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# NEW RESULTS OF THE ANALYSIS OF SOME SPECTRA FROM THE AMATEUR SCIENTIFIC PROGRAMME OF AMATEUR OBSERVERS AT THE BERNARD LYOT TELESCOPE - OATBL

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**Abstract.** Since 2016, OATBLs are there to fill in for the statutory observers if the schedule cannot be filled. Since 2018, the amateur program focuses on the study of high metallic stars. Some tools and programs are made by members to process the data (Lekic 2019). In September 2019, the Narval instrument, which was coupled to the TBL, has been replaced by its successor: Neo-Narval. This instrument provides radial velocity stabilisation (velocimetry) $\leq$ 3 m/s of the Narval/TBL spectrograph. In 2020 and 2021, an inter-school project has been set up to work on the OATBL data (Lekic et al. 2021). Here we present the following results from 2021-2022.

## 1 Characteristics of the high metallicity stars in our programme

The OATBL has been actively working for three years now on the analysis of the spectra obtained with Narval and Neo Narval since its installation and start-up. The OATBL amateur science programme consists of 36 spectra, some of which were obtained with Neo-Narval. In the sample of observed and processed stars, we notice a large proportion in the constellation of the great bear, the giraffe and the swan. Most of our stars are located in circum-polar constellations, which facilitates their observation. We notice that most of our observed stars are O or A spectral type stars for more than 83%. So most of these stars are very hot O-types $\geq$ 25 000 Kelvins and A-types between 7 500 and 10 000 Kelvins. The Doppler-Fizeau effect allows us to determine the Blueshift or Redshift of our stars and thus to know the motion relative to the observer of the star. We arrive at a result of 13 Blueshift, 14 Redshift and 9 undetermined cases because the result of $f$ is not important enough to know if the quality of the images does not give us a wrong result. When processing our stars to study the $H_\alpha$ line, we use mathematical models in MagicPlot either Gaussian, Lorentzian or Voigt profiles (a combination of both). These profiles are interesting because they allow us to know if the star has a high surface pressure or not.
- Gauss: high surface pressure
- Lorentz: low surface pressure
- Voigt: medium surface pressure

These profiles will give us information about the width at half height of $H_\alpha$ which will allow us to find the effective temperature.

## 2 Focus on $\beta$ Herculis

Beta Herculis is part of the constellation Hercules and is a constituent of a binary system. It is 9 billion years old on the main sequence with a temperature of 6000 K. Its spectrum shows weak hydrogen lines and stronger iron lines. The spectrum shows that it is a semi-detached binary system, with significant matter exchange. Following a second observation, we can see that a disc of debris orbits the star. However, in theory, these discs of matter are not supposed to be present since they are the result of asteroid impacts. As a result, the matter is subsequently ejected, so it is possible to hypothesise a permanent creation of matter.

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We wanted to understand this enigma: could the high metallicity of the star be linked to the presence of this disc of matter, even though the star does not seem to have any exoplanets in its orbit? We then try to see if the star's metallicity distribution is the same as another. We therefore calculated the effective temperature of the star, otherwise known as the surface temperature. From this we can deduce the radius of the star and arrive at the surface gravity of the star. Our results then allowed us to make an initial assessment and, in particular, to compare with the literature.

This first assessment showed us a star with a size 1/3 larger than the sun, with a log(g) of 4.16 which is very close to the value expected in the literature. However, the radius of the star is larger than expected by about 1.1 times that of the sun. For this star, the difference in Iron II abundance between the star and the sun did not allow us to really rule on the metallicity. Indeed, we are not able to say whether this figure is consistent or not, as we have no access to professional data. This is why the dialogue with the professionals has started again.

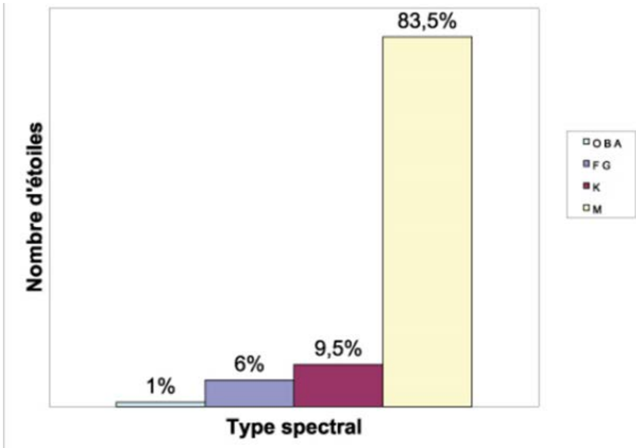


**Fig. 1.** Number of stars according to the spectral type

| Modèle | Gauss | Lorentz | Voigt |
|---|---|---|---|
| Fonction | $G(x) = e^{-\frac{x^2}{b^2}}$ | $L(x) = \frac{1}{1+x^2}$ | $\int_{-\infty}^{+\infty} \frac{e^{at^2}}{b+(x-t)^2} dt$ |
| Profil sur MagicPlot | $G(x) = a * e^{--\frac{\ln 2*(x-x_0)^2}{d_x^2}}$ | $L(x) = \frac{a}{1+\frac{(x-x_0)^2}{d_x^2}}$ | Association Gauss + Lorentz |

**Fig. 2.** Model equations

## 3 Conclusion

OATBL wants to continue its meticulous spectroscopic study in order to know: Is there a correlation between metallicity and the parameter of this line? What about the magnetic field strength? Is there a link between metallicity and magnetic field strength? Do these stars have exoplanets around them? Is there a link between metallicity and the existence of exoplanets taking into account an average magnetic field strength? These are fascinating questions that the OATBL and all the members who are involved in the analysis of these spectra, in close collaboration with the OMP astronomers, would like to answer.

## References

Lekic, A. 2019, in SF2A-2019: Proceedings of the Annual meeting of the French Society of Astronomy and Astrophysics, ed. P. Di Matteo, O. Creevey, A. Crida, G. Kordopatis, J. Malzac, J. B. Marquette, M. N'Diaye, & O. Venot, 467–469

Lekic, A., Barussaud, Q., Fayet, O., et al. 2021, in SF2A-2021: Proceedings of the Annual meeting of the French Society of Astronomy and Astrophysics, ed. A. Siebert, K. Baillié, E. Lagadec, N. Lagarde, J. Malzac, J. B. Marquette, M. N'Diaye, J. Richard, & O. Venot, 302–303