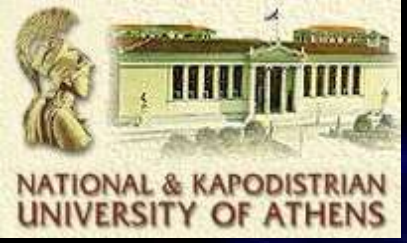

A statistical study of the UV Si IV resonance lines' parameters in 20 Be stars

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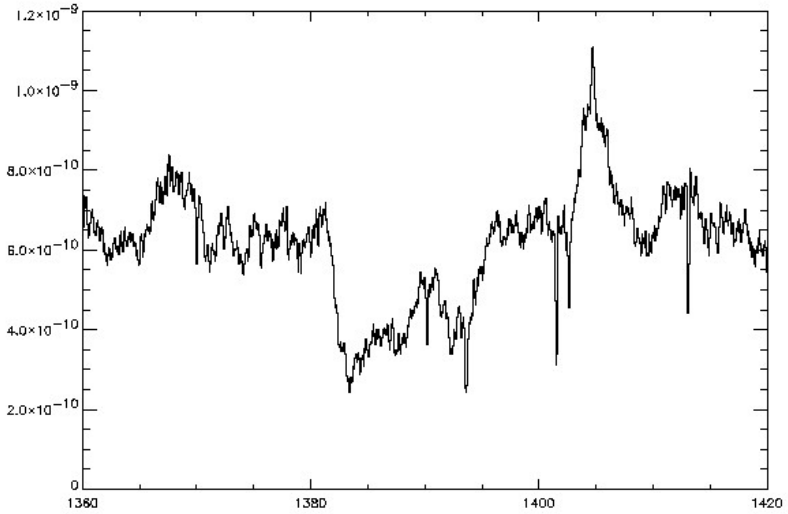
The Si IV resonance lines have a peculiar profile in the Be stellar spectra, which indicates a multicomponent nature of their origin region.



The Si IV $\lambda\lambda$ 1393.755, 1402.778 Å resonance lines in the star HD 203064

Many researchers * have observed the existence of absorption components shifted to the violet or red side of the main spectral line. These components were named Discrete or Satellite Absorption Components **. They probably originate in separate regions that have different rotational and radial velocities. In any case, the whole observed feature of the Si IV resonance lines is not the result of a uniform atmospherical region, but it is constructed by a number of components, which are created in different regions that rotate and move radially with different velocities.

*e.g. Doazan 1982, Danezis et al. 1991, Doazan et al. 1991, Lyratzi et al. 2003, 2007, Danezis et al. 2007

**Bates & Halliwell 1986, Danezis et al. 2003; Lyratzi & Danezis 2004

Our research

Using the GR model (Danezis et al., 2007), we analyze the **UV Si IV λλ 1393.755, 1402.778 Å resonance lines** in the spectra of 20 Be stars of different spectral subtypes (effective temperatures)

Parameters

- apparent rotational **(Vrot)**
- radial velocities **(Vrad)**
- the random velocities of the thermal motions of the ions **(Vrand)**
- Full Width at Half Maximum **(FWHM)**
- optical depth **(ξ)**
- absorbed energy **(Ea)**
- column density **(CD)**

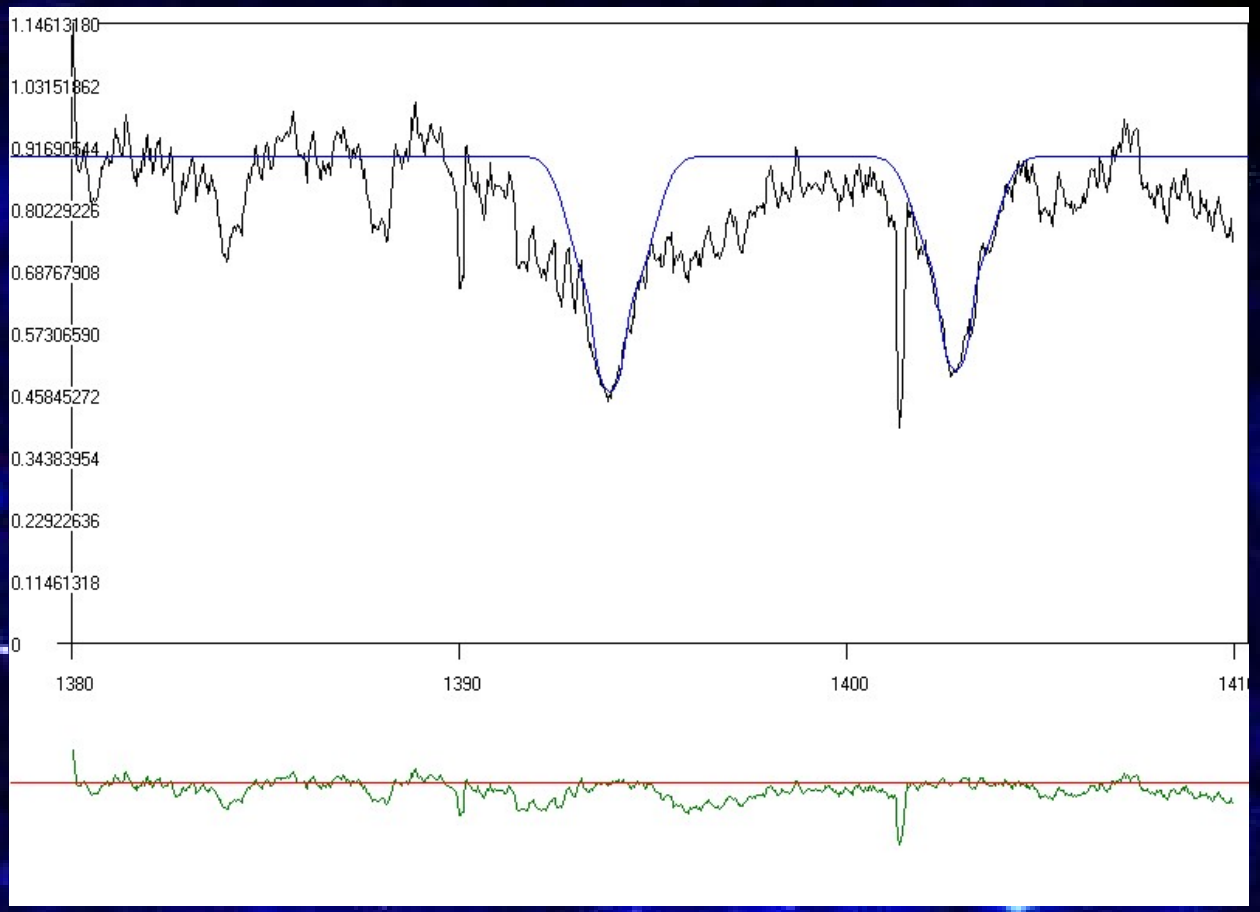
of the independent regions of matter which produce the main and the satellites components of the studied spectral lines.

Our research

- Relations between the above physical parameters and the effective temperature of the studied stars
- Linear trend line
- Coefficient of Determination R^2

The Data

Star	Spectral Subtype
HD 53367	B0 IV e
HD 44458	B1 V pe
HD 58343	B2 N ne
HD 45910	B2 III e
HD 41335	B2 V ne
HD 52721	B2 V ne
HD 37202	B2 IV p
HD 32991	B2 V e
HD 58050	B2 V e
HD 37490	B3 III e
HD 25940	B3 V e
HD 183362	B3 V e
HD 217050	B4 III pe
HD 67888	B4 III pe
HD 89884	B5 III
HD 23480	B6 IV e
HD 192044	B7 V e
HD 29866	B8 IV ne
HD 199218	B8 IV nne
HD 50138	B9



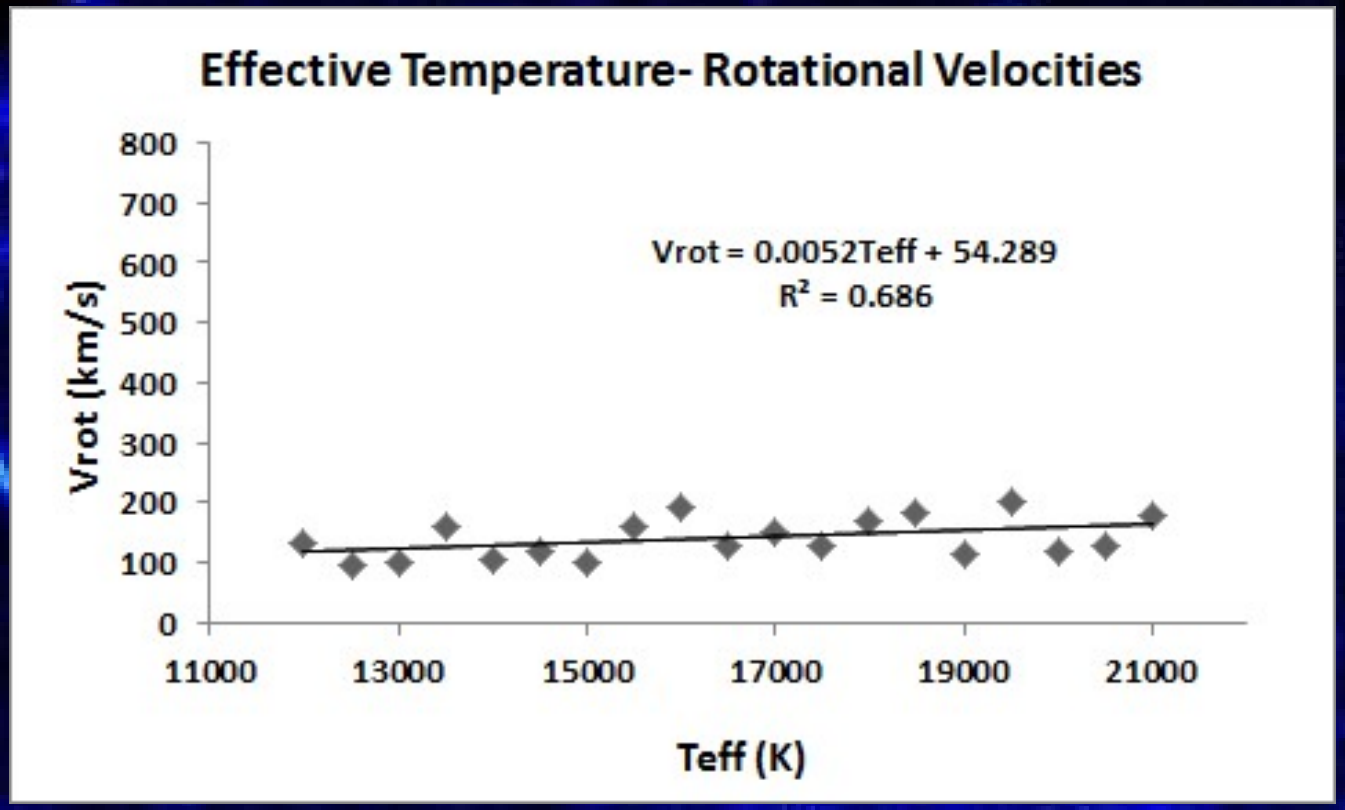
In this figure, we see the Si IV doublet of the B2 Ve star HD 58050 and its best fit. The best fit has been obtained with two absorption components. The graph below the profile indicates the difference between the fit and the real spectral line.

In the following figures we see the variation of the physical parameters of the Si IV regions of 20 Be stars, as a function of the stars' effective temperature (Teff).

In each case we give the linear trend line and the respective linear coefficient of determination R^2.

- $R^2=1$ the linear correlation is ideal
- $R^2>0.5$ the linear correlation is considered as "good"
- $0.3< R^2<0.5$ the linear correlation is considered as "weak".

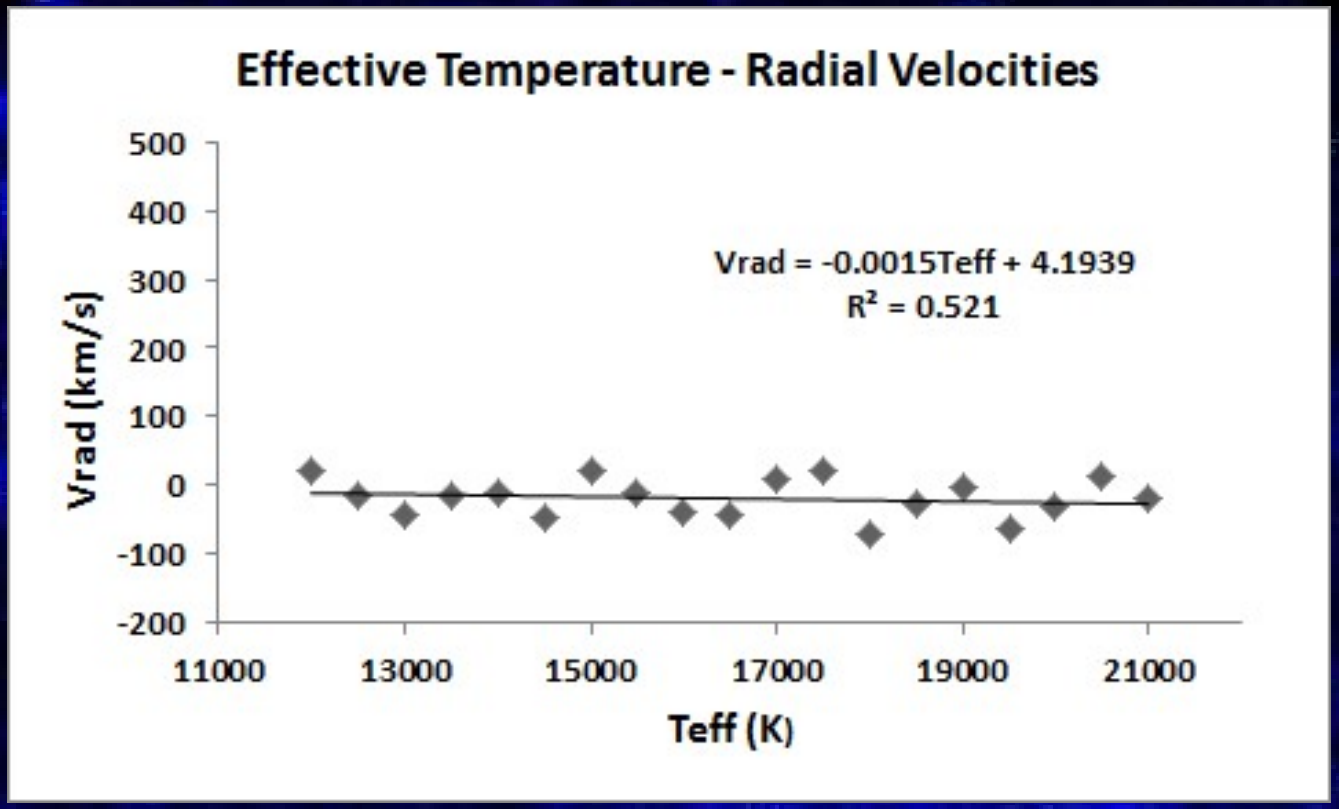
Rotational Velocities (Vrot)



Variation of the rotational velocities of the Si IV resonance lines ($\lambda\lambda$ 1393.755, 1402.778 Å) for the independent density regions of matter which create the absorption components, as a function of the effective temperature.

We see a slightly increasing linear trend of the rotational velocities and a "good" linear correlation (R^2=0.686)

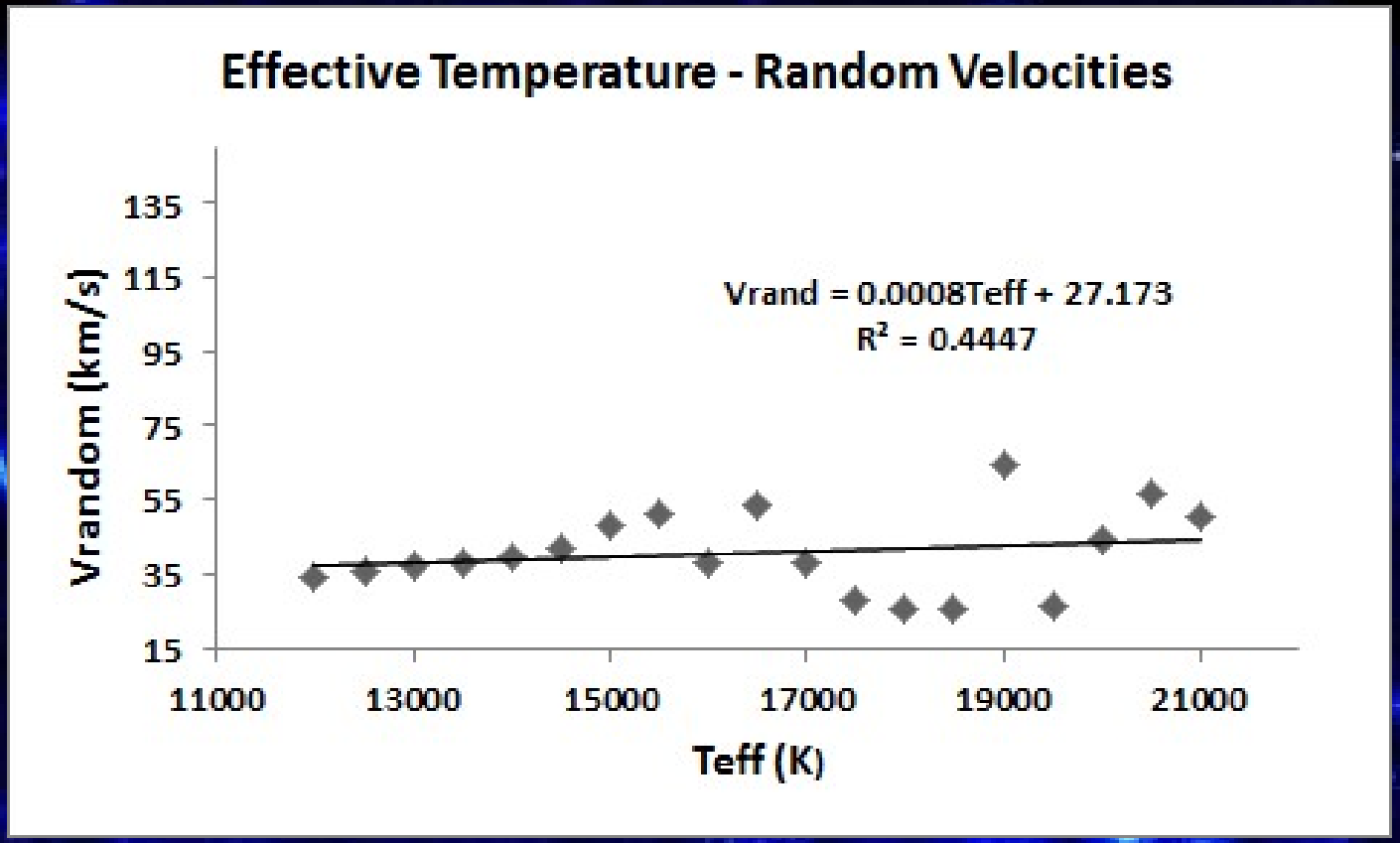
Radial Velocities (Vrad)



Variation of the radial velocities of the Si IV resonance lines ($\lambda\lambda$ 1393.755, 1402.778 Å) for the independent density regions of matter which create the absorption components, as a function of the effective temperature.

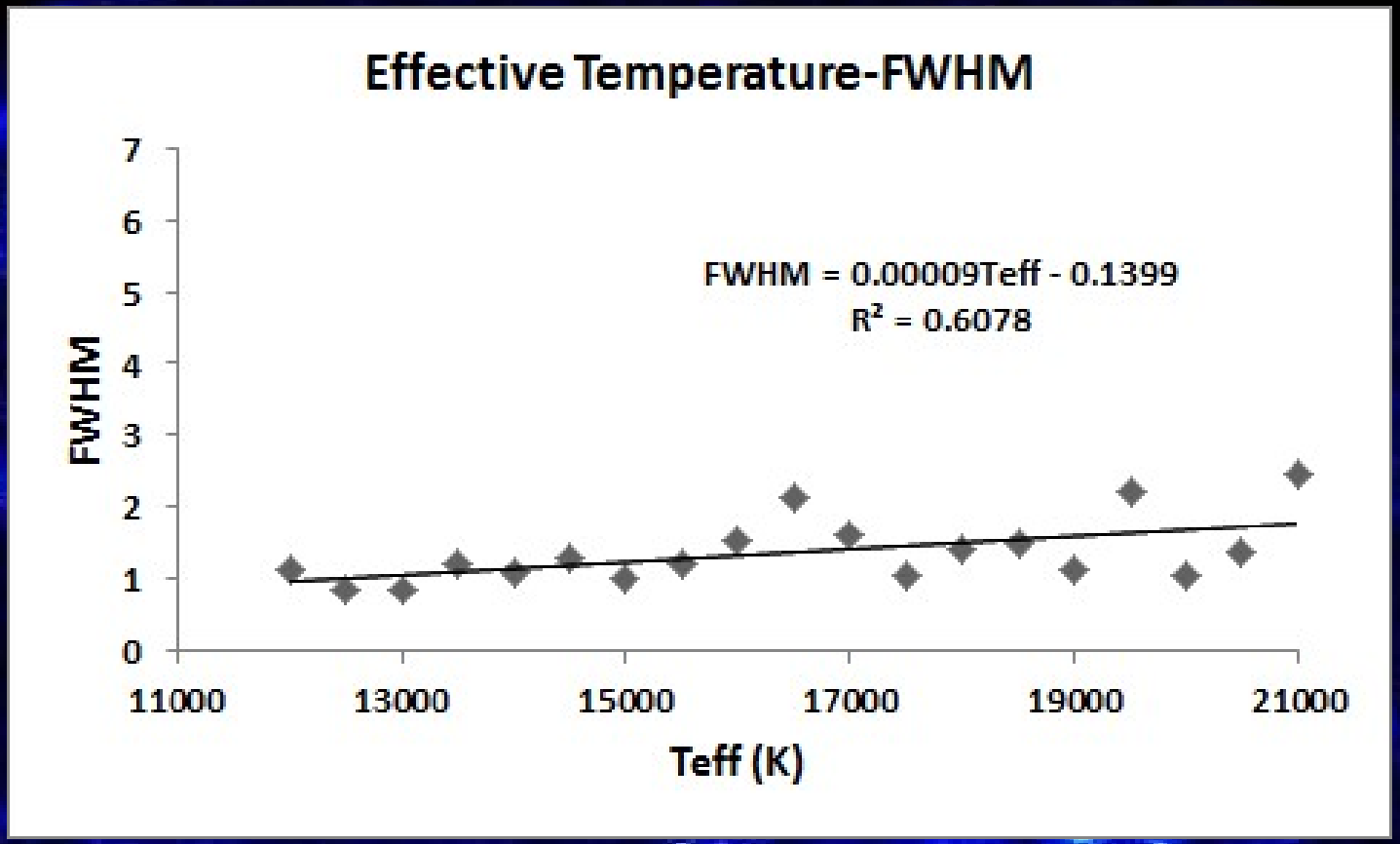
We have also found a very slightly negative slope and a "good" linear correlation (R^2=0.521)

Random Velocities (Vrand)



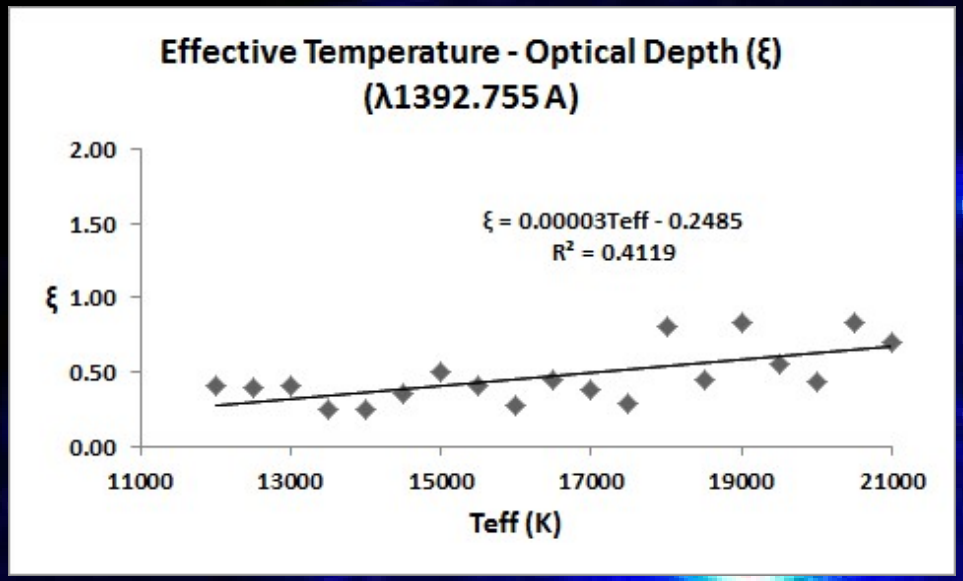
Variation of the random velocities of the ions of the Si IV resonance lines ($\lambda\lambda$ 1393.755, 1402.778 Å) for the independent density regions of matter which create the absorption components, as a function of the effective temperature.
We detected almost the same increasing trend of the random velocities as in the case of rotational velocities and a "weak" linear correlation (R^2=0.4447)

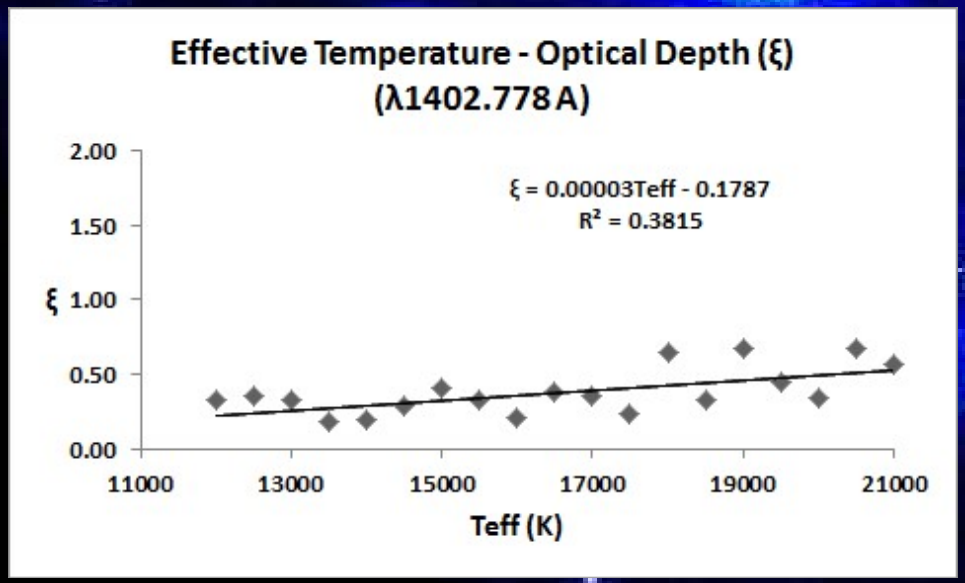
Full Width at Half Maximum (FWHM)



The variation of the FWHM is the same as the variation of the rotational and random velocities. This is expected because the FWHM is a parameter which indicates the line broadening and the rotational and random velocities are parameters which contribute to this situation. The linear correlation is "good" (R^2=0.6078).

Optical Depth (ξ)

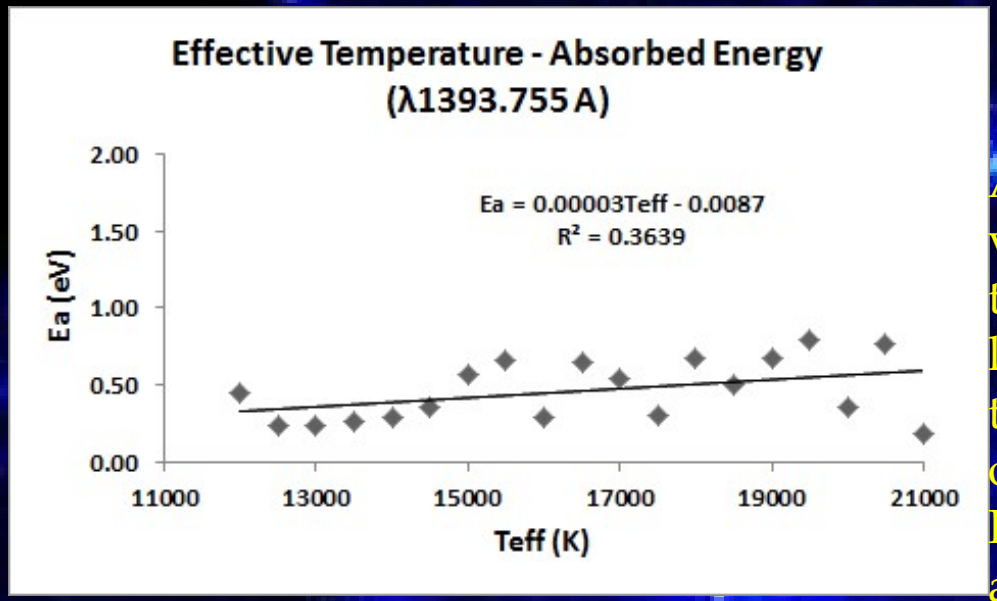


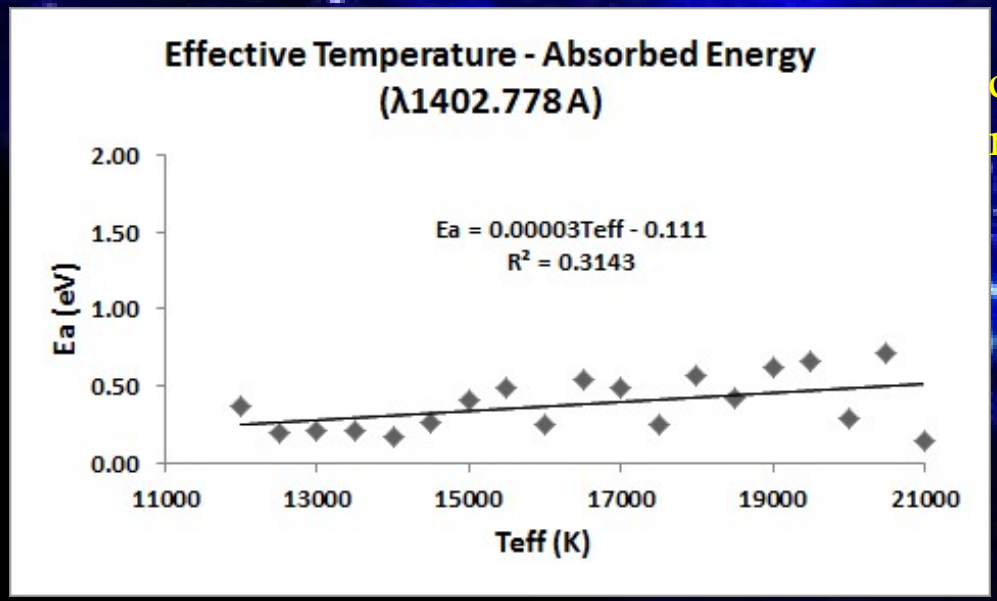


The variation of the optical depth (ξ) is the same in both of the Si IV resonance lines. The optical depth's values in the Si IV λ 1402.772 Å spectral line is 0.8 of the optical depth's values in the Si IV λ 1392.755 Å one. This in in agreement with the atomic theory.

The linear correlation in each case is "weak" (R^2=0.4119 and R^2=0.3815 respectively)

Absorbed Energy (Ea)

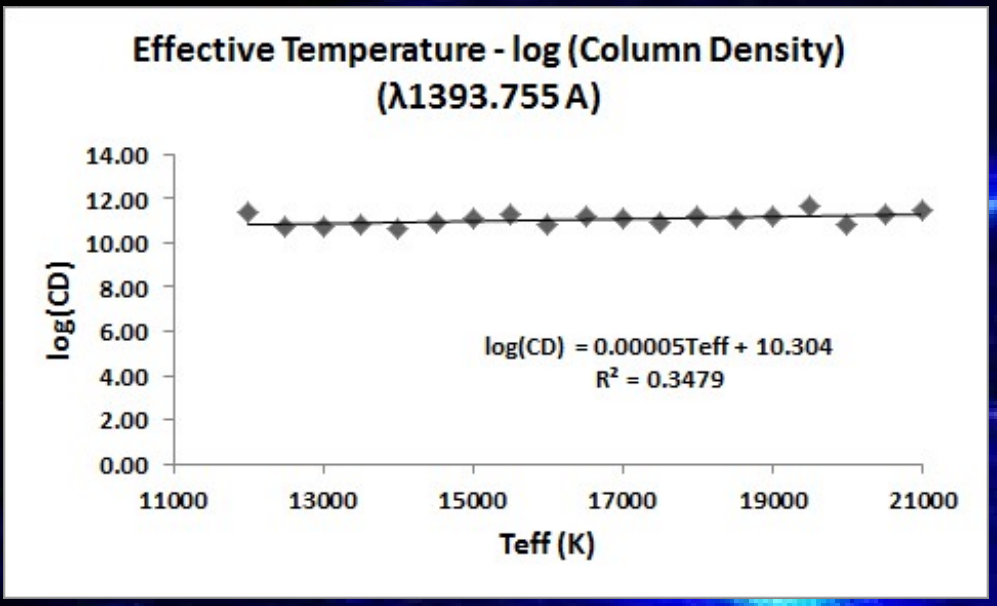


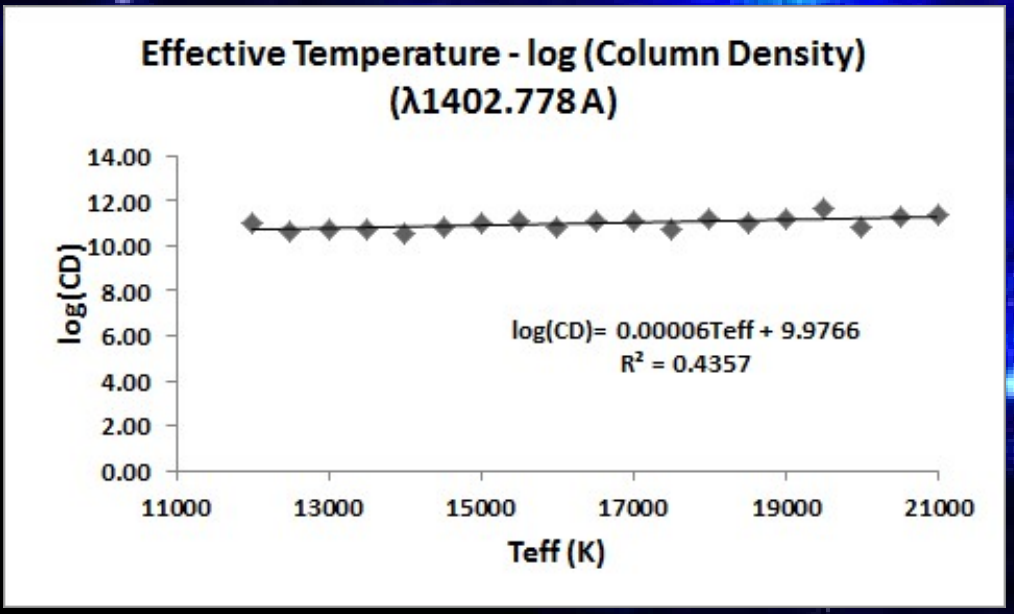


As in the case of the optical depth, the variation of the absorbed energy (Ea) is the same in both of the Si IV resonance line and the absorbed energy's values in the Si IV λ 1402.772 Å spectral line is 0.8 of the absorbed energy's values in the Si IV λ 1392.755 Å one. This in in agreement with the atomic theory.

As before, the linear correlation in each case is "weak" (R^2=0.3639 and R^2=0.3143 respectively)

Column Density (CD)

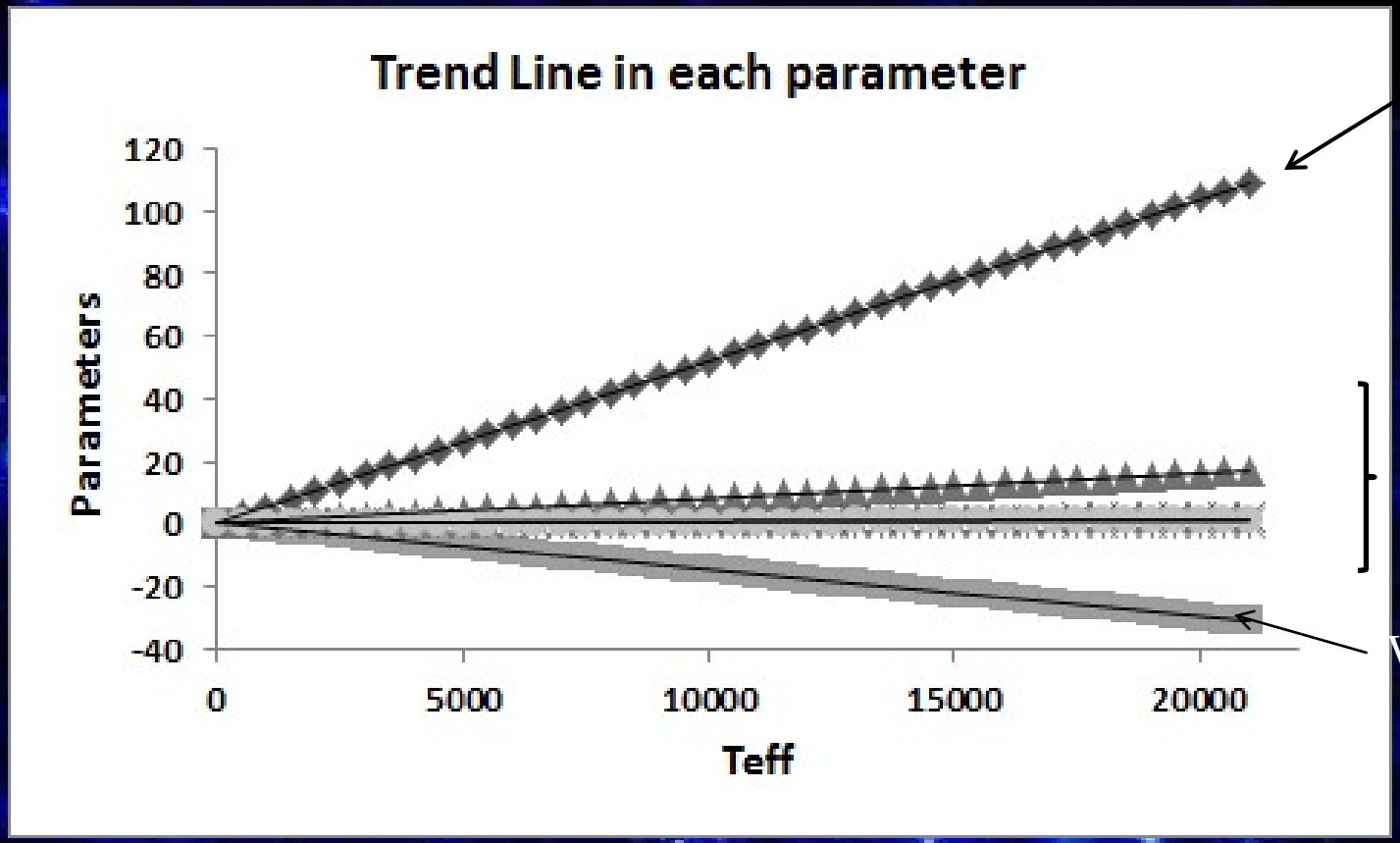




The variation of the column density of the Si IV resonance lines ($\lambda\lambda$ 1393.755, 1402.778 Å) remains almost constant between 10^{11} and 10^{12} cm^{-2}.

The linear correlation is "weak" (R^2=0.3479 and R^2=0.4357 respectively)

Trend Line in all of the parameters



Finally, in this figure, we see the trend lines of all of the parameters in the same diagram. The parameters Vrand, FHHM, Ea, CD present a very slightly slope.

Discussion

- The values of all of the calculated parameters are in agreement with the physical theory
- In most of the calculated parameters the linear correlation is stronger in the stars with lower effective temperature. This means that in Be stars with low effective temperatures, if we know the star's effective temperature, we could estimate the above mentioned parameters.
- It must be confirmed by a greater sample of Be stars.


Thank you very much for your attention