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AD LEO: FLARE ACTIVITY IN 1988

AD Leonis continued its ultraviolet activity this season although none of the seven flares that we observed within our 16.4 hours of sampling were particularly dramatic. All of these flares occurred during the 9.5 hours of the first five nights. As in the past, the 0.6-m telescope at Mt. Cuba, an EMI 6256S photomultiplier, and a Johnson U filter were used for the observations. Data analysis and plotting of the light curves was performed following the procedure described in IBVS 3069 (Herr & Opie, 1987).

All figures are plotted to the same vertical scale in units of the flux of the comparison star. Outside of the recognized flares AD Leo averaged 2.7 times brighter than the comparison star. However, on February 17 this level remained higher as may be seen in Table 3 and in the figures for the

Table 1. Flares of AD Leo

| No. | 1988 mo da | UT max h m | t_b min | t_a min | Δm mag | P min | Air Mass | JD 244 0000+ |
|-----|---------------|---------------|--------------|--------------|-------------------|----------|-------------|-----------------|
| 1 | Jan 24 | 04:55.3 | 0.3 | 3.3 | 0.26 | 0.50 | 1.22 | 7184.7051 |
| 2 | Jan 24 | 05:20?* | ? | 5 | >0.28? | 1.3? | 1.16 | 7184.7222 |
| 3 | Feb 17 | 02:06.6 | 0.6 | 4.4 | 0.66 | 0.71 | 1.52 | 7208.5872 |
| 4** | Feb 17 | 03:32.6? | 1 ? | 16 ? | 0.52? | 3 ? | 1.19 | 7208.6476 |
| 5 | Apr 10 | 03:09.2 | 0.5 | 4.8 | 0.45 | 0.92 | 1.09 | 7261.3614 |
| 6 | Apr 10 | 04:04.5 | 0.5 | 2.5 | 0.44 | 0.55 | 1.18 | 7261.6698 |
| 7 | Apr 14 | 03:00.0 | 0.4 | 7.4 | 0.53 | 0.90 | 1.10 | 7265.6250 |

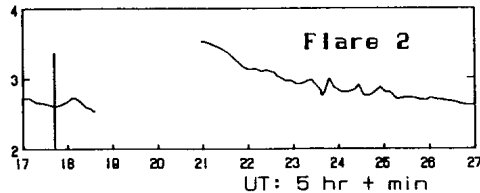
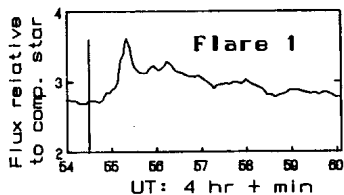
* Maximum probably occurred between 5:18.6 UT, when we moved to measure sky, and 5:21, when we returned to find an elevated, declining signal.

** Peak of Flare 4 may have been missed.

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 2. Monitoring Coverage in 1988

| Date | U.T. in hours and minutes | | |
|---------|--|---|---|
| Jan. 24 | 4:16.0- 4:21.3, 5:06.6- 5:18.6, | 4:30.1- 4:41.6, 5:21.0- 5:36.1, | 4:43.4- 5:02.5, 5:41.6- 5:56.9. |
| Feb. 17 | 1:29.7- 1:38.0, 2:12.6- 2:25.0, 2:59.5- 3:13.0, 3:48.5- 4:03.9, 4:39.2- 4:58.2, 5:34.8- 6:06.0. | 1:39.7- 1:51.7, 2:26.4- 2:38.6, 3:17.2- 3:30.7, 4:05.2- 4:19.1, 5:00.2- 5:14.1, | 1:54.5- 2:10.1, 2:41.9- 2:57.4, 3:32.0- 3:46.1, 4:21.1- 4:37.9, 5:15.4- 5:33.7, |
| Apr. 6 | 1:56.3- 2:04.2, 2:41.6- 2:51.9, 3:36.7- 3:56.6, | 2:05.4- 2:18.8, 3:05.3- 3:17.7, 3:58.7- 4:15.9, | 2:20.9- 2:39.8, 3:19.8- 3:34.5, 4:18.1- 4:29.5. |
| Apr. 10 | 3:02.0- 3:16.6, 3:42.8- 3:55.1, 4:31.0- 4:42.2, | 3:18.0- 3:21.4, 3:58.3- 4:11.7, 4:45.0- 4:55.4. | 3:22.8- 3:33.0, 4:15.2- 4:28.5, |
| Apr. 14 | 2:30.4- 2:33.0, 3:26.8- 3:32.0. | 2:55.4- 3:07.6, | 3:11.6- 3:23.7, |
| Apr. 27 | 1:20.9- 1:35.9, 2:05.1- 2:17.4, | 1:38.4- 1:40.3, 2:20.3- 2:39.0. | 1:52.0- 2:02.8, |
| May 8 | 1:40.3- 1:52.1, 2:26.4- 2:40.1, 3:18.1- 3:20.0, 3:58.3- 4:11.0. | 1:54.1- 2:08.0, 2:42.1- 2:57.8, 3:22.3- 3:38.0, | 2:09.1- 2:24.5, 2:59.7- 3:13.0, 3:40.1- 3:56.0, |
| May 9 | 1:27.8- 1:31.0, 2:00.6- 2:16.0, 2:52.2- 3:07.0, 3:42.4- 3:55.7, | 1:33.3- 1:40.1, 2:17.8- 2:32.0, 3:09.0- 3:22.0, 3:58.1- 4:10.2. | 1:42.5- 1:58.5, 2:34.4- 2:50.0, 3:26.8- 3:40.6, |
| May 15 | 2:17.8- 2:32.0, 3:09.2- 3:24.0, | 2:35.0- 2:49.0, 3:26.3- 3:39.0, | 2:51.2- 3:07.0, 3:41.1- 3:56.0. |



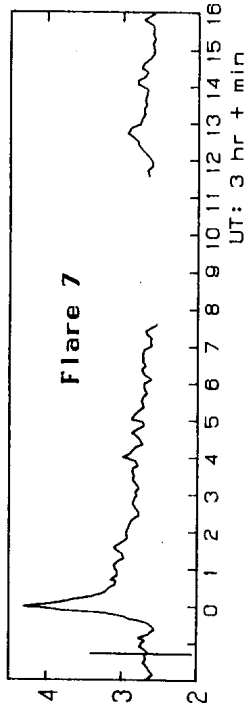
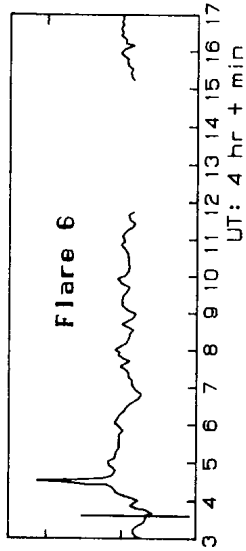
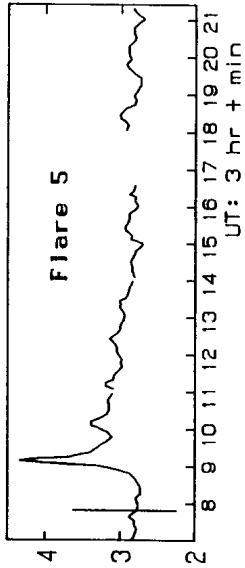
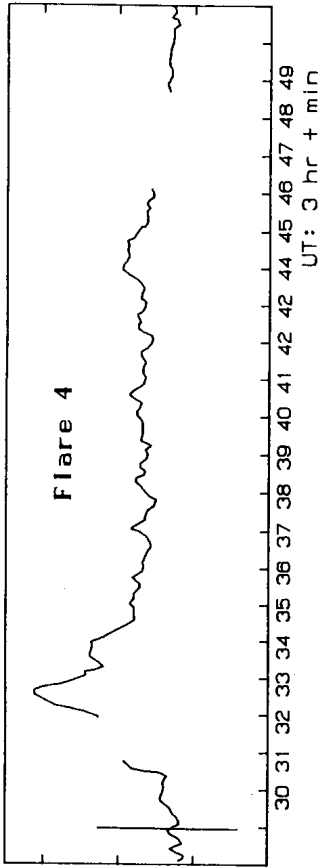
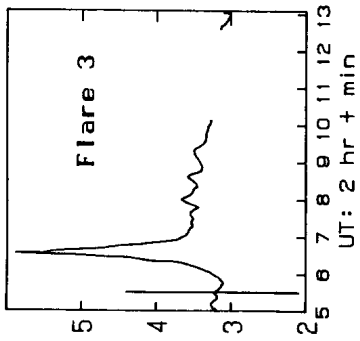


Figure 1. Light curves of the seven flares (see Table 1) normalized to the same scale (1 = UV flux of the comparison star). Vertical error bars indicate the peak-to-peak higher frequency noise (to 1 Hz) present in the original signal.

Table 3. Ultraviolet magnitude differences between the comparison star and AD Leo during quiescence. Signal/noise is estimated from the chart pen excursions (response to 1 Hz) within a four-minute interval.

| Date 1988 | Time hr min | JD 2440000+ | $m_C - m_V$ | $\frac{I_C}{\sigma}$ | Air Mass |
|--------------|----------------|----------------|-------------|----------------------|-------------|
| Jan. 24 | 4 48 | 7184.7000 | 1.14 | 8.6 | 1.24 |
| | 5 34 | 7184.7319 | 1.03 | 8.1 | 1.14 |
| Feb. 17 | 1 57 | 7208.5183 | 1.27 | 7.8 | 1.58 |
| | 3 21 | 7208.6396 | 1.24 | 8.6 | 1.22 |
| | 4 53 | 7208.7034 | 1.21 | 11.1 | 1.08 |
| Apr. 6 | 2 34 | 7257.6069 | 1.09 | 9.7 | 1.06 |
| | 3 22 | 7257.6403 | 1.18 | 9.3 | 1.09 |
| Apr. 10 | 3 05 | 7261.6285 | 1.12 | 12.3 | 1.09 |
| | 4 01 | 7261.6674 | 1.08 | 11.2 | 1.17 |
| | 4 39 | 7261.6938 | 1.16 | 11.1 | 1.27 |
| Apr. 14 | 2 57.4 | 7265.6232 | 1.10 | 11.4 | 1.10 |
| | 3 20 | 7265.6389 | 1.06 | 11.5 | 1.13 |
| Apr. 27 | 1 29 | 7278.5618 | 0.99 | 4.8 | 1.07 |
| | 2 35 | 7278.6076 | 1.01 | 4.5 | 1.14 |
| May 8 | 2 03 | 7289.5854 | 1.20 | 7.6 | 1.16 |
| | 3 03 | 7289.6271 | 1.13 | 7.3 | 1.32 |
| | 3 49 | 7289.6590 | 1.10 | 5.9 | 1.53 |
| May 9 | 1 56 | 7290.5806 | 1.05 | 8.7 | 1.15 |
| | 3 00 | 7290.6250 | 0.92 | 7.7 | 1.32 |
| | 4 02 | 7290.6681 | 1.12 | 6.0 | 1.64 |
| May 15 | 2 41 | 7296.6118 | 0.85 | 6.1 | 1.34 |
| | 3 37 | 7296.6507 | 0.92 | 6.6 | 1.63 |

flares (Nos. 3 and 4) on that night. After Flare 4, AD Leo remained even brighter for some minutes with evidence of continued activity. This may be contrasted to Flares 5-7 in similar time intervals following their peaks.

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RICHARD B. HERR
DARRYL H. CHARACHE

University of Delaware
Newark, DE 19716, U.S.A.

Reference :

Herr, R.B., and Opie, D.B., 1987, Inf. Bull. Var. Stars, No. 3069.