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OUTBURST OBSERVATIONS OF LL ANDROMEDAE

LL Andromedae is an obscure object listed in the General Catalogue of Variable Stars as a possible U Gem star with a magnitude range of 13 to fainter than 17th. Wild (1979) reported the discovery of this object during which the star was seen to brighten to m_{pg} ~13th and appeared to fade after about 10 days, although it was very poorly sampled. On 1993 Dec 07, LL And went into outburst and this note briefly describes our observations.

T. Vanmunster reported a rare outburst of LL And on 1993 Dec 7. This was quickly confirmed by G. Poyner and P. van Canteren and reported in Vanmunster and Poyner (1993). Figure 1 shows the outburst light curve of LL And as gathered from various observers. We see that the rise was very fast (<0.5 days) while the decline was slower, the outburst itself lasting about 8 days.

The minimum magnitude of LL And is estimated to be near V~20±0.5 on the POSS O plate. The maximum V magnitude reached was 13.8 ±0.1, thus giving LL And an outburst amplitude of ~6 magnitudes. A precise position for LL And is RA=$00^h39^m11^s.90$ DEC=+26°20' 54".9 [1950].

Spectroscopic observations of LL And were made on UT 1993 Dec 8 and 9, both when LL And was near maximum at V~14th magnitude. Our spectra show the Balmer Series and He 5876 as weak absorption lines, all with possible emission cores. Our spectra also show a rising blue continuum indicative of a DN in outburst.

Kato (1993) reported his discovery of superhumps in LL And from observations taken over a four-night period. He calculated a superhump period of 0.057006 days (1.37 hrs), one of the shortest known. In Table 1 we extend the tabulation of superhump periods given by Molnar and Kobulnicky (1992) with additional systems from the literature. We use all the stars with both orbital and superhump periods measured to derive a linear expression relating the two periods (periods given in days):

$$P_{SH}=1.06577(\pm 0.01457)P_0-0.00160(\pm 0.01564)$$

Note that this expression predicts that the superhump period and orbital period have a constant offset, regardless of orbital period. This simple approach provides observers with a fairly accurate starting point when looking for either period, if the other is known. It also fits all the known data to 1.5% as well. Figure 2 shows the results of this fit for the data in Table 1. Applying this equation to Kato's superhump period of LL And, we calculate an orbital period of 1.32 hours (79 minutes). This period is very close to the minimum orbital period allowed (~72 min) by theory for solar composition stars (Nelson et al. 1985).

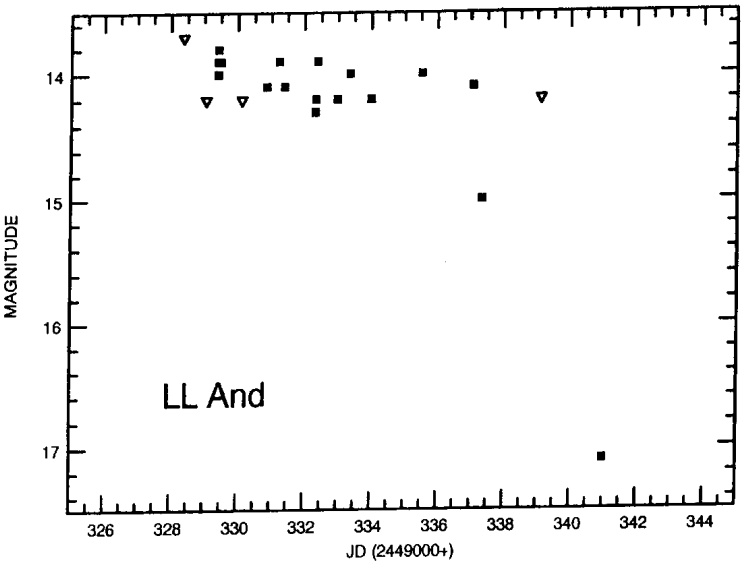

Figure 1. The outburst light curve of LL And. Open triangles are upper limits and filled squares have errors of $\sim\pm0.1$ mags.

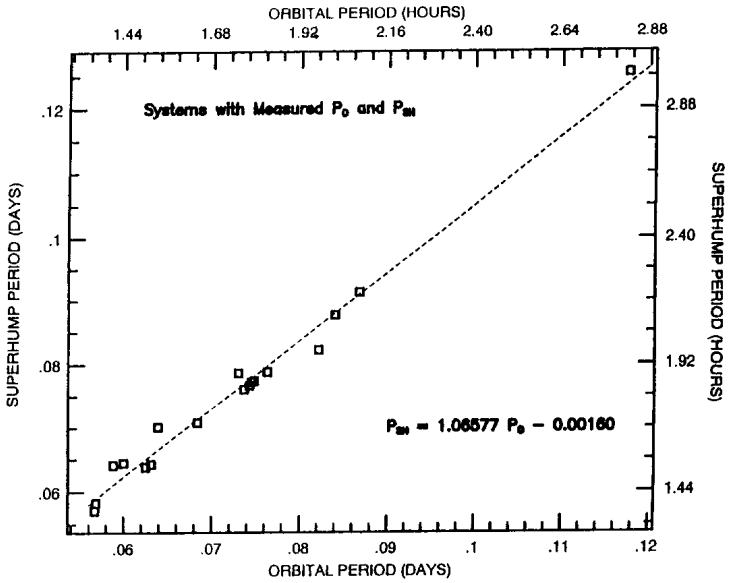

Figure 2. Linear relation between superhump period and orbital period.

Table 1
Short Period Dwarf Novae with Orbital and Superhump Periods[1]

Name	P_O (days)	P_{SH} (days)
WZ Sge	0.0567	0.0571
SW UMa	0.0568	0.0583
T Leo	0.0588	0.0641
HV Vir	0.0580	0.0584
VY Aqr	0.0600	0.0645
V436 Cen	0.0625	0.0638
OY Car	0.0631	0.0642
TY Psc	0.0639	0.0701
IR Gem	0.0684	0.0708
AW Gem	0.0730	0.0787
HT Cas	0.0736	0.0761
VW Hyi	0.0743	0.0767
Z Cha	0.0745	0.0773
WX Hyi	0.0748	0.0774
SU UMa	0.0764	0.0788
BR Lup	0.0822	0.0822
TY PsA	0.0840	0.0877
YZ Cnc	0.0868	0.0913
TU Men	0.1180	0.1255
WX Cet	(0.0513)	0.0530
LL And	(0.0550)	(0.0570)
CY UMa	(0.0571)	0.0593
AL Com	0.0583	(0.0606)
CI UMa	0.0604	(0.0628)
EK TrA	(0.0624)	0.0649
BC UMa	0.0632	(0.0657)
UV Per	(0.0637)	0.0663
AQ Eri	(0.0644)	0.0670
2138-453	0.0646	(0.0672)
SS UMi	(0.0672)	0.070
RZ Sge	(0.0673)	0.0702
EX Hya	0.0682	(0.0711)
FO And	(0.0700)	0.0730
RZ Leo	0.0708	(0.0739)
AY Lyr	(0.0728)	0.0760
V503 Cyg	0.0760	(0.0794)
CU Vel	(0.0765)	0.0799
TT Boo	0.0771	(0.0806)
EF Peg	(0.0832)	0.0871
KK Tel	0.0840	(0.0880)
DM Dra	0.0868	(0.0909)

[1] Numbers in () were calculated using the Eq. in text.

The observation of LL And at outburst confirms it as a dwarf nova. The superhumps observed allow us to be fairly confident that LL And has a short orbital period. See Howell and Hurst (1994) for more details.

Steve B. HOWELL
Planetary Science Institute
620 N. 6th Avenue
Tucson, Arizona 85705 USA

Guy M. HURST
The Astronomer Group
16, Westminster Close
Basingstoke, Hampshire
RG22 4PP, England

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