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P. Di Matteo, F. Billebaud, F. Herpin, N. Lagarde, J.-B. Marquette, A. Robin, O. Venot (eds)

GAIA-ESO SURVEY: HOT STARS IN CARINA NEBULA

A. Blazère[1] and E. Goset[1,]

Abstract.
In frame of Gaia-ESO survey, we have determined the fundamental parameters of a large number of hot stars (O and B type stars) in clusters situated in the Carina Nebula. The determination of the stellar parameters is based on medium and high resolution spectra obtained with FLAMES at ESO-VLT. We presented here the method used to determine the stellar parameters.

Keywords: massive stars, gaia-eso survey

1 Introduction

1.1 Gaia Eso Survey

Gaia-ESO Survey (GES) is a large spectroscopic survey, leading by G. Gilmore and S. Randich and including more than 300 Co-Investigators over 90 countries (Gilmore et al. 2012). The data are collected with FLAMES instrument at ESO-VLT, using both GIRAFFE and UVES spectrograph. It will require 300 nights, spread over 5 years. Around 10^5 spectra have been taken with Giraffe and 10^4 with UVES between 2012 and 2017. The observations covered all components of the Milky Way (thin disk, halo, bulge,...).

The main goal of the GES is to study the formation and evolution of the Milky Way and its stellar populations. Combined with the observation of Gaia mission, GES will revolutionise knowledge of Galactic and stellar evolution by quantifying the formation history and evolution of different Galactic populations. The data of GES was collected with the Fibre Large Array Multi Element Spectrograph (FLAMES) installed at the VLT. The analysis of these spectra will allow to quantify individual elemental abundances, stellar parameters and precise radial velocities for each stars. Thanks to the collected spectra, we will map kinematic gradients and abundance structure throughout the Galaxy and we will follow the formation and evolution of clusters. The GES will provide a legacy dataset that adds enormous value to the Gaia mission and ongoing ESO imaging surveys (see Fig. 1).

1.2 Hot stars in GES

Our specific interest is in the O and B-type stars in clusters. Studying these stars could address some scientific issues. Thanks to the stellar parameters determination, we will compare the position of the stars in the Hertzsprung-Russell diagram with theoretical evolutionary tracks and isochrones. This will test and improve stellar evolution modelling. We could also constrain the upper part of the Initial Mass Function (IMF). The mass-loss rate will be determined, for those stars where the Hα emission is strong enough, and bring some clues about the clumping issue of the driving winds. Further analysis will also lead to the determination of chemical abundances. A huge amount of high-resolution spectra will allow a much more accurate stellar age determination, and thus will separate the mass and age effects.

[1] Institut d'Astrophysique et de Géophysique, Université de Liège, Quartier Agora (B5c), Allée du 6 août 19c, 4000 Sart Tilman, Liège, Belgium

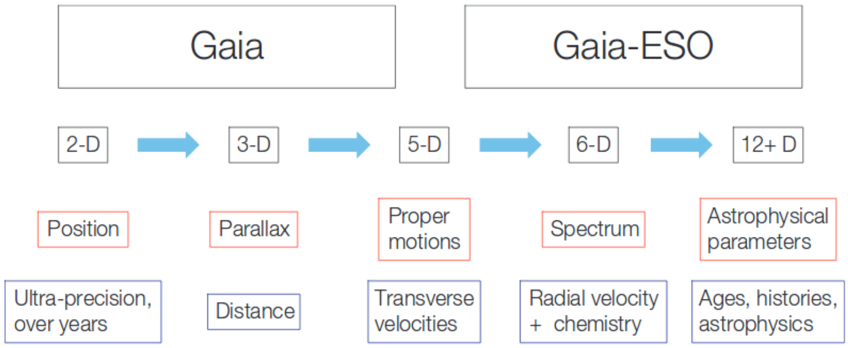

Fig. 1. Diagrammatic representation of the outputs of the Gaia and Gaia-ESO surveys, showing how they are complementary (Gilmore et al. 2012)

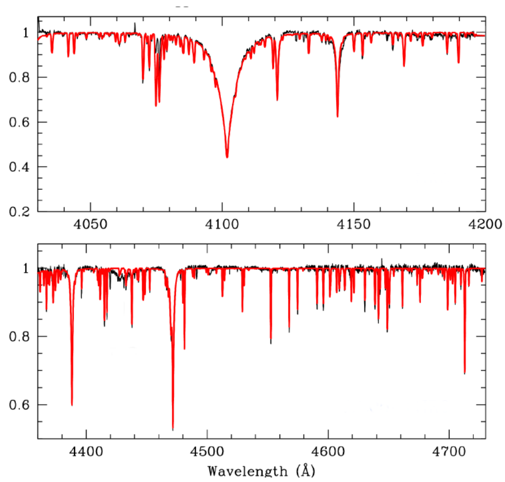

Fig. 2. The wavelength domains of GIRAFFE and UVES (in grey) used for the hot stars

2 Observations

The Carina Nebula is one of the most massive HII regions known in the Galaxy, situated at $\sim$ 2.3 Kpc (Davidson & Humphreys 1997; Smith 2006). It contains a large population of massive OB stars. Different age clusters (between 2 and 15 Myr) are embedded in the Nebula, we analyse the data of two of them: NGC3293 and Trumpler 14.

For the hot stars, 5 grating setups of GIRAFFE were used : HR3, HR4,HR5A, HR6, and HR14A, that cover wavelength domain between 4030-4750 $\mathring{A}$ and 6300-6700 $\mathring{A}$, with a mean resolving power of 20000. These domains include several strong helium lines that are very useful for the determination of the fundamental parameters of hot stars (see Fig. 2). They also include lines of several element like HeI, SiII, SiIII, CII and OII lines. Besides the Giraffe gratings, for some stars, we have also taken data with UVES spectrograph with the 520 nm setting with a resolution of 47000.

2.1 Data Analysis

The fundamental parameters (effective temperature, surface gravity and v_{sini}) and the radial velocities of the hot stars are obtained using the python code that we have developed. This program computed the stellar parameters by determining the best fit of the observed normalised spectra with a grid of synthetic spectra computed with the atmospheric code TLUSTY (Hubeny 1988) for the B stars and with the radiative code CMFGEN (Hillier & Miller 1998) for the O stars. The determination of the stellar parameters is performed over the whole wavelength domain of 4030-4750 $\mathring{A}$, excluding the interstellar bands and the emission components. For the B stars, we computed three different grids of synthetic spectra for 2, 5 and 10 km.s^{-1}. This allows us

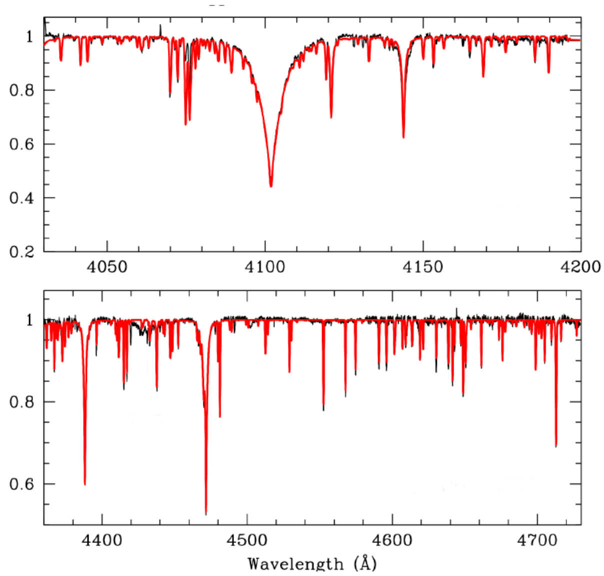

Fig. 3. Fit of an observed spectrum (in black) by a synthetic spectrum (in red)

to determine the best microturbulence velocity for each star. A precise microturbulence is required to have a better determination of the chemical abundances. An example of the observed spectrum fitted by a synthetic spectrum is shown in Fig. 3.

3 Conclusions

The Gaia-ESO survey is a challenging project that will improve our knowledge about the formation and evolution of the Milky Way. The hot stars of this project will lead to interesting results in stellar physics and will help us to have a better understanding about the process that occurs inside and in the vicinity of these stars.

References

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