

CO₂ rotational temperatures from the SOIR instrument on board VEx

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The SOIR instrument performs solar occultation measurements in the IR region (2.2 - 4.3 μm) at a resolution of 0.12 cm^{-1} , the highest of all instruments on board Venus Express. It combines an echelle spectrometer and an AOTF (Acousto-Optical Tunable Filter) for the order selection.

The wavelength range probed by SOIR allows a detailed chemical inventory of the Venus atmosphere at the terminator in the upper mesosphere and lower thermosphere (70 to 170 km) with an emphasis on vertical distribution of the gases. In particular, measurements of CO₂ density vertical profiles have been routinely performed. From these density measurements, kinetic temperature profiles are derived using the hydrostatic equilibrium. A permanent cold layer is observed at the mesopause ($\sim 120 \text{ km}$).

A different and independent method is developed here, making use of the information obtained from the rotational structure of the CO₂ bands to derive rotational temperature profiles. The rotational temperature profiles are compared to the hydrostatic temperature profiles, and they confirm the presence of the cold layer at the mesopause. At higher altitudes (above 140 km) there are systematic differences between them, although the sensitivity to the rotational structure is smaller. These differences will be discussed in view of the non-LTE theory, and in order to design future observations with SOIR.