Radial and Nonradial Pulsations as Probes of Stellar Physics
ASP Conference Series, Vol. 259, 2002
C. Aerts, T.R. Bedding, & J. Christensen-Dalsgaard, eds.

Line Profile and Photometric Variations of the Be Star η Cen[1]

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Abstract. We review the current status of our monitoring project on Be stars. Line profile variations in HeIλ667.8 nm were detected in the Be star η Cen, by means of high resolution and S/N spectroscopic observations. They were interpreted in terms of nonradial pulsations (NRP). The fundamental parameters of η Cen obtained from BCD spectrophotometric data and interpreted using models of rapidly rotating stars, have been used to estimate the stellar rotational frequency.

1. Introduction

Several authors have analyzed high resolution spectrocopic data of the Be star η Cen (HD 127972, B2.5IVe) that exibits variability in profiles (lpv) and interpreted as NRP (Leister et al., 1994; Janot-Pacheco et al., 1999). The characteristic frequencies for each set of observed spectra have shown a transient behaviour. In this work we have analyzed a new set of spectroscopic data secured in five epochs from March 1995 to May 2000 at the MCT/LNA Observatory in Brazil (S/N = 100 to 300 and R = 60000).

2. Results

Time analysis of lpv patterns was performed using the CLEANEST algorithm (Foster, 1995; Emilio, 1997), which furnished frequencies with high order of significance: 0.61 c d^{-1}, 1.48 c d^{-1} (ℓ = 3), 3.81 c d^{-1} (ℓ = 5), 5.31 c d^{-1} (ℓ = 5), 9.24 c d^{-1} (ℓ = 7) and 10.35 c d^{-1}. If the 10.35 c d^{-1} frequency is considered to be the first harmonic of 5.31 c d^{-1}, the corresponding parameters for ν = 5.31 c d^{-1} are ℓ = 5, $|m|$ = 4. (Telting & Schrijvers, 1997). Time analysis of V/R variations, likely produced by the circumstellar envelope (CE), identifies two frequencies with high significance: 0.6 c d^{-1} and 2.2 c d^{-1}. We suggest that the 0.6 c d^{-1} frequency obtained from lpv and V/R is probably due

[1]The follow-up spectroscopic data were gathered with the 1.60m Telescope of the Observatório do Pico dos Dias MCT/LNA (Brazil)

to the CE. The light curve (HIPPARCOS photometric data from 1990 to 1992) furnished the frequency $\mathbf{f}_{\rm phot} = 1.55$ c d^{-1}.

3. Fundamental parameters of η Cen

η Cen has been observed and analyzed in the BCD system, which keeps to a minimum level the uncertainties due to the perturbing effects of the circumstellar envelope on the determination of the Be star fundamental parameters. As most Be stars rotate at nearly the angular velocity ratio $\Omega/\Omega_{\rm c} \simeq 0.8$, it is expected that the quantities which allow to characterize the stellar photosphere are modified to some degree by the stellar rotation. They are then not only a function of the mass and stellar evolution, but also of $\Omega/\Omega_{\rm c}$ and the aspect angle i. From the observed (λ_1, D) BCD parameters of η Cen we obtained:

$$\log T_{\rm eff}(\Omega, i) = 4.294;\ \log L_{\rm eff}(\Omega, i)/L_{\odot} = 3.630;\ \log g_{\rm eff}(\Omega, i) = 3.83.$$

Assuming that the stellar core is not strongly affected by the rotation, from $V_{\rm e} \sin i = 310$ km s^{-1} and using models of stellar spectra modified by rotation we derived the required parameters to characterize the object as it would have been without rotation. This allowed us to obtain:

$\Omega/\Omega_{\rm c}$	=	0.91	$V_{\rm e}$	=	393 km s^{-1}
M	=	8.3 $M_{\odot}$	$R_{\rm e}(\Omega)$	=	6.0 $R_{\odot}$
i	=	52°	$R_{\rm e}(\Omega = 0)$	=	4.9 $R_{\odot}$

where $V_{\rm e}$ is the equatorial rotational velocity and $R_{\rm e}$ is the equatorial stellar radius. From the above values we derived then the frequency related to the stellar rotation: $\mathbf{f}_{\rm rot} = 1.29$ c d^{-1}, which is 20% smaller than $\mathbf{f}_{\rm phot}$. Although in the series of observations we analysed in the present work this frequency was not found, it has been already observed in a previous study of η Cen (Janot-Pacheco et al., 1999).

4. Conclusions and future work

We will continue our detailed analyses of all the data that we have gathered in the past years. In particular we will search for frequencies in the high quality data sets obtained at the ESO's 1.52m Telescope (La Silla - Chile, April 2000, 2001) from which important information about the internal structure of this star is expected.

References

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https://doi.org/10.1017/S0252921100016183 Published online by Cambridge University Press