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THE BINARY NATURE OF LSS 1964 (= WR 29)

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RESUMEN

Imágenes espectrales obtenidas con el telescopio de 2.15-m en CASLEO (San Juan, Argentina) mostraron que la estrella Wolf-Rayet LSS 1964 (= WR 29) es un sistema binario de corto período. Las variaciones en velocidad radial de las líneas de emisión del espectro WR determinan un período de 3.13 días. Líneas de absorción de la compañera también están presentes en el espectro, aunque la determinación de sus velocidades radiales se confunde con la superposición de las absorciones de los perfiles P Cyg del espectro WR.

ABSTRACT

Spectral images obtained with the 2.15-m telescope at CASLEO (San Juan, Argentina) disclose the Wolf-Rayet star LSS 1964 (= WR 29) to be a short period binary system. From the radial velocity variations of the WR emission lines a period of 3.13 days is determined. Absorption lines of a companion are also present. However, the determination of their radial velocities is confused due to blending with the blueshifted absorptions of the P Cyg profiles in the WR spectrum.

Key words: **STARS: BINARIES — STARS: INDIVIDUAL: (LSS 1964 = WR 29) — STARS: WOLF-RAYET**

1. INTRODUCTION AND OBSERVATIONS

LSS 1964 was discovered to be a Wolf-Rayet (WR) star by Mac Connell & Sanduleak (1970), and was thus included as star #29 in the Catalogue of Galactic Wolf-Rayet Stars (van der Hucht et al. 1981). WR 29 is a faint, reddened WN7 type star located in the Carina spiral arm. It has been recently classified as WN7h+abs, which means that also absorption lines of unknown origin are seen in the otherwise emission line spectrum of WN type (Smith, Shara, & Moffat 1996). These absorption lines could be either intrinsic to the WN star, i.e., blueshifted P Cyg absorptions, or come from an OB companion, or both.

We observed WR 29 in March 1997 with the Cassegrain spectrograph attached to the 2.15-m telescope at CASLEO[2] (San Juan, Argentina). A PM–CCD was used as detector, and the spectral resolution was $\sim 2.3\,\text{Å}\,\text{pixel}^{-1}$. The spectra were processed with IRAF routines at La Plata Observatory. Radial velocities were determined fitting gaussian profiles to the emission lines of the WN spectrum.

We present here the first radial velocity study of WR 29, showing this star to be a short period spectroscopic binary system.

2. RESULTS

When we observed WR 29 at CASLEO in March 1997, a preliminary reduction of the first two spectra already showed a large wavelength shift between the emission lines from spectra obtained during consecutive nights. Therefore, we decided to obtain several spectra of WR 29 during each night of our observing run. A total of 13 spectrograms were obtained during 7 consecutive nights. One of these spectra, corresponding to the maximum negative velocity of the emission lines, is shown in Figure 1.

Upper Balmer absorption lines appear noisy in our spectra, and the radial velocities of all absorption lines show a large scatter. Nevertheless, it is clear that two sets of absorptions are present in the spectrum of WR 29,

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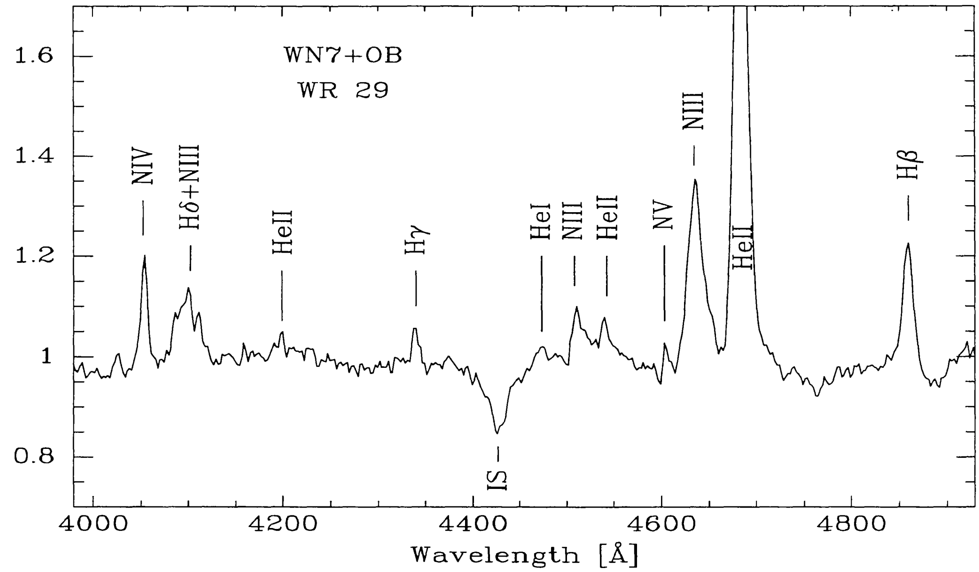

Fig. 1. Spectrum of WR 29 obtained during the minimum radial velocity of the WN7 component. Note the faint absorption lines of the OB component to the red of the WN emissions with P Cyg profiles.

namely those corresponding to an OB companion, detected at their maximum positive radial velocity, and also blueshifted absorption lines intrinsic to the WN7 star (see Fig. 1), which blend with the lines of the OB companion at negative radial velocities. Thus, the classification of this system, taking into account our data, is WN7ha + OB.

The large radial velocity variations of the emission lines that we observed in spectra obtained during successive nights indicated that WR 29 is a short period binary. We applied period search routines to the radial velocities of different emission lines, which revealed that the most probable period is $P = 3.13 \pm 0.01$ days. Figure 2 shows the radial velocity variations of N IV 4058 Å and He II 4686 Å emissions phased with this period.

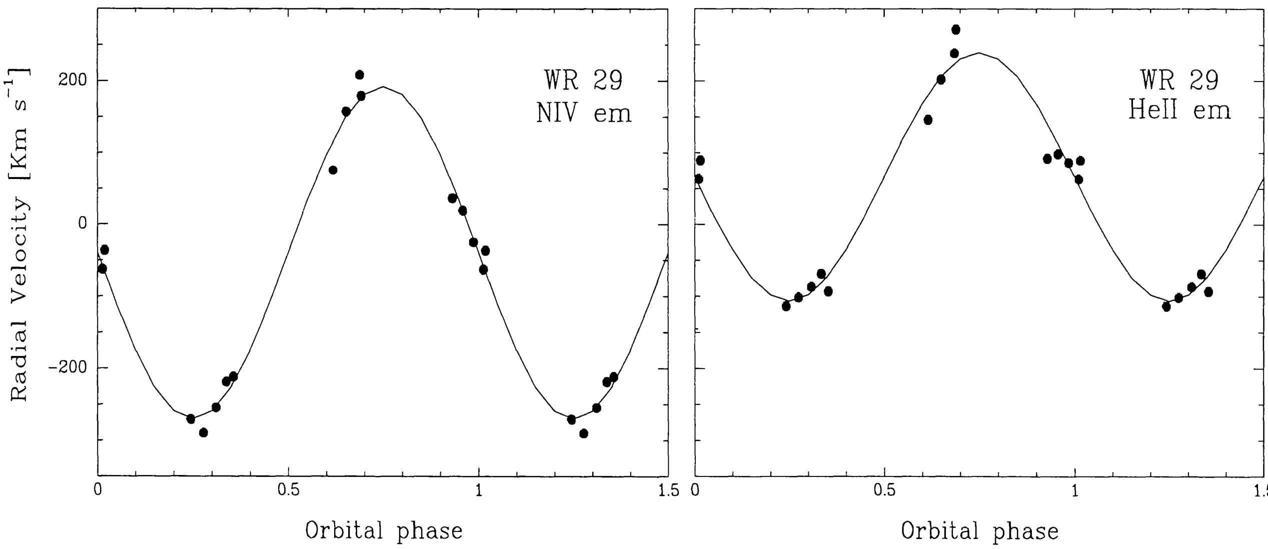

Fig. 2. Radial velocities of N IV 4058 Å (left) and He II 4686 Å (right) emissions in the spectrum of WR 29, phased with the period of 3.13 days. The curve represents the orbital solution of Table 1.

TABLE 1

PRELIMINARY CIRCULAR ORBITAL ELEMENTS OF WR 29

Parameter		N IV 4058			He II 4686		
V_0	[km s^{-1}]	−40	±	5	57	±	8
K	[km s^{-1}]	234	±	10	183	±	10
T_0	[HJD 2,450,000+][a]	540.95	±	0.03	540.9	±	0.2
$a \sin i$	[$R_\odot$]	14.4	±	0.6	10.9	±	0.8
σ	[km s^{-1}]	14			14		
$f(M)$	[$M_\odot$]	4.2	±	0.5	1.8	±	0.4

[a] Time of maximum radial velocity.

Preliminary circular orbital elements are listed in Table 1 with their corresponding standard errors. It is evident, from this table, that the radial velocity variations of the emission lines have different amplitudes, and different systemic velocities, as is the case for many other binaries with WR type components.

Higher resolution spectra are needed to determine the orbital motion of the OB companion.

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