Characterizing dust in dust-poor comet 2P/Encke and dust-rich comet 67P/Churyumov-Gerasimenko from observations and modeling

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Previously, from photometric and polarimetric observations of *dust-rich* comet 67P/Churyumov–Gerasimenko at the 6-m telescope of the SAO RAS in 2015–2016, we revealed that the dust color in the near-nucleus area was red, 0.84 ± 0.05^m, and then gradually became bluer, reaching ~0.4^m at distance ~40000 km. At the same time, the polarization initially sharply decreased within the first 5000 km from ~8% to ~2% and then gradually increased reaching ~7% at 36000 km. Thus, there is the "turning point", where the polarization trend changes from decrease to increase, which may be a diagnosis of dust properties.

New results on the spatial variations of polarization and color of dust in *dust-poor* comet 2P/Encke were obtained at the same 6-m telescope in January 2017. As in the case of comet 67P/C-G, we found that the near-nucleus area is redder and more polarized than the adjacent coma. The dust color BC(λ4429/36 Å)–RC(λ6835/83 Å) gradually changed from 1.0^m in the innermost coma to about 0.3^m in the outer coma. At the same time, the corrected for gas contamination radial profiles of polarization in the r-sdss filter showed that the polarization in the near-nucleus area was almost 12%, sharply dropped to 6% at the distance 2000 km, and then gradually increased with projected distance from the nucleus, reaching 12% at 12000 km, i.e. we again observe the similar "turning point" and trend of polarization.

The radial variations of polarization and color suggest a change in the particle properties with distance from the nucleus, most likely fragmentation and/or sublimation of the dust particles, and, hence, in the mean scattering properties on a time-of-flight timescale. For computer modeling of scattering particles, the *Sh*-matrix method was used. We considered cometary dust as random Gaussian particles distributed over the cometary coma with power law X^{-n}, where the n depends on projected distance from the nucleus. In the case of comet Encke, we considered of cometary dust as a mixture of particles of three types: silicates, organic matter, and water ice. Our simulation allowed us to determine the microphysical parameters of these model particles which demonstrated a good agreement with observational data. Contrary, in the case of comet 67P/C-G, cometary dust was presented by particles of single type which decayed with distance from the nucleus. Calculations showed that physical decay of particles can also explain the spatial variations of polarization and color of dust in the comet. In order to understand how different physical properties of the dust particles affect the behavior of color and polarization, further numerical simulations of light scattering by cometary dust particles are required.