

PHOTOELECTRIC PHOTOMETRY OF COMET BRADFIELD (1987s)

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Abstract. UVB observations and magnitudes of head of Comet Bradfield (1987s) during six nights in December 1987 are given. Magnitude and intensity variations and colour indices of three circular zones from the centre of the cometary head have also been estimated.

1. Introduction

The discovery of Comet Bradfield (1987s) was made by William A. Bradfield on 11 August 1987. Subsequent observations in respect of measuring its total visual magnitude, position and precise orbital elements were reported by many observers. For the present work the relevant data has been taken from IAU circular No. 4483 (November 5, 1987). The atmospheric conditions were good for measurements of photoelectric observations.

2. Observations

The comet was observed through UVB filters. The 30", 45" and 56" diaphragms were used for the photometry of the cometary head. For the geocentric distance of the comet; i.e. $\Delta = 1$ AU, these diaphragms would correspond to circular area of $D(30'') = 2.17 \times 10^4$ km, $D(45'') = 3.26 \times 10^4$ km and $D(56'') = 4.06 \times 10^4$ km in diameter respectively, centred on the cometary nucleus. Since the comet's geocentric distance varies daily, therefore the corresponding area would also vary. These values are given in Table I. The telescope used was 38-cm reflector using a cooled (-20°C) 1 P21 photomultiplier tube and UVB filters of the Johnson and Morgan system and a d.c. amplifier. The filter characteristics of the UVB filters are as follows:

U filter – Peak 3650 Å FWHM 600 Å

B filter – Peak 4400 Å FWHM 833 Å

V filter – Peak 5500 Å FWHM 1400 Å

A total of six nights of observations were secured on the following nights:

December 1987, (Date 3, 4, 5, 8, 9 and 14). Few standard stars were also observed to reduce the data to the standard system. The mean standardised magnitude of the comet, as well as the intensity per square centimetre for each night of observations were calculated. The values are reported in Table I.

TABLE I
UBV observations of Comet Bradfield (1987s)

Date 1987	Δ AU	r AU	Magnitude of comet					Corresponding area of zone $\times 10^{16} \text{ cm}^2$	Intensity per square centimetre ($I \text{ cm}^{-2}$) $\times 10^{-20}$		
			U	B	V	B-V	U-B		U	B	V
Diaphragm D(30")											
Dec. 3	0.857	0.987	7 ^m 550	8 ^m 833	8 ^m 216	0 ^m 617	-0 ^m 783	2.72	3.490	1.077	1.901
Dec. 4	0.850	0.990	7.770	8.809	8.210	0.599	-1.039	2.67	2.917	1.120	1.945
Dec. 5	0.848	1.000	7.604	8.772	8.236	0.536	-1.168	2.66	3.414	1.164	1.909
Dec. 8	0.840	1.030	7.901	8.952	8.385	0.567	-1.051	2.61	3.001	1.005	1.696
Dec. 9	0.838	1.040	8.164	8.970	8.526	0.444	-0.806	2.60	2.083	0.991	1.494
Dec. 14	0.835	1.095	8.024	8.929	8.504	0.425	-0.905	2.58	2.393	1.039	1.537
Diaphragm D(45")											
Dec. 3	0.857	0.987	6.863	8.416	7.902	0.514	-1.553	6.13	2.930	0.701	1.126
Dec. 4	0.850	0.990	7.258	8.458	7.873	0.585	-1.200	6.03	2.070	0.686	1.176
Dec. 5	0.848	1.000	7.296	8.621	8.065	0.556	-1.325	6.00	2.010	0.593	0.989
Dec. 8	0.840	1.030	7.611	8.626	8.066	0.560	-1.015	5.89	1.532	0.597	1.007
Dec. 9	0.838	1.040	7.984	8.815	8.012	0.803	-0.831	5.86	1.091	0.508	1.064
Dec. 14	0.835	1.095	7.428	8.718	8.136	0.582	-1.290	5.82	1.834	0.559	1.066
Diaphragm D(56")											
Dec. 3	0.857	0.987	5.878	—	—	—	—	9.51	4.683	—	—
Dec. 4	0.850	0.990	6.663	7.979	7.235	0.744	-1.316	9.35	2.310	0.687	1.363
Dec. 5	0.848	1.000	6.727	7.880	7.295	0.585	-1.153	9.31	2.188	0.756	1.297
Dec. 8	0.840	1.030	7.109	8.402	7.430	0.972	-1.293	9.14	1.579	0.477	1.166
Dec. 9	0.838	1.040	7.333	8.245	7.450	0.795	-0.915	9.09	1.282	0.551	1.151
Dec. 14	0.835	1.095	6.918	8.295	7.507	0.788	-1.377	9.03	1.892	0.532	1.102

3. Discussion and Conclusions

On each night, the comet was observed in three diaphragms and using each (U, B, V) filter for a few hours. The mean magnitude for each diaphragm thus determined is reported in Table I. The mean intensities per square cm ($I \text{ cm}^{-2}$) for each night of observations have been plotted against comet's heliocentric distance r in Figure 1. The various diaphragm sizes and filters used are written just above the respective light curves. The points O, X, Δ stand for observations taken through diaphragm sizes 30", 45" and 56" of arc respectively. The solid curves are free hand curves indicating an average intensity variation of comet through the entire duration of observations. An inspection of the light curve indicates that the comet's brightness was found minimum on December 9, when its heliocentric distance was about 1.05 AU. A sudden rise in brightness (maximum in U filter) in all the three diaphragms was observed on December 14. It is unfortunate that no observations after December 14, could be obtained which could have helped to ascertain the reason for this brightness increase which is mainly due to two reasons one is

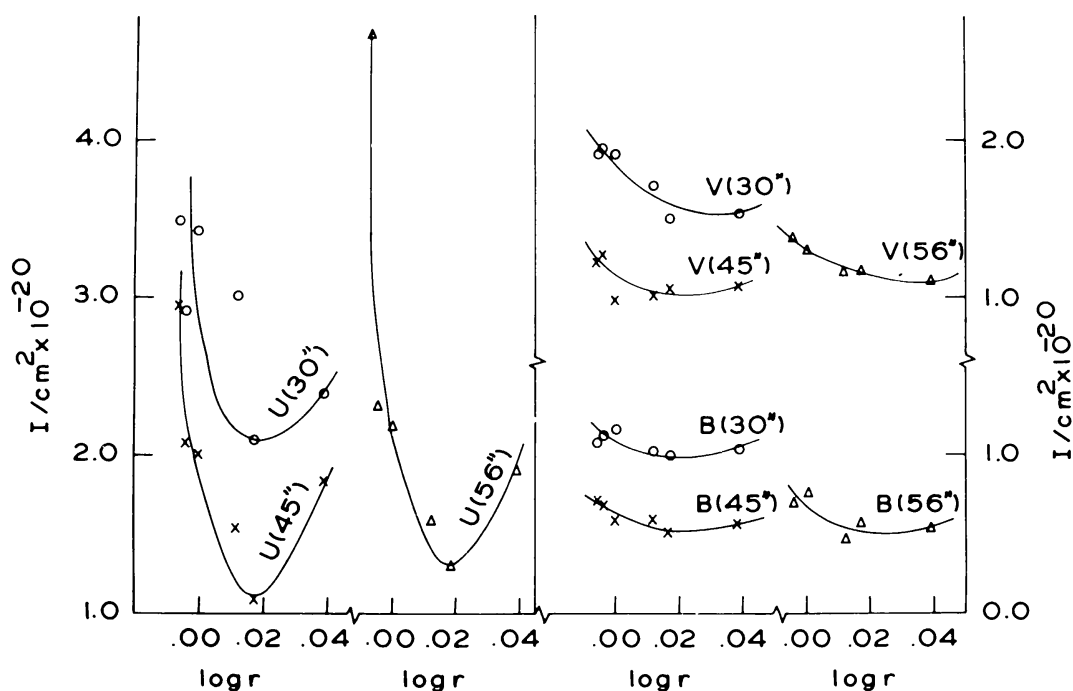


Fig. 1. Observed UBV intensity variations ($I \text{ cm}^{-2}$) of Comet Bradfield as a function of r .

intrinsic and the other triggered by solar activity. However, in the present case we feel that this increase in intensity can be attributed to enhanced solar activity on December 14, 1987, which was evidenced about 12 h before the observations of comet. The time lag of 12 h may be the time taken (though not clear) from solar triggering of comet to variation of (molecular) production rates of CN molecules.

The mean (B-V) colour indices in D(30''), D(45'') and D(56'') differ significantly from each other whereas (U-B) colour in D(45'') and D(56'') differ slightly. The mean colour indices are:

$$(B-V)_{30''} = 0^m531, (B-V)_{45''} = 0^m600, (B-V)_{56''} = 0^m775$$

$$(U-B)_{30''} = -1^m958, (U-B)_{45''} = -1^m202 \text{ and } (U-B)_{56''} = -1^m211$$

This decrease of (U-B) may be due to the difference in scale lengths for destruction of CN (in U system) and C_2 (in B and V system) molecules. Further details of colour indices and their nightly differences are given in Table I.

The average specific intensity on each night for each diaphragm; i.e. for each corresponding zone is given in Table I. This gives an idea of brightness variations of comet in different zones measured from the centre of the cometary nucleus.

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