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# THE MASSIVE BINARIES IN CAR OB1 ASSOCIATION

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RESUMEN

Presentamos resultados del estudio de velocidades radiales de dos estrellas de tipo espectral O en el cúmulo abierto Trumpler 16 en la asociación Car OB1. Nuestro estudio está basado en observaciones de espectros ópticos obtenidos entre los años 1986 y 1994. Nuestros espectrogramas revelan que en ambos casos se trata de sistemas binarios de corto período. Presentamos también elementos orbitales preliminares.

ABSTRACT

We present the results of a radial velocity study of two O type stars of the open cluster Trumpler 16 in the Car OB1 association. Our study is based on optical spectral observations obtained between 1986 and 1994. Our spectra reveal both stars to be short period binary systems. We also present preliminary orbital elements.

**STARS: BINARIES — STARS: INDIVIDUAL (TR 16 #1, TR 16 #104) — STARS: O TYPE**

## 1. INTRODUCTION AND OBSERVATIONS

The open cluster Trumpler 16 in the Car OB1 association is rich in O type stars. In their study of binary frequency of this open cluster, Levato et al. (1991) found several stars with variable radial velocity. Among them were the stars Tr 16 #1 and Tr 16 #104 (numbering from Feinstein, Marraco & Muzzio 1973), which have been classified as O9.5 Vn and O7: V:+Companion? (Levato & Malaroda 1982).

With the purpose to further study the radial velocities of Tr 16 #1 and Tr 16 #104, and their eventual binary nature, we have obtained several series of optical spectra during the years 1986–1994.

Our observations have been obtained:

1. During January 1986, at Cerro Tololo Inter-American Observatory (CTIO), Chile, with the Cassegrain IT spectrograph on the 1-m Yale telescope, with the 2-Dimensional Photon-Counting System as detector. The wavelength region covered is $\lambda 3800 - 4900$ Å.

2. During January, February, and March 1993, at Complejo Astronómico El Leoncito (CASLEO[3]), San Juan, Argentina, with the Boller & Chivens Cassegrain spectrograph attached to the 2.15-m telescope. A CCD was used as detector, and these spectra cover a bandwidth about $\lambda 400$ Å centered at $\lambda 4500$ Å.

3. During March 1994, at CASLEO, with the REOSC échelle spectrograph on the 2.15-m telescope. A Tek CCD was used as detector.

Data reduction and radial velocity measures in the spectra were performed with IRAF routines.

## 2. RESULTS

Our data confirm the previously found (Levato et al. 1991) radial velocity variations, indicating that we probably are dealing with short period binary systems.

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In our spectra, most spectral lines of Tr 16 #1 were observed to be double in several nights, whereas the spectral lines of Tr 16 #104 show variable shape, but only the He II $\lambda$4686 Å absorption was seen definitely splitted in two components.

The radial velocity variations in our data were searched for periodicities with the Entropy Information routine (Cincotta, Méndez, & Nuñez 1995), giving as the most probable periods $P = 1.469$ days for Tr 16 #1, and $P = 2.159$ days for Tr 16 #104. With these short periods, we have assumed circular orbits, and determined preliminary orbital elements, which are listed in Table 1.

TABLE 1

PRELIMINARY CIRCULAR ORBITAL ELEMENTS FOR TR 16 #1 AND TR 16 #104

| Parameter | | Tr 16 #1 | | | Tr 16 #104 | | |
|---|---|---|---|---|---|---|---|
| $P$ | [days] | 1.46937 | ± | 0.00001 | 2.15291 | ± | 0.00002 |
| $K_1$ | [km s$^{-1}$] | 268 | ± | 8 | 207.5 | ± | 11.5 |
| $K_2$ | [km s$^{-1}$] | 314 | ± | 8 | 334 | ± | 15 |
| $V_0$ | [km s$^{-1}$] | −5 | ± | 4 | −13 | ± | 7 |
| $T_0$ | [HJD][a] | 46 490.65 | ± | 0.01 | 46 484.60 | ± | 0.2 |
| $a_1 \sin i$ | [$R_\odot$] | 8 | ± | 0.2 | 9 | ± | 0.5 |
| $a_2 \sin i$ | [$R_\odot$] | 9 | ± | 0.2 | 14 | ± | 0.5 |
| $M_1 \sin^3 i$ | [$M_\odot$] | 16 | ± | 2 | 22 | ± | 5 |
| $M_2 \sin^3 i$ | [$M_\odot$] | 14 | ± | 2 | 13 | ± | 4 |

[a] $T_0 = (2,400,000+)$ time of maximum radial velocity.

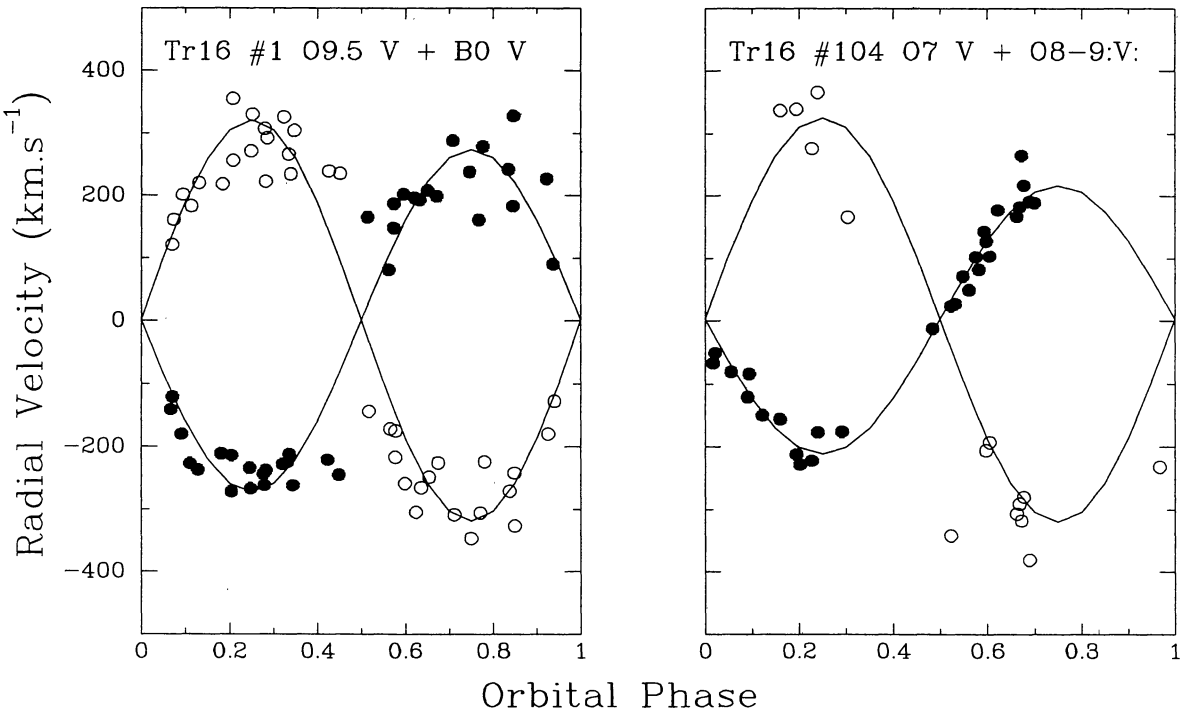


Fig. 1. Radial velocity orbits of Tr 16 #1 and Tr 16 #104.

Figure 1 shows the preliminary radial velocity orbits for the two binary systems.

In view of the rather large values obtained for the minimum masses, light variations should be searched for, in order to estimate the orbital inclinations of these binary systems.

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