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PHOTOELECTRIC OBSERVATIONS OF DO CEPHEI

I. The Observations

A total of 57.4 hours of actual monitoring time was recorded for DO Cephei in the 1970 and 1972-73 observing seasons.The charts in Figures 1 and 2 give graphically the photoelectric coverage in the two seasons.

The 60-cm Cassegrain telescope of Mt. Cuba Observatory was used at f/16 equipped with a single-channel photoelectric photom - eter. An uncooled EMI 6256 S photomultiplier was used with a stand ard U filter (Corning 7-54) of the Johnson three-color system. No attempt, however, was made to transform the data to standard U magnitudes.

Owing to the relatively small separation of the components of the Kruger 60 system, the photometry here presented includes the monitoring of both members. Thus, the flares listed in Table 1 and those shown in Figures 3 and 4 are changes in the ultraviolet flux of the Kruger 60 system as a whole. All such changes were measured against two comparison stars: BD +56°2777 was used as a primary comparison star with BD +56°2788 used as a secondary.

II. The Flares

Table 1 gives observed parameters for the flares detected. Presented in the Table for each flare is U_C, the total apparent difference in the ultraviolet magnitude of the Kruger 60 system at peak light and the primary comparison star. Since Petit (1961) indicates the existence of long term, aperiodic secondary variations of flare stars, referring peak flare light to the preceding quiescent level was avoided (Kunkel 1975). However, U_S gives the total apparent change in the ultraviolet magnitude of the Kruger 60 system relative to its just previous non-flaring level.

Maximum light and time of maximum light were determined by first visually drawing a curve through the signal, smoothing the noise. The point of maximum deflection of this smoothed signal was used to determine time of peak light and its intensity. Tic marks on the flares in Figures 3 and 4 indicate where maximum light was determined to be. Correction to the position of maximum light due to instrumental features was not applied.

As noted in Table 1, flares 8 and 14 required the upper portions of their light curves to be extrapolated. This was due to the fact that their fast rate of rise did not permit scale changes to be made.

Also presented in Table 1 are the total rise times, T_R, and decay times, T_D, estimated for each flare. Also given is $T_{0.5}$, the time in minutes of the interval from peak light to half maximum intensity (Kunkel 1973).

Table 1

NO.	DATE	U.T.	U_C	U_S	T_R	T_D	$T_{0.5}$	P	U_N
1	6 AUG 1970	6:01.1	.08	.25	.2	.5	.3	.08	.10
2	6 AUG 1970	6:02.6	- .20	.53	.6	4.	.8	.59	.10
3	6 AUG 1970	7:02.4	.09	.19	.4	.4	.3	.18	.10
4	2 SEP 1970	6:23.3	.06	.20	1.8	1.7	1.2	.42	.05
5	2 SEP 1970	6:25.3	- .21	.46	.2	12.	.7	.97	.05
6	29 SEP 1970	7:03.2	- .05	.33	.2	.3	.2	.36	.04
7	29 SEP 1970	7:06.0	- .35	.58	.5	5.2	1.3	1.17	.04
8	29 SEP 1970	7:39.0	(-1.5)	(1.9)	.4	12.	.3	3.7	.04
9	2 OCT 1970	6:30.7	- .60	.91	.1	5.3	.1	.64	.04
10	5 OCT 1970	3:56.2	.16	.13	.2	.8	.4	.10	.04
11	5 OCT 1970	4:06.8	.11	.51	.4	1.2	.4	.44	.04
12	5 OCT 1970	4:08.3	.18	.12	.4	.8	.3	.11	.04
13	5 OCT 1970	4:21.1	.18	.10	.3	2.2	.6	.09	.04
14	5 OCT 1970	4:58.1	(-2.0)	(2.3)	2.1	8.	1.3	9.2	.04
15	7 OCT 1970	5:55.1	- .61	.87	.3	.4	.1	.6	.04
16	7 OCT 1970	5:55.8	- .35	.61	.3	.6	.3	1.64	.04
17	8 OCT 1970	5:42.2	- .41	.55	.1	1.2	.1	.26	.05
18	9 OCT 1972	3:47.1	.10	.16	.1	2.9	.2	.18	.06
19	9 OCT 1972	4:15.4	.17	.12	.4	1.	.2	.03	.06
20	9 OCT 1972	4:45.6	.14	.15	.2	.3	.1	.04	.06
21	9 OCT 1972	4:47.0	- .21	.50	.2	4.	.3	.42	.06
22	10 OCT 1972	1:57.1	.31	.33	.1	1.9	.4	.20	.06

Observed and computed characteristics of the flares detected. Note that peak light of flares 8 and 14 was lost. Thus, quantities associated with these flares were extrapolated.

The integrated intensity, P, described in IBVS No. 326 is given for each flare (Andrews, et al. 1969).

An estimate of the magnitude of the noise is given by U_N, the magnitude difference corresponding to one standard deviation from the mean signal.

A few observers have noted that flares occur in a set or ensemble. Indeed, the present series of observations shows this same feature. We note that 54% of the flares detected occurred within 5 minutes of another flare, 64% within 15 minutes, 73% within 30 minutes, and 86% within one hour. This indicates, as was pointed out by many previous observers, that these events are associated with some active region on the star.

Inspection of Figure 4 shows that between the pair of near events there is a time where the signal is elevated above its quiescent level. This region of increased brightness between each two flares is very probably an intrinsic elevation in luminosity associated with the active region on DO Cep which produced the flares. The elevated portion of the signal corresponds to the stillstands reported by Roques (1961).

III. Secondary Variations

As stated earlier, Petit indicated the existence of aperiodic secondary variations of flare stars. Solomon (1966) gives rates of rise for these slower variations to be 0.002 to 0.005 mag/sec as compared to 0.02 to 0.25 mag/sec for flares. This behaviour has been confirmed in the case of DO Cep. The slow symmetric brightening just before flare 5 in Figure 3 has a rate of rise of 0.0018 mag/sec. This also substantiates the earlier observation of Herr and Brcich (1969) which detected a similar event with respect to change in magnitude, duration, and rate of rise. In their report, however, they mark this flare's reality to be less certain than others detected in their series of observations. Since the event depicted in Figure 3 is associated with an unmistakable flare, this weak event is also judged to be a flare.

No variation in the quiescent magnitude of the Kruger 60 system greater than 0.1 magnitudes was observed in either observing season.

IV. Acknowledgements

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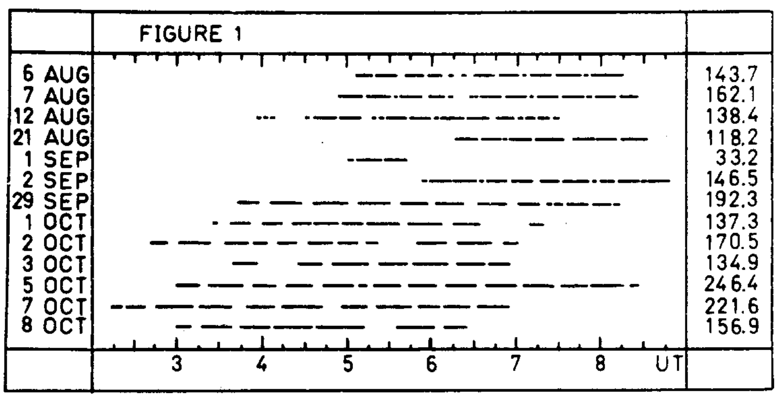
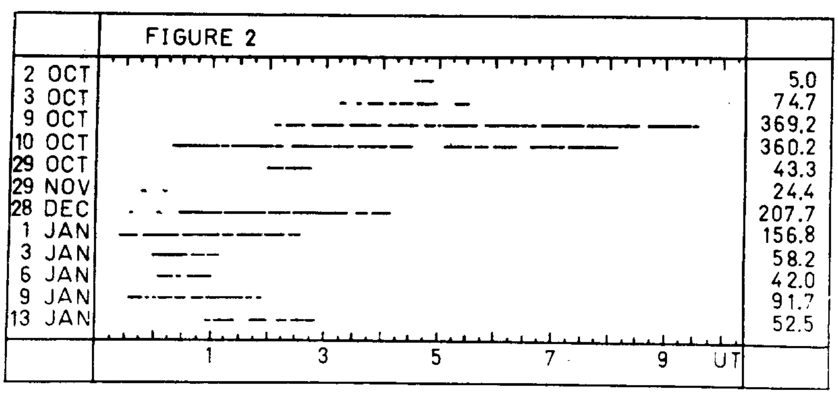
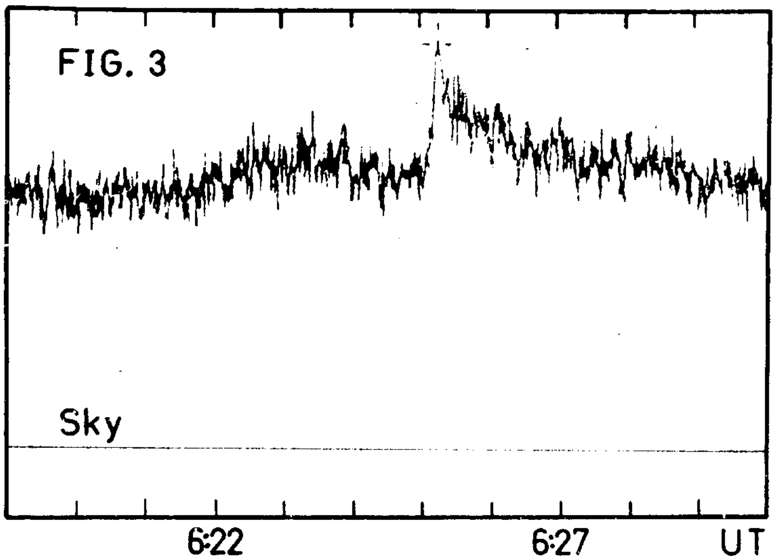


Photoelectric coverage of DO Cephei in 1970. The far left column gives the UT date of the beginning of the observing night. Nightly total monitoring time in minutes is given in the far right column. The total observing time in 1970 is 2002.0 min.



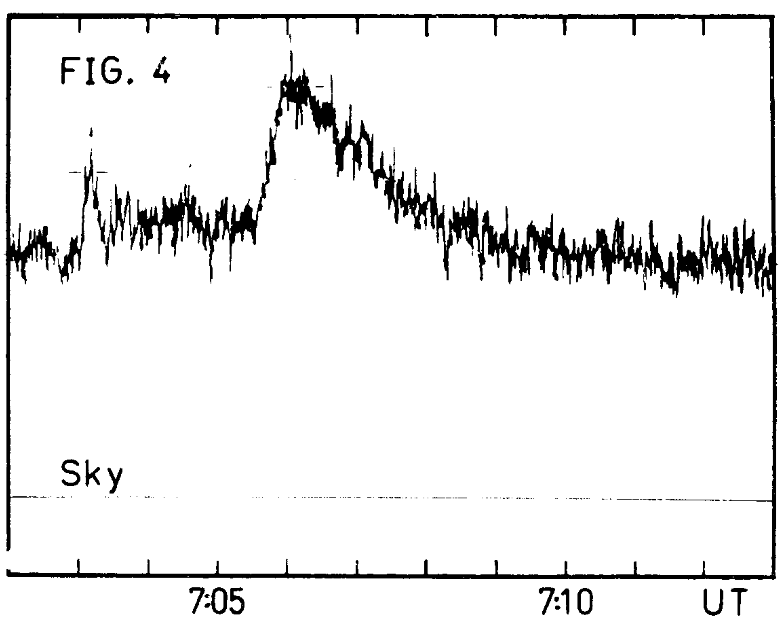
Photoelectric coverage of DO Cep in 1972-73. The total monitoring time in 1972-73 is 1442.4 min.

FIG. 3



Flares 4 and 5. Tracing from original record.

FIG. 4



Flares 6 and 7. Tracing from original record.