COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 3243

Konkoly Observatory
Budapest
29 September 1988

HU ISSN 0374-0676

DO CEP FLARE MONITORING IN THE 1987-1988 SEASON

In a continuation of the University of Delaware program of photoelectric monitoring of flare stars from Mt. Cuba Observatory, we have returned this season to the initial star in that program, DO Cephei. In 1968 when we observed the first flares to be photoelectrically recorded for that star (Herr and Brcich, 1969), it was surprisingly active. Ten flares were then observed within 27.8 hours of monitoring of the unresolved Kruger 60 AB system through a Johnson U filter. In 1987-1988, only five flares were seen in 30.5 hours, the largest producing only a 0.72 magnitude change in the system. The change, of course, would be larger if the flaring star could be observed alone. In a combination of observations from Mt. Cuba totaling 57.4 hours during the 1970 and 1972-73 seasons, Nicastro (1975) reported 22 flares. The flaring rate and the character of the flares agreed well with the 1969 data. The same EMI 6256S photomultiplier tube, UV filter and 0.6-m telescope were used for all of the above observations.

Table 1. Flares of DO Cep

No.	1987-8 mo da	UT max h m	t_b min	t_a min	Δm mag	P min	Air Mass	JD 244 0000+
1	Oct 26	03:13.9	0.3	0.8	0.21	0.09	1.12	7094.6347
2	Nov 16	04:06.2	0.9	3.8	0.24	0.41	1.38	7115.6710
3	Dec 13	04:47.9	0.4	3.3	0.72	0.65	2.15	7142.6999
4	Dec 14	02:03.5	0.8	3.0	0.35	0.56	1.35	7143.5858
5:	Jan 12	02 06.2	0.9:	2:	0.19	0.39	1.84	7172.5876

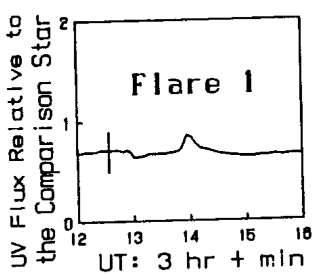
: Flare 5 uncertain; see text.

Times, including estimated minutes before and after the maximum, and the magnitude change were measured directly from the original charts. P is the flare's equivalent duration (in minutes of quiescent flux).

Table 1 contains the characteristics of the five flares, and Figure 1 shows plots of their light curves. These plots have been smoothed of high frequency noise using the procedure described in IBVS 3069 (Herr & Opie, 1987) where the relationship of such plots to the actual photometer chart is shown in detail. Only one of the present flares (#3) shows a sharp peak; and, even there, its rate of rise is undramatic. Moreover, No. 5 is of dubious reality, representing only a small, irregular enhancement in a noisy signal.

We thank Conrad Brink for his contributions to this project and the Mt. Cuba Observatory for granting us use of the 61-cm Cassegrain.

Figure 1. Light curves of the five minor flares (see Table 1) normalized to the same scale (1 = UV flux of the comparison star). The average quiescent flux, based on data in Table 3, is 0.78 (0.04 std. dev.) in units of the flux of the comparison star. Vertical error bars indicate the peak-to-peak higher frequency noise (to 1 Hz) present in the original signal.



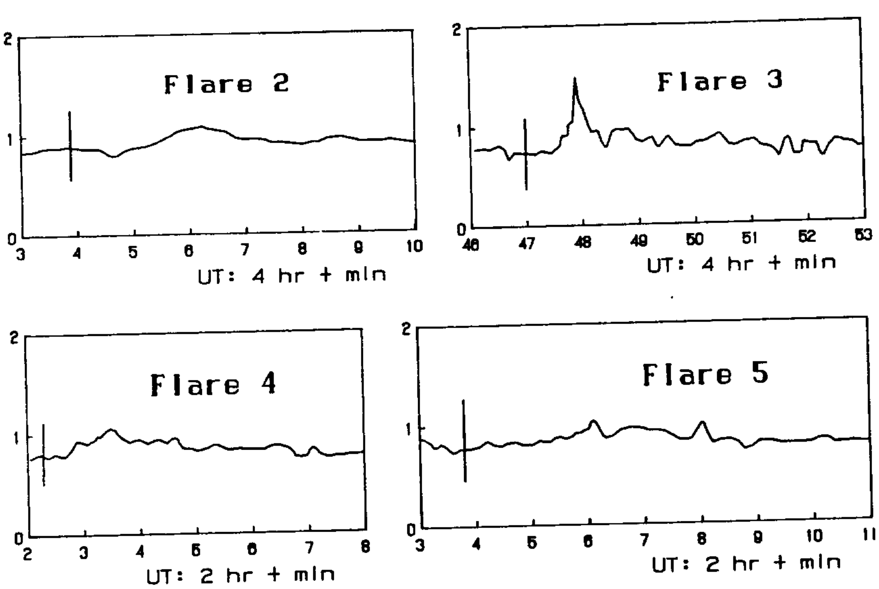


Table 2. Monitoring Coverage in 1987-1988

Date	U.T. in hours and minutes		
Sep. 29	4:05.0- 4:16.0,	4:24.3- 4:36.5,	4:49.6- 4:56.8,
JD 2447067	5:00.3- 5:11.4,	5:24.6- 5:38.1,	5:45.7- 5:58.9,
	6:01.5- 6:13.3.		
Oct. 26	0:28.1- 0:31.7,	0:38.3- 0:49.1,	0:54.3- 1:05.9,
JD 2447094	1:11.2- 1:13.2,	1:18.3- 1:31.0,	1:35.4- 1:36.0,
	1:36.8- 1:48.1,	2:32.8- 2:45.1,	2:52.7- 3:02.8,
	3:07.8- 3:19.6,	3:23.9- 3:36.0,	3:40.1- 3:51.5,
	3:55.3- 4:08.0,	4:11.8- 4:24.0,	4:28.0- 4:40.0,
	4:43.2- 4:57.6.		
Oct. 27	0:48.2- 0:58.2,	0:59.9- 1:09.0,	1:13.9- 1:25.6,
JD 2447095	1:55.0- 2:04.7,	2:21.1- 2:33.5,	2:54.0- 3:05.8,
	3:09.7- 3:24.0,	3:25.1- 3:39.6,	3:41.5- 4:00.0,
	4:05.7- 4:20.3,	4:21.5- 4:35.6,	4:39.1- 4:55.3,
	4:56.5- 5:09.4,	5:12.8- 5:29.0,	5:30.3- 5:35.0,
	5:54.4- 6:06.7,	6:08.2- 6:22.6,	6:26.0- 6:33.7,
	6:35.4- 6:47.0,	6:50.5- 7:13.0,	7:14.8- 7:25.0,
	7:26.7- 7:42.0.		
Oct. 29	0:09.0- 0:21.9,	0:27.8- 0:42.4,	0:43.8- 0:55.7,
JD 2447097	1:00.3- 1:12.0,	1:13.8- 1:25.2,	1:26.5- 1:32.6,
	2:17.9- 2:29.9,	2:35.8- 2:47.8,	2:49.2- 3:02.0,
	3:05.4- 3:08.6,	3:09.5- 3:17.5,	3:19.1- 3:33.9,
	3:35.5- 3:46.9,	3:50.7- 4:04.1,	4:05.5- 4:19.7,
	4:24.2- 4:34.3,	4:35.5- 4:47.0,	4:50.3- 5:04.8,
	5:06.1- 5:19.0.		
Nov. 16	2:31.7- 2:40.9,	2:47.2- 3:00.0,	3:01.5- 3:18.8,
JD 2447115	3:23.9- 3:36.2,	3:37.5- 3:52.0,	3:56.7- 4:10.0,
	4:11.3- 4:24.6,	4:28.0- 4:38.4,	4:39.5- 4:55.5,
	4:59.0- 5:18.0,	5:21.6- 5:34.2,	5:35.4- 5:47.9,
	5:51.0- 6:07.0,	6:08.3- 6:24.0.	
Nov. 21/22	23:41.8-23:54.0,	0:33.4- 0:47.0,	0:51.0- 1:04.0,
JD 2447121	1:06.3- 1:24.0,	1:25.3- 1:41.6,	1:45.8- 1:58.7,
	1:59.8- 2:19.2,	2:25.2- 2:37.6,	2:38.9- 2:53.0,
	2:56.6- 3:08.2,	3:09.4- 3:23.0,	3:26.3- 3:36.7,
	3:46.8- 4:00.3,	4:01.8- 4:13.3.	
Nov. 23	3:46.8- 4:00.1,	4:01.1- 4:13.7,	4:18.4- 4:31.4,
JD 2447122	4:32.3- 4:46.3,	4:51.3- 5:05.8,	5:06.9- 5:21.9,
	5:25.2- 5:39.6,	5:40.7- 5:56.5.	
Dec. 13	1:37.8- 1:47.0,	1:54.0- 2:09.0,	2:10.5- 2:26.0,
JD 2447142	2:30.0- 2:44.4,	2:46.3- 3:02.4,	3:06.1- 3:22.0,
	3:25.0- 3:32.8,	3:46.0- 3:48.1,	3:49.1- 3:51.8,
	3:53.0- 4:00.9,	4:14.5- 4:19.0,	4:20.2- 4:33.3,
	4:38.7- 4:54.0,	4:54.6- 4:55.6,	5:00.2- 5:07.2,
	5:17.7- 5:19.0,	5:35.4- 5:42.4.	
Dec. 13/14	23:46.9-24:00.0,	0:04.5- 0:20.0,	0:21.0- 0:36.9,
JD 2447143	0:39.7- 0:54.3,	0:56.0- 1:10.8,	1:14.6- 1:28.0,
	1:34.8- 1:52.1,	1:53.8- 2:11.0.	
Jan. 11	0:10.8- 0:21.6,	0:26.5- 0:42.3,	0:45.4- 1:04.2,
JD 2447171	1:12.4- 1:27.8,	1:29.4- 1:44.0,	1:57.8- 2:10.9,
	2:21.0- 2:34.0,	2:40.0- 2:57.0,	3:05.2- 3:05.9,
	3:09.5- 3:26.5,	3:28.0- 3:36.4,	3:36.8- 3:46.4.
Jan. 11/12	23:42.7-24:00.0,	0:04.6- 0:24.0,	0:25.0- 0:48.0,
JD 2447172	1:01.2- 1:14.0,	1:19.6- 1:35.0,	1:36.2- 1:52.0,
	1:55.0- 2:13.0,	2:14.8- 2:29.1,	2:31.9- 2:47.2,
	2:48.4- 2:50.0.		

Table III. Ultraviolet magnitude differences (v = DO Cep = BD +56°2783, c = BD +56°2777, k = BD +56°2788) and signal/noise estimates.

JD 2440000+	$m_c - m_v$	$m_c - m_k$	$\frac{I_o}{\sigma}$	Air Mass
7067.6799	-0.28		11.2	1.08
7067.6826	-0.27	-0.41		1.08
7067.7000	-0.30			1.10
7067.7067	-0.24			1.12
7067.7229	-0.26	-0.39		1.14
7067.7368	-0.29		11.1	1.17
7067.7618	-0.24			1.24
7094.5257	-0.33			1.06
7094.5361	-0.27	-0.41	11.4	1.05
7094.5528	-0.28			1.05
7094.5653	-0.23			1.05
7094.6056	-0.24			1.08
7094.6188	-0.27	-0.48	9.7	1.09
7094.6292	-0.22			1.11
7094.6403	-0.39			1.12
7094.6521	-0.28			1.15
7094.6625	-0.36			1.17
7094.6743	-0.28			1.20
7094.6851	-0.29			1.23
7094.6958	-0.41			1.26
7094.7076	-0.18	-0.43	7.5	1.30
7095.5500	-0.34		3.6	1.05
7095.5632	-0.44	-0.52		1.05
7095.5753	-0.14	-0.34		1.06
7095.6080	-0.15	-0.35	6.3	1.08
7095.6306	-0.24			1.11
7095.6681	-0.30	-0.46		1.19
7095.6931	-0.32			1.26
7095.7163	-0.32		6.2	1.34
7095.7431	-0.47			1.47
7095.7674	-0.23	-0.33		1.61
7095.7833	-0.25		4.7	1.72
7097.5184	-0.36	-0.46	7.0	1.06
7097.5406	-0.30			1.05
7097.5649	-0.19	-0.42	7.4	1.06
7097.6052	-0.29	-0.45		1.09
7097.6278	-0.23		7.5	1.12
7097.6594	-0.30			1.18
7097.6823	-0.33	-0.50		1.24
7097.7007	-0.30		7.6	1.30
7097.7243	-0.18	-0.38		1.40
7115.6139	-0.27	-0.36	6.9	1.19
7115.6406	-0.27			1.27
7115.6632	-0.22	-0.44		1.35
7115.6858	-0.17		6.6	1.45
7115.7069	-0.27			1.57
7115.7222	-0.17			1.68
7115.7431	-0.23			1.84
7115.7688	-0.29	-0.43	3.6	2.09
7121.5000	-0.34	-0.49	10.6	1.06
7121.5722	-0.26			1.13
7121.5986	-0.20	-0.44	7.5	1.19
7121.6219	-0.27			1.26
7121.6424	-0.26			1.33
7121.6785	-0.27	-0.42	6.8	1.50
7122.6597	-0.30	-0.52	6.4	1.42
7122.6781	-0.30			1.52
7122.7014	-0.22	-0.31	6.2	1.66
7122.7243	-0.32			1.84
7122.7465	-0.31	-0.44	5.5	2.06
7142.5771	-0.30	-0.43	7.2	1.30
7142.6031	-0.27			1.41
7142.6281	-0.25		6.6	1.54
7142.6417	-0.23			1.63
7142.6913	-0.28	-0.31		2.05
7142.7069	-0.31			2.24
7142.7333	-0.28			2.61
7142.7382	-0.22	-0.32	3.9	2.69
7143.5014	-0.23	-0.37	7.3	1.12
7143.5267	-0.30			1.16
7143.5507	-0.30			1.23
7143.5625	-0.28	-0.43	6.8	1.26
7171.5188	-0.30	-0.37	4.2	1.39
7171.5479	-0.21			1.54
7171.5948	-0.25	-0.41	3.3	1.88
7171.6271	-0.31			2.23
7171.6611	-0.17	-0.28	2.0	2.73
7172.5014	-0.25	-0.42	5.5	1.33
7172.5528	-0.21	-0.93	6.2	1.58
7172.5785	-0.22			1.77
7172.6049	-0.29		4.0	2.01

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