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LIGHT CURVE AND FAN-SHAPED COMA OF COMET P/TEMPEL 2 IN 1988-89

Hiroki Akisawa[1], Mitsunori Tsumura[2], Akimasa Nakamura[1] and Junichi Watanabe[3]

[1] *Hoshi-no-Hiroba; 8-13-607, Shiroyama 3-chome, Odawara-shi, 250 Japan*
[2] *Wakayama City Children's Science Center, & Hoshi-no-Hiroba*
[3] *National Astronomical Observatory of Japan*

ABSTRACT. Visual and Photographic Monitoring observations of comet P/Tempel 2 were carried out by a Japanese amateur group "Hoshi-no-Hiroba" in 1988 – 1989. We analyzed the light curve and the time variation of the fan-shaped coma. The light curve was asymmetric to the perihelion passage. The fan angle in September – October was wider than that in December. The direction of the fan generally coincided with Sekanina's prediction (1988).

Introduction

It is important to monitor the activity of comets which are potential targets of future missions. Comet P/Tempel 2 was a candidate of the CRAF mission (Naugebauer, 1987). The monitoring observations of this comet was carried out by a Japanese amateur group "Hoshi-no-Hiroba" in 1988 – 1989 apparition. The observations were divided into two categories. One is the visual observations of total magnitude of this comet. The other is the photographic observations of the fan-shaped coma in order to know its time variation. In this paper, we report some results obtained by these observations.

Observations of total magnitude

Visual observations of comet P/Tempel 2 were performed by many members in the "Hoshi-no-Hiroba". The original charts for standard comparison stars were supplied to all the observers in advance. We obtained 87 total magnitude data in 1988.

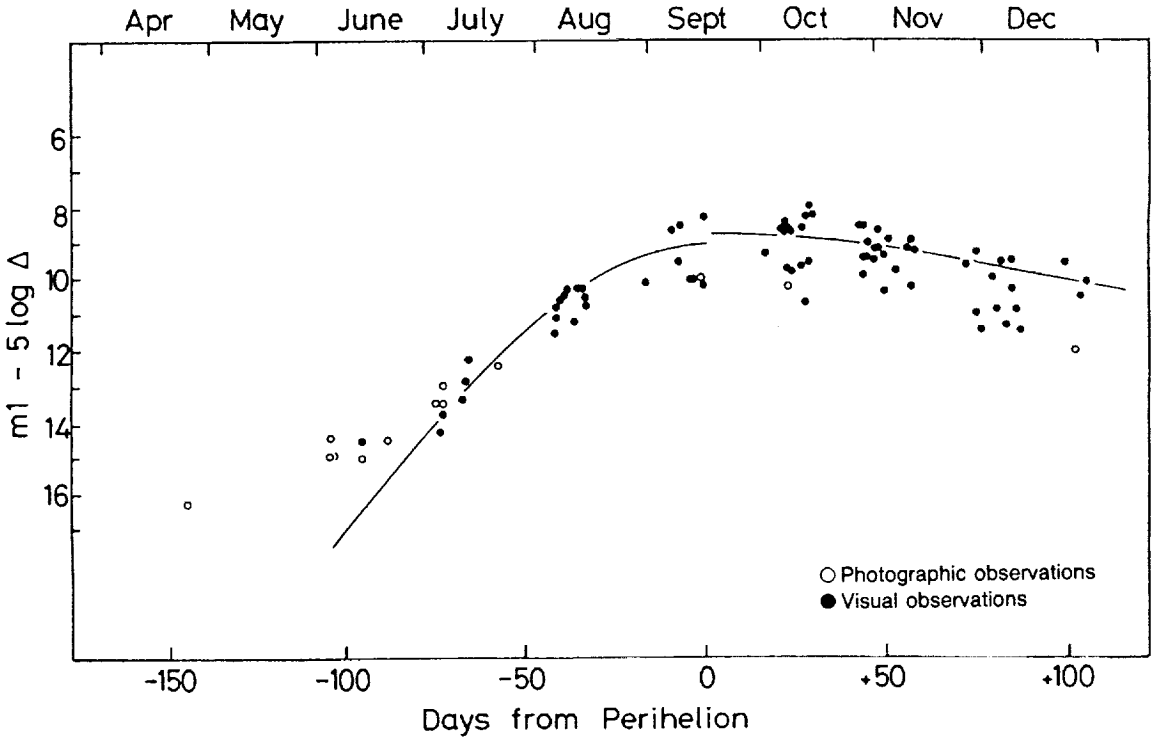

Figure 1. The light curve of comet P/Tempel 2

Figure 1 shows the light curve, which is clearly asymmetric to the perihelion passage. The obtained equations of the light curve are follows.

$m_1 = -2.38\ (\pm 0.99) + 5\ log\ \Delta + 81.83\ (\pm 5.95)\ log\ r$ (pre-perihelion)

$m_1 = +6.86\ (\pm 0.54) + 5\ log\ \Delta + 14.04\ (\pm 3.11)\ log\ r$ (post-perihelion)

The regressions of these light curves are shown in Figures 2 and 3, respectively.

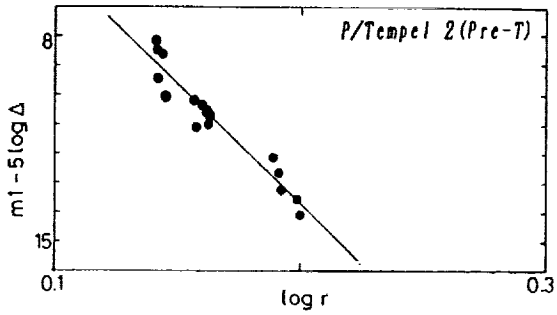

Figure 2. The light curve in pre-perihelion

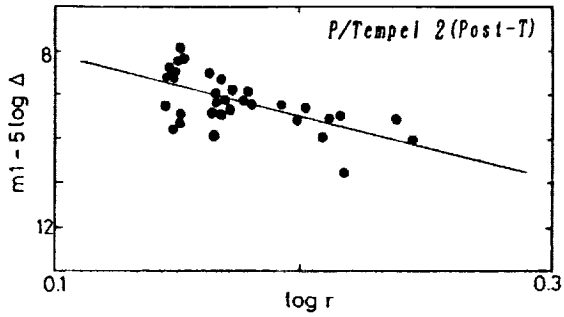

Figure 3. The light curve in post-perihelion

Observations of the fan-shaped coma

The photographic observations of the fan-shaped coma were performed by 31 cm reflector (f.l. 1650 mm) with focal reducer (for F4.2, f.l. 1290 mm) in Oishi observatory. The site is located on the Wakayama prefecture in Japan (E=135°20'23", N=34°07'57", H=340m above see level). We used the emulsion Kodak TP2415, which is sensitive over a wide range of wavelength (300 – 700 nm). The film was hypersensitized with a forming gas (8% H_2 + 92% N_2), and was developed with D-19 at 20°C for 5 min. We obtained sixteen photographs of the fan-shaped coma during the period between September 12, 1988 and February 5, 1989. One of the photographs is shown in Figure 4, on which the fan-shaped coma is recognized. The position angle of the fan's direction was measured by inspection. Two or three combinations of comparison stars were selected on each photograph. The position angle of the fan-shaped coma was measured by using these selected S.A.O. stars. These data are shown in Table 1.

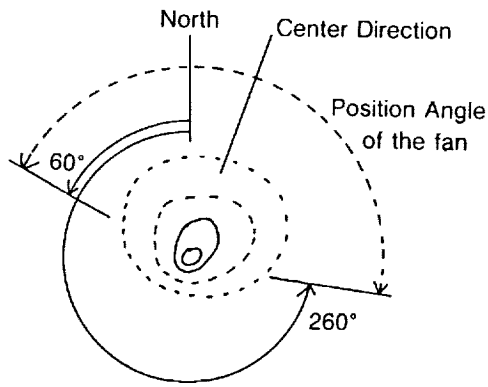

Figure 4. The observed fan-shaped coma of comet P/Tempel on Oct. 31.43, 1988 (No. 6)

Table 1. Observational data of fan-shaped coma

No.	Date (UT)	Oishi Obs. Plate No.	Exposure	Position Angle of the fan	Center Direction	Dia.	D.C.
1	Sept. 12.46, 1988	6673	5	220° – 60°	320°	4.0'	4
2	Sept. 13.47, 1988	6686	20	210° – 60°	315°	3.0'	4
3	Sept. 15.48, 1988	6710	15	275° – 35°	335°	2.0'	4
4	Oct. 3.44, 1988	6752	20	280° – 30°	335°	3.0'	3
5	Oct. 14.48, 1988	6798	10	280° – 20°	330°	2.0'	4
6	Oct. 31.43, 1988	6831	20	260° – 60°	340°	2.5'	4
7	Nov. 8.44, 1988	6846	15	275° – 45°	340°	2.0'	4
8	Nov. 12.47, 1988	6897	15	300° – 45°	352°.5	2.0'	4
9	Nov. 30.42, 1988	6912	15	320° – 70°	15°	1.5'	3
10	Dec. 1.45, 1988	6916	14	300° – 70°	5°	1.5'	2
11	Dec. 6.41, 1988	6925	15	310° – 70°	10°	1.5'	3
12	Dec. 8.45, 1988	6969	15	290° – 70°	0°	1.5'	3
13	Dec. 12.49, 1988	6972	15	280° – 60°	350°	1.2'	2
14	Dec. 27.47, 1988	6989	16	Uncertainty	about 20°	0.8'	2
15	Jan. 2.41, 1989	7000	15	330° – 70°	20°	0.7'	3
16	Feb. 5.43, 1989	7053	15	Uncertainty	about 20°	0.7'	0

Sekanina (1987a, b) analyzed the rotation axis and the surface structure of nucleus of comet P/Tempel 2 by applying the spin-vector model to the fan-shaped coma observed in 1899 – 1972. On the basis of his model, Sekanina (1988) predicted the direction and shape of the fan of this comet in 1988 – 1989 apparition. The comparison between Sekanina's prediction and our observations is shown in Figure 5. The observed center of the direction of the fan agrees with his prediction. On the other hand, the fan angle in September – October was wider than that in December. This is an opposite sense to the Sekanina's prediction.

Concluding Remarks

Visual and Photographic Monitoring observations of comet P/Tempel 2 were carried out by a Japanese amateur group "Hoshi-no-Hiroba" in 1988 – 1989. The photographic observations show the developed fan-shaped coma which generally coincides with Sekanina's prediction (1988). This suggests that the CRAF mission can be based on the Sekanina's model (1987a, b) for the nucleus of this comet. The result of the visual observations shows the strong asymmetry in the light curve to the perihelion passage. This may be due to a seasonal effect of the cometary nucleus (Weissman, 1987). Visual magnitude observations give us useful information on the global activities of comets even if each estimate is less accurate than the photometry. More than 300 members in the "Hoshi-no-Hiroba" have great potential for contributing to such monitoring observations of the mission targets.

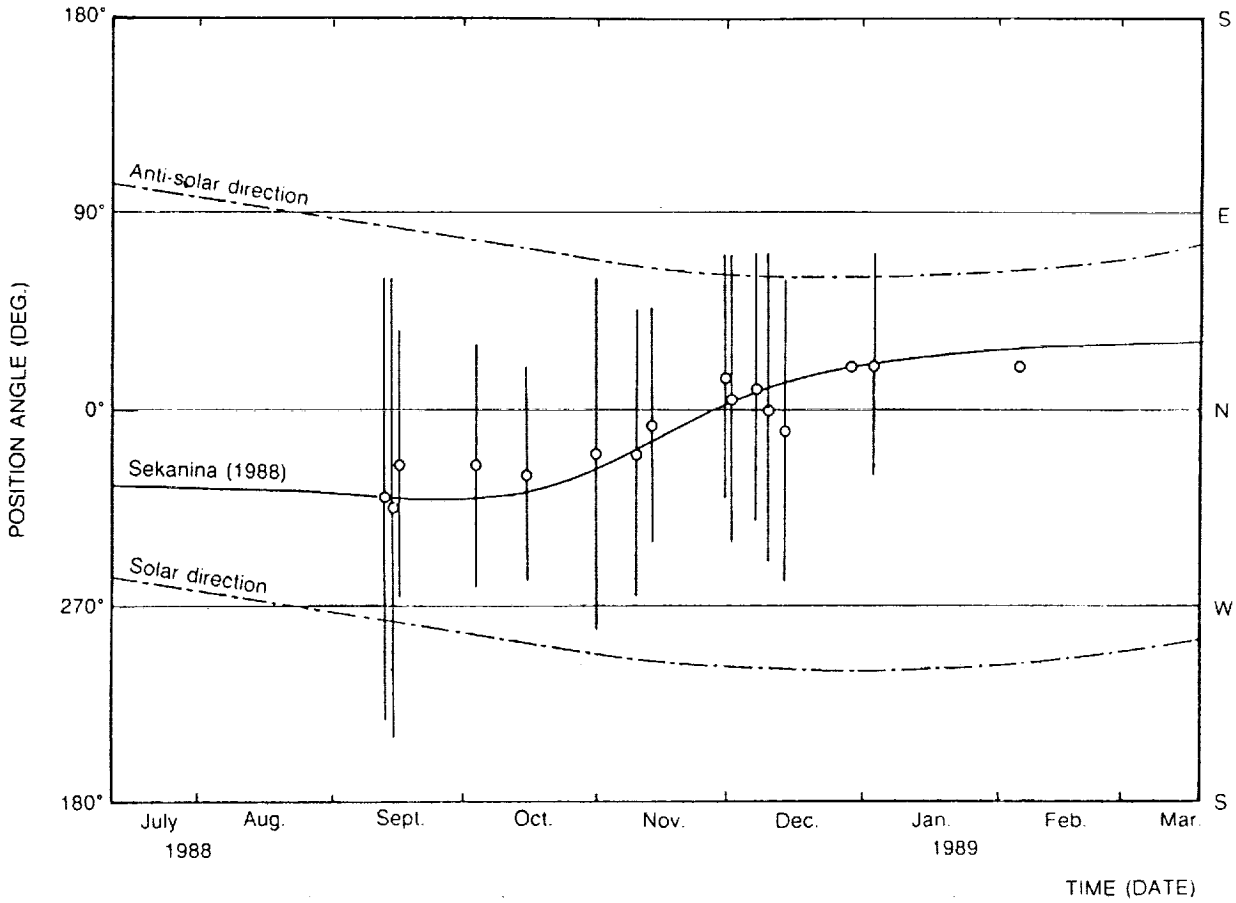

Figure 5. The observed direction of the fan-shaped coma and the comparison with the Sekanina's prediction.

References

Neugebauer M. (1987) The comet rendevous asteroid flyby mission. In Proc. Symposium on the Diversity and Similarity of Comets, pp.517–522, ESA SP-278.

Sekanina Z. (1987a) Anisotropic emission from comets: Fans versus jets — I. Concept and modeling. In Proc. Symposium on the Diversity and Similarity of Comets, pp.315–322, ESA SP-278.

Sekanina Z. (1987b) Anisotropic emission from comets: Fans versus jets — II. Periodic Comet Tempel 2, In Proc. Symposium on the Diversity and Similarity of Comets, pp.323–336, ESA SP-278.

Sekanina Z. (1988) Comet P/Tempel 2. In IAU Circular, 4624 (8 July 1988).

Weissman P.R. (1987) Post-perihelion brightening of comet P/Halley: Springtime for Halley. Astron. Astrophys., 187, 873–878.