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Evolution of superhump characteristics in SU UMa and nova-like variables

I.L. Andronov[1], A.V. Baklanov, L.L. Chinarova, S.V. Kolesnikov, N.I.Ostrova, A.V. Yushchenko[2]

Department of Astronomy and Astronomical Observatory, Odessa National University, UA 65014 Odessa, Ukraine,
[1] *Guest investigator at the Department of Mathematics, University of Madeira, PT 9000-390 Funchal, Portugal*
[2] *Guest investigator at the College of Education, Chonbuk National University, Chonju, 561-756, (South) Korea*

P.G. Niarchos, K.D. Gazeas

Department of Astrophysics, Astronomy and Mechanics, University of Athens, GR 157 84 Zografos, Athens, Greece

N.M. Shakhovskoj, E.P. Pavlenko

Crimean Astrophysical Observatory, UA 98409 Nauchny, Crimea, Ukraine

Abstract. Recent highlights of our study of positive and negative superhumps in cataclysmic varibles are briefly reviewed. The "genuine" superhumps have been detected a day after the unexpected superoutburst of WZ Sge, when the orbital variability dominated the light curve. TT Ari has shown an unprecedented switch form the usual negative superhump state to the positive state with an excellent coincidence between the observed and theoretically predicted period values. Both stars show evidence for variability at a time scale of 20 minutes. The superhump period of RZ LMi has been corrected based on the observations of the superoutburst in 2001. ES Dra shows no evidence for prominent superhumps, possibly indicationg its low inclination. However, the superoutburst has shown a splitted maximum with a separation of 20 days. The "superhump period-luminosity" dependence has been detected for two cataclysmic variables of different types – the nova-like BZ Cam and the UG SU star V368 Peg.

The superhumps, i.e. the photometric variations of cataclysmic variables with a period $P_{\rm sh}$ differing from the orbital one $P_{\rm orb}$ by a few per cent, are a common feature of the SU UMa-type stars (cf. Warner 1995). These periods are statistically related: $\lg(P_{\rm sh}) = -0.0043(\pm 0.0033) + 1.077(\pm 0.006)\lg(P_{\rm orb})$ (P in hours, Andronov 1990). Here the misprint in the zero–point has been corrected. Another form of this relation has been introduced and discussed by Patterson (1998). Recent models of superhumps have been discussed by Buat-Menard & Hameury (2002) and Osaki & Meyer (2002).

Another type of cataclysmic variables exhibiting permanent superhumps are the nova-like variables. Contrary to the SU UMa binaries, they may show not only "positive", but also "negative" superhumps with photometric periods *shorter* than the orbital one. Such a negative superhump was observed in 1965–1996 in TT Ari (e.g. Andronov et al. 1999), and has switched to the "positive" one in 1997 (Skillman et al. 1998). The superhump was still positive in 2001 (Andronov et al. 2001a) and it is interesting to monitor the process of switching to negative superhumps. It may be suggested that the type of the superhump depends on luminosity.

The luminosity dependence of the superhump period has been detected in the nova-like variable BZ Cam (Andronov et al. 2000) with a statistical dependence $\mathrm{d}\lg P/\mathrm{d}\lg L = 1.0\pm0.2$. In the dwarf nova V368 Peg the photometric period during 6 nights varied with luminosity by a factor of 2.3. Ostrova et al. (2001) have suggested the continuous P-L dependence, but the case of frequency doubling may also not be ruled out, which corresponds to the switch from the bright hot spot to the elliptic accretion disk. Drastic changes of the photometric period have also been detected in another group of dwarf novae (Kuznetsova et al. 1999).

The superhumps of WZ Sge have been detected after the superoutburst, acting simultaneously with the orbital variability dominating in amplitude at this stage (Andronov et al. 2001b).

The superoutburst of ES Dra had shown two maxima separated by 20 days. The superhump variability is not very prominent, what may be explained by a low inclination (Baklanov et al. 2001). The superhump period of RZ LMi have been corrected (Baklanov & Pavlenko 2001).

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