Asteroids, Comets, Meteors 1991, pp. 175–176
Lunar and Planetary Institute, Houston, 1992

N93-19154

WATER AND DUST PRODUCTION RATES IN COMET P/HALLEY DERIVED FROM ULTRAVIOLET AND OPTICAL OBSERVATIONS

M.C. Festou

Southwest Research Institute, San Antonio, TX, 78228, USA and Observatoire Midi-Pyrénées, URA 285 du CNRS, F-31400 Toulouse, France

ABSTRACT

We evaluate wether the activity of comet P/Halley is due solely to the presence of discrete active areas. We preliminarily conclude that the dark areas of the nucleus contribute to the formation of the coma.

I. INTRODUCTION

Comet P/Halley (1986 III) was observed with the IUE instruments between April 1985 and July 1986 to simultaneously characterize its ultraviolet spectrum, record the evolution of its spectrum and monitor the activity of its nucleus over the widest possible range of heliocentric distances (Feldman *et al.* 1987). Superimposed on a marked pre-post perihelion asymmetry, very different activity levels were recorded on a few hour time scale. Variations far exceeded what could have been expected from the mere change of the heliocentric distance of the comet and this was interpreted as the apparition of active areas into sunlight. Since the FES camera records the light scattered by CN and C_2 radicals and dust particles, since the IUE records the emission of OH and that of the continuum, the modelization of both the spectroscopic and FES observations is possible and only requires the knowledge of the dust to gas production ratio. This will allow us to separate the short and long activity terms of the comet production of matter.

II. OBSERVATIONS AND DATA INTERPRETATION

387 raw FES count rates and 136 low resolution spectra of comet P/Halley (Festou, 1990), recorded while the slit was positioned at the center of the coma, were employed in this study. OH(0-0) fluxes and the Afρ parameter (reduced to zero phase angle assuming the phase function of Divine *et al*, 1985) were used to evaluate the water and dust productions, respectively. Due to the phase effect alone, the continuum signal decreased by about 30% from September 1985 until mid-January 1986 and it increased by ≈ 70% from March until July 1986, an effect that partially explains the post-perihelion brightening of the comet.

We first simulated the FES observations. Recent works on abundance correlations in comets (e.g.Cochran 1987, 1989a,b) indicate that it is fair to assume that the ratio of the C_2 to the main coma gases productions is constant from comet to comet, and that this ratio is known. C2 production rates were taken in Schleicher *et al.* (1990). Continuum fluxes in the FES bandpass were determined using our own IUE measurements obtained in the 2920-3020 Å window, taking into account the FES camera characteristics. Fig. 1. shows that our modelization mimics quite well the evolution of the FES count rates. Then we separated the short and long terms in the FES curve (this was obtained by assuming that when the FES count rates remained at a nearly constant level, the active areas did not contribute, see Fig. 2). We finally derived the dust and the water productions curves.

We have found that the comet was on average twice as 'gassy' before perihelion than after. There is also an indication that the comet had the same gas to dust ratio far from perihelion on both legs of its orbit, when the insolating conditions of the nucleus were rather similar, which suggests the existence of a marked seasonal effect. Closer to perihelion, one observes a net decrease of the gas production relative to that of the dust. This could be either a real decrease of the water evaporation rate, as this parameter did not increase as the energy available at the nucleus, or be an increase of the number of dust particle total cross section because of the larger lifting power of the gas, a change in the dust to gas content of the emissive areas or fractionation of the particles into smaller grains. These hypotheses cannot be tested in that short study.

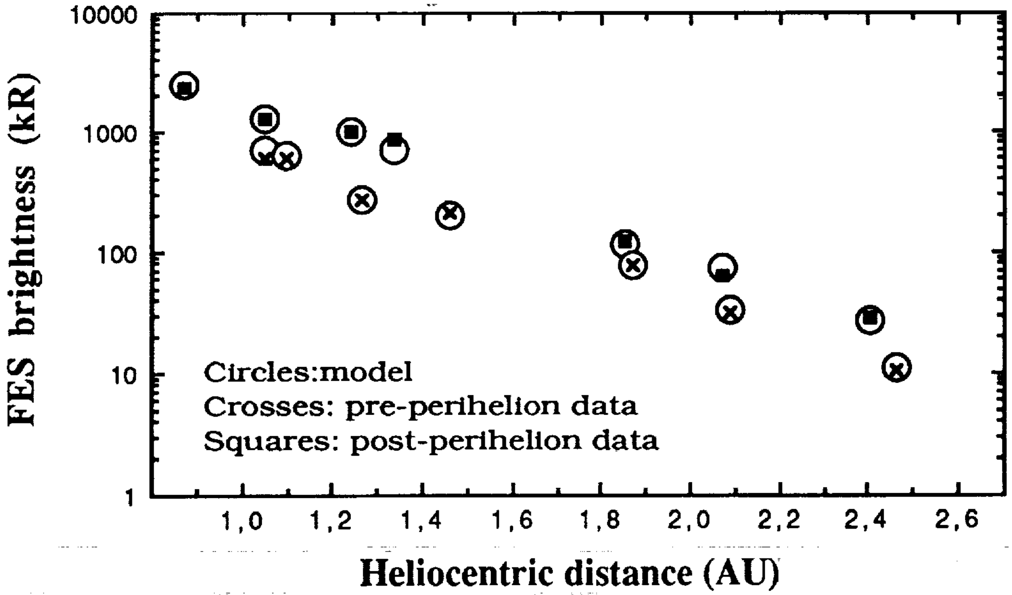

Fig. 1: simulation of the FES observations. Within some 10-15%, the relative contributions of the gas and dust emissions can be evaluated.

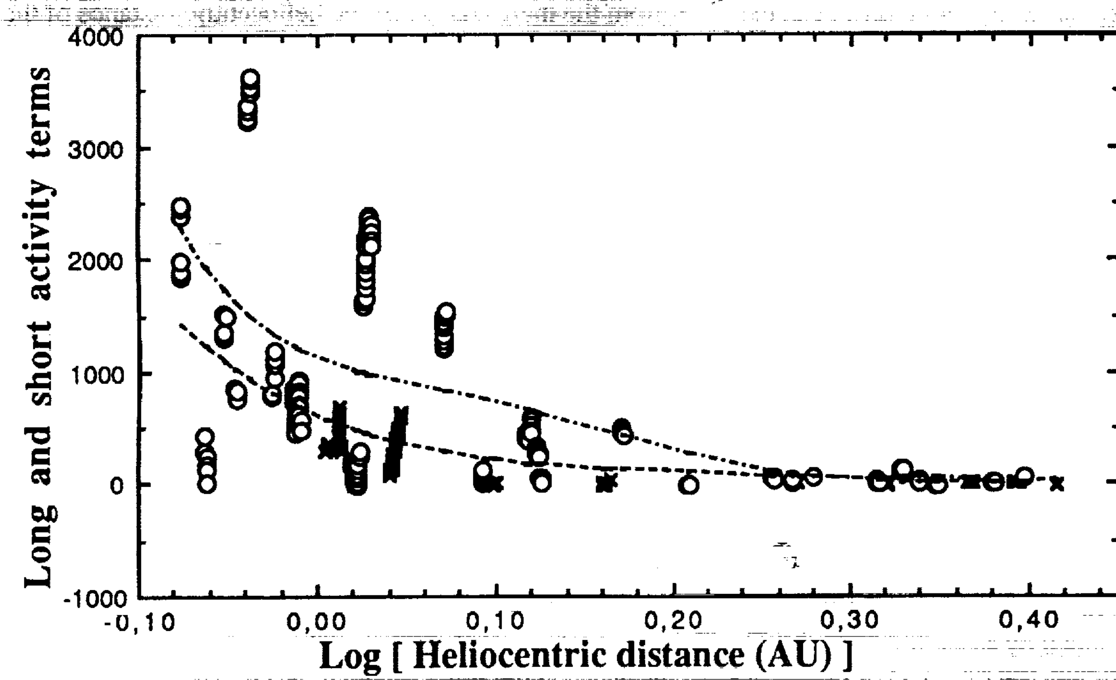

Fig. 2: long (dashed line) and short (dots and crosses) activity terms of the nucleus of comet P/Halley

REFERENCES

Cochran A.L., 1987. *Astron. J.* **92**, 231-238.

Cochran A.L. 1989a,b. In *Asteroids, Comets, Meteors III*, Lagerkvist C.-I., Rickman H., Lindblad B.A., Lindgren M., Eds, Uppsala Observatory, 281-284 and 285-288.

Divine N. et al., 1986. *Space Sc. Rev.* **43**, 1-104.

Feldman P.D. et al., *Nature*, **324**, 433-436.

Feldman P.D. et al., 1987. *Astron. Astrophys.* **187**, 325-328.

Festou M.C., 1990. ESA SP-1134. IUE - ULDA Access Guide n°2. Comets. W. Wamsteker Ed. ESTEC, Noordwjik, The Netherlands.

Schleicher D.G. et al., 1990. *Astron. J.* **100**, 3, 896-912.