Jiří Bouška

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Absolute Brightness of Comet Ikeya-Seki 1965 f and of other Comets of Kreutz's Group

JIŘÍ BOUŠKA
Astronomical Institute of the Charles University, Prague
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Using the observations collected in Table 1 the photometric parameters and the heat of desorption were calculated. All these values of the Comet 1965*f* were quite average and no differences were found between the results of the pre-perihelion and post-perihelion observations. Table 2 shows that most of other Sun-grazing comets of Kreutz's group have also average absolute brightnesses.

Comet 1965*f* discovered by Japanese astronomers K. Ikeya and T. Seki has already been the ninth member of the well-known Kreutz's Sun-grazing comets group. Comet 1965*f* was discovered 32 days before the perihelion passage and had been observed by many observers during two months. Observations were also made on the day sky during the perihelion passage. A survey of the observations is given in Table 1 and in Fig. 1.

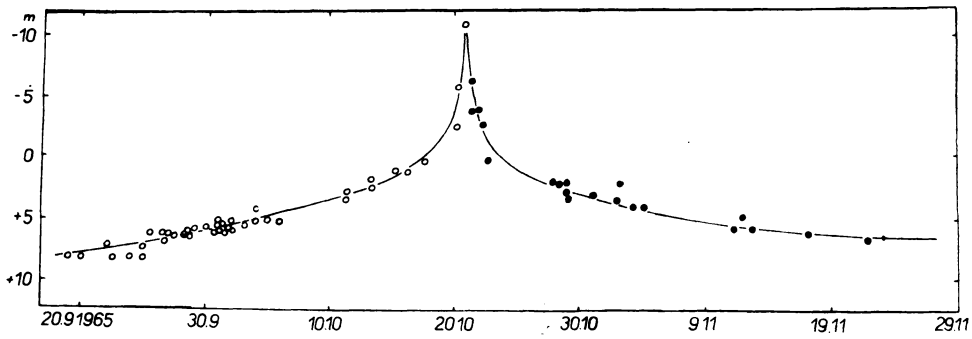

Fig. 1. *Observations of the brightness* (o – *pre-perihelion*, ● – *post-perihelion observations*) *and the theoretical light-curve* ($m = 6.2 + 5 \log \Delta + 9.5 \log r$) *of Comet 1965f.*

Table 1

1965(UT)	*m*	*m'*	*log r*	*Observer*	*Reference*
Sep. 18.8	8^m	$+6.9^m$	+0.05	Ikeya, Seki	IAUCirc. 1921
19.8	8	+7.0	+0.04	(Woomera)	IAUCirc. 1921
22.1	7.0	+6.1	+0.02	Bennett	BAACirc. 469
22.5	8	+7.1	+0.02	Milon, Van Biesbroeck	IAUCirc. 1922
24.1	8	+7.2	0.00	Antal	IAUCirc. 1923
24.7	7.1	+6.3	−0.01	Nelson	BAACirc. 470
25.1	8	+7.2	−0.01	Antal	IAUCirc. 1923
25.5	6	+5.3	−0.01	Larsen, Van Biesbroeck	IAUCirc. 1925
26.5	6	+5.4	−0.03	Larsen, Van Biesbroeck	IAUCirc. 1925
26.7	6.6	+6.0	−0.03	Nelson	BAACirc. 470
26.8	6	+5.4	−0.03	Tomita	IAUCirc. 1925
27.7	6.3	+5.7	−0.04	Nelson	BAACirc. 470
28.4	6	+5.4	−0.05	Pereyra, Rodríguez	IAUCirc. 1933
28.4	6	+5.4	−0.05	Pereyra, Rodríguez	IAUCirc. 1933
28.4	6	+5.4	−0.05	Pereyra, Rodríguez	IAUCirc. 1933
29.1	5.7	+5.2	−0.06	Venter	BAACirc. 470
29.5	6.0	+5.5	−0.06	Van Biesbroeck	IAUCirc. 1926
30.1	5.6	+5.1	−0.07	Venter	BAACirc. 470
Oct. 1.1	5.4	+5.0	−0.08	Venter	BAACirc. 470
1.1	5.7	+5.3	−0.08	Benett	BAACirc. 470
1.1	6	+5.4	−0.08	Antal	IAUCirc. 1926
1.1	6.0	+5.4	−0.08	Dujnič	Říše hvězd 47. 18
1.2	6	+5.4	−0.08	Poljakova	Kiev Comet Circ. 31
1.8	5	+4.6	−0.10	Tomita	IAUCirc. 1930
2.1	6	+5.6	−0.10	Antal	IAUCirc. 1926
2.1	6.0	+5.6	−0.10	Dujnič	Říše hvězd 47. 18
3.1	5.5	+5.2	−0.12	Dujnič	Říše hvězd 47. 18
3.8	4	+3.7	−0.13	Tomita	IAUCirc. 1930
4.1	5.4	+5.1	−0.13	Benett	BAACirc. 470
5.1	5.2	+5.0	−0.16	Venter	BAACirc. 470
5.8	5	+4.9	−0.17	(Woomera)	IAUCirc. 1932
11.3	3	+3.0	−0.29	Pereyra, Rodríguez	IAUCirc. 1933
11.3	3	+3.0	−0.29	Pereyra, Rodríguez	IAUCirc. 1933
13.3	2	+2.1	−0.36	Pereyra, Rodríguez	IAUCirc. 1933
13.3	2	+2.1	−0.36	Pereyra, Rodríguez	IAUCirc. 1933
15.4	1	+1.2	−0.44	Pereyra, Rodríguez	IAUCirc. 1933
16.4	1	+1.2	−0.50	Pereyra, Rodríguez	IAUCirc. 1933

Table 1 (cont.)

1965 (UT)	*m*	*m'*	*log r*	*Observer*	*Reference*
Oct. 17.8	0^m	$+0.2^m$	−0.70	(Woomera)	IAUCirc. 1932
20.5	−6.0	−5.9	−1.16	Vanýsek	BAC (in press)
20.5	−2.6	−2.5	−1.16	Valníček	BAC (in press)
21.0	−10.5	−10.5	−1.55	Roemer	IAUCirc. 1932
(*Perihelion passage*)					
21.5	−6.6	−6.5	−1.22	Kaminski	IAUCirc. 1932
21.5	−3.8	−3.7	−1.22	Valníček	BAC (in press)
22.2	−4.0	−4.0	−0.96	Antal	IAUCirc. 1944
22.4	−2.7	−2.7	−0.88	Valníček	BAC (in press)
22.7	0	0.0	−0.82	Sinton, Boyce	IAUCirc. 1932
28.3	2	+1.9	−0.41	Pereyra, Rodríguez	IAUCirc. 1941
28.4	2	+1.9	−0.41	Pereyra, Rodríguez	IAUCirc. 1941
29.1	2	+1.9	−0.37	Beytrishvili	Kiev Comet Circ. 32
29.3	3	+2.9	−0.37	Pereyra, Rodríguez	IAUCirc. 1941
29.3	3	+2.9	−0.37	Pereyra, Rodríguez	IAUCirc. 1941
31.2	3.0	+2.9	−0.30	Antal	IAUCirc. 1944
Nov. 1	2	+1.9	−0.27	Gulmedoff	Kiev Comet Circ. 33
2.2	3.5	+3.4	−0.25	Antal	IAUCirc. 1944
3.2	4.0	+3.9	−0.22	Antal	IAUCirc. 1944
4.1	4	+3.9	−0.20	Kadyroff	Kiev Comet Circ. 32
11.3	6	+5.8	−0.08	Pereyra, Rodríguez	IAUCirc. 1941
12.0	5	+4.8	−0.07	Rozhkovskyi	Kiev Comet Circ. 33
12.8	6	+5.8	−0.06	Tomita	IAUCirc. 1941
17.2	6.5	+6.3	−0.01	Antal	IAUCirc. 1944
21.8	7	+6.9	+0.02	Tomita	IAUCirc. 1943

From these observations photometric parameters, absolute brightness m_0 and exponent n may be determined, using the known formula

(1) $$m_0 = m' - 2.5\, n \log r\,,$$

where r is the distance of the comet from the Sun and

(2) $$m' = m - 5 \log \Delta\,,$$

where m is the apparent brightness of the comet and Δ the distance of the comet from the Earth. For computing the values m_0 and n ephemerides published by B. G. Marsden (IAU Circ. 1925) and L. E. Cunningham (IAU Circ. 1928 and 1930) were used. The observations collected in Table 1 yield following photometric parameters (Fig. 2):

$$m_0 = 6.2 \qquad \text{and} \qquad n = 3.8$$

Using these values the curve of apparent brightness given in Fig. 1 was computed.

Figures 1 and 2 show that there are no differences between pre-perihelion and post-perihelion observations. This fact is very interesting if we take into account that the distance of the Comet from the Sun's surface was only 4.6×10^5km during the perihelion passage. The nucleus of the Comet was exposed to temperatures over 3000°K for about 2 hours, to temperatures over 2000°K for about 16.5 hours and to temperatures over 1000°K for about 42 hours. Although during the perihelion passage the nucleus of the Comet splitted into two pieces at least, the photometric parameters were the same after the perihelion passage as before the perihelion passage of the Comet. Both photometric parameters are quite average so that in this respect there are practically no differences between Comet 1965*f* and most other comets.

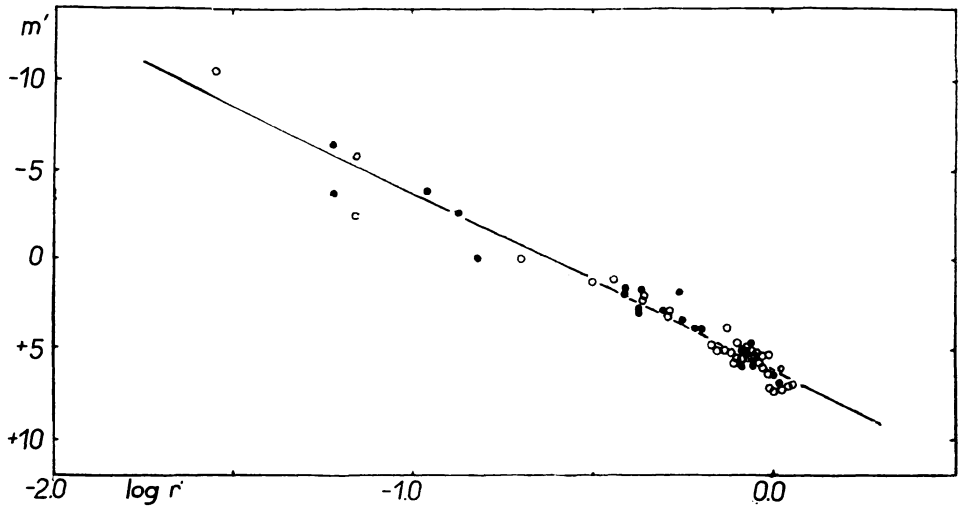

Fig. 2. *Reduced brightness* ($m' = m - 5 \log \Delta$) *vs. logarithm of the heliocentric distance* (o – *pre-perihelion*, ● – *post-perihelion observations*).

For the determination of the desorption-heat L of cometary gases the known Levin's (1948) formula was used

$$m_0 = m' - 0.547 \frac{L}{T_0} (\sqrt{r} - 1) \tag{3}$$

where for T_0 (for $r = 1$) the temperature of 350°K was accepted. Using the pre-perihelion observations the heat of desorption

$$L = 9070 \text{ cal/mol}$$

and the absolute brightness

$$m_0 = 6.5$$

were found. According to the post-perihelion observations these values are

$$L = 8950 \text{ cal/mol}$$

and

$$m_0 = 6.8$$

These results also show that there are practically no differences between the values computed from the pre-perihelion and the post-perihelion observations. The mean absolute brightness according to formula (3) is

$$m_0 = 6.6 .$$

The differences between the values of the absolute brightnesses computed according to formula (3) and formula (1) are very small. The mean value of the desorption-heat 9000 cal/mol reduced for the unit distance ($r = 1$) is

$$L = 5300 \text{ cal/mol.}$$

This value of the desorption-heat found for Comet 1965*f* also is in a good agreement with the mean value of L for other comets. According to Levin (1948) the mean value of desorption heat determined from observations of 28 comets is $L \approx 5000$ cal/mol.

Table 2 shows the values of absolute brightnesses m'_0 for all nine members of Kreutz's comets group. The absolute brightnesses m'_0 of all these comets were computed supposing that the photometric exponent $n = 4$. The values of m'_0 for the comets Nos. 1—7 were taken from the catalogue by Vsekhsviatskyi (1958). The absolute brightness of Comet 1963 *V* was computed by the author using the observations obtained during the period September 16 – October 23, 1963, by M. Antal (IAU Circ. 1842, 1843 and 1855), F. Börngen (IAU Circ. 1866), A. McClure (IAU Circ. 1841), H. L. Giclas (IAU Circ. 1842), K. Tomita (IAU Circ. 1845) and at the Baker Nunn Station in South Africa (IAU Circ. 1842). The first observation of September 14, 1963, by Z. M. Pereyra (IAU Circ. 1841) evidently is erroneous by about 3 magnitudes and was omitted when determining m'_0.

Table 2

No.	*Comet*	m'_0
1	1668 – Gottignies	6.0
2	1843 I – Brilliant Comet	4.9
3	1872 – Pogson	6.3
4	1880 I – Gould	7.1
5	1882 II – Brilliant Comet	0.8
6	1887 I – Thome	6.3
7	1945 VII – Du Toit	10.8
8	1963 V – Pereyra	6.5
9	1965 f – Ikeya-Seki	6.2

According to the mentioned observations the photometric parameters of Comet 1963 *V* were determined using formula (1)

$$m'_0 = 6.0 \quad \text{and} \quad n = 11.6 .$$

Supposing $n = 4$, the same as for other comets of Kreuzt's group by Vsekhsviatskyi, we get

$$m_0 = 6.5 \pm 0.6 .$$

For the computation of the absolute brightness of Comet 1963 *V* the ephemeris published by M. P. Candy (IAU Circ. 1844) was used.

Supposing that the photometric exponent $n = 4$ also for Comet 1965*f* we get according to the observations collected in Table 1 following absolute magnitudes

$$m_0' = 6.2 \pm 0.1 \text{ (pre-perihelion observations)}$$

$$m_0' = 6.2 \pm 0.2 \text{ (post-perihelion observations)}$$

Table 2 shows that most of the comets of Kreutz's group have quite average absolute brightnesses. The only exceptions are Comet 1882 *II* the absolute brightness of which was extraordinarily great and Comet 1945 *VII* the absolute brightness of which was very small.

Moreover, Figure 1 confirms that the simple photometric formula (1) may be used also for comets with such extraordinary orbits as the Sun-grazing comets of Kreutz's group are.

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Absolutní jasnost komety Ikeya-Seki 1965 f a ostatních komet Kreutzovy skupiny

Souhrn

V tabulce 1 jsou shromážděna všechna dostupná pozorování jasnosti, z nichž byly počítány fotometrické parametry a hodnoty výparného tepla. Výsledky ukazují, že všechny tyto veličiny pro kometu 1965*f* jsou zcela průměrné. Nebyly také zjištěny rozdíly mezi hodnotami, určenými z pozorování, vykonaných před a po průchodu komety přísluním. Tabulka 2 ukazuje, že také většina ostatních komet Kreutzovy skupiny měla zcela průměrné absolutní jasnosti.

Фотометрические характеристики кометы Икейя-Секи 1965 f и других комет группы Крейца

Резюме

Из наблюдений, приведенных в табл. 1, были определены фотометрические характеристики и величина теплоты десорбции. Результаты показывают, что фотометрические характеристики для кометы Икейя-Секи средние. Нет систематических различий между величинами, определенными из наблюдений кометы до прохождения и после прохождения перигелия. Табл. 2 показывает, что тоже большинство других комет группы Крейца имеет средние абсолютные величины.