THE NEW ABSOLUTE PARAMETERS OF OU GEM - THE STAR OF BY DRA TYPE

T.V. Mishenina[1], L.V. Glazunova[1,2], C. Soubiran[3], V.V. Kovtyukh[1]

[1] Department of Astronomy, Odessa National University
T.G.Shevchenko Park, Odessa 65014 Ukraine, *astro@paco.odessa.ua*
[2] Odessa National Academy of Telecommunications, Kuznechnaya street 1, Odessa, 65029, Ukraine
[3] Universite de Bordeaux - CNRS - Laboratoire d'Astrophysique de Bordeaux, France

ABSTRACT. The spectra of OU Gem were obtained with the fiber-fed echelle spectrograph SOPHIE at the 1.93-m telescope of the Observatoire de Haute-Provence (France). The temperatures of components of the system were defined and are equal to 5013 ± 15 K and 4486±50 K for primary (A) and secondary (B) components, accordingly. The rotation velocity of components are measured: for primary component it is equal to 5.1±1 km/s and 6.2 ± km/s for the secondary one. The definition of radial velocities of components by LSD profile method and redetermination of spectral orbital elements were carried out. New absolute parameters of components were obtained too.

Key words: Spectroscopic:absolute parameters: binary of the BY Dra type; stars: individual: OU Gem

1. Introduction

HD 45088 (=OU Gem) is a BY Dra-type spectroscopic binary with an orbital period of 6.99 days and an eccentricity of 0.15 (Griffin&Emerson, 1975; Tomkin, 1980). The photometric variability has been found by Bopp et al. 1981, V - light variations are up to 0.05 m with a period of 7.36 days. Spectral type of components are K3V + K5V (Montes et al., 1995). The eclipse of the system didn't found (Tomkin, 1980) The purpose of the given work is redetermination of spectral orbital elements using 8 of the new high dispersion spectries and definition of absolute parameters of system.

2. Observations and the effective tempratures of star

The spectra of OU Gem were obtained in the region of the λ 3387–6940 Å and with S/N about 70–170 using the 1.93 m telescope at the Observatoire de Haute-Provence (France) equipped with the echelle-spectrograph SOPHIE (Perruchot et al., 2008), a resolving power is R = 75 000. The spectral processing carried out by (Katz et al., 1998; Galazutdinov, 1992).

The effective temperatures $T_{\rm eff}$ for both components were estimated by line depth ratio method (Kovtyukh et al., 2003) for not blending lines. The temperatures of components of the system are equal to 5013±15 K and 4486±50 K for A and B components, accordingly. The microturbulent velocity $V_t$was determined using the Fe I lines and it is equal to 1.02 km/s for A and 2.1 km/s for B components.

3.Velocities of components and spectral orbital elements

To determine the radial and rotation velocities of the components, we employed the least square decomposed (LSD) profiles obtained using the method described by Glazunova et al. (2008). In this approach we use two line-lists optimized for the temperature of each component, A (5000K) and B (4500K). The heliocentric radial velocities obtained from LSD profiles of primary and secondary components are presented in Table 1. The orbital radial velocities are shown in Figure 1. The radial velocities of the components of the system were obtained by averaging the radial velocities measured at the centre of LSD profile and its core. The solution, obtained solely on the basis of our radial velocity curve, is shown in column 4 of Table 2. The solution derived by Griffin&Emerson, 1975 data is given in column 2. Column 3 shows the orbital parameters obtained by Tomkin (1980).The orbital period of system and the epoch were refined. The rotation velocity is equal to 5.1±1 km/s for A component and 6.2±1 km/s for the secondary (B). For the visual demonstration of the contribution of components, we present in Figure 2 the LSD profiles constructed from the spectra obtained at phase 0.74. The LSD profile of the components yielded a Fourier expansion with a clear first minimum because we determined the projection of rotational velocity with good accuracy.

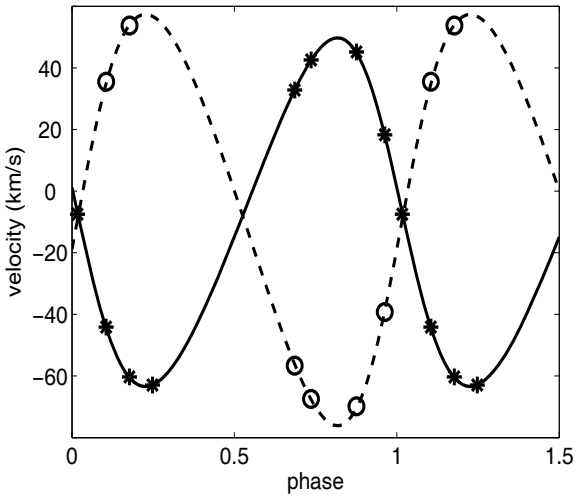

Figure 1: The observed and theoretical Vr.

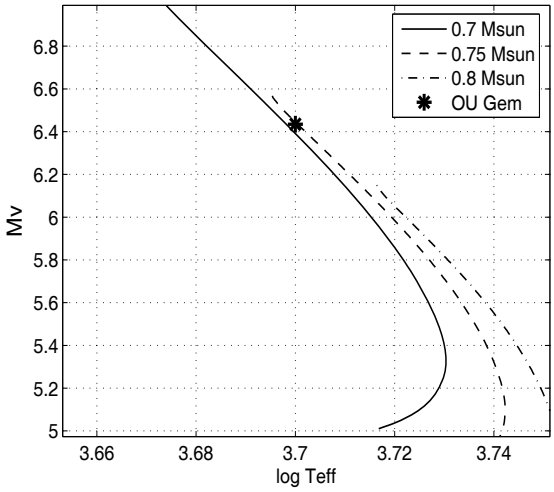

Figure 3: Mv vs. log(Teff).

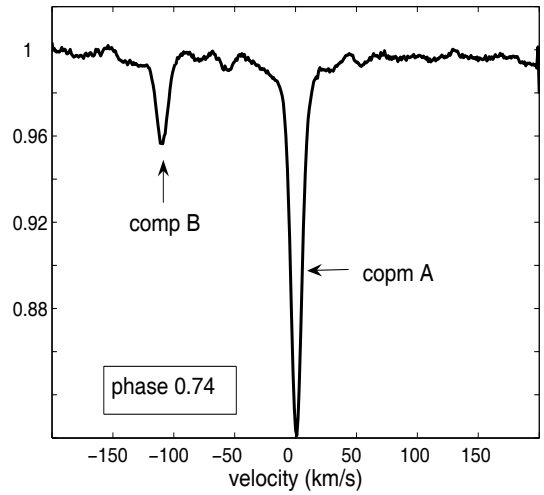

Figure 2: LSD profile for phase 0.74.

4.The absolute parameters of systems OU Gem

$M_{bol} = 6.11^m$ and M_v=6.38^m were determined using V = 6.79^m , B–V=0.88^m, distance 12 pc (Mishenina et al., 2009) and BC=–0.268 (Flower et al. 1996) . The position of A component at the tracks (Mv vs. $\log(T_{\rm eff})$, Pietrinferni et al., 2006) marked by asterisk in Fig.3. The radius of the A component ($R_A = 0.71$ $R_\odot$) was estimated using M_{bol} and T_{eff}.

To determine the mass of the components it need to know the angle of inclination i of the orbit in the visible plane. Using the radius and spectral elements of orbit we calculated the light curves for different angle of inclination by code for binary systems at http://www.physics.sfasu.edu/astro/ binstar.html . Eclipse can occur, since the angle is i = 86 degrees (Fig.5). Hence, the minimal masses of components (Table 2) are equal to $M_A = 0.72$ and $M_B = 0.61$ $M_\odot$) and, consequently, the gravities are $logg_A = 4.5$ and $logg_B = 4.6$.

Conclusion

1. We determined the effective tempratures for both components system OU Gem using not blending lines.
2. We measured the rotation velocities of components with good accuracy by LSD method. The definition of radial velocities of components and redetermination of spectral orbital elements were carried out too.
3. We made an estimate for angle of inclination of the orbit in the visible plane and determined the absolute parameters of system.

References

Bopp B. W., Noah P., Klimke A. et al.: 1981, *PASP,* **93**, 504.
Galazutdinov G.A.: 1992, *Preprint SAO RAS,* **92**, 1.
Glazunova L.V. et al.: 2008, *AJ, 139*, 1736.
Griffin R.F., Emerson B.: 1975, *The observatory,* **95**, 23.

Table 1: Radial velocities of components depending on the phase.

JD 24+	VR_A(km/s)	σ	VR_B (km/s)	σ	New phase
54898.313	42.57	0.6	–67.43	0.97	0.74
54899.293	45.16	0.9	–69.84	1.05	0.88
54900.280	–7.52	1.2	–	–	0.02
54901.395	–60.32	1.04	53.74	2.1	0.18
55128.695	32.82	0.5	–56.62	1.5	0.69
55130.627	18.25	0.9	–39.20	1.3	0.96
55131.623	–44.11	1.5	35.55	1.8	0.11
55132.622	–62.96	0.8	56.41	0.9	0.25

Table 2: Spectral orbit elements

Parameters	G&E (A comp)	Tomkin (A+B)	ours
P (days)	6.99187±0.00007	6.9990±0.003	6.99185±0.00016
T(JD+24)	40203.163±0.029	43867.020±0.064	2454900.158±0.02
e	0.150±0.004	0.141±0.005	0.146±0.002
w (degre)	77.6±1.4	81.4±2.8	81.9±1.1
K_A (km/s)	56.55±0.21	55.97±0.25	56.57±0.17
K_B (km/s)		66.88±0.19	66.74±0.21
V_0 (km/s)	–8.40±0.15	–10.37±0.25	–8.01±0.11
$M_A sin^3$i ($M_\odot$)		0.71	0.711±0.005
$M_B sin^3$i ($M_\odot$)		0.59	0.603±0.004
A sin i ($R_\odot$)		12.68	11.68

Katz D., Soubiran C., Cayrel R. et al.: 1998, *A&A,* **338**, 151.

Kovtyukh V.V., Soubiran C., Belik S.I., Gorlova N.I.: 2003, *A&A,* **411**, 559.

Kurucz R.L.: 1993, *CD ROM n13.*

Mishenina et al.: 2009, *KFNTSuppl,* in pres.

Montes et al.: 1995, *A&A,* **294**, 165.

Perruchot et al.: 2008, *"The SOPHIE spectrograph Proceedings of the SPIE,* 7014.

Pietrinferni et al.: 2006, *ApJ,* **642**, 797.

Tomkin J.: 1980, *AJ,* **85**, 284.

Yushchenko A.V., Gopka V.F., Khokhlova V.L. et al.: 2004, *A&A,* **425**, 171.