Mem. S.A.It. Vol. 7, 128
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Memorie della
Supplementi

Investigation of rotational velocity of ε-Persei

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Abstract. We present here the analysis of spectral line profiles of the Si III triplet at 455.3 nm, 456.8 nm and 457.4 nm of the variable star ε-Persei, and we investigate the vsin(i) value of the star using Fourier transform technique. Since the star is a strong non-radial pulsator, the spectra averaged over several pulsational cycles have been used. The derived average value using all lines is 135±4 km/s.

Key words. Stars: variable – Stars: ε-Persei – Method: Fourier transform

1. Introduction

ε-Persei (HD 24760, HR 1220, HIP 18532) is a BO.V spectral-type star, which belongs to a group of stars with the prominent line-profile variations. The variability could be explained by corotating circumstellar structures above the stellar photosphere (Harmanec 1999) but the observed multiperiodicity can be explained only by non-radial pulsations in the star (Gies et al. 1999).

For the stars with complex atmospheres, as it is our case, the Fourier transform analysis is more appropriate in determination of vsin(i), (because it does not depend on prior knowledge about conditions in stellar atmosphere), thus we used it in this paper for calculation of projected rotational velocity of ε-Persei.

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2. Fourier analysis of the rotational profile

In the wavelength (λ) domain the distribution of the rotationally broadened spectral line-profile can be represented by convolution of flux profile H(λ) for a non-rotating star and a rotational profile G($\Delta\lambda$), as long as H(λ) has the same shape over the disc of the star (Gray 1995). Caroll (1933) noticed that vsin(i) of the star could be obtained from positions of zeros in Fourier transform of line profile. Since the Fourier transform g(σ) of G($\Delta\lambda$) is a Bessell function, g(σ) has zero amplitude at certain Fourier frequencies (σ). The multiplication of g(σ) by the h(σ) may add zeros but will not change the position of the zeros (h(σ) is Fourier transform of H(λ)). The important fact is that G($\Delta\lambda$) is independent of H(λ) and depends only of the value of the limb-darkening coefficient ε.

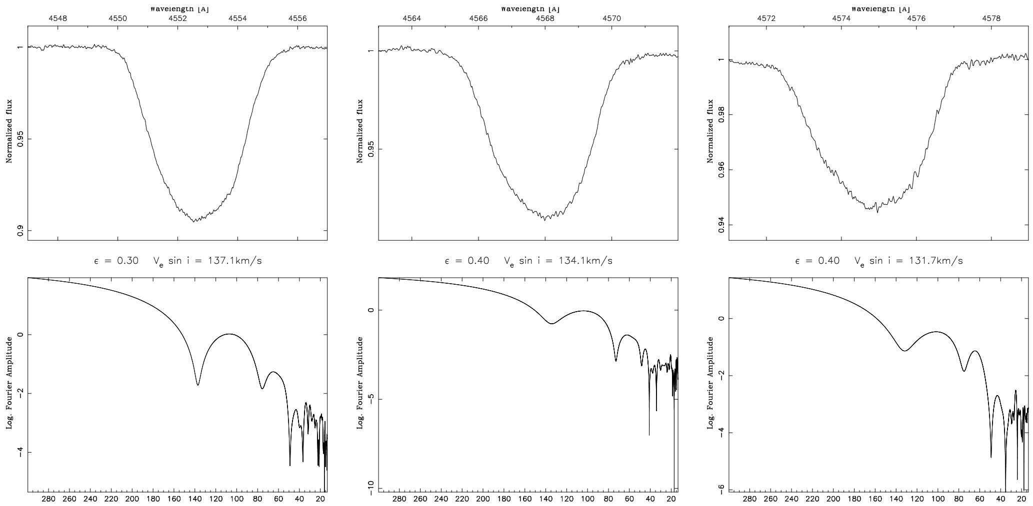

Fig. 1. Flux line profile of the Si III triplet (top) and its Fourier transform (bottom). Left: 455.3 nm line. Middle: 456.8 nm line. Right: 457.4 nm line.

Table 1. Determined values of $v \sin i$ (km/s) for the Si III 455.3nm, 456.8 nm and 457.4 nm using Fourier transform analysis The average value is 135±4 km/s.

Data_obtained_in	$v \sin i$
Si_III_455.3_nm	139.1
Si_III_456.8_nm	131.7
Si_III_457.4_nm	134.1

3. Results

The observations as well as data reduction are described in detail by De Cat et al. (2000). Since the line profile variability of the star is very complex, we use spectra averaged over several pulsational cycles. The first minimum of the Fourier-transformed average spectrum was used to estimate the projected rotational velocity, taking into account limb-darkening coefficient ε=0.4 (Jankov 1995; Jankov et al. 2000). Figure 1. shows the Si III 455.3 nm, 456.8 nm, 457.4 nm triplet and its Fourier transform while Tab. 1. lists the deduced values for the projected rotational velocity of the star.

4. Discussion

Differences between obtained values of rotational velocities for these tree lines can be explained with noise and blended first and second Si III line by shallow absorption lines. Since ε-Persei is rapid rotator, these blends are smeared and difficult to detect, so we can not correct it for these blending effects.

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