PHOTOGRAPHIC OBSERVATIONS OF COMET HALLEY (1982i)

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Abstract. Positions of Comet Halley have been measured from the photographic plates taken at Cassegrain focus of the 104-cm telescope of Uttar Pradesh State Observatory.

1. Introduction

Under the Indian Halley-watch observing programme it was decide that positions measurements of the comet be also included in the programme related to the study of Comet Halley during its current apparition (1985–1986). As part of this program we have measured a few positions as available to us.

2. Observations

Photographs of Comet Halley have been obtained at the Cassegrain focus of the 104-cm reflector of the U.P. State Observatory on 13 nights during the period September 1985 – June 1986. The plate scale at the Cassegrain focus is 15 arc sec mm^{-1} covering a field of 40′ × 31′. Table I gives the journal of observations.

3. Procedure

Five of the selected plates, in which at least three reference stars with known precise coordinates were photographed, have been reduced for the astrometric positions of the comet. The method employed by us is applicable when at least three reference stars with precisely known coordinates and proper motion are photographed on the same plate along with the comet.

For measurement of the rectangular x and y coordinate on the plate of the reference stars and the comet, we have used the C. Reidel X coordinate measuring machine at the U.P.S.O. The X-Screw has a least count of 0.0001 cm. For y measurement the plate is turned 90° on the carriage and the same screw is used for measuring y. The origin of the xy coordinates on the plate has been chosen arbitrarily at one corner of the plate. xy measurements have been repeated by turning the plate through 180°. At least three observations for x and y of each star and of the comet were made and the average values of x and y have been used. For the coordinates of the centre of the plate (A, D), we have used the α and δ coordinates of telescope axis at the beginning of the exposure as read from the coordinate indicating dials.

TABLE I

Photography of Comet Halley with the 104-cm Reflector.
Plate scale 15 arc sec mm^{-1}

Date (UT)	No. of plates	filter	Emulsion	Mid-instant of Exposure (UT)		Exposure duration
				(hr)	(min)	(min)
1985						
Sept. 29	One	Yellow	103a-F	22	50.5	63
Sept. 30	Two	None	IIa-O	–	–	30
				–	–	40
Dec. 1	Four	None	103a-O	17	31.5	15
			103a-O	17	51.0	10
			103a-O	–	–	10
			103a-F	–	–	10
Dec. 2	Two	None	IIa-O	15	45.5	5
			IIa-O	16	36.5	5
Dec. 7	Four	None	IIa-O	15	00.5	7
				15	12.5	7
				17	17.0	10
				17	37.0	10
Dec. 20	Two	None	IIa-O	14	25.5	5
				14	44.0	10
Dec. 23	Three	None	IIa-O	14	26.5	7
			IIa-O	14	46.5	7
			IIa-O	15	06.5	7
1986						
Jan. 08	One	None	IIa-O	13	57.5	5
March 15	Two	Blue GG 385	IIa-O	23	46.8	5
				23	56.6	5
March, 16	One	Yellow GG 495	103a-F	23	21.9	15
May, 09	Two	None	103a-F	21	36.0	30
				22	14.5	20
June, 03	Two	Yellow	103a-F	21	22.5	20
		Yellow	IIa-O	20	46.2	30
June, 12	One	None	IIa-O	20	58.7	46

The standard coordinates ξ, η on the plate for the reference stars were determined using standard formulae (cf. Edberg, 1983)

$$\xi_i = \frac{\cos \delta_i \sin(\alpha_i - A)}{\sin \delta_i \sin D + \cos \delta_i \cos D \cos(\alpha_i - A)} \, ,$$

$$\eta_i = \frac{\sin \delta_i \cos D - \cos \delta_i \sin D \cos(\alpha_i - A)}{\sin \delta_i \sin D + \cos \delta_i \cos D \cos(\alpha_i - A)}$$

(1)

In which α_i and δ_i are 1950 coordinates of the ith star corrected for the proper motion to the date of observation.

TABLE II
Measured position of Comet Halley for the year 1950

Date (UT)	Plate No.	Mean epoch of exposure (UT)	Measured coordinate of Comet Halley (1950) α	δ
1 Dec. 1985	1	$17^h\ 31^m5$	$00^h\ 57^m825$	$13°3'13$
23 Dec. 1985	1	$14^h\ 26^m5$	$22^h\ 39^m0.84$	$-0°07'10$
	3	$15^h\ 16^m5$	$22^h\ 38^m946$	$-0°07'66$
15 March 1986	3	$23^h\ 46^m5$	$19^h\ 55^m192$	$-23°11'77$
16 March 1986	4	$23^h\ 21^m6$	$19^h\ 52^m363$	$-23°48'75$

TABLE III
XY Coordinates of Comet Halley

Date (UT)	Plate No.	Midinstant of exposure	Plate centre	Identified stars and Comet DM	X (cm)	Y (cm)
Dec. 7, 1985	4	17^h37^m0	$A = 00^h05^m22^s$	$+7°5129$	3.5965	1.7101
			$D = +8°37'5$	$+7°5128$	3.5972	10.5241
				Comet	6.3696	4.8943
Dec. 20, 1985	1	14^h25^m5	$A = 22^h50^m1$	$+0°4936$	3.7950	3.6046
			$D = +01°2'5$	$+0°4935$	5.9108	1.9110
				$+0°4933$	12.3017	6.4507
				Comet	6.5268	5.6124
May 9, 1986	1	21^h36^m0	$A = 10^h37^m2$	$-11°2923$	4.5282	0.6727
			$D = -12°17'51$			
				$-11°2924$	4.9472	2.1573
				$-11°2920$	0.6841	2.8389
				$-12°3217$	1.2270	6.9295
				$-12°3222$	6.3011	10.1939
				Comet	5.1314	7.5451
June 3, 1986	1	21^h22^m5	$A = 10^h26^m01^s$	$-5°3067$	1.9712	0.8146
			$D = -6°21'0$	137566	3.7071	1.4292
				137563	6.8512	4.6360
				$-5°3064$	6.6540	4.3970
				$-5°3065$	7.2103	4.0366
				Comet	4.6317	4.5109

The plate constants a, b, c, a', b', c' were determined from the relations

$$\xi_i - \frac{x_i}{F} = ax_i + by_i + c,$$

$$\eta_i - \frac{y_i}{F} = a'x_i + b'y_i + c', \tag{2}$$

where $x_i\, y_i$ are the xy measurements for the ith star, in case of three star $i = 1, 2, 3$. F is the focal length of the telescope expressed in cm, x and y measures are also in cm.

By use of the measured x_c, y_c of the comet and the plate constants determined above, the standard coordinates for the comet ξ_c, η_c were calculated from

$$\xi_c - \frac{x_c}{F} = ax_c + by_c + c, \tag{3}$$

$$\eta_c - \frac{y_c}{F} = a'x_c + b'y_c + c'.$$

The right ascension and the declination of the comet were then determined using the relations

$$\alpha_c = A + \tan^{-1} - \frac{\xi_c}{\Delta}, \tag{4}$$

$$\delta_c = \tan^{-1} \frac{\sin D + h_c \cos D}{\Gamma},$$

where $\Delta = \cos D - \eta_c \sin D$ and $\Gamma = (\xi_c^2 + \Delta^2)^{1/2}$.

Table II gives the coordinates measured by us. The accuracy of these measurement is 4 arc sec.

Due to small field of view, available at the Cassegrain focus of the 104-cm reflector, not all the plates taken, contained three stars having precisely known coordinates. In Table III, we give the details of such plates along with the identified stars, plate-center, mid-instant of the exposure and measured xy values. Precise position of the comet can be determined from the above plates once we know the precise coordinates and proper motion of the identified stars.

Reference

Edberg, J. S.: 1983, JPL Publication, 83-16 Part I, p. 7−1.