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PHOTOELECTRIC MONITORING OF BUTLER'S FLARE STAR

Butler's Flare Star (finding chart: Arp (1958), Plate 1, Star 'R') was discovered (Andrews, 1966) at Boyden Observatory during photo-electric observations of a "standard" star in the field of the Small Magellanic Cloud previously observed by Arp (1958), with further monitoring (Andrews et al., 1966) confirming UV Ceti-type flaring activity.

This activity was considered as extremely unusual as objective prism spectroscopy gave the spectral type as an early G-type star, later revised (Andrews, 1967) by slit spectroscopy to dKO with no trace of emission lines in the spectrum.

As this classification is earlier than any solar neighbourhood flare star listed by Pettersen (1977), and no report of monitoring since 1966 has been published, it was decided to investigate the variability of Butler's Flare Star to determine the rate and photometric characteristics of any flaring activity.

Butler's Flare Star was photoelectrically monitored in the Johnson 'B' band with the Nishimura 0.41 m reflector at Boyden Observatory employing an EMI 6256 photomultiplier tube and pulse-counting electronics. As a compromise between photometric precision and the resolution of any rapid variation, 10 second integrations were used. The dates and times of observing hours are given in Table I.

Table I

Date	Times of observations(SAST)	Duration
25/26 October 1984	01.30 - 03.05	1 Hour 35 minutes
30/31 October 1984	21.05 - 23.40	2 Hours 35 minutes
01/02 November 1984	20.40 - 23.00 and 23.20 - 02.20	5 Hours 20 minutes
03/04 November 1984	20.35 - 23.25 and 23.40 - 02.15	5 Hours 25 minutes
21/22 November 1984	20.30 - 21.30 and 21.50 - 01.00	4 Hours 10 minutes
22/23 November 1984	20.30 - 21.30 and 21.50 - 01.00	4 Hours 10 minutes
Total monitoring time:		23 Hours 15 minutes

The typical photometric precision of any 10 second integration was estimated by evaluating the statistical fluctuations of short periods of (sky subtracted)

data selected at random from the observing runs; the mean of the standard deviations was found to be $0.^m015$. Flare activity of more than $0.^m090$ would thus be detectable at a high level of confidence (6σ) even if of short duration, quite adequate for UV Ceti-type flares which should typically produce a 'B' band flux increase if several tenths of a magnitude persisting for several hundred seconds.

No statistically significant flare activity greater than $0.^m09$ persisting for longer than 10 seconds was observed during the 23 hours of monitoring. Smaller amplitude flare activity cannot be completely discounted due to the photon noise statistics, but these are considered unlikely above $0.^m06$ (4σ) as any flares persisting for longer than 10 seconds should be detected at this lower threshold of activity. Flare activity below $0.^m06$ cannot be discounted by the observations.

In addition to monitoring, differential photometry was also obtained on the night of 01/02 November 1984 employing HD 6172 = SAO 225729 as the comparison star. No evidence of variability in excess of $0.^m03$ was detected, with the mean differential 'B' magnitude determined as $2.^m31$, within $0.^m01$ of the value determined by Arp (1958).

The complete absence of flares of the sort reported by Andrews et al. (1966) is disconcerting and suggests that Butler's Flare Star has quite long quiescent periods with very low levels of activity. An alternate possibility is that reported flare activity is erroneous, explaining the unusually early spectral type and the lack of emission lines in the spectrum.

In order to investigate these possibilities it is intended to resume photoelectric monitoring of Butler's Flare Star after an interval of a few months and if possible to obtain a contemporary spectral classification.

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References:

- Andrews, A.D. (1966) I.A.U. Inform. Bull. Var. Stars, No.156
 Andrews, A.D., Butler, C.J., and Eksteen, J.P. (1966) I.A.U. Inform. Bull. Var. Stars, No.157
 Andrews, A.D. (1967) P.A.S.P. 79, No.469, 368.
 Arp, H.C. (1958) A.J. 63, 118.
 Pettersen, B.R. (1977) Inst. of Theor. Astrophysics Blindern-Oslo Report No.46.