A DESCRIPTION OF A POSSIBLE COUPLING BETWEEN DUST GRAINS AND WATER BASED IONS IN COMET P/HALLEY

R. A. McDonald; W. G. Tanner and W. M. Alexander
Space Science Laboratory; Dept. of Physics
Baylor University Waco, Texas

The flyby of Halley's comet by the Giotto probe was an exciting event which improved our knowledge on cometary structure. ESA's Giotto spacecraft carried into the inner coma of Comet P/Halley instruments which measured the dust grain flux (DIDSY) and the abundances of ions (HERS and PICCA). Five deviations or anomalies from the expected $1/r^2$ distribution of the dust grain flux were found by DIDSY during the flyby. Two of these occurred before closest approach and the remaining three were noted after closest approach. As has been noted previously there does seem to be a geometric structure that connects the anomalies occurring farthest away from the nucleus as well as the anomalies displaying mass sensitivity (Alexander, 1988). Unfortunately the HERS and PICCA experiments were disabled near closest approach, and therefore since no post-encounter data exist the figure refers only to pre-encounter data (Schween et al, 1986). From the figure it can be seen that the first anomalous dust peak is preceded by a smooth decrease and then an order of magnitude rise in the temperature of the water-based ions. It should also be noted that the outflow velocity of the water-based ions decreased to close to zero just outside the contact surface.

In the figure it is seen that the second anomalous region is much more diffuse than the one close to the contact surface. Once again a decrease and then a sharp rise in the temperature precedes a deviation from the anticipated dust flux. The temperature of the water-based ions then oscillates around a fairly stable mean. During these oscillations the dust flux deviates from the $1/r^2$ distribution it had followed after leaving the first anomalous region. The count of the water-based ions does not correlate as clearly as it did for the first anomalous dust peak; however, it also begins to deviate from the $1/r^2$ curve it had observed after the ion pileup. The outflow velocity like the temperature undergoes a fourfold increase and then hovers at a fairly constant value until it reaches 40,000 km where it undergoes another significant increase. All of the above data is examined in more depth.

At present no *in situ* measurement of a charge on a dust grain in interplanetary space has been made. Since several of the possible charging mechanisms are proportional to the surface area of the particle (Rhee, 1967; Morfill and Grun, 1979; Corbin 1981; Lohdi, 1987) then the charge to mass ratio is inversely proportional to the grain's radius. The relationship of the charge to mass ratio to the observed dust flux anomalies is explored. This ratio is believed to be important since the neutral particles do not seem to deviate significantly from the $1/r^2$ distribution pattern predicted before the flyby (Ip, et al 1987). It should be emphasized that the one effect preceeding both dust grain anomalies is a sudden rise in the temperature of the water-based ions. Also the fact that the second anomaly is broader corresponds to a less drastic gradient in the temperature. The possible correlation between temperature and dust flux deviations is examined.

The water-based ions depart from the anticipated radial distribution pattern. The cometary dust grain flux exhibits deviations from $1/r^2$ distribution. The existence of a coupling between the water-based ions and cometary dust grains is examined, and the results of this study are presented.

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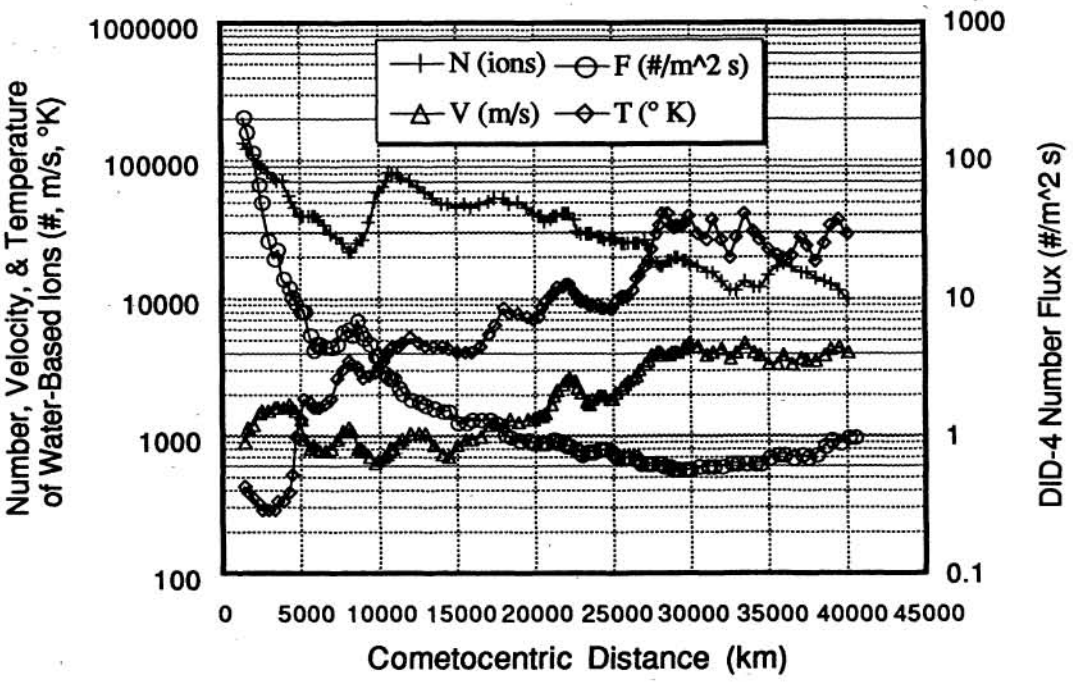

Figure 1. DIDSY DID 4 Data superimposed on HERS Data

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