The N IV Density Regions in the Spectra of 20 Oe Stars

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Abstract. The presence of Satellite Absorption Components (SACs) in the N IV spectral lines of 20 Oe stars of different spectral subtypes were analyzed and the physical parameters which characterize the corresponding N IV density regions were studied. We found that the N IV spectral lines consist of one or two Satellite Absorption Components. We calculate the values of the apparent rotational and radial velocities, the random ion velocities, as well as the Full Width at Half Maximum (FWHM), the absorbed energy and the column density of the independent regions of matter which produce the main and the satellite components of the studied spectral lines. Finally, we present the variations of these physical parameters as a function of the spectral subtype.

Keywords: stars: Oe, line profiles – absorption components
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INTRODUCTION

Some of the peculiar and complex spectral line profiles of Oe and Be stars can be explained by the DACs/SACs phenomenon [1, 2, 3]. Using the Gauss-Rotation (GR) model [3, 4] we study the N IV UV resonance lines in the spectra of 20 Oe stars of different spectral subtypes, taken with International Ultraviolet Explorer (IUE). We calculated the values of the apparent radial velocities, the random velocities of thermal motions of the ions, as well as the Full Width at Half Maximum (FWHM), the absorbed energy and the column density of the independent regions of matter which produce the main and the satellites components of the studied spectral lines. Finally, we present the variations of some of these physical parameters as a function of the spectral subtype.

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

Our sample includes the subtypes O4 (one star), O6 (four stars), O7 (five stars) O8 (three stars) and O9 (seven stars). In our sample we detect that the N IV spectral line consists of two components in 17 stars, and one in 3 stars.

In Fig. 1, we present the N IV doublet of the O9 star HD 24534 and its best fit, obtained with two SACs. 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.

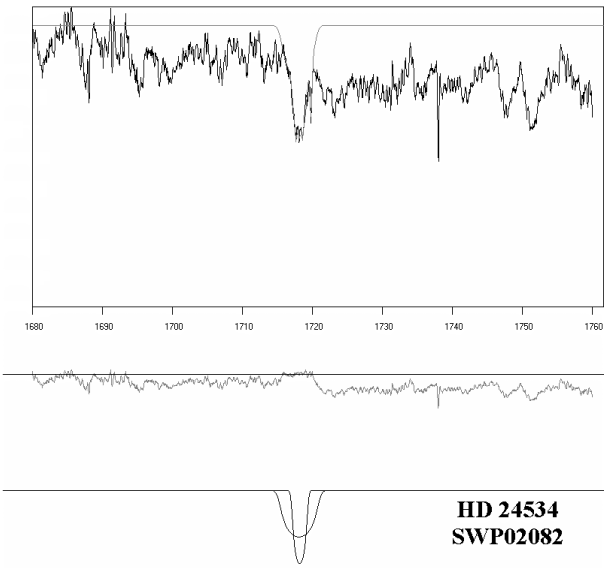

FIGURE 1. The N IV λ 1718.8 Å spectral line in the spectrum SWP 02082 of HD 24534. The N IV spectral line consists in two SACs. Below the fit one can see the decomposition of the observed profile to its SACs.

The Apparent Radial and Random Velocities

In Fig. 2a,b we present the variation of the mean values of the radial velocities (Fig. 2a) and the random velocities of the thermal motions of the ions (Fig. 2b), for the N IV independent density regions of matter (SACs) which create the 1 or 2 satellite components of the N IV spectral line (λ 1718.8 Å), as a function of the spectral subtype.

In the N IV region we detect two groups of radial velocities. The first has values between -350 and -150 km/s and the second about -70 km/s. In the case of the random velocities we detected also two groups: the first has values between 350 and 220 km/s and the second between 150 and 50 km/s.

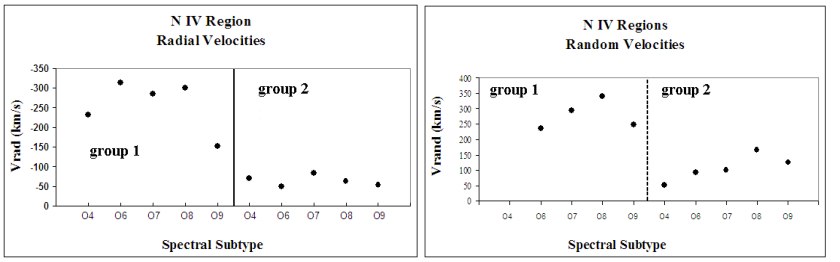

FIGURE 2a,b. The radial velocities (left) and the random ion velocities (right) of the N IV spectral line (λ 1718.8 Å) for the independent density regions of matter which create the 1 or 2 SACs as a function of the spectral subtype.

The Full Width at Half Maximum (FWHM)

In Fig. 3 we present the variation of the Full Width at Half Maximum (FWHM), of the 1 or 2 satellite components of the N IV spectral line (λ 1718.8 Å), as a function of the spectral subtype. We detected two groups of values. The first has values between 5 and 3 Å and the second between 2 and 1 Å.

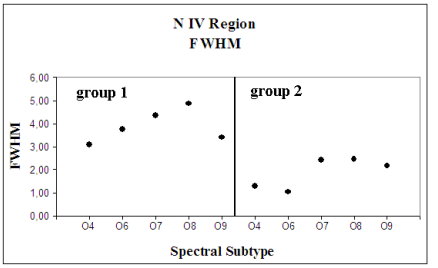

FIGURE 3. The mean value of the Full Width at Half Maximum (FWHM) of the 1 or 2 SACs of the N IV spectral line, as a function of the spectral subtype.

The Absorbed Energy and the Column Density

In Fig. 4a,b we present the variation of the absorbed energy (Ea) in eV (Fig. 4a) and the column density (CD) in 10^{10} cm^{-2} (Fig. 4b) of the N IV independent density regions of matter, which create the 1 or 2 satellite components of the N IV spectral line (λ 1718.8 Å), as a function of the spectral subtype.

We detected two groups of values of the absorbed energy. The first has values between 2 and 1.2 eV and the second between 0.6 and 0.4 eV.

We found the same for the column density. The first group has values between 4.5×10^{10} cm^{-2} and 3×10^{10} cm^{-2} and the second has a constant behavior with values about 2.5×10^{10} cm^{-2}.

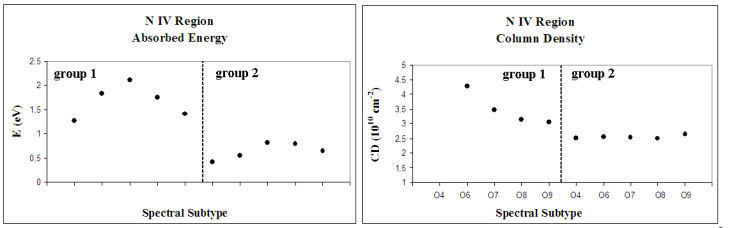

FIGURE 4a, b. The absorbed energy (Ea) in eV (left) and the column density (CD) in cm^{-2} (right) of the N IV spectral line (λ 1718.8 Å) for the independent density regions of matter which create the 1 or 2 satellite components as a function of the spectral subtype.

CONCLUSIONS

We found that the N IV spectral line consists of one or two Satellite Absorption Components. We found that the N IV regions present lower values of radial velocities, FWHM and column density than the C IV [7] and N V [8] regions. In [1, 5, 6] it is noted that there are two mechanisms which create the radial velocities. The first one creates high and the second low radial velocities. We detect the same phenomenon for all of the studied parameters, which present two groups of values. The first has high and the second low values.

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REFERENCES

1. B. Bates, D. R. Halliwell, *Mon. Not. R. Astr. Soc.* **223,** 673 (1986).
2. E. Lyratzi, E. Danezis, *AIP Conf. Proc.* **740**, 458 (2004).
3. E. Danezis, D. Nikolaidis, E. Lyratzi, A. Antoniou, L. Č Popović, M. S. Dimitrijević, *Mem. Soc. It. Suppl.* **7**, 107 (2005).
4. E. Danezis, D. Nikolaidis, E. Lyratzi, L. Č. Popović, M. S. Dimitrijević, A. Antoniou, E. Theodosiou, *PASJ* **59**, in press (2007).
5. M. L. Franco, E. Kontizas, M. Kontizas, R. Stalio, *A&A* **122**, 9 (1983).
6. S. R. Cranmer, S. P. Owocki, *ApJ* **462**, 469 (1996).
7. A. Antoniou, E. Danezis, E. Lyratzi, D. Nikolaidis, L. Č. Popović, M. S. Dimitrijević, "A Statistical Study of Physical Parameters of the C IV Density Regions in 20 Oe Stars", in this volume, (2007).
8. A. Antoniou, E. Danezis, E. Lyratzi, D. Nikolaidis, L. Č. Popović, M. S. Dimitrijević, "Investigation of the Post-Coronal Density Regions of Oe Stars, with the N V UV Resonance Lines" in this volume, (2007).