Geophysical Research Abstracts, Vol. 9, 05103, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05103

Implications of the opposition surge observed in Saturn's rings

R. M. Nelson(1), B. W. Hapke(2), R. H. Brown(3), L. J. Spilker(1), W. D. Smythe(1), L. Kamp(1), M. Boryta (4), F. Leader (1), D. L. Matson(1), S. Edgington (1), P. D. Nicholson (5) , G. Filacchione (6), R. N. Clark (7), J-P Bibring (8), K. H. Baines(1), B. Buratti (1), G. Bellucci(6), F. Capaccioni(6), P. Cerroni(6), M. Combes (9), A. Coradini (6), D. P. Cruikshank(10), P. Drossart (11), V. Formisano(6), R. Jaumann (12) Y. Langevin(8), T. B. McCord(13), V. Mennella(14), B. Sicardy(8) and C. Sotin(15)

(1)JPL/NASA, Pasadena, CA USA, robert.m.nelson@jpl.nasa.gov, (2)U of Pittsburgh, Pittsburgh PA, USA, (3)U of Arizona, Tucson, AZ,USA, (4)Mount San Antonio College, Walnut, CA USA, (5)Cornell University, Ithaca NY, (6)Istituto di Astrofisica Spaziale, Rome, Italy, (7)USGS, Denver, CO, USA, (8)Universite de Paris Sud-Orsay, France, (9)Observatoire de Paris-Paris, France, (10)NASA AMES, Mountain View, CA, (11)Observatoire de Paris-Meudon, France, (12)Institute for Planetary Exploration, DLR, Berlin, Germany, (13)University of Washington, USA, (14)Osservatorio Astronomico di Capodimonte, Italy, (15)University of Nantes, Nantes, France

Robert.m.nelson@jpl.nasa.gov, 4800 Oak Grove Drive, Pasadena CA 91104

During its orbital tour the Cassini spacecraft flew between the sun and Saturn on several occasions. The zero phase point passed through the rings. The Visual and Infrared Mapping Spectrometer (VIMS) recorded spectral image cubes ($0.4< \lambda <5.2\mu$m) that showed the opposition effect (OE) at zero phase. The OE is a spike in the reflected light observed near 0^o phase when it is displayed as a function of phase angle. This is the first time the OE has been resolved for small areas on the rings.

Previous work has shown that the OE arises from two distinct processes, shadow hiding (SHOE) and coherent backscattering (CBOE). The SHOE process causes an OE by the elimination of shadows cast by regolith grains upon one another as phase angle decreases. The CBOE process causes an OE by constructive interference between photons traveling in opposite directions along the same path within the medium. SHOE

is expected to dominate the contribution to the OE in absorbing media where multiple scattering of photons is not significant. CBOE is expected to dominate the contribution to the OE in highly reflective media with much multiple scattering.

We have made spectral scans the VIMS images that traverse the zero phase point. We selected 9 narrow spectral bands that reflected a variety of wavelengths and reflectance levels. In this way phase curves of the ringlet were obtained for each band. We have compared these data to data we acquired in the laboratory using the JPL long arm goniometer where we measured the phase curve of particulate materials that simulate the surface of Satrun's ring particles. We argue here that the OE is due to coherent backscattering because: 1) The theoretical CBOE function fit to the data is excellent. 2) The OE width is extremely narrow 3) The angular width of the peak increases with wavelength. CBOE theory also predicts that the width depends on the transport mean free path (TMFP) in the medium. We find that the OE is caused by coherent interactions between sub-particles in the outer layers of the ring particles, and that these sub-particles are of the order of 10 μm in size.

A portion of this work was performed at JPL under contract with NASA