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NEW ELEMENTS OF THE CONTACT BINARY V839 OPHIUCHI

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V839 Oph as a W UMa type contact binary system was first detected by R. Rigollet in 1947. According to the *General Catalogue of Variable Stars* (GCVS Kholopov et al., 1985) the spectral type of the system is F8V with the period P=$0^{\rm d}.40899532$. So far a lot of studies have been conducted on the period variation and light curve analysis of V839 Oph (see especially Akalin & Derman, 1997). The first spectroscopic observations of this system were done by Rucinski and Lu in 1999. They found that the mass ratio of the system (q=m_2/m_1) is 0.305 with the spectral type of F7V.

The authors made new photoelectric observations of V839 Oph in 2000. The light curves and times of minima resulted from our observations are given in IBVS (No. 5190, 2001). We used the latest version of Wilson program (2001) in order to find simultaneous radial velocity and light curves solutions of the system.

The B, V magnitude differences were converted to intensities and used as a photometric input data. For radial velocity analysis we used the 29 observations provided by Rucinski & Lu (1999). The radial velocity curves along with the two (B, V) light curves were utilized simultaneously to determine the geometric and physical elements of the system.

For detailed analysis mode 3 of Wilson's (2001) program was used with constraints for gravity-darkening exponents g_1=g_2, the bolometric albedos A_1=A_2, the modified surface potentials of two components Ω_1=Ω_2, the limb darkening coefficients x_1=x_2, y_1=y_2. We supposed that there is neither a third light, $l_3 = 0.0$, nor any spot.

The parameters of Akalin & Derman (1997) were taken as a starting point. We used the bolometric logarithmic law of limb darkening for both components and the x and y parameters of the components were fixed to their theoretical values, as interpolated with VLimp program by Van Hamme (1993). Since the spectral type of this system is F7V, the temperature of the primary component was assumed to be T_1=6550K. The following parameters were free to be adjusted: the orbital inclination i; the mass ratio q; the temperature of secondary component T_2; the potential function Ω_1; the gravity darkening g_1; the bolometric albedos A_1; the monochromatic luminosity of primary component L_1; the semi-major axis a; and the systemic velocity V_γ. These nine parameters were varied until the solution converged.

Table 1 summarizes the adopted solution while Table 2 lists the values of the absolute dimensions of V839 Oph. Similarly Fig. 1 and Fig. 2 represent the light curves and radial velocity curves, respectively.

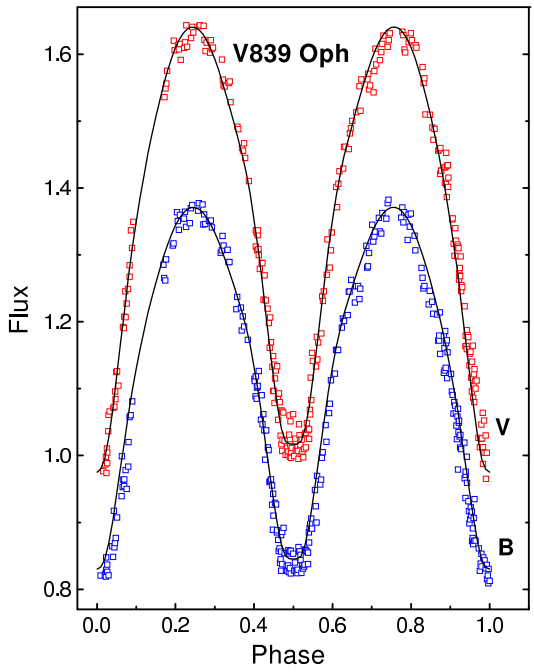

Figure 1. Open squares show the observed points and continuous lines show the model fit.

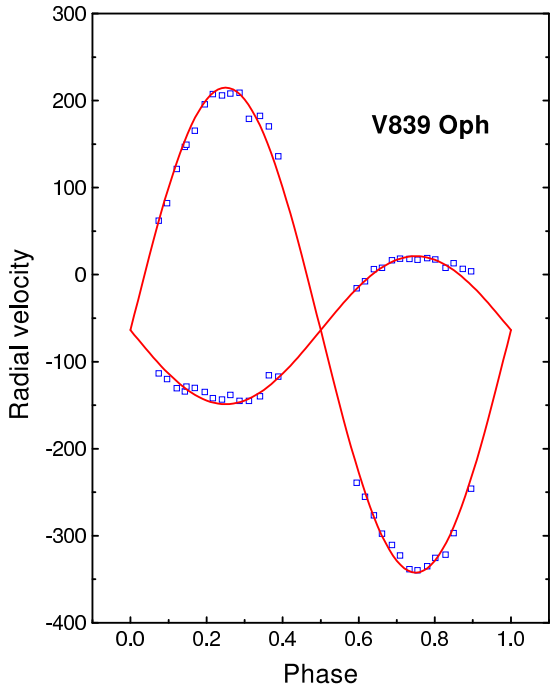

Figure 2. The same as Fig. 1 for radial velocity data.

Table 1: The Geometric and Physical elements of the contact binary system V839 Oph (most quantities are defined in the text).

Element	Value	Element	Value
i	80.059 ± 0.378	q	0.305 ± 0.001
$a(R_\odot)$	2.982 ± 0.005	$V_\gamma(km/s)$	-63.76 ± 0.33
$x_{1(bol)}$=$x_{2(bol)}$	0.641	$y_{1(bol)}$=$y_{2(bol)}$	0.242
$g_1 = g_2$	0.630 ± 0.044	l_3	0.00
$\Omega_1 = \Omega_2$	2.434 ± 0.007	$A_1 = A_2$	0.984 ± 0.115
$T_1(K)$	6650	$T_2(K)$	6554 ± 15
$L_{1B}/(L_1 + L_2)$	0.756 ± 0.004	$L_{2B}/(L_1 + L_2)$	0.243 ± 0.004
$L_{1V}/(L_1 + L_2)$	0.753 ± 0.004	$L_{2V}/(L_1 + L_2)$	0.243 ± 0.004
$r_{1(pole)}$	0.463 ± 0.004	$r_{2(pole)}$	0.271 ± 0.005
$r_{1(side)}$	0.500 ± 0.006	$r_{2(side)}$	0.284 ± 0.006
$r_{1(back)}$	0.528 ± 0.088	$r_{2(back)}$	0.325 ± 0.012

Table 2: Absolute dimension of V839 Oph calculated for mean values of Table 1.

Element	Primary	Secondary
$Mag_{(bol)}$	3.31	4.51
$M(M_\odot)$	1.64	0.5
$R(R_\odot)$	1.48	0.88
$L(L_\odot)$	3.51	1.14

In a nutshell, the present study of the V839 Oph showed that the system posseses partial eclipses and is a A-type contact binary with a degree of overcontact of $f = (\Omega_{in} - \Omega_{1,2})/(\Omega_{in} - \Omega_{out}) \cong 23\%$. According to Kopal (1959), the relation $r_1 + r_2$= 0.75 should be fulfilled for contact system; therefore, taking the mean values of r_1 and r_2, we have $r_1 + r_2 = 0.79$. As a result, V839 Oph is an overcontact system which has two stars overfilling their respective Roche lobes.

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