Dust in Active Asteroids

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Some asteroids exhibit activity, manifesting a comet-like appearance with the development of a coma and a tail due to material being released from their surface or interior. This activity commonly arises from the presence of volatile substances in their composition or as a consequence of collisions with other asteroids.

In this presentation, we consider photometric and polarimetric observations of active asteroids, specifically focusing on asteroid (248370) QN173, for which we have quasi-simultaneous data on the distribution of color and polarization along the asteroid tail. We apply computer modeling to these data to recover the dust characteristics. We consider irregular solid particles, consisting of material similar to that for C-type asteroids, and use the surface-integral-equation (SIE) method for the PMCHWT formulation for particle sizes $r \leq 3$ micron, and SIRIS4 code based on the geometric optics approximation using inhomogeneous plane waves for particles larger than $r > 3$ micron. The modeling allows us to determine the size distribution of particles and their change with the distance to the asteroid and with phase angle.

One more object of our interest is the dust, ejected by asteroid Dimorphos as a result of impact by the DART spacecraft. We are combining the observations of polarization (FORS2, VLT) and color (MUSE, VLT) with the HST WFC3/UVIS imaging data for the same dates. As this was done for (248370) QN173, we model the DART ejecta dust as irregular solid particles, although in this case the composition is taken to be typical for S-type asteroids. The observations showed an absence of any trends in color and polarization with the distance from the impact, thus, limiting our capability to study the variations in the dust properties along the observed tail and indicating that the ejecta dust was dominated by large particles that scatter light in the geometric optics regime. To extract more information about the ejecta particles, we considered several dates of observations, thus, exploring the change in the dust with the time after impact. The characteristics of the size distribution obtained from the modeling were applied to the HST images, enabling estimation of the dust column density at different distances from the asteroid and for different dates.

We also present radiative transfer modeling of the DART ejecta images acquired by the camera LUKE onboard LICICube CubeSat in close proximity to the impacted asteroid.