The Photospheric And The Respective C IV Regions' Rotational Velocities In 20 Oe Stars

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Abstract. It is known that some spectral lines of many Oe and Be stars present Discrete Absorption Components (DACs) or Satellite Absorption Components (SACs). Recently, we developed a method to study many parameters of the regions that create this kind of spectral lines. Using this method, we study here the relation between the rotational velocities of the C IV regions of 20 Oe stars and their photospheric rotational velocities.

Keywords: Oe stars, DACs, SACs, rotational velocity, photospheric rotational velocity.
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INTRODUCTION

As it is already known, some of the spectral lines of many Oe and Be stars present Discrete Absorption Components (DACs) which, due to their profiles' width as well as the values of the radial velocities, create a complex profile of the spectral lines [1]. The DACs are not unknown absorption spectral lines, but spectral lines of the same ion and the same wavelength as a main spectral line, shifted at different $\Delta\lambda$, as they are created at different density regions which rotate and move radially with different velocity [2,3].

However, if the regions that give rise to such lines rotate with large velocities and move radially with small velocities, the produced lines have large widths and small shifts. As a result, they are blended among themselves as well as with the main spectral line and thus they are not discrete. In such a case the name Discrete Absorption Components is inappropriate and we use only the name SACs (Satellite Absorption Components). We presented a model able to reproduce the complex profile of DACs or SACs and a method to study many parameters of the regions that create this kind of spectral lines [2,3].

In this paper, using the proposed method [2-5] and, using I.U.E - spectra we study the relation between the rotational velocities of the C IV regions of 20 Oe stars and their photospheric rotational velocities.

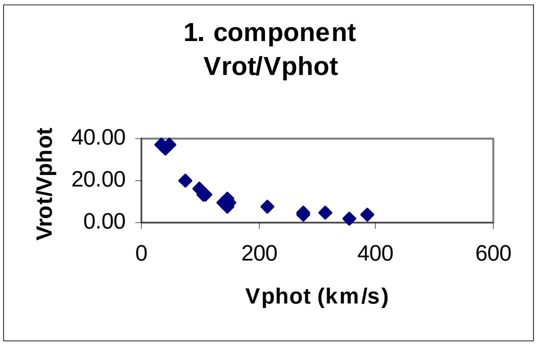
THE GAUSSIAN-ROTATIONAL MODEL (GR-MODEL)

Using GR model [2-5] we can calculate many parameters of the regions that create spectral lines which present DACs or SACs, as the apparent rotational and radial velocities, the Gaussian deviation of the ions' random motions, the random velocities of these motions, as well as the optical depth, the Full Width at Half Maximum (FWHM), the absorbed and the emitted energy and the product of the Source function S and the optical depth ξ of the independent regions of matter, which produce the main line and the discrete or satellites components (DACs, SACs) of the studied spectral lines.

THE RELATION BETWEEN THE PHOTOSPHERIC AND THE RESPECTIVE C IV REGIONS ROTATIONAL VELOCITIES OF 20 Oe STARS

This study is based on the analysis of 20 Oe stellar spectra taken with the IUE – satellite (IUE Database http://archive.stsci.edu/iue). We examine the complex structure of the C IV resonance lines (λλ 1548.155 Å, 1550.774 Å). Our sample includes the subtypes O4 (one star), O6 (four stars), O7 (five stars), O8 (three stars) and O9 (seven stars). The values of the photospheric rotational velocities are taken from the catalogue [6].

In our study we detect that the C IV spectral lines consist of two components in 9 stars, three in 7 stars, four in 3 stars and five in one star. In Figs. 1a, 2a, 3a and 4a we present the ratio V_{rot}/V_{phot} of the first, second, third and fourth detected component as a function of the photospheric rotational velocity (V_{phot}). This ratio indicates how many times the rotational velocity of the specific C IV layer is higher than the apparent rotational velocity of the star. In Figs. 1b, 2b, 3b and 4b we present the respective ions' random velocities (V_{rand}) as a function of the photospheric rotational velocity, where V_{rot} is the rotational velocity of the successive C IV regions that create each of these components.



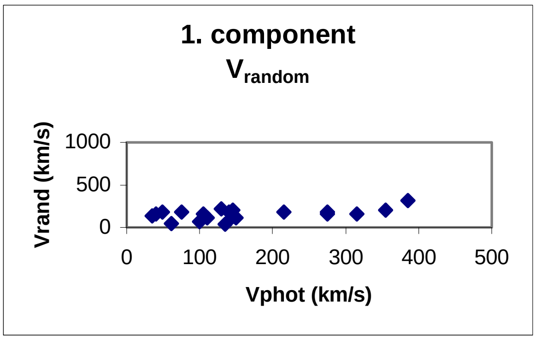


FIGURE 1a, b. The ratio V_{rot}/V_{phot} (left) and the ions' random velocities (right) as a function of the photospheric rotational velocity V_{phot} of the first component in the sample of 20 Oe stars.

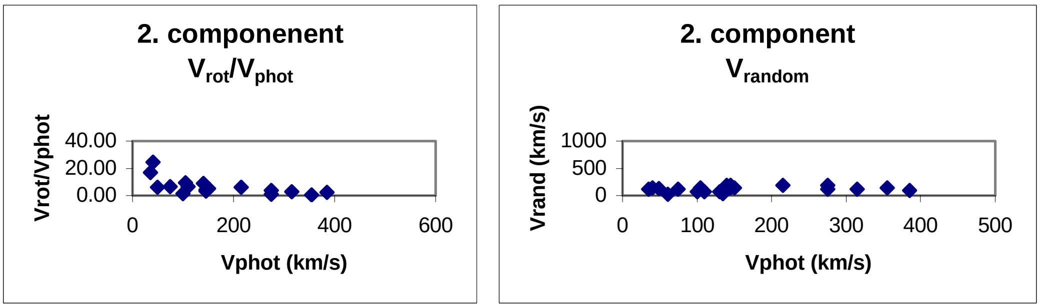


FIGURE 2a, b. The ratio V_{rot}/V_{phot} (left) and the ions' random velocities (right) as a function of the photospheric rotational velocity V_{phot} for the second component in the sample of 20 Oe stars.

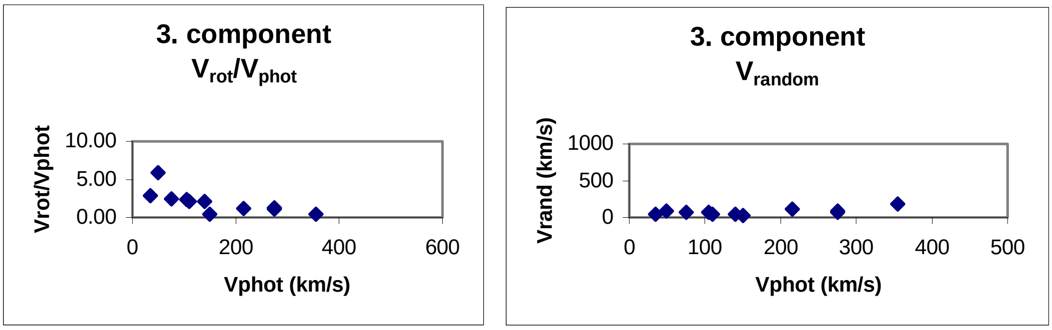


FIGURE 3a, b. The ratio V_{rot}/V_{phot} (left) and the ions' random velocities (right) as a function of the photospheric rotational velocity V_{phot} for the third component in the sample of 20 Oe stars.

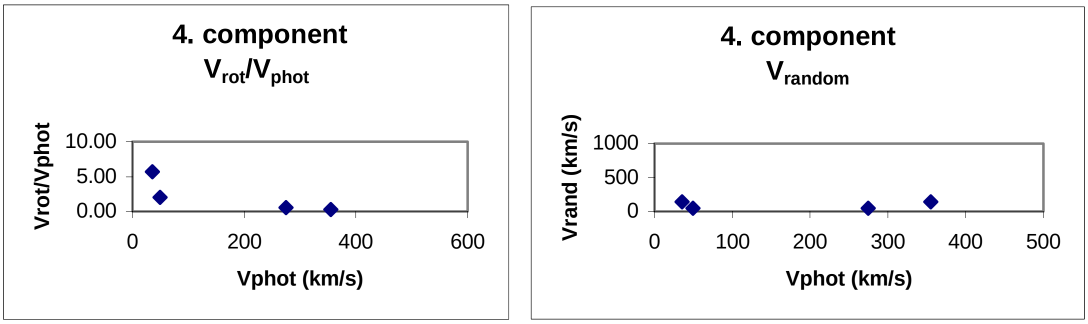


FIGURE 4a, b. The ratio V_{rot}/V_{phot} (left) and the ions' random velocities (right) as a function of the photospheric rotational velocity V_{phot} for the fourth component in the sample of 20 Oe stars.

RESULTS

In each region and for each component we can conclude that there exists a logarithmic relation between the ratio V_{rot}/V_{phot} and the photospheric rotational velocity V_{phot}. The maximum ratio V_{rot}/V_{phot} varies from 40, for the first to 5 for the fourth component (Figs. 1a, 2a, 3a, 4a). A possible explanation of this situation is the inclination of the stellar axis. In order to test the validity of our model we check, for all the studied stars, whether the ion's random velocities of each C IV component, are constant and do not depend on this angle, as it is theoretically expected. Our results confirm this phenomenon, meaning that the mean values of the ions' random velocities are almost constant (Figs. 1b, 2b, 3b, 4b).

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