The Nature of Cometary Grains from Remote Sensing

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Our knowledge of the physical properties of cometary grains derives primarily from measurements of their thermal emission and optical scattering. These results are consistent with the properties of micrometeorites collected in the stratosphere (Brownlee particles).

1. The scattered light at λ 1-2 μm is neutral or somewhat red. The lack of Rayleigh scattering => grain diameter $\gtrsim \lambda$.

2. Thermal emission spectra indicate grain temperatures higher than a theoretical black body in equilibrium => grains composed of absorbing material and grain size < 10 μm.

3. Emission features near 10 μm and 18 μm => small silicate grains present.

4. Ratio of scattered/thermal radiation => grains very dark; geometric albedo $A_p \approx 0.015 - 0.04$ at λ 1.2 - 2.2 μm, comparable to the rings of Uranus.

5. Analysis of particle trajectories in dust tails => $\beta_{max} \sim 2.5$ and ~ 0.5, typical of small absorbing and dielectric (silicate) particles, respectively.

6. Icy grains (H_2O) are probably present in the coma of new comets at large heliocentric distance (3 μm feature seen in Cernis; large OH production in Bowell), but not generally in comets within ~ 2 AU of the sun.

7. Three comet nuclei have now been detected in the thermal infrared (IRAS-Araki-Alcock; Neujmin 1; Arend-Rigaux), with T ~ 300 K and $A_p < .05$ => some "old" comet nuclei have a dark, nonvolatile surface.