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An Albedo Map of P/Halley on 13 March 1986

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We present in figure 1 an albedo map of comet Halley made from a 10 μm image taken from the Wyoming Infrared Observatory at 16:56 UT on 13 March 1986 (Ref. 1), and a 7311 Å CCD image taken from the Anglo-Australian Telescope about an hour later (Ref. 2). To construct this map, the CCD image was first converted from 0.49 arcsec/pixel to 1 arcsec/pixel to match the scale of the 10 μm image, then both were calibrated in λF_λ units. Because the peak of a black-body curve in these units is proportional to the area underneath, the albedo γ is:

$$\gamma = \frac{S}{S+1},$$

where S is the ratio of the optical to infrared peak flux density (Ref. 3). Because 7311 Å and 10 μm are near the peaks of the reflected and reradiated parts of the comet's spectrum, respectively, we simply divided the optical map by the infrared map to obtain S for each pixel. Errors due to the strong silicate feature and the poorly known 10 μm background correction have not been fully evaluated at this time, but they should not affect the general appearance of figure 1.

According to our albedo map, most of the inner coma of Halley lies between $\gamma = 0.04$ and 0.08. The overall smoothness of the map, especially near the nucleus, is remarkable considering the large dynamic range of the optical and IR maps, and the differences in spatial resolution and image processing. The ridge near the south edge is due to the slight shifting of the IR image that was done to accurately register it with the optical image.

There is a fairly strong east-west slope in the albedo, almost parallel to the direction to the sun. Such a gradient along the solar direction has been reported for comet Giacobini-Zinner (Ref. 4), and for Halley (Ref. 5), and in both cases it has been attributed to the lower albedo of larger grains caused by multiple internal scattering. The larger grains are ejected more slowly from the nucleus; therefore they are more tightly confined to a line extending from the nucleus in the anti-solar direction. Figure 1 does not show the radial increase of albedo shown in the previous maps, but its small angular size and the background subtraction uncertainties make an exact comparison difficult. The albedo map of Halley presented by Hammel *et al.* (Ref. 5), taken when Halley was near opposition, exhibits a range of $\gamma = 0.2 - 0.3$ and higher, roughly three or four times the values in our map. Hammel *et al.* notes that the high albedos may be due to enhanced backscattering by dust grains at small phase angles. The lower values in our map, taken at the more moderate phase angle of 64°, are in excellent agreement with this conclusion.

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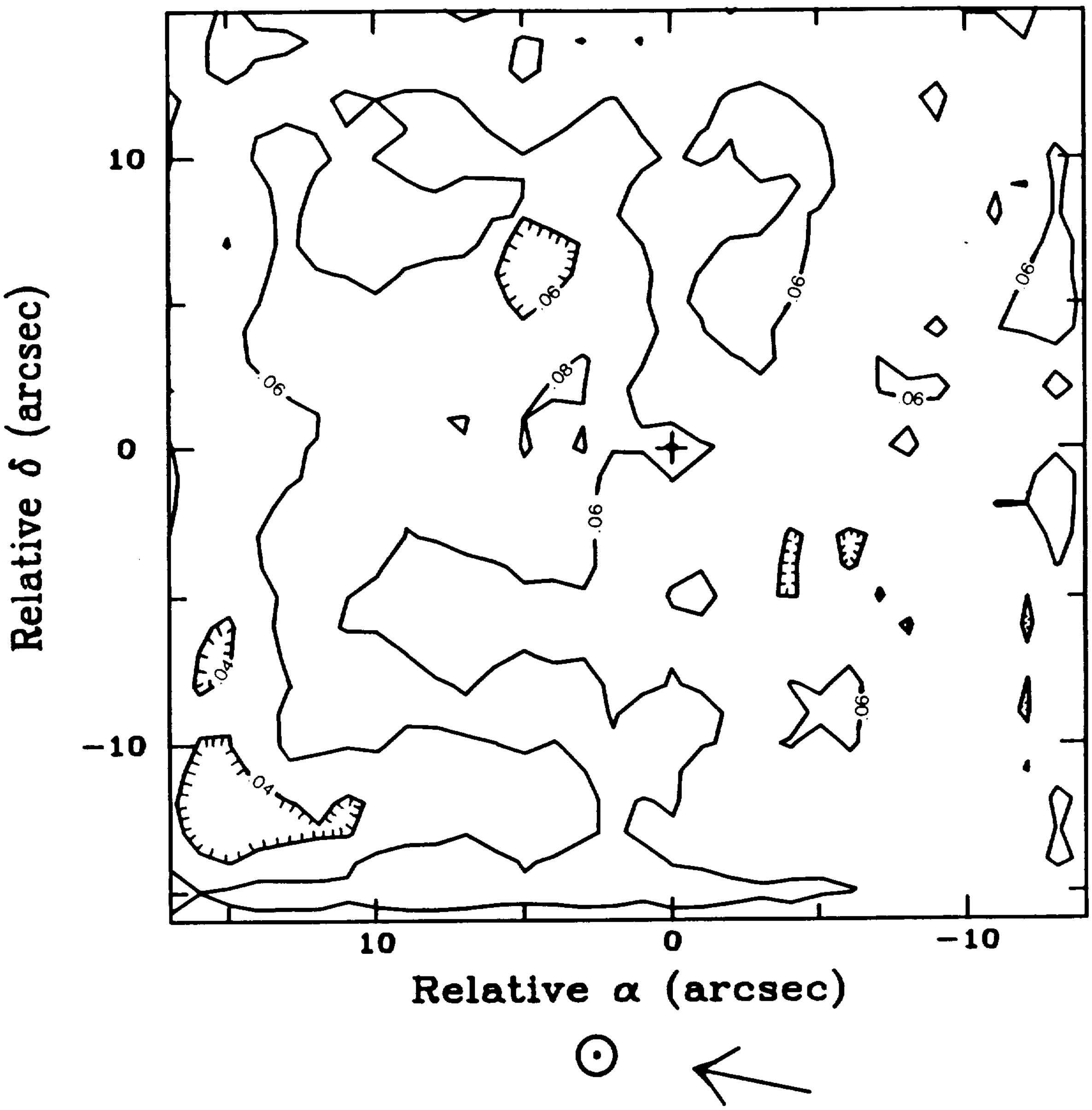

Figure 1: The albedo map derived from the IR and optical images. Contour levels are drawn at $\gamma = 0.04$, 0.06, and 0.08. The central cross marks the position of peak optical and 10 μm emission.