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Coherent Backscattering Effect in Spectra of Icy Satellites and its Modeling using Multi-Sphere T-Matrix (MSTM) Code for Layers of Particles

Karly M. Pitman[1], Ludmilla Kolokolova[2]*, Anne J. Verbiscer[3], Daniel W. Mackowski[4], Emily C. S. Joseph[51]

Space Science Institute, 4750 Walnut Street, Suite 205, Boulder, CO 80301, USA; pitman@spacescience.org

[2] *Department of Astronomy, University of Maryland, College Park, MD 20742, USA; ludmilla@astro.umd.edu*

[3] *Department of Astronomy, University of Virginia, P.O. Box 400325, Charlottesville, VA 22904-4325, USA; verbiscer@virginia.edu*

[4] *Samuel Glenn College of Engineering, Auburn University, Auburn, AL 36849, USA; mackodw@auburn.edu*

[5] *Planetary Science Institute, 1700 East Fort Lowell Rd., Suite 106, Tucson, AZ 85719-2395, USA; emily@psi.edu*

Abstract

The coherent backscattering effect (CBE), the constructive interference of light scattering in particulate surfaces (e.g., regolith), manifests as a non-linear increase in reflectance, or opposition surge, and a narrow negative polarization feature at small solar phase angles. Due to a strong dependence of the amplitude and angular width of this opposition surge on the absorptive characteristics of the surface material, CBE also produces phase-angle-dependent variations in the near-infrared spectra. In this paper we present a survey of such variations in the spectra of icy satellites of Saturn obtained by the *Cassini* spacecraft's Visual and Infrared Mapping Spectrometer (VIMS) and in the ground-based spectra of Oberon, a satellite of Uranus, obtained with TripleSpec, a cross-dispersed near-infrared spectrometer on the Astrophysical Research Consortium 3.5-m telescope located at the Apache Point Observatory near Sunspot, New Mexico. The paper also presents computer modeling of the saturnian satellite spectra and their phase-angle variations using the most recent version of the Multi-Sphere T-Matrix (MSTM) code developed to simulate light scattering by layers of randomly distributed spherical particles. The modeling allowed us not only to reproduce the observed effects but also to estimate characteristics of the icy particles that cover the surfaces of Rhea, Dione, and Tethys.

Keywords: coherent backscattering effect; *Cassini* VIMS, ground-based; infrared spectra; T-matrix modeling

*Corresponding author Ludmilla Kolokolova; email:Ludmilla@astro.umd.edu, phone: +1-301-405-1539.