

The Atmospheres of Titan and Saturn in the Infrared from Cassini: The Interplay Between Observation and Laboratory Studies

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The Composite Infrared Spectrometer (CIRS) aboard the Cassini spacecraft has been recording spectra of Saturn and Titan since its arrival in the Saturn system in 2004. CIRS, a Fourier transform spectrometer, observes the thermal infrared spectrum of both atmospheres from 10 to 1500 cm^{-1} with resolutions up to 0.5 cm^{-1} (Flasar et al. 2004). From these data CIRS provides global coverage of the molecular composition of the stratosphere and troposphere, as well as maps of temperature and winds. From such studies CIRS helps reveal the chemistry and evolutionary history of Saturn and Titan and their relationships to other Solar System bodies. The Cassini mission is continuing until 2017, permitting CIRS to search for atmospheric changes during more than a Saturnian season. By combining with results from Voyager (1980, 1981) the baseline becomes more than one Saturnian year (Coustenis et al. 2011).

CIRS spectroscopy of the atmospheres of Saturn and Titan has raised a variety of questions that require new laboratory studies. A complete understanding of the CIRS high-resolution atmospheric spectra cannot be fully achieved without new or improved line positions and intensities for some trace molecules (e.g., Nixon et al. 2009). Isotopic variants of some of the more abundant species often need improved line parameters in order to derive isotopic ratios (e.g., Coustenis et al. 2008 and Fletcher et al. 2009). Isotopic ratios contain information about the history of an atmosphere if experimental fractionation rates are available (Jennings et al. 2009). Some aerosol and haze features continue to defy identification and will not be explained without better knowledge of how these materials are formed and until we obtain their laboratory spectra. The interaction between CIRS investigations and laboratory research has been productive and has already led to new discoveries.

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