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INFRARED OBSERVATIONS OF P/HALLEY AND P/ENCKE

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We used broadband optical/infrared photometers responding from 0.5 to 23 microns mounted on the University of Minnesota (UM) O'Brien 76-cm telescope, Wyoming Infrared Observatory (WIRO) 234-cm telescope, and UM's Mount Lemmon Infrared Observatory 152-cm telescope to measure P/Halley more than 30 times between 1985 December 12 and 1986 May 6. The Wyoming system was used to measure P/Encke on 1987 July 24. Our equipment and the observations of P/Halley have been more fully described by Gehrz and Ney (1986, Proc. 20th ESLAB Symposium, ESA SP-250). Conclusions based on a preliminary analysis of the P/Halley and P/Encke data are reported here.

Infrared energy distributions observed for P/Halley on several dates are shown in Figure 1. Halley showed the characteristic continuum dust emission that is probably caused by small iron and carbon grains. The continuum always was hotter than the black sphere temperature appropriate to the comet's heliocentric distance. This "superheat," which is characteristic of small comet grains because of their low emission efficiency, is a grain-size indicator. An important constituent of Halley's dust was silicate material as indicated by the presence of strong 10 and 20μm emission features on many occasions. The 10μm silicate signature was always present but varied in strength and shape for heliocentric distances within one AU. The feature was observed to be very weak for distances substantially greater than one AU. Halley's dust albedo appeared to decrease when the feature was weak. P/Encke, observed at a distance of 0.37 AU, showed very little continuum superheat and no appreciable silicate emission; the implication is that the grains in P/Encke are large.

Our observations of many comets thus far suggest a significant difference between comets which have primarily Type I (ion) tails and those which have prominent Type II (dust) tails in addition to Type I tails. P/Encke and Kobayashi/Berger/Milon are examples of the former which we shall designate IR Type I. West, Bennett, and P/Halley are examples of the latter and we designate these IR Type II. IR-Type I comets have muted or missing silicate signatures and weak superheating of the grains contributing to the continuum emission, while IR-Type II comets show strong silicate emission and continuum superheating. The silicate emission becomes weak or missing in some IR-Type II comets, like Halley, when they are at distances significantly greater than one AU. We conclude that the small grain component is severely depleted in IR-Type I comets, and that the small grain component in IR-Type II comets is incorporated into the nucleus in such a way that it can be frozen out for temperatures much lower than about 300K.

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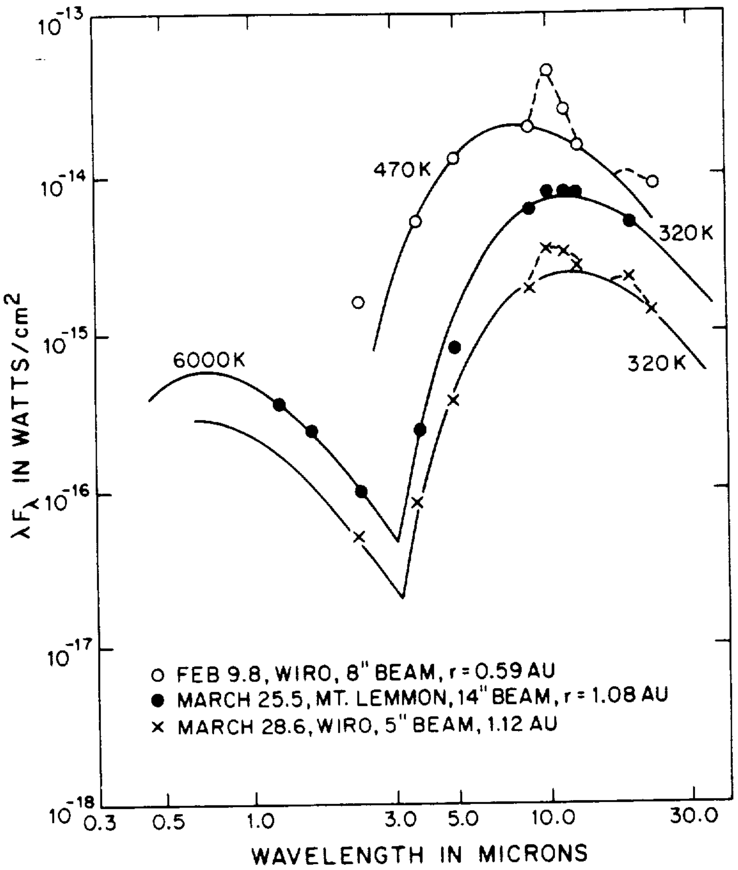

Figure 1 - The energy distribution of P/Halley on several dates showing the reflected solar and continuum thermal emission components as well as the 10 and 20μm silicate emission features. Typical variations observed in the contrast and shape of the silicate signature in P/Halley are represented. On 25.5 March, when the signature was absent, the albedo of P/Halley fell to about 5% suggesting that darker carbonaceous material was dominating the reflected light. Solar heating of localized jets coupled with rotation of the nucleus can account for the disappearance of the silicate feature of 25.5 March and its reappearance on 28.6 March. The continuum is superheated compared to the black grain temperature appropriate to the heliocentric distance (T_{BB} = 356K, 270K, and 265K for 0.59, 1.08, and 1.12 AU respectively) indicating that the grains producing the continuum emission are small. Values of delta (the earth-comet separation) were 1.55 AU on 9.8 February, 0.66 AU on 25.5 March, and 0.61 AU on 28.6 March.