Abstract. HD 45166 was selected as a candidate to the V Sagittae Class. Its spectrum shows quite narrow emission lines of He, C, N, and O, possibly indicating a low inclination for the binary system. We performed high resolution and high stability Coudé spectroscopy in order to search for low amplitude radial velocity variations. The orbital period determined from the radial velocity curve is 0.357 days, and the radial velocity semi amplitude is $K=3.8 \text{ km/s}$. The system inclination, determined from the mass function of the secondary star, is $0.7^\circ < i < 1.0^\circ$.

1. Introduction

The class of the V Sagittae stars (Steiner & Diaz 1998), is composed of galactic binary systems with similar observational properties. The stars of this class are spectroscopically characterized by the simultaneous presence of the emission lines of OVI and NV and by the strength of the HeII 4686Å emission line, usually more than 2 times stronger than H$\beta$. The orbital periods are distributed between 5 and 12 hr. The V Sagittae stars are possible galactic counterparts of the close binary supersoft X-Ray sources (CBSS), found in the Magellanic Clouds and in M31 (Steiner & Diaz 1998). The CBSS are presently accepted to be binary systems containing massive white dwarfs with stable nuclear burning of accreted matter on its surface (van den Heuvel et al. 1992). This stable nuclear burning can occur when the mass transfer is very high ($10^{-7}M_\odot \text{ yr}^{-1}$), a situation found in systems with mass ratios $(q = M_2/M_1)$ inverted when compared to the mass ratios usually found in cataclysmic variables (Kahabka & van den Heuvel 1997).

HD 45166 is classified in the Sixth Catalogue of Galactic Wolf-Rayet Stars (van der Hucht et al. 1981) as a low mass WR-like star of spectral type qWR + B8V. However, its spectrum shows unusually narrow emission lines for a Wolf-Rayet star, besides a solar chemical composition and both WN and WC features. Willis & Stickland (1983) confirmed the binary nature of the system with the observation of a UV photospheric absorption spectrum and reported the evidence for variability in the strengths of the NIV, NV, CIV and HeI emission lines, probably arising in structural changes in a wind. A SdOp rather than qWR interpretation is suggested, where the "p" designation indicates the narrow emission line spectrum. These authors report that no velocity variability
in excess of $\sim 10$ km/s was found in the optical spectra of HD 45166. If the amplitude of radial velocity variations is lower than 10 km/s this could mean a low inclination for the binary system, which is compatible with the narrow emission lines found in its spectra.

In an effort to determine the orbital period of HD 45166 we performed high resolution and high stability Coudé spectroscopy at the 1.6 m telescope of the Laboratório Nacional de Astrofísica, Brazil. A total of 42 spectra were obtained with the 1800 l/mm dispersion grating, resulting in 0.2 Å FWHM spectral resolution. Typical rms residuals in wavelength calibrations are $\sim 2$ mA.

2. The spectroscopic period

Radial velocities were measured with the cross-correlation method using as template the average spectrum. A period search routine based on Fourier analysis with cleaning of spectral windows effects (Roberts et al. 1987) was applied to the RV data. The resultant power spectrum clearly shows a signal at $P = 0.357$ d. The ephemeris for this period is

$$T_{0(spec)}(\text{HJD}) = 2450914.484 \pm 0.030 + 0.357 \pm 0.009E$$

where the zero phase is defined as the crossing from positive to negative values when compared to $\gamma$. The sinusoid fit to the radial velocity curve yields the values of $\gamma = -0.8$ km/s to the systemic velocity and $K = 3.8$ km/s to the radial velocity semi amplitude.

Assuming that the secondary star is at the main sequence and fills its Roche Lobe we can use the mean empirical mass-period relationship (Warner 1995) to derive a mass of $M_2 = 0.95M_\odot$. The primary star, being a white dwarf with hydrostatic nuclear burning, requires a mass larger than $0.5M_\odot$ (Hachisu et al. 1999) but smaller than the secondary star ($0.50 < M_1 < 0.95$) in order to keep the inverted mass ratio. With the observed period, radial velocity amplitude and the standard relationship for the mass function of the secondary star, the inclination of the system would be quite low, $0.7^\circ < i < 1.0^\circ$.

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