Aperture-Averaged and Imaging Polarimetry of Comets

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Aperture-averaged polarimetry of comets show a high resemblance of their negative polarization branch (NBP) near backscattering with that is observed for C-type asteroids [1]. Such resemblance is typically interpreted as an indicator for similarity between properties of cometary dust and asteroid particles [1,2]. However, laboratory measurement of light scattering by single dust particles and regolith consisting of the same particles reveal substantial difference in the degree of linear polarization [3]. For instance, single dust particles produce up to 10 times deeper NPB. Therefore, the resemblance in NPBs produced by comets and C-type asteroids has to point on significant difference rather than similarity between cometary dust and asteroid particles. Such conclusion is quite hard to accept, especially, taking into account a possibly common origin of comets and asteroids of some types.

However, imaging polarimetry shows that NPB of comets is originated mostly from circumnuclear haloes [4]. Circumnuclear halo is bright and small part of inner coma surrounding a cometary nucleus; its radius is up to 2000 km. As was found in [4], haloes produce relatively deep NPB (up to -6%). Thus, the difference between NPB of cometary circumnuclear haloes and asteroids regoliths is qualitatively consistent with that was found in laboratory measurements [3].

Numerical simulation of light scattering by irregularly shaped particles allows to interpret the deep NPB of cometary circumnuclear haloes as follows: (1) dust particles are made of weakly absorbing material [5] and (2) dust particles could be relatively compact agglomerates with packing density of 0.25 and consisting of non quite small constituent grains [6].

Keywords: comets; cometary circumnuclear halo; negative polarization.

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