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ASTRONOMY AND ASTROPHYSICS

Research Note

Polarimetric observations of comet P/Halley on 19 March 1986

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Summary. Optical linear polarization data are presented for the coma and tail region of comet P/Halley observed on 19 March 1986. Polarization in the continuum has been found to increase with wavelength while the position angle remains almost constant. The nature of the wavelength dependence of polarization seems to be different for the coma and the tail region, signifying a size difference of the particles in the two regions. The wavelength dependence of polarization shows a decrease in polarization across different emission bands (CN, C_3, CO^+, C_2 and H_2O^+).

Key words: comets – polarization

1. Introduction

Comets are generally known for their high degree of polarization. Measurements made by Ohman (1941) showed for the first time that polarization in the cometary light is produced by two mechanisms: (1) scattering of sunlight by the cometary particles and (2) fluorescense emission by the cometary molecules. Michalsky and Wolstencroft (1986, private communication) performed several measurements on emission polarization of comet Kohoutek. Richter (1963) and Wurm (1963) have discussed about the polarimetric observations of comets in general.

2. Observations

Observations were made with the 1 m telescope of Vainu Bappu Observatory, Indian Institute of Astrophysics, Kavalur, India on 19 March 1986. A photopolarimeter (Deshpande et al., 1985) was mounted at the Cassegrain focus of the telescope. This instrument works on a rapid modulation principle, the sampling rate being 2 ms and the data are processed on-line with a microprocessor. The polarimeter was fitted with the IHW (International Halley Watch) filter system containing three continuum bands at 3650/80, 4845/65, 6840/90 and five emission bands at CN (3871/50), C_3 (4060/70), CO^+ (4260/65), C_2 (5140/90) and H_2O^+ (7000/175), all figures given in Ångstrom, central wavelength/band pass. An entrance aperture of 24″ diameter, corresponding to a linear size of about 1.4 10^4 km on the comet, was employed for observing the central region of the coma. Another region across the dust tail was also observed with the same aperture, changing the RA and DEC each by −66.″6 from the center of the coma.

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3. Results

The error in polarization is estimated using a least squares method. The error in position angle can be estimated by the relation (Serkowski, 1962)

$$E_\theta = 28.65\ E_p/P; \quad (\text{for } E_p \ll P)$$

The degree of polarization (P), error in polarization (E_p) and position angle (θ) in the continuum filters for coma and tail region are listed in Table 1. The degree of linear polarization increases with wavelength, both in the coma and tail region (Fig. 1), which is a general feature found for most of the comets. The coma is found to be more polarized than the tail at 3650 Å and 4845 Å, whereas at 6840 Å the error bars overlap for coma and tail. This is due to the generally known density effect, in which the coma is obviously richer in dust content as compared to the tail regions. Also it is noticed that the nature of wavelength dependence of polarization is different for the coma and the tail, which presumably is due to the varying distribution of the dust particles (Elvius, 1958), the

Table 1. Percent polarization (P), error in polarization (E_p) and position angle (θ) in degrees in the three continuum filters for coma and tail

		U 3650/80	B 4845/65	R 6840/90
COMA	P	13.89	16.67	18.24
	E_p	1.35	0.21	0.46
	θ	165.1	166.2	165.0
TAIL	P	9.38	14.29	18.99
	E_p	1.47	0.55	1.02
	θ	164.1	167.1	171.3

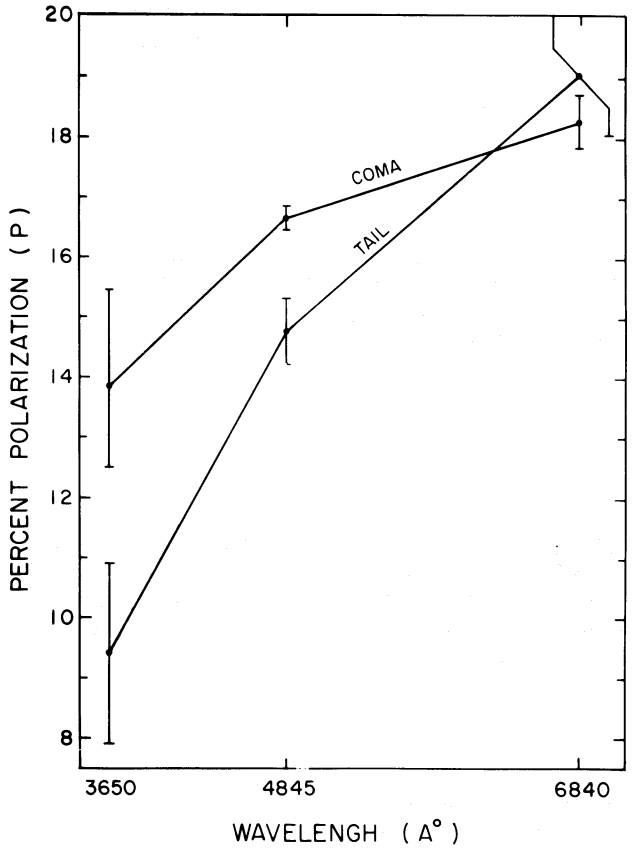

Fig. 1. Wavelength dependence of linear polarization for the coma and tail of comet P/Halley observed on 19 March 1986

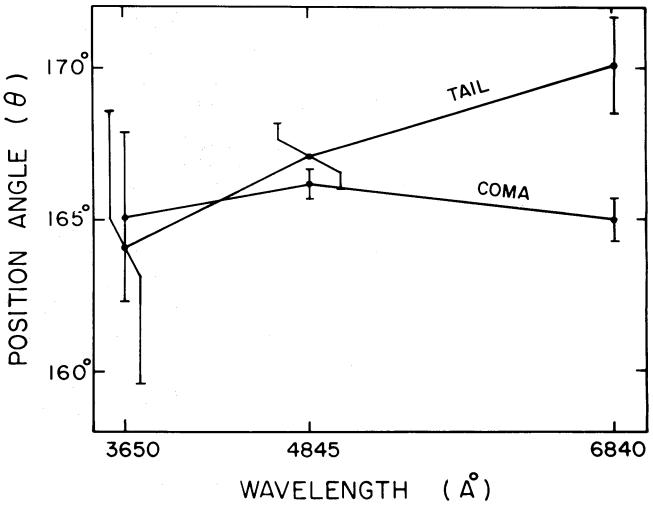

Fig. 2. Wavelength dependence of position angle for the coma and tail of comet P/Halley as observed on 19 March 1986

Table 2. Percent polarization (P), error in polarization (E_p) and position angle (θ) in degrees in the five emission filters for coma and tail

		CN 3871/50	C_3 4060/70	CO^+ 4260/65	C_2 5140/90	H_2O^+ 7000/175
Coma	P	6.20	9.29	15.47	16.67	18.52
	E_p	0.43	0.29	0.45	0.21	0.29
	θ	164.9	165.7	165.7	166.2	165.8
Tail	P	6.84	8.12	13.39	7.66	15.15
	E_p	0.53	0.55	0.83	0.28	0.84
	θ	165.2	165.4	167.0	165.2	167.1

coarser ones being in the central regions of the coma (Bappu et al., 1980).

The position angle is found to be independent of wavelength and also perpendicular (within the errors) to the scattering plane (Fig. 2). The observed polarization also shows a decrease across different emission bands (Table 2), characteristic of cometary molecular emissions.

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