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Infrared Variability of Jupiter and Saturn

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Strategy

Infrared spectroscopy provides unique insights into the chemistry and dynamics of the atmospheres of Jupiter and Saturn, and of the enigmatic satellite of Saturn, Titan. The 5 micron spectral region of these objects is transparent to deep levels, and is therefore particularly useful for the identification of molecules that are present at very low (parts per billion) concentrations. In Titan, 5 micron observations probe atmospheric layers at or near the surface. Ground-based spectroscopy complements Voyager, Galileo and Cassini measurements. The spectroscopy is sensitive to lower mixing ratios for selected molecules, while the on-board mass and infrared spectrometers probe molecules and levels that are inaccessible from the ground. The observations also provide time-based data for preparation of the upcoming missions.

Progress and Accomplishments

In the past year we initiated 5 micron observations of Titan with the goal of investigating trace molecular constituents and atmospheric structure. These observations revealed the surprising result that Titan is a factor of 2-3 times fainter at 5 microns than it was at the time of the last observations at this wavelength in 1975. At the present time we do not know the origin of the variability, or if it is a seasonal or orbital effect. Clearly such a major change in brightness has significant implications for the understanding of the atmosphere and/or surface of Titan. We also obtained the first low resolution 5 micron Titan spectrum. The data contain evidence for CO near 4.3 micron, and for an unidentified absorber at longer wavelengths.

Projected Accomplishments

With the discovery of Titan's 5 micron variability, we will concentrate the current year's effort on this object. Observing time has been granted for photometry to follow Titan's infrared brightness during an orbital period. We are also organizing long-term observations to follow Titan during the Saturn year. We believe that such data will be important, both for their intrinsic interest and to support the Cassini-Huygens probe. Intermediate resolution (R=50) observations with the Aerospace Corporation BASS spectrometer have also been scheduled on the IRTF. This multiplexing instrument will provide unprecedented sensitivity to further explore Titan's 5 micron spectral region.

Publications

K. S. Noll and R. F. Knacke 1991, "Discovery of Strong Variability of Titan at 5 μm ," in preparation.