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A post-Rosetta understanding of polarimetric observations of comets

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Numerous polarimetric observations of solar light scattered by dust in cometary comae have been obtained by various teams, providing phase angle and wavelength dependences for many comets and revealing different classes of comets [e.g., 1]. Besides, numerical and experimental simulations have suggested interpretations for such observations. The Rosetta long duration rendezvous with comet 67P/Churyumov-Gerasimenko (thereafter 67P/C-G) now allows us to compare our understanding of the polarimetric properties of cometary dust with the ground-truth provided by the Rosetta mission, at least for two typical results.
First, some comets present a highly-polarized positive branch, the most conspicuous case being that of new comet C/1995 O1 Hale-Bopp [2], while other comets suffering a partial fragmentation or a total disruption, such as C/1995 S4 LINEAR [3], present a significant increase in polarization. We will discuss these observations in the context of evidence for changes between the porosity (and possibly the dust/ice ratio) of the subsurface and of the interior of 67P/C-G, a periodic Jupiter Family Comet, as derived from analyses [4] of the CONSERT bi-static radar measurements on board Rosetta and Philae.
Secondly, numerical simulations of the phase and wavelength dependence of polarimetric observations of some comets (extensively observed on a wide range of wavelengths and phase angles) have suggested the presence of fractal, likely-porous aggregates and of compact particles within their comae [e.g., 5]. We will review such results in the context of evidence for porous and compact aggregates of submicron-sized grains in the inner coma of 67P/C-G [6], as given by 3D images (with a resolution down to tens of nanometers) of the MIDAS atomic force microscope on board Rosetta.

References:
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