COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5375

Konkoly Observatory
Budapest
11 February 2003

HU ISSN 0374 – 0676

SPECTROSCOPIC BINARIES IN THE OPEN CLUSTER TRUMPLER 16 REVISITED

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The open cluster Trumpler 16 is near the Carina nebula (NGC 3372). There is a large amount of literature on the clusters in this region. The spectral morphology of members of Trumpler 16 has been studied by Levato & Malaroda (1982) and references therein. The cluster's distance has been determined using different methods, and there is an agreement that it is around 3.5 kpc. This value obviously depends on the interstellar absorption which may be abnormal for this cluster. Trumpler 16 is a rich cluster with a large variety of objects like WR stars, O3 stars, spectroscopic binaries and η Carinae. The age estimated for Trumpler 16 is approximately 10^7 years (Massey & Johnson, 1993).

The study of spectroscopic binary systems is needed to tackle a classic problem in astronomy: the stellar mass determination. A good knowledge of mass for individual stars allows the calibration with other stellar parameters which are most easily observable, and also permits to test current stellar evolution theories. Spectroscopic binaries in open clusters are important in yet another context. It has been proposed that the average projected rotational velocity of the stars in an open cluster depends on its content of close spectroscopic binaries and chemically peculiar magnetic stars (Abt & Sanders, 1973). Both tidal and magnetic braking are responsible for reducing the rotation. (Levato et al., 1987; Abt et al., 1973)

We used the Jorge Sahade-2.1m Telescope at CASLEO, San Juan, Argentina. A REOSC echelle spectrograph was employed during the following nights: February 27th 1996, from April 21st to 23rd 2000 and from March 10th to 11th 2001. The spectra centered on the blue wavelength region were recorded on a TEK1024 CCD and the resolution was 0.14 Å/pixel. The usual flat-fields and bias frames were obtained each night and the wavelength calibration was done using a Th-Ar lamp. The reduction was made with the standard procedure, using IRAF[1]

We have selected five stars for this project, that are probable members of Trumpler 16, suggested by Levato et al. (1991). Three of them were chosen because the number of available radial velocity measurements was smaller than ten, and the other two because the authors considered them radial velocity variables. To derive the radial velocities we have measured the Doppler shifts of H, He I, He II, Si IV, C IV, N III, C III lines. (Walborn et al. 2000), and applied heliocentric correction to the measurements. The observational results for the three stars for which we have recalculated the orbits are given in Table 1,

[1]IRAF is distributed by the National Optical Astronomy Observatories, operated by AURA, Inc., under cooperative agreement with the NSF.

where we have indicated in successive columns the Julian Date, the average radial velocity for each spectra, the number of lines measured, and the probable errors. The stars are identified by their HD number or Feinstein, Marraco and Muzzio (1973) numbers.

Table 1: Radial Velocity Observations

Identification	Julian Date	RV (Km/s)	n n	P.E. (Km/s)
#112	2450141.73	−85.39	6	2.0
	2451656.52	18.46	7	6.2
	2451657.52	54.45	8	5.8
	2451657.61	50.24	7	7.0
	2451658.57	−30.15	8	10.7
HD 93161	2451979.76	−76.7	9	11.5
	2451979.78	−118.91	4	15.5
	2451979.79	−91.11	12	8.6
	2451980.61	−105.69	6	8.8
	2451980.65	−96.64	8	12.3
	2451980.77	−97.58	10	9.8
#104	2451979.74	−181.2	7	6.1
	2451979.77	−174.7	7	12.2
	2451980.57	−19.7	7	5.8
	2451980.63	2.3	5	10.3
	2451980.74	109.2	7	18.6
	2451980.79	123.4	6	25.6

We have added the new observations presented in Table 1 to those published by Levato et al. (1991) and searched for periods, using Morbey's code (Morbey, 1978) and, when successful, computed orbital elements starting from the results from Levato et al. (1991) improving them with the code of Bertiau & Grobben (1969).

For HD 93161, #112 and #114 stars, we found new orbital parameters, while for #10 and #110, we could not find any significant evidence of variability. We have applied an analysis of variance test (Conti et al., 1977) which confirms that the distribution of the observations for stars #110 and #10 does not depart significantly from a random one. The new orbital elements for stars HD 93161, #112, and #114 are shown in Table 2.

Table 2: Orbital Elements obtained in this work

Element	**HD 93161**	**#104**	**#112**
$\mathbf{a}\sin\mathbf{i}$ (km)	3.72×10^6	4.03×10^6	3.67×10^6
K (km/s)	50.9±5.1	162.8±11.4	86.0±4
e	0.309±0.116	0.156±0.057	0.249±0.026
$\omega(^\circ)$	184.4±17.8	85.7±28.4	286.6±8.8
$\mathbf{T_0}$ (J.D.) (2.400.000+)	45778.39±0.22	45779.37±0.13	45773.02±0.1
P (days)	$5.60486\pm9\times10^{-5}$	$1.82303\pm1\times10^{-5}$	$4.07997\pm2\times10^{-5}$
$\mathbf{V_0}$ (km/s)	−44.5±3.4	−32.7±7.5	−19.1±1.7
Mass Function	0.06±0.03	0.78±0.18	0.24±0.02

Figures 1, 2 and 3 show the radial velocity curves for #104, #112 and HD 93161, respectively.

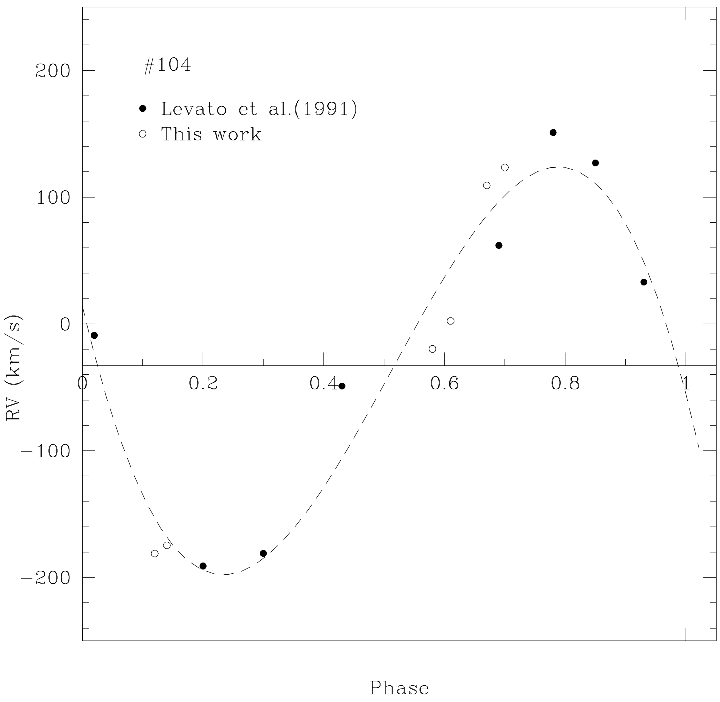

Figure 1. Radial velocity curve of #104

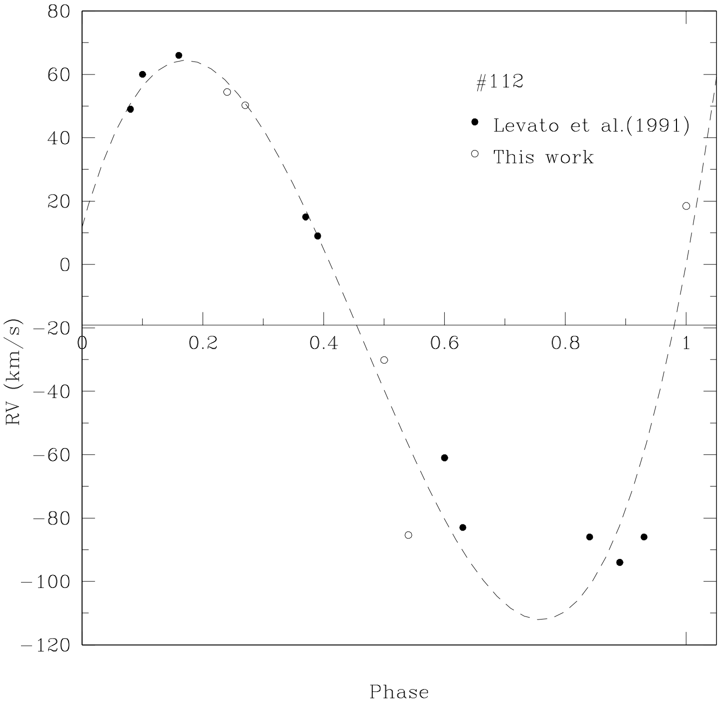

Figure 2. Radial velocity curve of #112

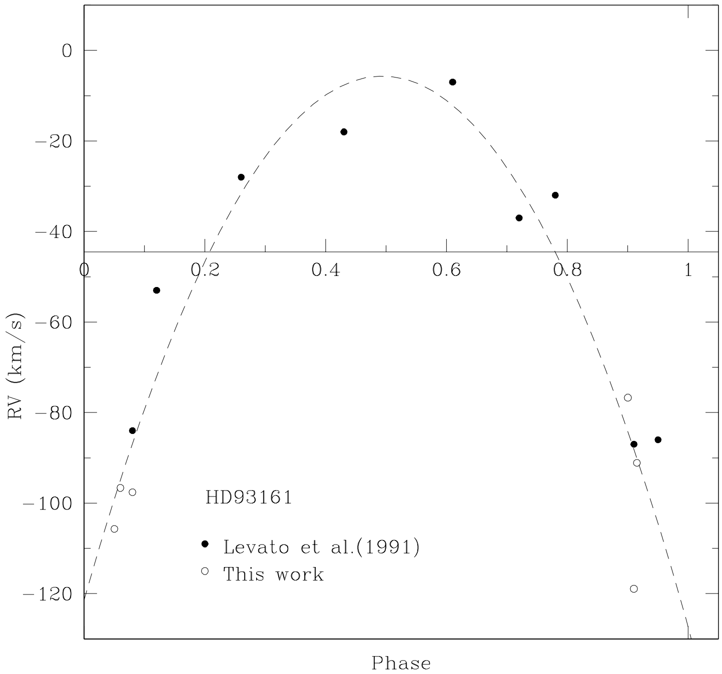

Figure 3. Radial velocity curve of HD 93161

Summarizing, we have recalculated new orbital elements for three spectroscopic binary systems which belong to the open cluster Trumpler 16 and obtained the mass function for these three systems. We could not find significant radial velocity variations for #110 and #10 of the same cluster.

Support from Universidad Nacional de San Juan and CASLEO is deeply appreciated.

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