A New Approach For DACs And SACs Phenomena In The Atmospheres Of Hot Emission Stars

D. Nikolaidis, E. Danzič, E. Lyatra, L. C. Popović, M. S. Dimijtijević, A. Antonius and E. Theodossiou
1 University of Athens, Faculty of Physics, Department of Astrophysics, Astronomy and Mechanics, Panepistimioupoli, Zografou 157 84, Athens - Greece
2 Astronomical Observatory, Volos 311 10 Belgrade, Serbia

Introduction

As it is already known, the spectra of many Oe and Be stars present Discrete Absorption Components (DACs) or/and Absorption Structures (SACs), which are due to their profiles' widths as well as the values of the radial velocities, create a complicated profile of the most spectral lines. This fact is interpreted by the existence of two or more independent layers of matter, in the region where the spectral lines are formed. Such a structure is responsible for the formation of a series of satellite absorption lines, emission lines and general absorption lines respectively. This function has two limits, the absorption coefficient and has no units).

\[
\text{L}(\lambda) = \frac{1}{\chi^2 \lambda^2} \cos \chi \text{ or} \frac{1}{\chi^2 \lambda^2} \sin \chi \text{ (5)}
\]

For each of \( i \) along the spectral line, we extract a \( \Delta \lambda \) from each \( S \). The program we use calculates \( \Delta \lambda \) for the center of the line and \( \Delta \lambda \) from the following integral. So, \( \Delta \lambda = \frac{1}{\Delta \lambda} \int \Omega = \frac{1}{n} \sum_{i=1}^{n} \Delta \lambda \).

If we add the values of all \( \Delta \lambda \) along the spectral line then we have:

\[
\sigma = \frac{1}{\Delta \lambda} \sum_{i=1}^{n} \Delta \lambda = \frac{1}{\Delta \lambda} \sum_{i=1}^{n} \Delta \lambda \text{ (6)}
\]

Testing the model

In order to check the above spectral line function, we calculated the rotational velocity of H\( \beta \) 4387.928 Å absorption line in the spectra of five of the stars, using two methods, the classical Fourier analysis and our model. The results are found to be equal for our model. The rotational velocities, calculated with Fourier analysis, are equal, are a little higher than the values calculated with our method, as it is Fourier analysis the whole broadening of the spectral line is used to represent the rotational velocity.

The example of HD 66811, some first conclusions

The distribution function from the semi-spherical region is:

\[
\frac{1}{2} \sum_{i} \left( \frac{1}{\lambda^2} \cos \phi \right) \text{(7)}
\]

\[
\Delta \lambda = \frac{1}{\chi^2 \lambda^2} \cos \chi \text{ or} \frac{1}{\chi^2 \lambda^2} \sin \chi \text{ (8)}
\]

For each \( i \) along the spectral line, we extract a \( \Delta \lambda \) from each \( S \). The program we use calculates \( \Delta \lambda \) for the center of the line and \( \Delta \lambda \) along the spectral line. This means that if we divide the calculated energy density(\( \Omega^* \)) by the number of the emitting matter, which creates the spectral line. If we divide \( \sigma \) with the atomic weight of the ion which creates the spectral line, we extract the number density of the emitters, meaning the number of the emitters per square centimeter.

This number density corresponds to the energy density which is emitted by the whole matter which creates the spectral line \( \Delta \lambda \) (8) and which is obtained by the model.

This means that if we divide the calculated energy density \( \Omega^* \) by the energy needed for the transition, we obtain the column density (cm\(^{-2}\)).