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Exploration of Saturn, its rings, and its moons with the Composite Infrared Spectrometer (CIRS)

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We present early results on the thermal structure and composition of the Saturn system obtained with the thermal-infrared spectrometer on the Cassini orbiter. Although it is southern summer, Saturn's south pole is much warmer than predicted by simple radiative models, suggesting a meridional circulation with subsidence at high southern latitudes. The zonal winds derived from the temperature field exhibit a marked decay with altitude near the equator. If the decrease in winds reported from recent Hubble-Space-Telescope images is not a temporal change, then the features tracked must have been at least 130 km higher than in earlier studies. The C/H ratio on Saturn is 7 times solar, twice Jupiter's, and is at least consistent with the core-accretion model of giant-planet formation. Saturn's ring temperatures have radial variations down to the smallest scale resolved (100 km). The temperatures observed on the unlit side vary from 70-110 K, with higher temperatures occurring in regions of lower optical depth. Surprisingly, the unlit and lit sides of the A ring observed shortly after Saturn orbital insertion had the same derived temperatures, and this may be explained by differences in solar phase angles and the rotation of the ring particles in their orbits about Saturn. Temperatures maps of Phoebe and Iapetus show the effects of topographical relief. Diurnal curves for both satellites imply a thermal inertia that is roughly half that of the Galilean satellites, indicating that the first centimeter below the surface is highly fragmented. Unlike Saturn, Titan's stratospheric temperatures are several Kelvin cooler at the south pole than at the equator, again suggesting a meridional circulation, but with upwelling at the pole. The coldest temperatures are at mid and high northern latitudes. The zonal winds are weakest at high southern latitudes, and strongest in the north. However, the northern circumpolar vortex appears to be very broad and extends to low latitudes. Several organic compounds show a marked enhancement in the northern hemisphere.

The retrieved abundance of stratospheric CH_4 is roughly consistent with tropospheric CH_4 saturating just below the tropopause, and that of stratospheric CO is compatible with an external origin of oxygen compounds.