frequency phase offsets.

- Average three simultaneous detector spectra over 6 minutes to produce archived spectra

• **Data Product: Spectral Radiance 80 to 2000 cm^{-1}**

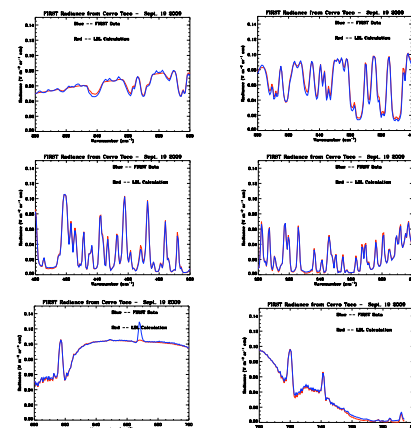
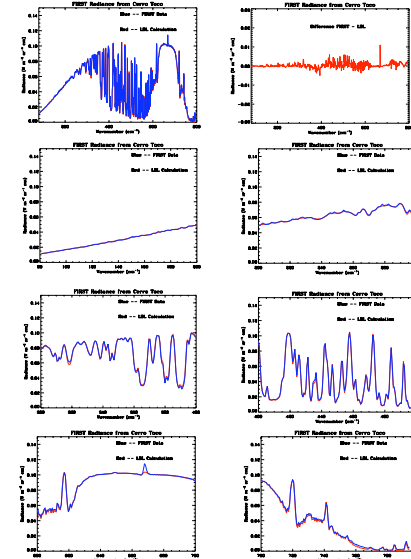
Comparison with Theoretical Radiance

- Comparisons against MRTA Line-by-Line Code (Kratz, 2008) 2008 abundances of:
 CO_2 , CH_4 , N_2O , CO , CFC-11, CFC-12, CFC-22, CCl_4 , CF_4 , SF_6 , O_3 from Mid-latitude Winter atmosphere
 H_2O temperature & pressure from RHUBC-II Radiosonde
 2008 HITRAN Database; MT_CKD 2.1 Continuum code

• **LBL calculations with FIRST instrument function & resolution**

Results

- Two days illustrated below:
 September 5, 2009, a “wet” day, PWV = 0.75 mm
 September 19, 2009, a “dry” day, PWV = 0.4 mm



Initial comparisons appear excellent

~ 75% of available FIRST data uploaded to the RHUBC archive