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Saturn ring temperature variations with changing geometries

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After more than six years in orbit around Saturn, the Cassini Composite Infrared Spectrometer (CIRS) has acquired an extensive set of thermal measurements of Saturn's main rings (A, B, C and Cassini Division) in the thermal infrared. Temperatures were retrieved for the lit and unlit rings over a variety of ring geometries that include solar phase angle, spacecraft elevation and local hour angle. Temperatures were also retrieved at solar elevations ranging from 24 degrees to zero degrees at equinox.

Ring temperatures decreases with decreasing solar elevation for any observational geometry. To first order, the largest temperature changes on the lit face of the rings are driven by variations in phase angle while differences in temperature with changing spacecraft elevation and local time are a secondary effect. Phase curves of ring temperature for a small range of solar elevation typically show about a 5K scatter for any given solar elevation. Some of this intrinsic scatter is a function of ring local time, particle local time and spacecraft elevation, and we are studying the ring temperature changes as a function of these parameters as well.

To better understand this thermal behavior, we are comparing the CIRS observations to a thermal model developed by Morishima et al. (2010). This model depends on ring parameters such as optical depth, scale height ratio, and fraction of fast rotators, and on regolith parameters such as particle albedo, emissivity and thermal inertia. In this model, ring temperatures usually decrease with increasing spacecraft elevation, as cooler particles shadowed by other particles can be seen at high elevation, and CIRS observations show the same sense. However, other effects such as the wakes and the finite volume filling factor of a ring (not yet implemented), also depend on the spacecraft elevation, and can play an important role. The results of this work will be presented.

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