Long term variability of the coronal and post - coronal C IV region of the Oe star HD 93521

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ABSTRACT

SACs in the C IV regions of HD 93521

We examine the timescale changes of C IV spectral lines of the Oe star HD 93521, during a period of 16 years, applying the model proposed by Danezis et al. (2003, 2005a, b). We found that the spectral lines consist of one or more Satellite Absorption Components (SACs or DACs) which construct the whole spectral profile. In this paper we present the time scale variation of the rotational and random velocities.

Key words: Oe stars, HD 93521, SACs, best fit, rotational velocity, random velocity

1. Introduction

HD 93521 is a relatively bright, very rapidly rotating O9.5V star with a rotational velocity about 400 km/s (Conti & Ebbets (1977), Hobbs et al. (1982)). These characteristics, together with its exceptionally high Galactic latitude (b=+63.130, Galactic length l =183.30, Costero & Stalio (1984)) have made it a favorite target for studies regarding stars out of the Galactic plane (e.g. Pettini & West (1982); Hobbs et al. (1982); Danly (1989); Spitzer & Fitzpatrick (1992)).

In this paper we apply the model proposed by Danezis et al. (2005) and Nikolaidis et al. (2006) for the outer atmospheres of Oe and Be stars, to the star HD 93521 and we present some first results deriving from this application. This model allows the existence of many absorption shells or many independent density regions, considers that the expanding outer atmosphere consists of some absorbing and an outer emitting shell and concludes to a function for the spectral line able to reproduce the profiles of all the spectral lines with grate accuracy. We calculate the values of parameters which contribute to the line broadening as the apparent rotational and random velocities of the independent regions of matter which produce the main absorption spectral lines of C IV and their satellite components as well as the Full Width at Half Maximum (FWHM). Finally, we present the time- scale changes for the calculated parameters.

2. The Gaussian - Rotational model (GR-model)

For our study the line broadening is only an effect of two reasons: The first is the rotational velocity of the spherical region that produces the spectral line and the second one is the random velocities of the ions, which make thermal random motions. In this model we present a new approach, which describes both of these factors. We consider that the area of gas, which creates a specific spectral line consists of independent absorbing regions followed by independent regions that both absorb and emit and an outer absorbing region. We apply the method proposed by Danezis et al. (2003- 2005) and Nikolaidis et al.(2006) on spectra of the star HD 93521 and we examine the timescale variation of the physical parameters stated below.

3. The study of the coronal and post - coronal C IV region of the moving atmosphere of the Oe star HD 93521

This study is based on the analysis of eleven different spectra of HD 93521 taken with the IUE -satellite (IUE Database http://archive.stsci.edu/iue) and we examine structure of the spectral lines C IV $\lambda\lambda$ 1548.155 , 1550.774 Å.

In Fig. 1 we present a spectral line of C IV region and its best fit. We consider that in each region there are some very small Gaussian thermal motions and other blends, which are present in the spectrum as very small peaks. In the graph below each profile we present the difference between the fit and the real spectral line.

In Figs. 2, 3, 4 and 5 we present the time -scale change of the apparent rotational V_{rot} (km/s), random velocities V_{rand} (km/s), the radial velocities V_{rad} and the Full Width at Half Maximum (FWHM) of the $\lambda\lambda$ 1548.155, 1550.774 Å C IV resonance lines for the independent density regions of matter which create the 5 satellite components.

4. Conclusions

As a first result we detect that the above C IV spectral lines consist of one or more Satellite Absorption Components (SACs or DACs, Danezis et al. (2005)). The ro-

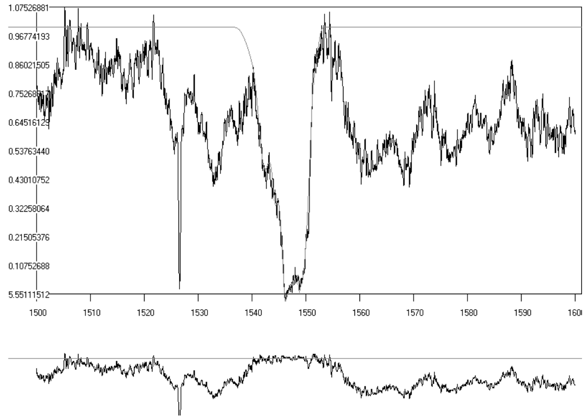

Figure 1: The C IV $\lambda\lambda$ 1548.155, 1550.774 Å resonance lines in the spectrum SWP04472 of HD 93521. Each of C IV spectral lines consists of five SACs.

tational velocities of each of the five regions present a relatively constant behavior, apart from the value in the component in the spectrum SWP54524 (28.4.95), which has been tested carefully. The same phenomenon we can see in the random, in the radial velocities as well as in the FWHM, except of three values in the first component. We point out that the new and important aspect of our study is the values' calculation of the above parameters and their time scale variations, using the DACs or SACs theory. Our results are a successful test of this theory and of Danezis et al. (2003, 2005) and Nikolaidis et al. (2006) proposed

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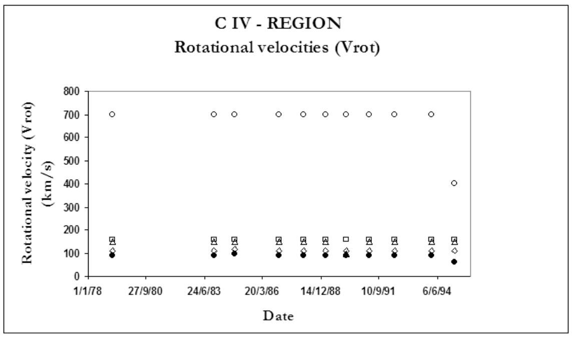

Figure 2: Timescale changes of the apparent rotational velocities V_{rot} (km/s) of the C IV resonance lines ($\lambda\lambda$ 1548.155, 1550.774 Å) for the independent density regions of matter which create the 5 satellite components. The low value (about 400 km/h) in the first component has been tested carefully.

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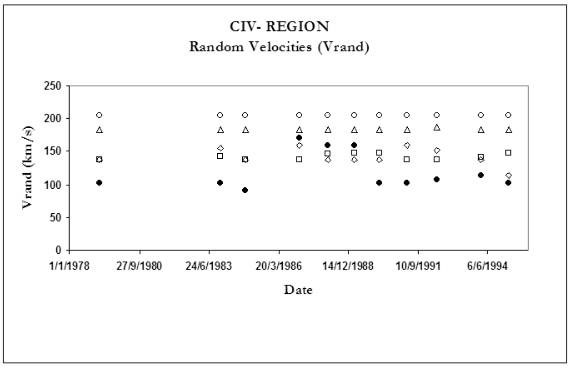

Figure 3: Timescale changes of the Gaussian random velocities V_{rand} (km/s) of the $\lambda\lambda$ 1548.155, 1550.774 Å C IV resonance lines for the independent density regions of matter which create the 5 satellite components

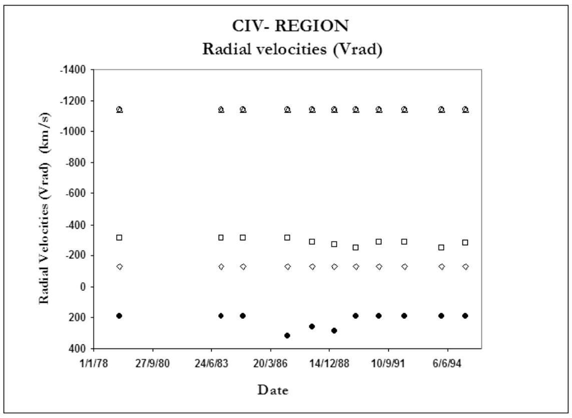

Figure 4: Timescale changes of the radial velocities V_{rad} (km/s) of the $\lambda\lambda$ 1548.155, 1550.774 Å C IV resonance lines for the independent density regions of matter which create the 5 satellite components

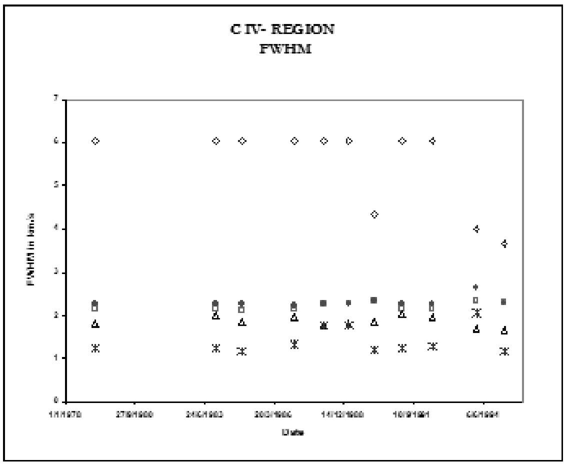

Figure 5: Timescale changes of the Full Width at Half Maximum (FWHM) of the $\lambda\lambda$ 1548.155, 1550.774 Å C IV resonance lines for the independent density regions of matter which create the 5 satellite components