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UNDERSTANDING CV SECONDARIES AND THE ENERGETICS OF DWARF NOVAE OUTBURSTS VIA PARALLAXES

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We combine *HST* and ground-based parallaxes for cataclysmic variables (CVs) to examine their outburst energetics, as well as the nature of their secondary stars. Harrison et al. (2004) have recently published parallaxes for WZ Sge, YZ Cnc, and RU Peg, and have reanalyzed the *HST* parallaxes for U Gem, SS Aur, and SS Cyg. Combined with existing *HST* parallaxes for RW Tri (McArthur et al. 1999), TV Col (McArthur et al. 2001), EX Hya and V1223 Sgr (Beuermann et al. 2004a,b), ten high-quality parallaxes are available to constrain the various types of outbursts of CVs. In addition, Thorstensen (2003) has published ground-based parallaxes for fourteen CV systems.

In Fig. 1 we plot the inclination-corrected (see Harrison et al. 2004) absolute visual magnitudes during outburst for all of the CVs with parallaxes *and* that exhibit outbursts. The filled circles (*HST*) and squares (Thorstensen 2003) are the dwarf novae, including both the SS Cyg/U Gem-type and SU UMa-type systems (the latter are plotted at their "normal" outburst levels, except for WZ Sge, which only exhibits superoutbursts). We derive a new $M_V - P_{orb}$ relationship of $M_V = 5.52 - 0.323 P_{orb}(\mathrm{hr})$. This should be compared with the relationship found by Warner (1995): $M_V = 5.74 - 0.259 P_{orb}(\mathrm{hr})$. The steeper relationship we find is mostly due to our greater distances for U Gem, SS Cyg and RU Peg. In Fig. 1, we have plotted the positions of the non-dwarf novae systems with open circles (EX Hya, TV Col, V1223 Sgr, and RW Tri). These four systems all exhibit infrequent outbursts of unknown origin. The fact that the rare outbursts of these systems are consistent with the relationship found for the dwarf novae suggests that the cause of their outbursts may have a similar origin.

One remarkable result from these new parallaxes is the calorimetry of the superoutbursts of WZ Sge. The existence of an $M_V - P_{orb}$ relationship suggests that during their normal outbursts, the accretion disks of all dwarf novae systems have similar radial temperature profiles. But during the superoutbursts of systems like WZ Sge, the radial temperature profile must be different (or an additional source of luminosity exists in the system). For example, the accretion disk of U Gem is expected to have 4.5× the area of the disk of WZ Sge, yet during superoutbursts, WZ Sge is more luminous than U Gem! Additional high-precision parallaxes of CV systems covering the entire range in orbital period would be useful for examining the intrinsic range of dwarf novae outbursts.

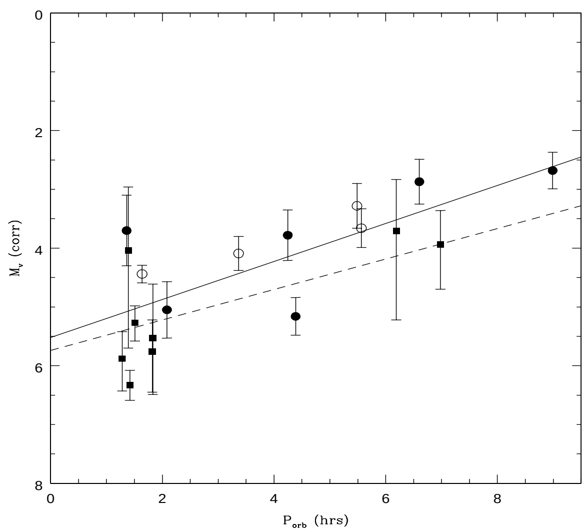

Fig. 1. The absolute visual outbursts magnitudes (M_V) versus orbital period (P_{orb}) for CVs that exhibit outbursts. A least squares fit to the data is plotted as a solid line, while the old relationship from Warner (1995) is plotted as a dashed line.

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