IAU Symposium 282 "From Interacting Binaries to Exoplantes: Essential Modeling Tools" Tatranská Lomnica, Slovakia, July 18 – 22, 2011

Spectroscopic study of the early type binary HX Vel A

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Abstract. *This paper presents high resolution spectroscopy of the HX Vel (IDS 08390-4744 AB) multiple system. New spectroscopic observations of the system were made at Mt. John University Observatory in 2007 and 2008. Radial velocities of both components of HX Vel A were measured by Gaussian fitting. The spectroscopic mass ratio of the close binary was determined as 0.599±0.052, according to a Keplerian orbital solution. The resulting orbital elements are $a_1 sini=0.0098 \pm 0.0003$ AU, $a_2 sini=0.0164 \pm 0.0002$ AU, $M_1 sin^3 i=1.19 \pm 0.07\ M_\odot$ and $M_2 sin^3 i=0.71 \pm 0.04\ M_\odot$*

Introduction

HX Vel (CCDM J08423-4806AB) is a quite bright (V=5.4 mag.) double/multiple star according to SIMBAD database. Hiltner etal. (1969) classificated the spectral type of the system as B1.5 V. Moreno and Moreno (1968) gave UBV colors and magnitudes for 251 stars in the region of the Scorpio-Centaurus association including HX Vel. The absolute visual magnitude and spectral type of HX Vel, together with 380 stars earilier than class A7, were estimated by Buscombe (1969) using the equivalent widhts and central depths of Hγ and Hδ. Jerzykiewicz and Sterken (1977) compiled a list of all Bright Star Catalogue objects spectroscopically similar to B Cephei variables, and recorded this system to be variable star. Shobbrook (1981) and Waelkens and Rufener (1983) obtained light curves of the binary, but only four radial velocity measurments were taken by Buscombe (1962). Morris (1985) presented an extensive catalog of ellipsoidal variables and classified as a suspected ellipsoidal variable our target star. He suggested more radial velocity data are needed to confirm this ellipsoidal classification.

Spectroscopic observations and reductions

High-resolution spectra of HX Vel were taken at the Mt John University Observatory (MJUO, New Zealand) in September and October 2007, and December 2008, using HERCULES (High Efficiency and Resolution Canterbury University Large Échelle Spectrograph) and a 4kx4k Spectral Instruments 600 series (SI600s) CCD camera attached to the 1-m McLellan telescope. The spectrograph is placed in a vacuum tank located on a stable platform in a thermally isolated room. It is designed to obtain 100 échelle orders for the wavelength interval between 380 nm and 900 nm. Three resolving powers are possible, delivering R=35000, 40000 and 80000. These are arranged by optical fibres located in the Cassegrain focus of the telescope. During our programme, observations were made with the slitless 100 μm fiber cable and the second option of R=40000, that is considered better adjusted to the mean seeing value (3.5 arcsec) at MJUO, according to Hearnshaw et al. (2002).

A total of 20 spectra of HX Vel have been collected during six observing nights in 2008, while 7 high-resolution spectra were obtained during four observing nights between September and October 2007. For all observations, a thorium-argon lamp was used for wavelength calibration, taken before and after each stellar exposure. White lamp spectra for flat fielding were also taken every night. All spectra obtained were reduced using HRSP (Hercules Reduction Software Package, HRSP: (Skuljan and Wright, 2007) software.

Radial velocities and orbital solution

Radial velocities (RVs) of both components of HX Vel A binary were measured using Gaussian fittings to selected spectral lines. According to the B1.5V spectral type of the binary, there should be strong neutral He lines and hydrogen lines of the Balmer series in the observed spectra. We found four spectral regions (include HeI line) where the secondary star's spectral lines could be clearly detected. The information about the spectral regions used is given in Table 1.

Table 1. *Spectral orders and stellar lines used in RVs measurements of HX Vel A*

Order No	Wavelength interval (Å)	Dominant Spectral Lines
85	6647–6715	He I (6678.151 Å)
97	5840–5907	He I (5875.989 Å)
116	4884–4939	He I (4921.931 Å)
127	4453–4508	He I (4471.480 Å)

The ELEMDR77 program, developed by T. Pribulla was used in order to obtain orbital parameters from the radial velocity data derived here. The best fitting orbital elements are given in Table 2 and the best fits to the composite spectra are presented in Fig. 1 showing échelle order 85 (including He I line) as example.

References
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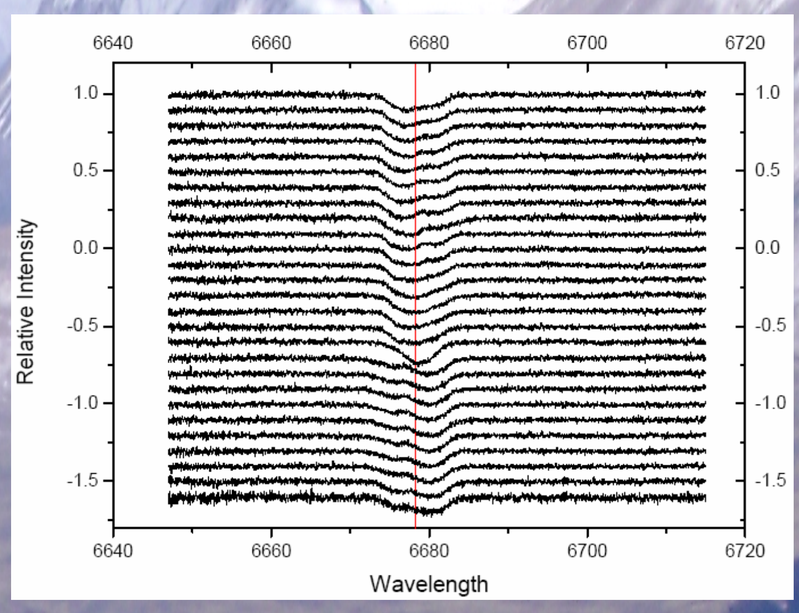

Fig 1. *The He I lines (échelle order no 85) of both components of HX Vel A, as used for RV measurements. The vertical line shows the laboratory wavelength of He I line (6678.151 Å).*

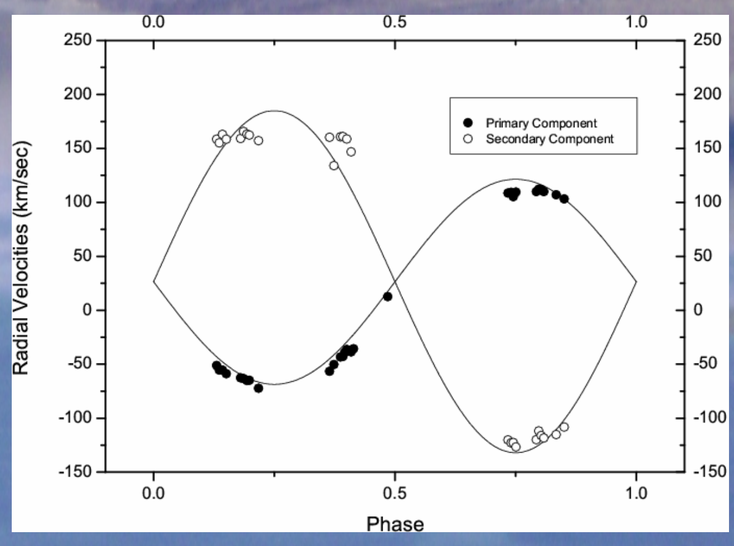

Fig 2. *Best theoretical fit to the radial velocity curves of HX Vel A. The continuous line fitted to the radial velocities represents the theoretical fits for a Keplerian orbit.*

Table 2. *Spectroscopic orbital parameters of HX Vel A*

Parameter	Value
P (days)	1.12447 (const.)
T_0 (HJD+2448501)	0.0833 ± 0.0046
e	0
w	1.571
K_1 (km/s)	95 ± 3
K_2 (km/s)	158 ± 3
q	0.599 ± 0.052
Vγ (km/s)	26 ± 3,4
$M_1 sin^3 i$ ($M_\odot$)	1.19 ± 0.07
$M_2 sin^3 i$ ($M_\odot$)	0.71 ± 0.04
$a_1 sini$ (AU)	0.0098 ± 0.0003
$a_2 sini$ (AU)	0.0164 ± 0.0003

RESULTS

We performed high-resolution spectra of the HX Vel A binary in this study. Radial velocities of the components were measured using the Doppler shifts of chosen spectral lines by Gaussian fittings, with the aid of the 'splot' task of IRAF. A first spectroscopic orbital solution of HX Vel A was then obtained. The spectroscopic mass ratio of the system was derived to be 0.599±0.052. In our next work, the physical parameters of HX Vel A will be examined together with available light curves of the system.