Geophysical Research Abstracts
Vol. 14, EGU2012-6890, 2012
EGU General Assembly 2012

Multi-wavelength studies of Saturn's rings to constrain ring particle properties and ring structure

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A great deal can be learned about the nature of Saturn's ring particles and their regoliths by modeling the changes in brightness, color and temperature with changing viewing geometry over a wide range of wavelengths, from ultraviolet through the thermal infrared. Data from Cassini's Composite Infrared Spectrometer (CIRS), Visual and Infrared Mapping Spectrometer (VIMS), Imaging Science Subsystem (ISS) and Ultraviolet Imaging Spectrograph (UVIS) are jointly being studied using scans of the lit and unlit main rings (A, B, C and Cassini Division) at multiple geometries and solar elevations. Using multi-wavelength data sets allow us to test different thermal models by combining the effects of particle albedo, regolith grain size and surface roughness with thermal emissivity and inertia, particle spin rate and spin axis orientation. With the high spatial resolution of the Cassini data it is now possible to analyze these effects at smaller spatial scales and characterize regions such as the C ring plateaus and ringlets, where albedo differences may be present.

In the CIRS data, over a range of solar elevations from -23 degrees to -8 degrees, the bulk of the temperature variations are confined primarily to phase angle. Only small temperature differences are observed with changing spacecraft elevation. Similar behavior is seen in the ISS color data. Color and temperature dependence with changing solar elevation angle are also observed. VIMS observations show that the IR ice absorption band depths are (almost) independent of phase angle, out to $\sim$140 deg phase, suggesting that interparticle light scattering is relatively unimportant except at very high phase angles. These results imply that the individual properties of the ring particles may play a larger role than the collective properties of the rings, in particular at visible wavelengths. The temperature and color variation with phase angle may be a result of scattering within the regolith and on possibly rough surfaces of the clumps, as well as a contribution from scattering between individual particles in a many-particle-thick layer. Preliminary results from our joint studies will be presented.

This research was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA. Copyright 2012 California Institute of Technology. Government sponsorship is acknowledged.