New Precision CCD Light Curves, Analyses, and Absolute Parameters for the Overcontact Binaries V842 Her and DZ Psc

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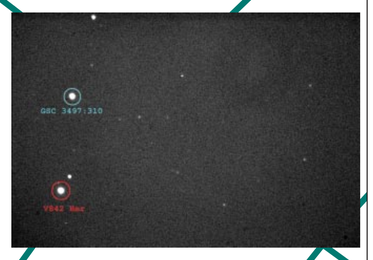
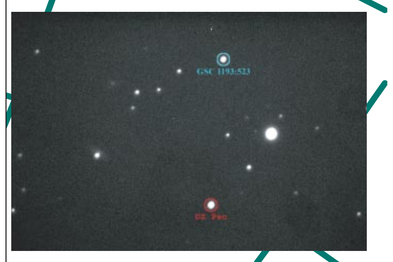
New V & R_C light curves and the derived absolute parameters are presented for the overcontact systems DZ Psc and V842 Her. These systems were selected for photometric study because the existing radial velocity solutions (Rucinski et al. 1999, 2003) necessitate precision light curves to complete the description of their absolute geometric and orbital parameters. Data were obtained using the 41-cm telescope at the Eastern University Observatory equipped with an SBIG ST-10XME CCD.

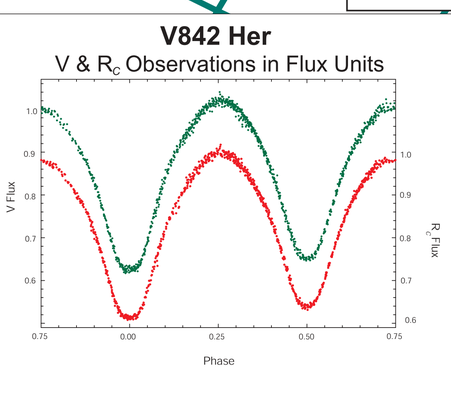
V842 Her (P=0.41903 d) is a W-type contact binary with two previously published light curves. The light curves exhibit a total primary eclipse and slight asymmetries in the maxima due to the presence of cool spots. A light curve solution has been previously published but no solutions existed that incorporated the mass ratio information from the recent radial velocity data of Rucinski & Lu (1999). V & R_C observations of V842 Her were obtained on 7 nights from 13 March 2004 to 8 June 2004 resulting in approximately 1100 data points in each bandpass. These were binned into 200 equidistant normal points in flux units and analyzed using ***Binary Maker 3*** (Bradstreet & Steelman 2002) and Wilson-Devinney (1971, 1979, 1992).. A cool spot was placed on the more massive star to compensate for the small asymmetry in the maxima of the light curves near phase 0.75P. The differential corrections solution is shown below along with the absolute parameters of the stars. Our results confirm those of Torres & Melendo (1996) except that we modeled the system with a cool spot and they used a hot spot. However, the essential parameters (mass ratio, fillout, inclination, etc.) are nearly identical. Analysis of the O-C diagram for V842 Her clearly indicates that it is increasing its period at the significant rate of $+7.280 \times 10^{-2}$ sec/yr. Csizmadia (2001) suggested that the period of V842 Her was constant, although he mentions the possibility of a slight period increase. Our analysis of all the existing times of minimum light shows a definite increase in period.

DZ Psc (NSV 223; P=0.36613 d) is a low mass ratio, high fillout A-type contact binary with two previously published light curves. We confirm the totality of the secondary eclipse. We also find the light curve has changed between the 2003 and 2004 observing seasons; the depth of secondary eclipse has increased by nearly 0.04 mag in R_C. DZ Psc was observed during the late fall of 2003 and again in the early fall of 2004. The 2004 observations consisted of five nights from 5 October to 12 October 2004 and resulted in 945 observations in V and 919 observations in R_C. These data were binned into 200 normal flux points in each bandpass and analyzed in the same manner as V842 Her. The results of these analyses are presented below. Subsequent to this work Niarchos & Gazeas (2004) published their own analyses of their $BVRI$ light curves and our results are nearly identical to theirs. The only significant difference between the two solutions is that our model found a fillout of 93% compared to theirs of 83%, both very large values! Analysis of the O-C diagram of DZ Psc (shown below) revealed only that the period has remained constant over the short interval of time (6.2 years) that the binary has been observed since its discovery.

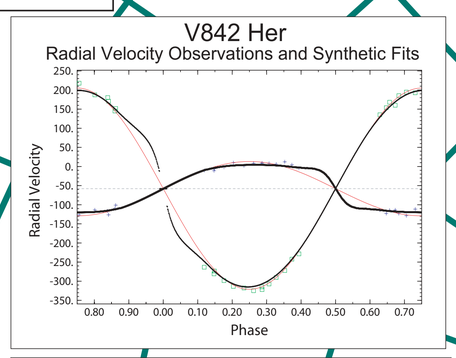




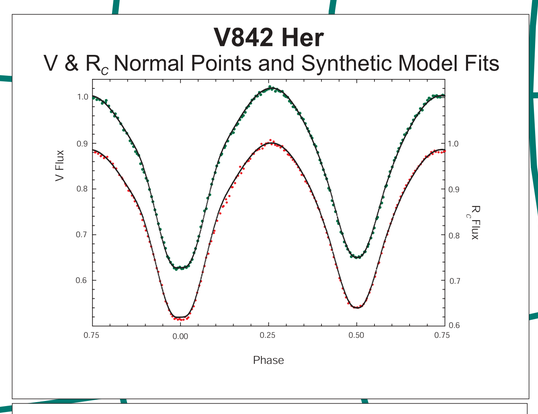
V842 Her



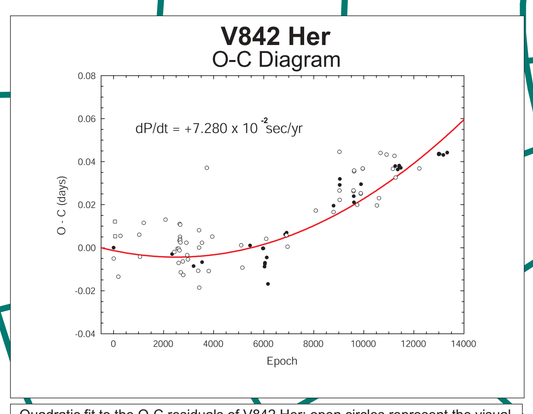
Individual V (green dots) and R_C (red dots) observations of V842 Her



Radial velocity observations of V842 Her from Rucinski & Lu (1999) are plotted against the Wilson-Devinney synthetic fits. Black curves are the light centered model, the red curves the mass centered model. The blue crosshairs represent the primary star's observations, the green squares the secondary star's.



V & R_C synthetic Wilson-Devinney fits (solid curves) to normal points of V842 Her



Quadratic fit to the O-C residuals of V842 Her; open circles represent the visual timings, open squares the photographic timings and solid circles the CCD timings.

Light Curve Parameters for V842 Her

(Probable errors given in parentheses)

mass ratio	= 3.7027 (84)
$\Omega_1 = \Omega_2$	= 7.3557 (92)
fillout	= 0.2806
inclination	= 78°.53 (10)
mean density$_1$	= 0.9952 g/cm^3
mean density$_2$	= 0.6438 g/cm^3
T_1	= 6000° K (assumed)
T_2	= 5703° K (3)
albedo$_1$ = albedo$_2$	= 0.50 (assumed)
luminosity$_1$ = L_1(6400 Å)	= 0.2764 (12)
luminosity$_2$ = L_2(6400 Å)	= 0.7236
limb darkening $x_1 = x_2$ = (6400 Å)	= 0.614 (9)
luminosity$_1$ = L_1(5500 Å)	= 0.2825 (12)
luminosity$_2$ = L_2(5500 Å)	= 0.7175
limb darkening $x_1 = x_2$ = (5500 Å)	= 0.698 (8)
gravity brightening $g_1 = g_2$	= 0.32 (assumed)

Stellar Radii

r_1 back	= 0.32000 (100)	r_2 back	= 0.54261 (15)
r_1 side	= 0.27725 (53)	r_2 side	= 0.51461 (9)
r_1 pole	= 0.26480 (44)	r_2 pole	= 0.47449 (6)

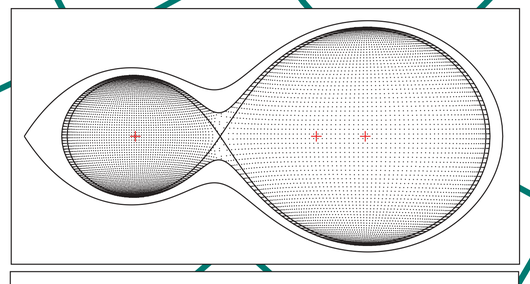
Spot Parameters on Star 2

Latitude	Longitude	Radius	Temperature Factor
45°.0	270°.0	15°.0	0.9

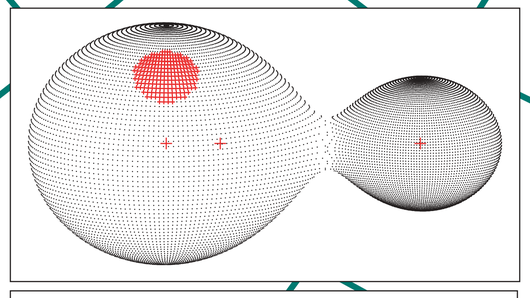
Absolute Parameters

Star 1	Star 2
M_1 = 0.36 $M_\odot$	M_2 = 1.37 $M_\odot$
R_1 = 0.81 $R_\odot$	R_2 = 1.44 $R_\odot$

Semi Major Axis = 2.82 $R_\odot$

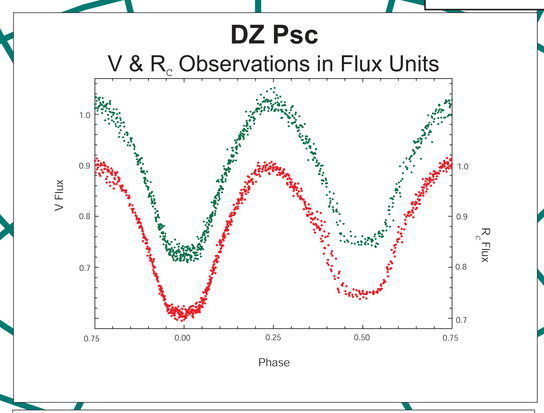


V842 Her with inner and outer Lagrangian surfaces

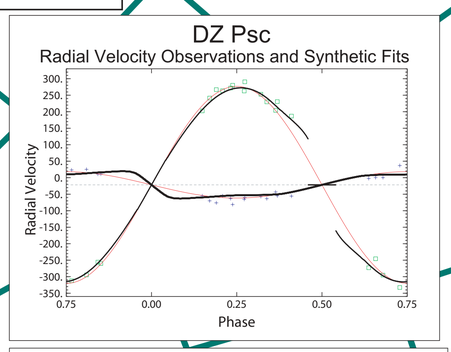


V842 Her shown at 0.75P with cool spot

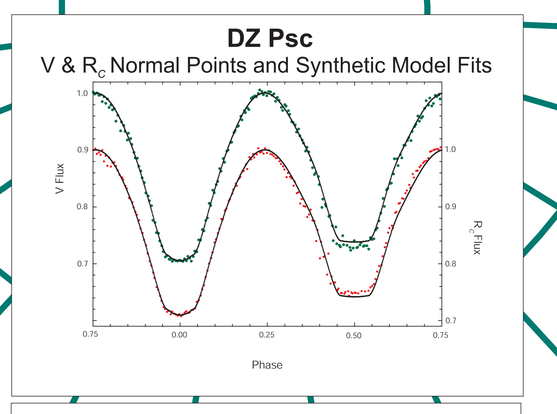
DZ Psc



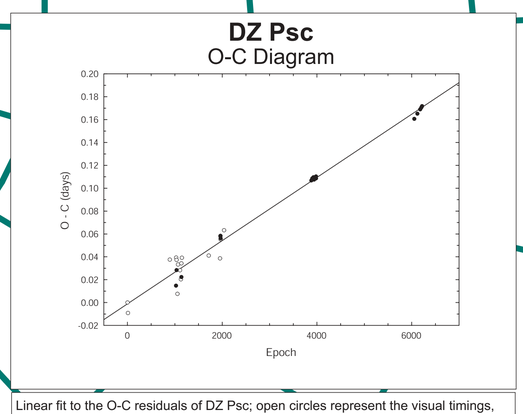
Individual V (green dots) and R_C (red dots) observations of DZ Psc



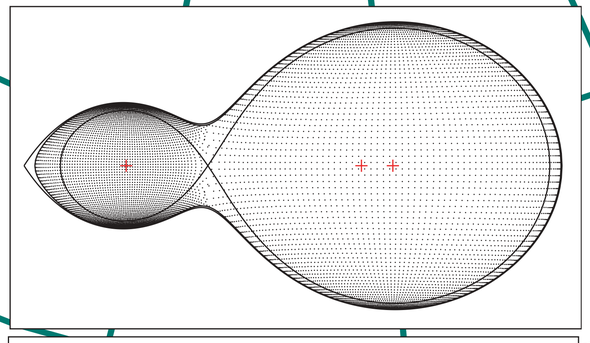
Radial velocity observations of DZ Psc from Rucinski *et al.* (2003) are plotted against the Wilson-Devinney synthetic fits. Black curves are the light centered model, the red curves the mass centered model. The blue crosshairs represent the primary star's observations, the green squares the secondary star's.



V & R_C synthetic Wilson-Devinney fits (solid curves) to normal points of DZ Psc



Linear fit to the O-C residuals of DZ Psc; open circles represent the visual timings, open squares the photographic timings and solid circles the CCD timings.The period appears to be constant, but has only been observed over a 6.2 year timespan.



DZ Psc with inner and outer Lagrangian surfaces

Light Curve Parameters for DZ Psc

(Probable errors given in parentheses)

mass ratio	= 0.1336 (5)
$\Omega_1 = \Omega_2$	= 1.9772 (51)
fillout	= 0.9311
inclination	= 78°.36 (43)
mean density$_1$	= 0.6208 g/cm^3
mean density$_2$	= 0.9864 g/cm^3
T_1	= 6280° K (assumed)
T_2	= 6260° K (11)
albedo$_1$ = albedo$_2$	= 0.50 (assumed)
luminosity$_1$ = L_1(6400 Å)	= 0.8415 (16)
luminosity$_2$ = L_2(6400 Å)	= 0.1585
limb darkening $x_1 = x_2$ = (6400 Å)	= 0.505 (21)
luminosity$_1$ = L_1(5500 Å)	= 0.8417 (17)
luminosity$_2$ = L_2(5500 Å)	= 0.1583
limb darkening $x_1 = x_2$ = (5500 Å)	= 0.528 (21)
gravity brightening $g_1 = g_2$	= 0.32 (assumed)

Stellar Radii

r_1 back	= 0.63069 (244)	r_2 back	= 0.34231 (1483)
r_1 side	= 0.60379 (208)	r_2 side	= 0.24808 (188)
r_1 pole	= 0.53776 (127)	r_2 pole	= 0.23424 (146)

Absolute Parameters

Star 1	Star 2
M_1 = 1.38 $M_\odot$	M_2 = 0.19 $M_\odot$
R_1 = 1.48 $R_\odot$	R_2 = 0.69 $R_\odot$

Semi Major Axis = 2.50 $R_\odot$