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# SPECTROSCOPIC ANALYSIS OF THE RS CVn STAR EI Eri

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## ABSTRACT

We present results of a new high-resolution spectroscopic study of the RS CVn-type binary system EI Eridani (HD26337). We used high S/N ratio LSD profiles to measure a new RV orbit of the primary component and new orbital parameters. We found evidence of strong spectral line profile variations at time intervals indicating the existence of short-lived (few days) spots on the surface of the primary component. We measured a projected rotation velocity of star of 53.2 km/s

*Key words:* RS CVn variable star: Least-Squares Deconvolution technique

## 1. INTRODUCTION

EI Eri (HD 26337) is a bright, single-lined, non-eclipsing short-period (P = $1.94722^d$) RS CVn type binary star. The G5IV primary component is a chromospherically active, synchronously rotating star. It shows seasonal variations in spectral line profiles caused by surface spots (Fekel et al., 1987; Hall et al., 1987; Washuettl et al., 2008).

## 2. OBSERVATIONS

The new spectroscopic observations of EI Eri were obtained during October 2004 and February 2006 with the HERCULES echelle-spectrograph fibre-fed to the 1-m telescope at Mt John University Observatory, New Zealand. The wavelength coverage spans 4657-7060 Å, with a resolving power of 41000. Spectra were extracted, calibrated, and normalized in a standard way using the IRAF package, and barycentric corrections were applied.

## 3. ORBITAL RADIAL VELOCITIES AND ROTATION

A spectral interval of 4677-5777Å was used to construct the least square deconvolution (LSD) profiles using the version of the code described in Tkachenko et al. (2013). The Vienna Atomic Line Database VALD (Piskunov et al., 1995) was used to prepare the list of spectral lines for the primary component. Strong spectral lines with R > 0.1 in continuum units were selected. Spectral intervals covering the $H_\beta$ hydrogen line and those with telluric lines were not used. The resulting LSD profiles plotted vs orbital phase are shown in Figure 1. On some dates (JD 2 453 336.992 63 JD 2 453 402.939 52 JD 2 453 402.914 79 and JD 2 453 405.930 71) the LSD profiles show significant changes in shape indicating the existence of short-lived contrast spots on the surface. This detection needs further investigation. For an orbital solution, these spectra were excluded. The orbital radial velocities measured from the rest of the LSD profiles are shown in Figure 2. The orbital elements for EI Eri were calculated using the Specbin program (Skuljan et al., 2004).

Table 1
Orbital elements for EI Eri for circular solution

| Parameter | $e = 0$ |
|---|---|
| $K$ [km/s] | 27.82 ± 0.25 |
| $e$ [days] | 0.0 |
| $\omega$ [°] | - |
| $T_0$ [HJD] | 245 3304.4522 ± 0.0052 |
| $P$ [days] | 1.947 145 ± 0.000 037 |
| $\gamma$ [km/s] | 20.61 ± 0.19 |
| $a \sin i$ | 744 895.7 ± 691 9.9 |
| $f(M)$ [$M_\odot$] | 0.004 3442 ± 0.000 1199 |
| $\sharp_{obs}$ | 42 |
| $\sharp_{rej}$ | 6 |
| $\sigma$ [km/s] | 1.31 |

Using the Reiners & Schmitt (2002) technique, the projected rotational velocity of the primary component was found to be $vsini$ = 53.2 km/s. Table 1 lists the orbital elements when a circular orbit is adopted. The numbers in parentheses show the errors of the parameter determinations. The standard error of the fit to observations is 1.31 km/s. Phases of all line profiles were then computed using our revised ephemeris

$$HJD = 245\ 3304.4522 + 1.947\ 45 \times E \qquad (1)$$

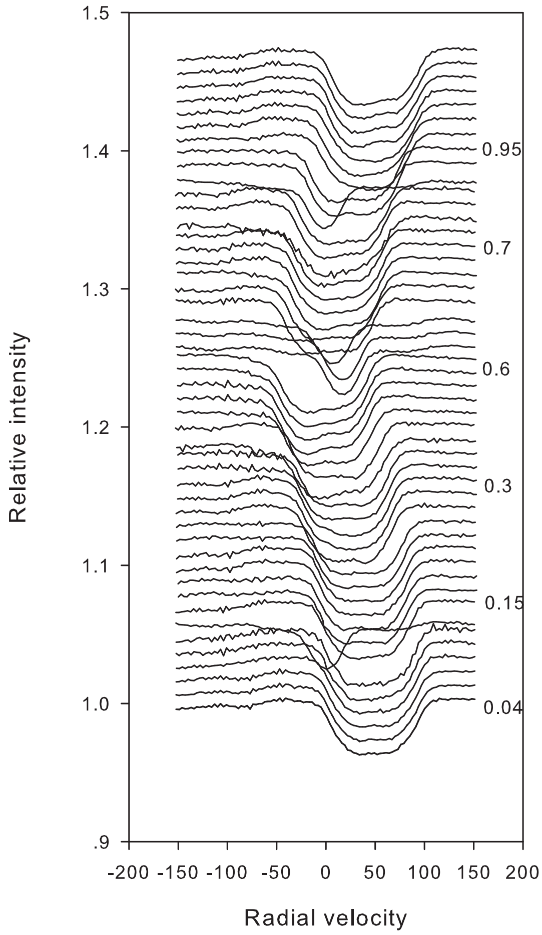


Figure 1. LSD profiles of EI Eri showing the line mean profile variations.

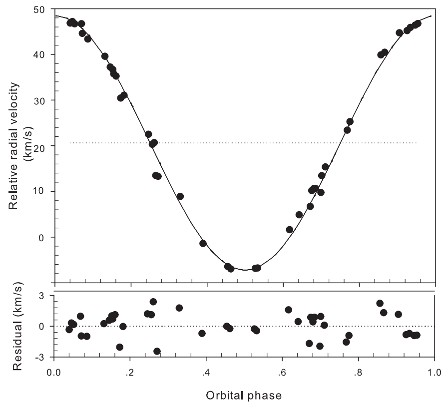


Figure 2. Top panel: Radial velocity of EI Eri. The solid line is calculated from the circular solution. Bottom panel: The residuals from the orbital fit.

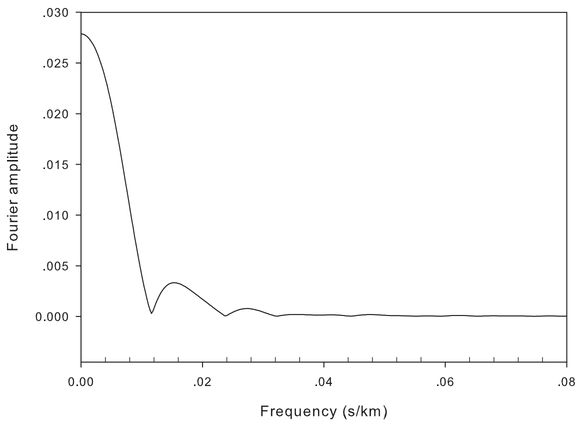


Figure 3. Fourier transform of the broadening function.

## 4. CONCLUSION

We applied the LSD technique to new spectroscopic observations of EI Eri and get spectral line profiles indicating short-lived contrast surface spots. We obtain a new estimation of the projected rotational velocity of EI Eri and new orbital parameters for a circular orbit.

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