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Cassini/CIRS observations of water vapor in Saturn's stratosphere

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Abstract

The Composite Infrared Spectrometer (CIRS) on the Cassini spacecraft has obtained numerous spectra of Saturn at varying spectral and spatial resolutions since Saturn Orbit Insertion in 2004. Emission lines due to water vapor in Saturn's stratosphere were first detected using whole-disk observations from the Infrared Space Observatory [1] and subsequently confirmed by the Submillimeter Wave Astronomy Satellite [2]. CIRS has detected water and the data permit the retrieval of the latitudinal variation of water on Saturn. Emission lines of H_2O on Saturn are very weak in the CIRS data. Thus, large spectral averages as well as improvements in calibration are necessary to detect water vapor. Long integrations at the full 0.5 cm^{-1} spectral resolution were performed at targeted latitudes on Saturn. High emission angles were chosen to enhance stratospheric emission. Over the course of the prime and extended mission a set of observations has been built up spaced roughly every 10 degrees of latitude. Stratospheric temperatures in the 0.5 - 5.0 mbar range were obtained by inverting spectra of CH_4 in the ν_4 band centered at 1304 cm^{-1}.

The origin of water vapor is believed to be from the ablation of micrometeorites containing water ice, followed by photochemistry. This external source of oxygen originates either from the Saturn system (from the rings or perhaps from Enceladus) or from the interplanetary medium. Connerney [3] proposed a mechanism to transport water from the inner edge of the B-ring along magnetic field lines to specific latitudes (50N and 44S) on Saturn. Prange *et al* [4] interpreted a minimum in the abundance of acetylene from ultraviolet spectra near 41S on Saturn as possibly due to an enhanced influx of water. We will be able to test the "ring rain" mechanism by searching for localized water vapor enhancement at mid-latitudes. Our results may be used to constrain photochemical models of Saturn's stratosphere [5].

References

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