Wavelength Dependence of the Coherent Backscattering Induced Phase Curve in Simulated Planetary Regolith Material.

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We have searched for wavelength dependent effects in phase curves of candidate planetary regolith materials where coherent backscattering contributes to the opposition phase curve.

We have measured the low phase angle scattering properties of a suite of highly reflective aluminum oxide powders at two wavelengths in order to search for wavelength dependent effects in the reflectance phase curves. Wavelength dependent effects have been predicted theoretically (Stephen and Cwilich, 1986; MacKintosh and John, 1989; Mischenko, 1992; Peters, 1992) and they have been observed in aqueous suspensions of latex spherical particles (Kuga and Ishimaru, 1984, Akkermans, et al, 1986;, and van Albada, et al, 1987). The half width at half maximum (HWHM) of the phase curves is observed to vary as $\sim \lambda/D$.

We used a long arm goniometer at JPL to measure the phase curves from 0.05-5 degrees the powdered samples. The samples were illuminated by HeNe lasers at two wavelengths of 0.63 and 0.54 μm. At both wavelengths, the phase curves of these highly reflective samples exhibit a pronounced increase in reflectance and an increase in circular polarization ratio with decreasing phase angle in the region near zero phase. In addition, the linear polarization ratio of these samples decreases with decreasing phase angle These findings are consistent with the hypothesis that coherent backscatering is the principal contributor to the phase curve at both wavelengths. (Skhuratov, 1989, Hapke 1990, Nelson, *et al* 1998).

However, we do not observe an appreciable wavelength dependent effect in our powder samples. Theory predicts that the maximum HWHM effect is expected when the particle size is close to the wavelength of the incident light. We find that the maximum effect is observed when the particle size is about twice that of the wavelength of the incident light. These differences between our simulated planetary regolith and previous theoretical and laboratory studies may be due to theoretical models being premised on widely separated spherical particles, while our samples are irregularly shaped and more closely packed. In addition, variations in the size distribution of the samples and/or the effect of irregularities on the surfaces of larger particles may cause coherent effects to be less dependent on particle size.

References

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