OPTICAL PROPERTIES OF COMETARY GRAINS

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An analysis of visible/near-infrared polarimetry of Comet Halley[1] leads to a variation of the complex refractive index m=n-i·k of grain material with wavelength, i.e., a slight decrease of n from 1.39 at λ=0.37μm to 1.37 at λ=2.2μm, in contrast to an increase of k from 0.024 at λ=0.37μm to 0.042 at λ=2.2μm. The mass distribution of grains reported by Mazets *et al.* from *in situ* measurements of Vega 2 was applied in the analysis.

Combining these optical constants with those of "astronomical silicate" proposed by Draine[2], we present "cometary silicate" as a candidate for cometary grains. Figure 1 shows the complex refractive index of the proposed "cometary silicate."

Based on the Mie theory, an emission coefficiency of each of the grains is computed, as well as its temperature, as functions of grain radius and sun-comet (grain) distance r (see Fig. 2).

It is found (Fig. 3) that the tentative thermal spectrum from these "cometary silicates," where the mass distribution of grains reported by Mazets *et al.*[3] from Vega 2 was applied, fits very well to the infrared spectrum of Comet Halley at r=1.3 AU detected by Tokunaga *et al.*[4] and Herter *et al.*[5]

This means that "cometary silicate" can explain not only the phase angle (sun-comet-observer angle) and wavelength dependences of visible/near-infrared polarization, but also the thermal emission spectrum of Comet Halley.

REFERENCES

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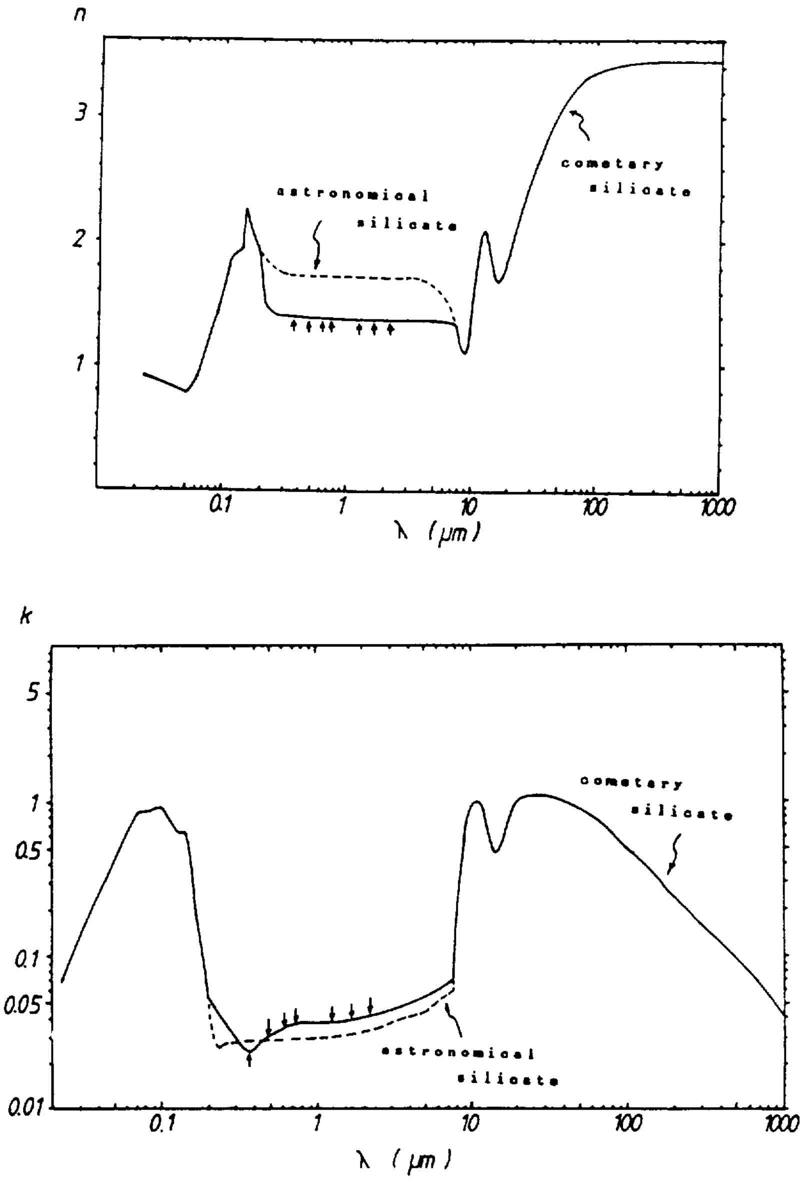

Figure 1. Refractive index n and absorption coefficient k of the proposed "cometary silicate," as a function of wavelength λ. Seven arrows indicate the values deduced from an analysis of polarimetry of Comet Halley.[1]

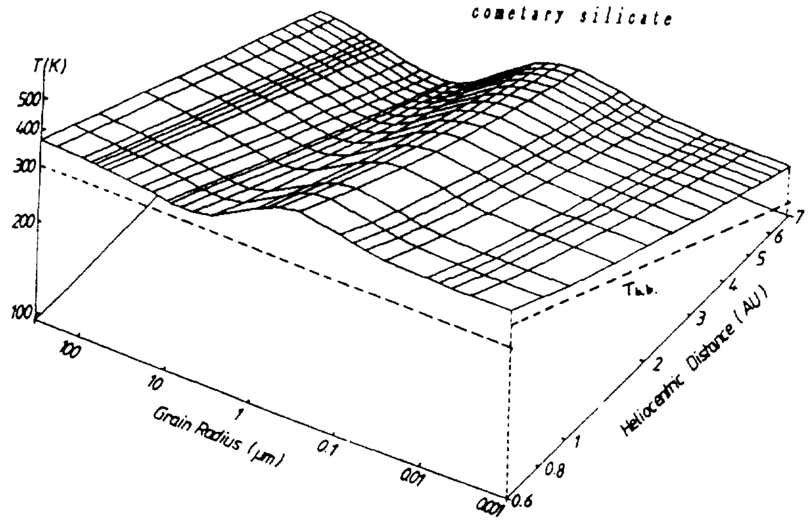

Figure 2. Temperature T, in units of K, of the proposed "cometary silicate." $T_{b.b.}$ denotes the temperature of a black body, which is independent of grain radius.

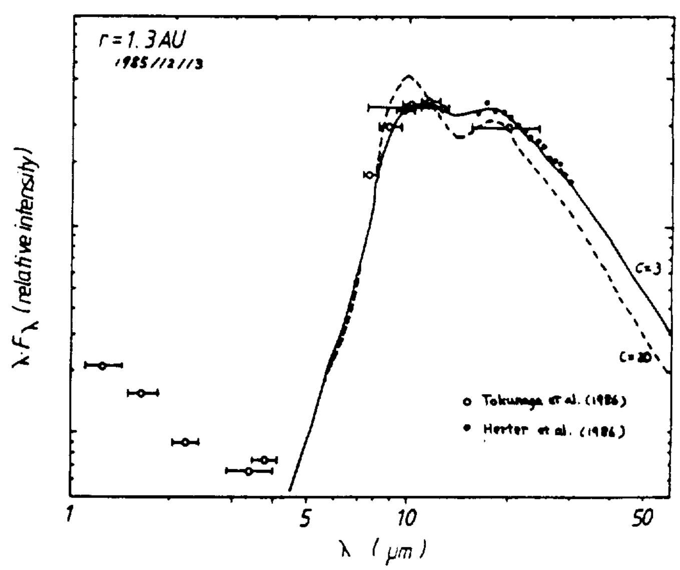

Figure 3. The energy distribution of Comet Halley λF_λ vs. λ. Computed curves (thermal emission alone) are normalized to the observed data of Tokunaga *et al.* (1986) at $\lambda = 12.5\mu m$. The data of Herter *et al.* (1986) have been scaled to match a value computed at $\lambda = 20\mu m$. In order to demonstrate a variation of spectrum due to an increase of smaller grains with radii less than $0.1\mu m$ by a factor c in number, two computed results are illustrated based on dust distribution by Masets *et al.* (1986). c=3 leads negligible changes in brightness and polarization in visible (scattered light), but c=20 produces significant variations in both.