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Cassini CIRS Observations of the Phase Angle Dependence of Temperatures in Saturn's Main Rings

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The Cassini Composite Infrared Spectrometer (CIRS) obtained spatially resolved temperature scans of Saturn's main rings (A, B, C and Cassini Division) when the solar inclination angle was between 22 and 23 degrees. These show ring particle temperatures decreasing with increasing solar phase angle on both the sunlit and backlit sides of the rings. These temperature differences indicate that the ring particles spin slowly, less than a few rotations per orbit. The ring particles that dominate our measurements also have low thermal inertia as determined from eclipse heating and cooling [1].

At low phase angle, the C ring and Cassini Division are the warmest, between 95 and 105 degrees, while the B ring and A ring are cooler, between 85 and 95 degrees. At high phase angle the rings appear cooler than at low phase angle. The C ring is 8-15 degrees cooler, and the A and B rings are 3-10 degrees cooler. CIRS is primarily seeing the particle night sides, which would be cooler for a population of slowly rotating ring particles. A similar temperature effect is seen for the backlit rings at low and high phase angle. The C ring and Cassini Division again display large differences in temperature, 10-15 degrees.

The magnitude of the temperature variation with phase angle is indicative of the particle spin rate. Our derived temperatures are compared to a model that assumes ring particles are spherical, identical in size, distributed in a monolayer and have finite, but small thermal inertia; the spin rates and obliquities are fixed [2]. The model shows that a distribution of particle sizes and spin rates is required to fit the observations.

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References: [1] Ferrari, C. et al., (2005) Astron. & Astrophys, Vol. 441, #1, 379-389. [2] Ferrari, C. et al., (2006) Astron. & Astrophys. (accepted).