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TRANSIENT PERIOD FOUND IN THE BY DRA VARIABLE OU GEMINORUM

Results from Mt Cuba Astronomical Observatory

A transient period of 46 seconds was found in ultraviolet monitoring of the BY Dra variable OU Geminorum (Gliese 233, HD 45088), using the methods described by Andrews (1990).

Our flare star monitoring system comprises a 61-centimeter reflecting telescope, a Hamamatsu HC124-03 photomultiplier (spectral range 300-650 nm), and a Keithley MetraByte CTM-05 pulse counter. All observations of OU Gem were made through a Johnson U filter, though not reduced to the U system. A total of 10.2 hours have been accumulated on OU Gem; in addition, several stars have been observed as comparisons, primarily BD+18°1212. A comprehensive journal of the OU Gem observations is found in Table 1. The data are analyzed by modified autocorrelation and discrete Fourier transform (MAC+DFT), to look for periodic behavior in the light curve. This procedure has been used by us in previous studies (Mullan et al, 1992). The data of 94feb17, 94mar13, and the last ten minutes of 94feb15 are corrupted by some cirrus clouds; these data are not useful for period searches, but can be used to look for flares. No obvious flares have been detected; however, a period has been found on the exceptionally photometric night of 94feb04.

The sequence of observations on 94feb04 is listed in Table 2. OU Gem and Gliese 169 were observed as flare star candidates; the other two stars were used as comparisons. What concerns us in this bulletin is the detection of a transient period in the first half of the ninety-minute data set. With the MAC+DFT we have found a period of 46 seconds that appears to be strongest in the segment from t=900 to 2250 seconds (see periodogram in Figure 1). For subsets earlier in the data set, the power in the 46-second periodogram peak is diminished significantly, and for subsets toward the end of the run the peak disappears entirely. No periodicity was found in any of the other star data sets, including the later OU Gem run. To test the statistical significance of the detection, we implemented the randomization technique described in Mullan et al; the result of this procedure was multiplied by a factor derived from the probability distribution of the frequencies in the randomly generated power spectra (McKenzie, 1993). The result is a two-dimensional Chance Probability of $P_c^{2D} = 0.87\%$; that is, the detection is considered to be 99.1% reliable. This period (46 sec) lies comfortably within the range expected for Ionson-Mullan magnetic wave resonance. In fact, for a period of 46 seconds Andrews (1989) suggests an X-ray flux of log $F_X = 6.66$, remarkably close to the value of 6.61 found by Panagi and Mathioudakis

Table 1. **Journal of OU Gem Observations.** The mean signal level (μ) and the standard deviation (σ) for the star are in counts per second and have had the sky and dark counts subtracted.

Date	UT Start Time	Length	μ	σ
94feb04	01:13:01	90 min	29850	0651
	05:33:21	60 min	21140	1527
94feb15	01:34:21	90 min	26805	0959
	04:01:01	81 min	18708	2287 (clouds)
94feb17	02:47:11	90 min	24585	1933 (clouds)
94mar12	00:34:01	90 min	27107	0861
	03:22:16	30 min	20516	0944
94mar13	00:27:41	90 min	24362	1608 (clouds)

Table 2. **Journal of 94Feb04.** The mean signal level is as in Table 1. Mean dark count for this night was 45 counts/sec and sky was 2095 counts/sec.

Star	UT Start Time	Length	μ	σ
OU Gem	01:13:01	90 min	29850	0651
Gliese 169	03:53:01	30 min	01889	0190
BD+21°650	04:33:46	30 min	02294	0216
OU Gem	05:33:21	60 min	21140	1527
BD+18°1212	06:46:21	12 min	05612	0294

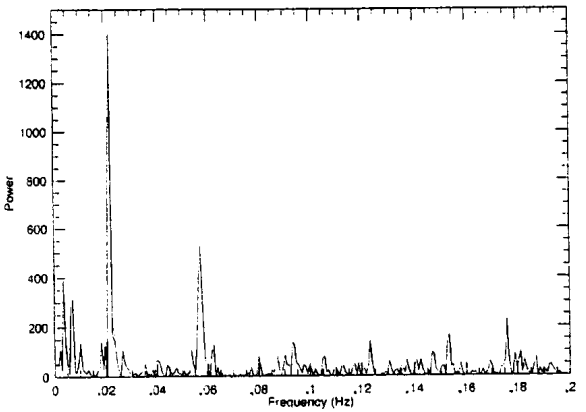

Figure 1. Periodogram of OU Gem, 94Feb04.

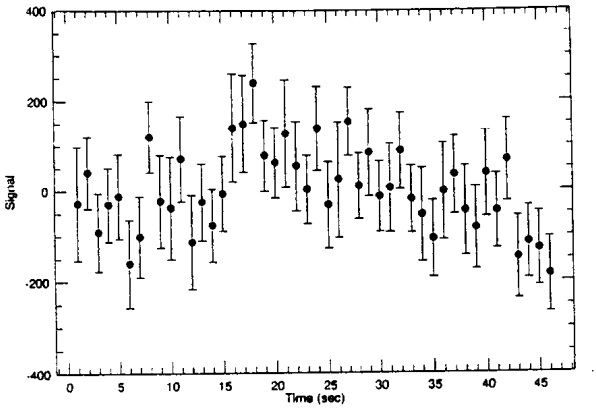

Figure 2. Average Profile of 46-sec Oscillation.

(1993) for OU Gem. That the apparent duration of the oscillation is less than 30 cycles is also consistent with the Ionson-Mullan theory. To reveal the profile of the oscillation, we have folded this segment of the data set (t=900-2250 sec) at a period of 46 seconds. The coaddition routine is very straightforward: the data stream is divided into 29 subsets, each 46 seconds in length. These subsets are then averaged point-by-point. The resulting average profile is shown (with standard deviation errorbars) in Figure 2. It is noted that the (average) amplitude is approximately 0.38 times the standard deviation of the raw data, consistent with the findings of Mullan et al regarding the sensitivity of the MAC+DFT analysis routine. We are currently exploring alternative techniques for period searching, for the purpose of comparison with the MAC+DFT used to detect this period.

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