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THE OBSERVATION OF SUPERHUMPS IN AY LYRAE

AY Lyr, an SU UMa type dwarf nova experienced a superoutburst in June 1 - 16, 1994. Figure 1 shows the long-term visual light curve around this superoutburst. The abscissa is Julian Day minus 2 400 000. 49 505 corresponding to June 1, 1994. The big arrow indicates the epoch of our observation. The smaller arrows indicate upper limits. The variability is characterized by a precursive normal outburst, followed by a usual course of a superoutburst. We designed this observation to investigate the rôle of precursor in the development of superhumps.

Our observation was performed on June 3, 1994 using a CCD camera (Thomson, TH7882 CDA, 576 × 384 pixels with 23 μm square pixel size) attached to the Cassegrain focus of 0.6-m reflector at Ouda Station, Kyoto University (Ohtani et al.,1992). The mode of 2 × 2 on-chip summation was employed. The observation was done for about five hours interrupted for 30 min with Thomson V-band filter. The exposure time was 90 sec with read-out dead time of 13 sec.

We reduced the data using the personal-computer-based aperture photometry package developed by one of the authors (T.K.). This package automatically subtracts bias-flames, applies flat fielding and enables us to estimate the instrumental magnitudes. The aperture size was 8" in radius. The sky level was determined from pixels whose distance from the individual objects are between 16" to 30".

Figure 2 shows the short-term light curve of differential magnitude between AY Lyr and a comparison star whose magnitude is 13.0. Using a nearby check star we confirmed the constancy of the comparison star within $0^m.01$. Table 1 shows the details of the comparison star and the check star from Guide Star Catalogue (GSC). The expected error for one mesurement of the differential magnitude is about $0^m.01$.

We analyzed the light curve using PDM (Stellingwerf 1978) program within IRAF package (IRAF is distributed by National Optical Astronomy Observatories, U.S.A.). Figure 3 shows the Θ diagram, whose abscissa is frequency(day^{-1}). The lowest minimum point in Θ corresponds to 108.5 minutes. For the estimation of error, another period analysis was made. We smoothed the light curve and took the maxima and the middle of rising stages. From the distances between two adjacent points with the same phase we get the periods. The average of the periods was 109.2 min and the standard deviation was 1.2 min. The value determined by PDM is within the estimated error. Since we used all data in our PDM analysis, PDM gives a better estimate of the period. So we take 108.5 ± 1.2 min as the best estimate of the superhump period and its error. There are some published values; the one is 108.8 min (Patterson 1979), the other, 109.4 (Udalski and Szymanski 1988, Ritter 1990). The period we found is clearly consistent with them.

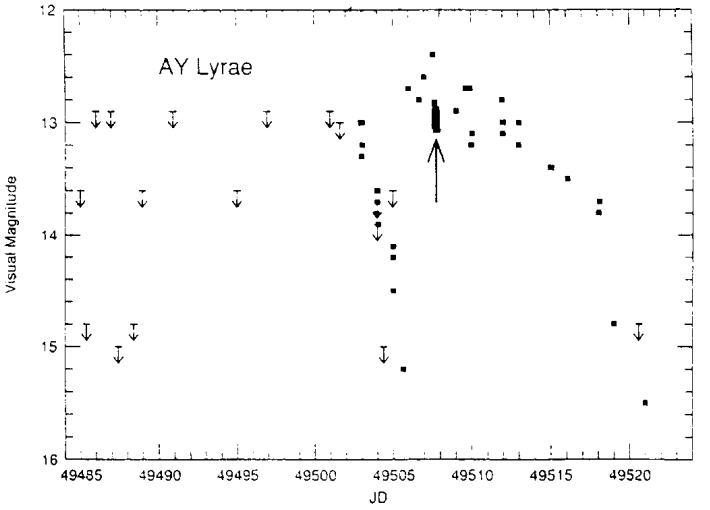

Figure 1: Long-term light curve around this superoutburst

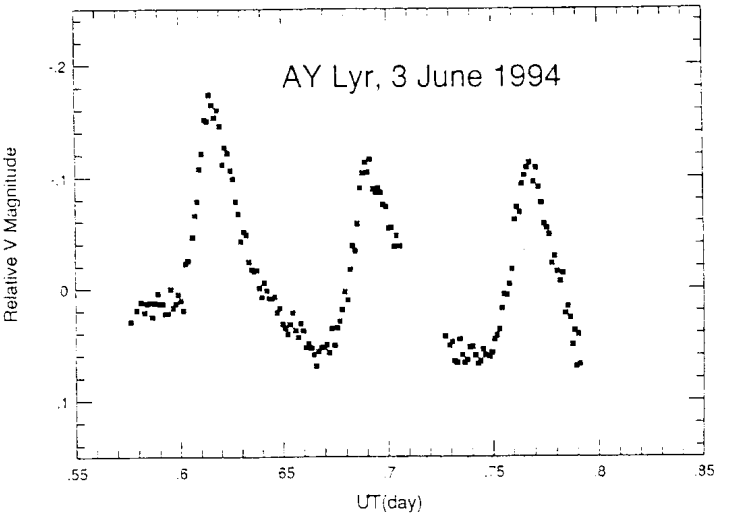

Figure 2: Short-term light curve of differential magnitude of AY Lyr

Table 1: Details of the comparison star and check star from Guide Star Catalogue

	GSC number	$\alpha_{2000.0}$	$\delta_{2000.0}$	magnitude
comparison	3118 01482	$18^h44^m15^s.84$	$+38°00'26''.8$	13.0
check	3118 01147	$18^h44^m22^s.43$	$+37°55'17''.2$	12.0

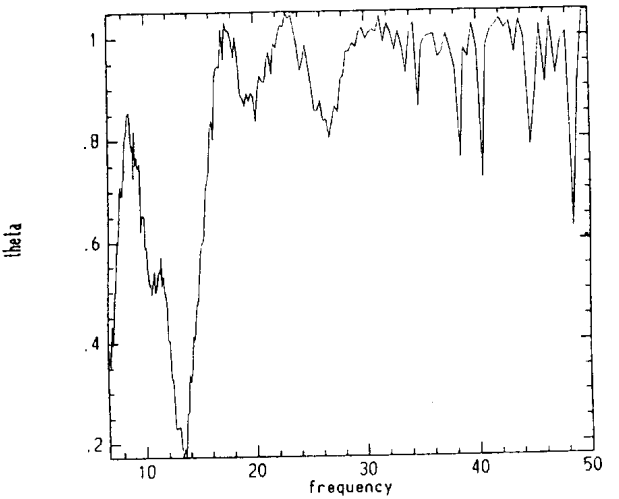

Figure 3: The Θ diagram

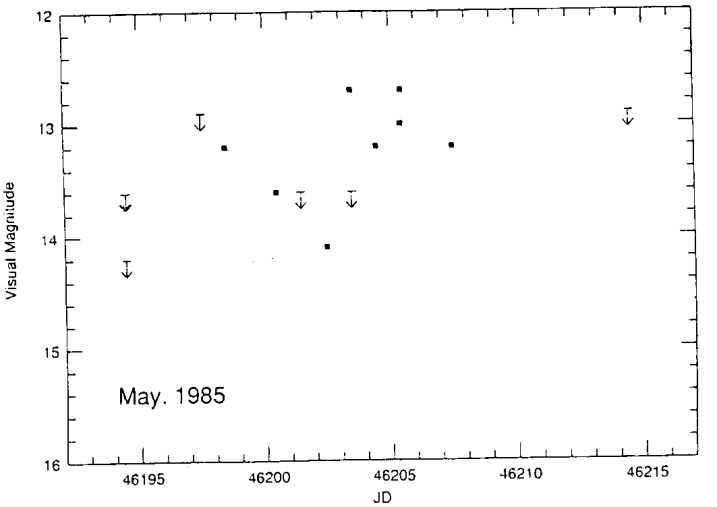

Figure 4: Light curve of a previous superoutburst

Some discussions are as follows:

- The superhumps had already developed fully within two days after the onset of the superoutburst, although it usually take three days or more to develop superhumps. It implies that the accretion disk had been processed by tidal force before the beginning of the superoutburst, i.e. in the precursive outburst phase.

- Tonny Vanmunster supplied us the data of 12 previously observed superoutbursts, one of which shows a superoutburst with a precursor similar to our present observation (see Figure 4).

In conclusion, the appearance and development of superhumps should be more systematically surveyed in such "precursor-superoutburst" complex.

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