

PROBING TITAN'S ATMOSPHERIC COMPOSITION AND EVOLUTION WITH CASSINI CIRS

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Titan's atmosphere is rich in organics and other molecules, and its chemistry is thought to be related to the prebiological chemical evolution on the early Earth. The Composite Infrared Spectrometer (CIRS) is an infrared Fourier Transform Spectrometer on the Cassini orbiter that measures thermal radiation over more than two decades in wavenumber from 10 to 1400 cm^{-1} (1 mm to 7 μm). With its broad spectral coverage, high spectral resolution (0.5 cm^{-1} apodized), and its ability to probe Titan's atmosphere in both the nadir- and limb-viewing modes, it will map Titan's atmospheric composition well beyond previous efforts. We describe planned observations to map the vertical and horizontal distribution of hydrocarbons and nitriles, many of which are condensables on Titan. The resulting maps in the troposphere and middle atmosphere will elucidate not only the photochemical and charged-particle impact processes, but also meridional and vertical transports. There is already evidence from earlier Voyager observations of strong circumpolar winds, which can inhibit mixing between air masses at low and high latitudes, and CIRS will map the composition and thermal structure of such vortices in detail. CIRS will also map the distribution of carbon dioxide, carbon monoxide, and water, elucidating the origin of oxygen-bearing compounds in Titan's atmosphere. Finally, its ability to determine the isotopic ratios of carbon in several molecules, as well as the deuterium to hydrogen ratio, will help constrain evolutionary histories of Titan.