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Seasonal effects on the temperature structure of Saturn's A ring

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The Voyager flybys of Saturn occurred just after northern vernal equinox. With the Sun at an inclination angle of 4° (Voyager 1) and 8° (Voyager 2), the Infrared Radiometer and Spectrometers (IRIS) onboard both spacecraft saw the rings at a very different phase in the seasonal cycle than Cassini's Composite Infrared Spectrometer (CIRS) when it arrived at Saturn in July 2004, just after southern summer solstice. At Saturn Orbit Insertion (SOI) the Sun was near its most southerly point in the sky, 24° below the ring plane. Since direct solar heating is the largest factor in the rings' heat budget, IRIS and CIRS observations might be expected to paint different pictures of the rings in the thermal infrared.

An intriguing result from Cassini's first A ring observations is the lack of a temperature contrast between the ring's sunlit (i.e. that receiving direct solar illumination) and backlit (i.e. that visible from the northern hemisphere at SOI) sides [1]. This suggests efficient heat and/or particle transport across the ring plane, but is difficult to reconcile with the $5-10\,K$ temperature contrast from IRIS observations. December 2004 CIRS observations reveal slight ($2-4\,K$) temperature differences. This contrast grew to $7-10\,K$ in April 2005 observations and $5-15\,K$ in observations from June 2005. Voyager 1 A ring temperatures are $15-25\,K$ colder than those measured at SOI.

Since SOI, the Sun has been moving north as seen from Saturn. Before this increase in temperature contrast can be attributed to decreasing solar inclination, differences in observing geometry must be taken into account. Measurements since SOI show

that the observed ring temperature profile changes with phase, emission and local hour angle [2]. We will explore the extent to which the observed ring temperatures and temperature contrasts are attributable to variations in observing geometries and to what degree these differences reflect actual seasonal changes.

[1] F.M. Flasar *et al*. “Science”, vol. 307, pgs. 1247-1251.
[2] L.J. Spilker *et al*. “Bull. Amer. Astron. Soc.”, vol. 37, pg. 764.