Seasonal Changes in Thermophysical Properties of Saturn's Rings from 1995 - 2009

PADMA A. YANAMANDRA-FISHER[1], RYUJI MORISHIMA[2] and THOMAS W. MOMARY[1]

[1]*Jet Propulsion Laboratory/ California Institute of Technology*
[2]*LASP, University of Colorado*

Saturn's rings are predominantly composed of water ice, with various contaminants, from their ultraviolet to microwave behavior. Recent results from Cassini mission indicate that microparticles may be responsible for and influence several features in Saturn's rings: possible tholin-like contaminants; water ice particles of size 0.35 microns in the spokes in the Bring; the plumes of Enceladus, source of the E ring, contain icy grains and other materials of sizes in this range. Implicitly assumed also is that the water ice exists in its amorphous phase. A mutli-spectral analysis of ground-based near- and mid-infrared imaging and spectral data of Saturn's rings indicates correlations of diurnal variations in the brightness temperature, near-infrared reflectivity and water bands at 1.5-, 1.65- and 3-micron. Given the unknown composition of the contaminants in Saturn's rings, the phase of water ice and its thermal properties and structure will be affected. Implications of this hypothesis will be explored regarding the thermal and compositional differences in the main ring system. Ground-based near- and mid-infrared observations of Saturn's rings from 1995 – 2009 from NASA/InfraRed Telescope Facility (IRTF) and NAOJ/Subaru, covering half a Saturnian year, provide a rich data set to model seasonal changes as a function of solar elevation. We apply the model of Morishima et al. (Icarus, 2009), based on classical radiative transfer, which takes into account the heat transport due to particle motion in the azimuthal and vertical directions. The key influential parameters, which control ring temperatures, are the visual albedo (A), the fraction of spinning particles and the thermal inertia Γ. The scattering and thermal properties of the ring particles are numerically modeled as an ensemble of interacting electromagnetic dipoles Our computer simulations depend upon a variety of factors such as shape, size, composition, structure, water ice phase, surface and sub-surface porosity of the ring particles. Using these two independent approaches, we report on our results to: (i) establish the contaminant-to-water-ice ratio required to suppress the signature of the contaminant in the ring particle; and (ii) distinguish between amorphous and crystalline states of the ring particle.