THE UMOV EFFECT FOR AGGLOMERATE PARTICLES WITH VARYING STRUCTURE. E. Zubko,[1,2] G. Videen,[3] Yu. Shkuratov,[2] K. Muinonen,[1,4] and T. Yamamoto,[5] [1]University of Helsinki, Finland, e-mail address: evgenij.zubko@helsinki.fi, [2]Kharkov National University, Ukraine, [3]Space Science Institute, USA, [4]Finnish Geodetic Institute, Finland, [5]Hokkaido University, Japan

Introduction: The Umov effect manifests itself as an inverse correlation between the linear polarization maximum of an object's scattered light P_{max} and its geometric albedo A. This effect is observed for regoliths on the Moon, Mercury and Mars, and there are data suggesting it is valid for asteroids. Recently, the Umov effect also was found to be valid for single irregular particles whose sizes are comparable with wavelength λ [1]. Therefore, using the Umov effect, one can estimate from polarimetric observations the geometric albedo of dust particles in comets.

Modeling Light Scattering: Using the discrete-dipole approximation (DDA) [e.g., 2], we compute light scattering by agglomerate particles with three different types of structure. All particles are generated with the same algorithm that is described, e.g., in [1]. The particles are of the same size but have different packing densities of ρ = 0.169, 0.236, and 0.336. Example images of these particles are shown in the top of Figure 1 (the density increases from left to right). We repeat computations of light scattering for three different refractive indices m = 1.313 + 0i, 1.5 + 0.1i, and 1.6 + 0.0005i, which represent water ice, organic material, and Mg-rich silicates, i.e., the most abundant species in comets. The size parameter $x = 2\pi r/\lambda$ (where, r is the radius of the circumscribing sphere) is varied from 1 to 36 for icy particles, 32 for organic particles, and 26 for silicate particles. Difference in the upper value of x is caused by convergence limitations in DDA. In all the cases, we perform averaging of light-scattering properties over a minimum of 500 particles. We also incorporate a size averaging of light-scattering properties with a power law size distribution r^{-a} and the index a varying from 1 to 4. It is important to note that this range includes the range of a measured *in situ* in comet 1P/Halley, i.e., a = 1.5 – 3.4 [3].

Results: Figure 1 shows the correlation between the logarithm of albedo A and the logarithm of the maximum of positive polarization P_{max} for icy (top), silicate (middle), and organic particles (bottom). In these plots, the larger values of the power index a form the upper ranges of the curves; whereas, the smaller values of a are responsible for the lower ranges. As one can see, all the cases reveal quite regular distributions of the data points on the $\log(P_{max})$ – $\log(A)$ diagram, which could be approximated well with a smooth curve. Moreover, agglomerate particles with various ρ reveal quite similar behaviour on the diagram $\log(P_{max})$ – $\log(A)$; whereas, data points corresponding to different materials can be easily distinguished from each other.

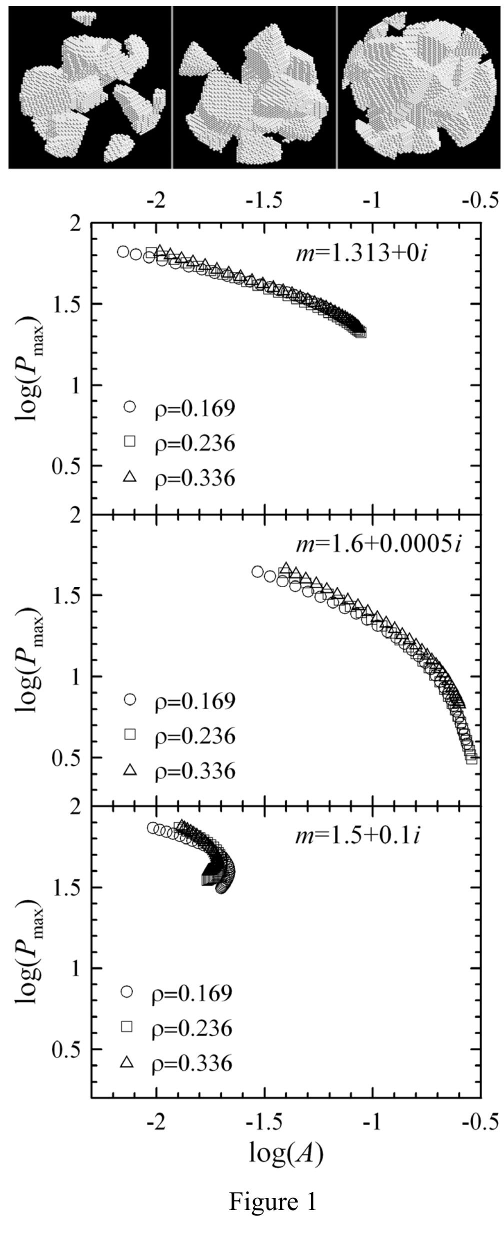

Figure 1

References:

[1] Zubko E. et al. (2011) *Icarus, 212,* 403–415.
[2] Zubko E. et al. (2010) *Appl. Opt., 49,* 1267–1279.
[3] Mazets E. P. et al. (1986) *Nature, 321*, 276–278.