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Winds and Temperatures in Venus Upper Atmosphere from High-Resolution Infrared Heterodyne Spectroscopy

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Narrow non-LTE emission lines of CO_2 at 10μm are induced by solar radiation in Venus upper atmosphere. Measurements of fully resolved emission lines can be used to probe the emitting regions of the atmosphere for winds and tempertaures. Using infrared heterodyne spectroscopy kinetic temperatures with a precision of 5 K can be calculated from the width of emission lines and wind velocities can be determined from Doppler-shifts of emission lines with a precision up to 10 m/s. The non-LTE emission can only occur within a narrow pressure/altitude region around 110 km.

At the I.Physikalisches Instiut of the University of Cologne we developed a Tunable Infrared Heterodyne Spectrometer (THIS) capable of accomplishing such ground-based measurements of planetary atmospheres. Beside high spectral resolution (R>10^7) infrared observations also provide high spatial resolution on the planet.

Over the last two years we observed wind velocities and temperatures at several characteristic orbital positions of Venus using the McMath-Pierce-Solar Telescope on Kitt Peak, Arizona, USA. This telescope provides a field-of-view of 1.7 arcsec on an apparent diameter of Venus of approximately 20-60 arcsec.

New observations close to inferior conjunction have been accomplished in March and in April 2009 An additional observing run took place in June 2009 at maximum western elongation. These observing geometries allow investigations of wind velocities of different combinations of the superrotational component and the subsolar-antisolar (SS-AS) flow component. Due to the observing geometry during the March and April runs we focused on SS-AS flow. Wind velocities around 140 m/s were found decreasing significantly at high latitudes. No significant superrotational component could be observed and the variability between these two runs was moderate. Data analysis for the run in June 2009 addressing mainly the superrotational component is still in progress.

Retrieved temperatures from all three observing runs show significantly higher values than predicted by the VIRA reference atmosphere.

At the conference we are going to present analyzed data from these runs including a brief comparison to our previous results and other ground-based observations.