OBSERVATIONS OF ECLIPSING DWARF NOVAE

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Abstract

High Speed Photometry of four eclipsing dwarf novae, Z Cha, OY Car, HT Cas and IP Peg, is used to determine the orbital parameters and the masses of the two stars in each system. The mass ratio, q, and inclination, i, are found by constraining theoretical stream trajectories (Lubow and Shu 1975) to pass through the observed light centre of the bright spot eclipse. The light centre is defined as the point corresponding to the half flux points in the ingress and egress of the eclipse of the compact part of the bright spot. The theoretical stream width indicates that the centre of the stream must intersect the bright spot close to this point.

The length of ingress and egress in the primary eclipse, constrains the radius of the central object relative to the orbital separation. The shape of this eclipse and the temperature of the central objects in Z Cha, OY Car and HT Cas imply that the measured

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radius corresponds to the radius of the white dwarf. Thus using the Hamada-Salpeter mass-radius relationship for white dwarfs, the mass of the white dwarf, M_{WD}, of the secondary star, M_R, the orbital separation and the radial velocities of each star, K_W and K_R, can be found. IP Peg, however was observed at the end of an outburst and its white dwarf was surrounded by a thick boundary layer. I therefore used the value of K_R, measured by Martin, Jones and Smith (1986), instead of the white dwarf radius, to calculate the system parameters. The detailed calculations can be found in Wood et. al. (1986) for Z Cha, Wood et. al. (1987) for OY Car, Horne, Wood and Stiening (1987) for HT Cas, and Wood and Crawford (1986) for IP Peg.

The resulting parameters are listed in table I for each object. The large range of possible values for IP Peg, occurs because the white dwarf and bright spot ingresses overlap, and therefore the white dwarf eclipse width is not known accurately. IP Peg, the only object with orbital period, P_{orb}, above the period gap, has a much higher mass ratio and secondary star mass, than the systems below the period gap. It looks like a much younger system than those below the gap. The masses of the secondary stars in Z Cha, OY Car and HT Cas are extremely low and their radii are larger than those of main sequence stars (both the theoretical and observational main sequences). These stars are probably out of thermal equilibrium and may be becoming degenerate. The large range of possible masses of the secondary star in IP Peg, means that it could be a main sequence star.

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Table I The Measured System Parameters

	Z Cha	OY Car	HT Cas	IP Peg
P_{orb} (hrs)	1.78	1.51	1.77	3.80
$q=M_R/M_{WD}$	0.149	0.102	0.15	0.35–0.49
i (°)	81.7	83.3	81.0	90.0–80.9
$M_{WD}/M_\odot$	0.55	0.68	0.61	0.71–0.90
$M_R/M_\odot$	0.08	0.07	0.09	0.25–0.44
$R_R/R_\odot$	0.16	0.13	0.15	0.36–0.43
K_W (km/s)	56	45	58	101–141
K_R (km/s)	375	439	388	288

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