THE NATURE OF THE OPPOSITION EFFECT IN FROST, VEGETATION AND SOILS; B. Hapke[1], D. DiMucci[1], R. Nelson[2] and W. Smythe[2], [1]U. of Pittsburgh, [2]JPL.

Two different mechanisms can cause an opposition effect: shadow-hiding and coherent backscatter. Because each mechanism samples different properties, it is important to the interpretation of earth and planetary remote sensing observations to understand which dominates in a given medium. This question can be answered by measuring the circular polarization ratio, μ_c, the ratio of the intensity of circularly polarized light reflected with the same helicity as incident to that reflected with the opposite helicity. If the opposition surge is caused primarily by shadow-hiding, μ_c decreases with decreasing phase angle, while if it is caused primarily by coherent backscatter, μ_c increases. We have measured μ_c as a function of phase angle for lunar and terrestrial soils, vegetation and H_2O frost. Typical samples of our results are shown in the figure, which plots reflectance, r, and μ_c against phase angle. The reflectances of all samples possess opposition effects 5-10° wide. The ratio μ_c increases with decreasing phase angle for the frost and dry terrestrial soil, showing that the opposition effects in these media are dominated by coherent backscatter. However, μ_c decreases for broad-leafed vegetation and moist terrestrial soil, showing that shadow-hiding is the important mechanism for these media.

The media in which coherent backscatter dominates the oppostion effect, frosts and dry soils, are all fine-grained with abundant particles in the micrometer size range. However, apparently, filling the pores of the terrestrial soil with moisture reduces particle surface reflectivity, which inhibits the multiple scattering necessary for coherent backscatter. Similarly, although the leaves of the vegetation contain small structures, such as cells, most of these are in contact with water, so that multiple scattering between cells is insufficient to cause much coherent backscatter and the opposition effect is dominated by shadow-hiding.

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