A Statistical Study of Physical Parameters of the C IV Density Regions in 20 Oe Stars

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Abstract. We detected the presence of Satellite Absorption Components (SACs) which accompany the C IV resonance lines in the spectra of 20 Oe stars of different spectral subtypes, taken with IUE. The values of the apparent rotational and radial velocities, the random velocities of the thermal motions of the ions, as well as the column density and the Full Width at Half Maximum (FWHM) of the independent regions of matter which produce the main and the satellites components of the studied spectral lines were calculated. The variations of these physical parameters are presented as a function of the spectral subtype.

Keywords: stars: Oe, line profiles – absorption components
PACS: 97.10.Ex; 97.10.Fy; 97.20.Ec; 97.30.Eh

INTRODUCTION

It has been discussed previously [1, 2, 3] how some peculiar and complex spectral line profiles in Oe and Be stellar spectra can be explained by the DACs/SACs phenomenon.

Here, we study the C IV UV resonance lines in the spectra of 20 Oe stars of different spectral subtypes, taken with IUE, using the Gauss-Rotation (GR) model [3, 4]. We calculate the values of the apparent rotational and radial velocities, the random velocities of the thermal motions of the ions, as well as the Full Width at Half Maximum (FWHM) and the column density of the independent regions of matter which produce the main and the satellites components of the studied spectral lines. We present the variations of these physical parameters as a function of the spectral subtype.

CP938, *Spectral Line Shapes in Astrophysics—VI Serbian Conference (VI SCSLSA)*
edited by L. Č. Popović and M. S. Dimitrijević
© 2007 American Institute of Physics 978-0-7354-0449-6/07/$23.00

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THE PHYSICAL PARAMETERS IN THE C IV REGIONS OF 20 Oe STARS, AS A FUNCTION OF THE SPECTRAL SUBTYPE

The subtypes O4 (one star), O6 (four stars), O7 (five stars) O8 (three stars) and O9 (seven stars) are present in our sample. We found that the C IV resonance lines consists of two components in 9, three in 7, four in 3 and five in 1 star.

In Fig. 1, we present the C IV doublet of the O9 star HD 34656, and its best fit. The best fit has been obtained with three SACs and one emission component. The graph below the profile indicates the difference between the fit and the observed spectral line. Below the fit we present the decomposition of the observed profile to its SACs.

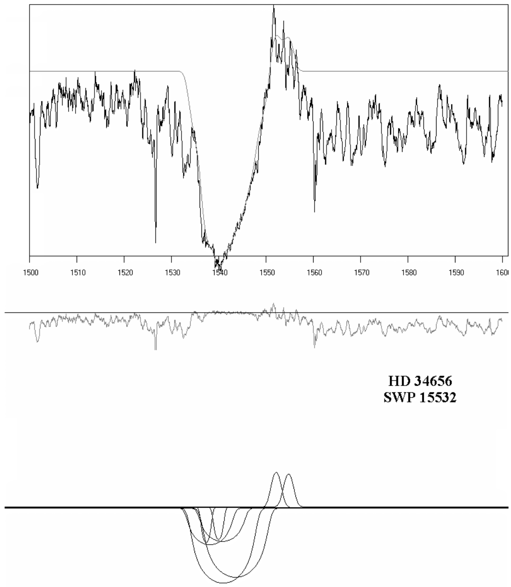

FIGURE 1. The C IV resonance lines (λλ 1548.155, 1550.774 Å) in the spectrum SWP 15532 of HD 34656. Each of C IV spectral lines consists of three SACs and one emission component. The graph below the profile indicates the difference between the fit and the observed spectral line. Below the fit one can see the decomposition of the observed profile to its SACs.

The Apparent Radial and Rotational Velocities

In Fig. 2a,b we present the variation of the mean radial velocities (Fig. 2a) and the mean rotational velocities (Fig. 2b) obtained from the C IV resonance lines (λλ 1548.155, 1550.774 Å) for the independent density regions of matter which create the 2, 3, 4 or 5 SACs as a function of the spectral subtype.

In the C IV regions we detect four groups of radial velocities, with mean values -2066 km/s, -1743 km/s, -1235 km/s -469 km/s and -80 km/s.

We detect the same phenomenon in the case of the rotational velocities with mean values 1458 km/s, 821 km/s, 251 km/s, 133 km/s and 65 km/s.

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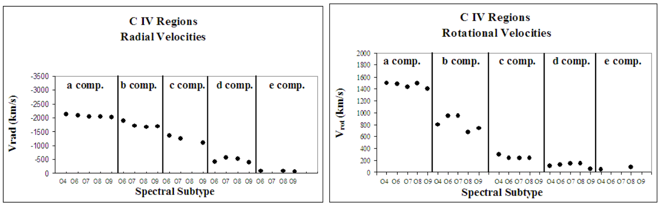

FIGURE 2a,b. The mean radial velocities (left) and the rotational velocities (right) of the independent density regions of matter which create the 2, 3, 4 and 5 SACs of the C IV resonance lines (λλ 1548.155, 1550.774 Å) as a function of the spectral subtype.

The Random Velocities and the Full Width at Half Maximum (FWHM)

In Fig. 3a,b we present the variation of the mean random velocities of the ions (Fig. 3a) and the Full Width at Half Maximum (FWHM) (Fig. 3b) of the 2, 3, 4 and 5 SACs of the C IV resonance lines (λλ 1548.155, 1550.774 Å), as a function of the spectral subtype.

There are also four groups of the random velocities, with mean values 187 km/s, 163 km/s, 130 km/s, 108 km/s and 56 km/s.

For the FWHM we detect the same phenomenon with values 13.0 Å, 6.2 Å, 2.2 Å, 1.2 Å and 0.4 Å.

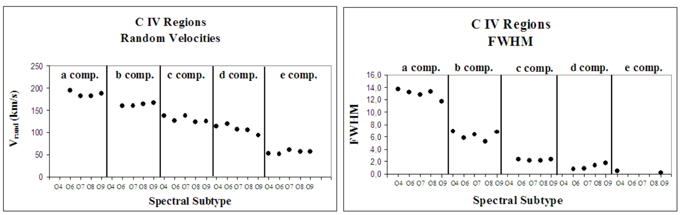

FIGURE 3a, b. The mean random velocities of the ions (left) and the FWHM (right) of the C IV resonance lines (λλ 1548.155, 1550.774 Å) for the independent density regions of matter which create the 2, 3, 4 and 5 SACs as a function of the spectral subtype

The Column Density

In Fig. 4a,b we present the variation of the Column Density (CD) in 10^{10} cm^{-2} for the C IV resonance lines (λ 1548.155 Å in Fig. 4a and λ 1550.774 Å in Fig. 4b), for the independent density regions of matter which create the 2, 3, 4 or 5 satellite components in all the stars of our sample, as a function of the spectral subtype. We detect four groups of the column densities, with values 5.6 $\times 10^{10}$ cm^{-2}, 4.5 $\times 10^{10}$ cm^{-2}, 3.6 $\times 10^{10}$ cm^{-2}, 2.6 $\times$ 10^{10} cm^{-2} and 1.2$\times$ 10^{10} cm^{-2}. We note that each component of both of the resonance lines presents the same variation.

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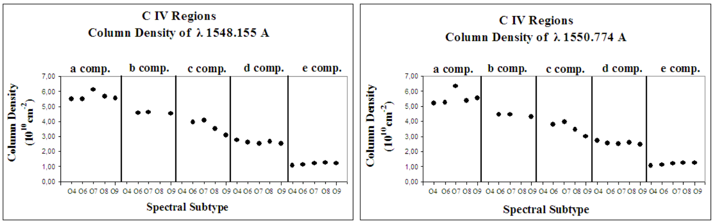

FIGURE 4a, b. The Column Density (CD) in 10^{10} cm^{-2} of the C IV resonance line λ 1548.155 Å (left) and λ 1550.774 Å (right) for the independent density regions of matter which create the 2, 3, 4 or 5 satellite components as a function of the spectral subtype.

CONCLUSIONS

We found that the C IV resonance lines consist of one to five SACs. We detected five groups of values for all the studied parameters. We found that the maximum radial velocity of the C IV regions is -2200 km/s, which is similar with the case of N V (-2400 km/s) [5] and higher than in the case of N IV (-340 km/s) [6]. The rotational velocity maximum value of C IV regions is about 1500 km/s, similar with the N V regions (1800 km/s) [5]. We detected lower maximum values of random velocities (200 km/s) than for the N IV (350 km/s) [6] and N V (430 km/s) [5] regions. The maximum value of the FWHM (14 Å) is similar with the N V (15 Å) [5] and higher than the N IV (5 Å) [6] case. Finally, the maximum value of the column density is similar in all three cases of C IV, N IV [6] and N V [5] regions (5.5×10^{10} cm^{-2}, 4×10^{10} cm^{-2} and 4×10^{10} cm^{-2}, respectively).

ACKNOWLEDGMENTS

This research project is progressing at the University of Athens, Department of Astrophysics - Astronomy and Mechanics, under the financial support of the Special Account for Research Grants, which we thank very much. This work also was supported by Ministry of Science of Serbia, through the projects: Influence of collisional processes on astrophysical plasma line shapes - P146001 and Astrophysical spectroscopy of extragalactic objects - P146002.

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