Massive stars in the Gaia-ESO Survey

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The Gaia-ESO Survey (GES)

The Gaia-ESO Survey (GES) is a public spectroscopic survey, targeting more than 100 000 stars. Its main goal is to study the formation and evolution of the Milky Way and its stellar populations. This includes determining the substructure of the halo, the nature of the bulge, studying the formation of the thick and thin disks, as well as the dynamical and stellar evolution of open clusters.

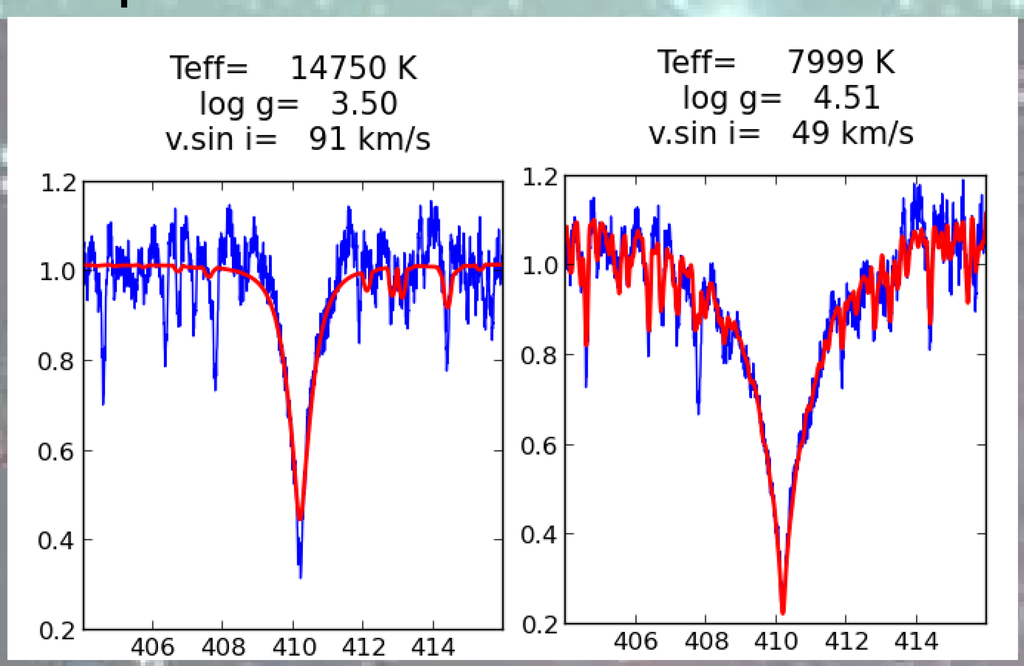
The survey is led by Gerry Gilmore and Sofia Randich and includes more than 300 Co-Investigators. Since the beginning of 2012, it has been using the VLT FLAMES instrument with both the Giraffe and UVES fibres. The observations will take 300 nights, spread over 5 years.

As part of the survey, about 60 old clusters (> 100 Myr) will be studied and 40 young clusters. Among those young clusters, 13 were chosen specifically for their massive-star content.

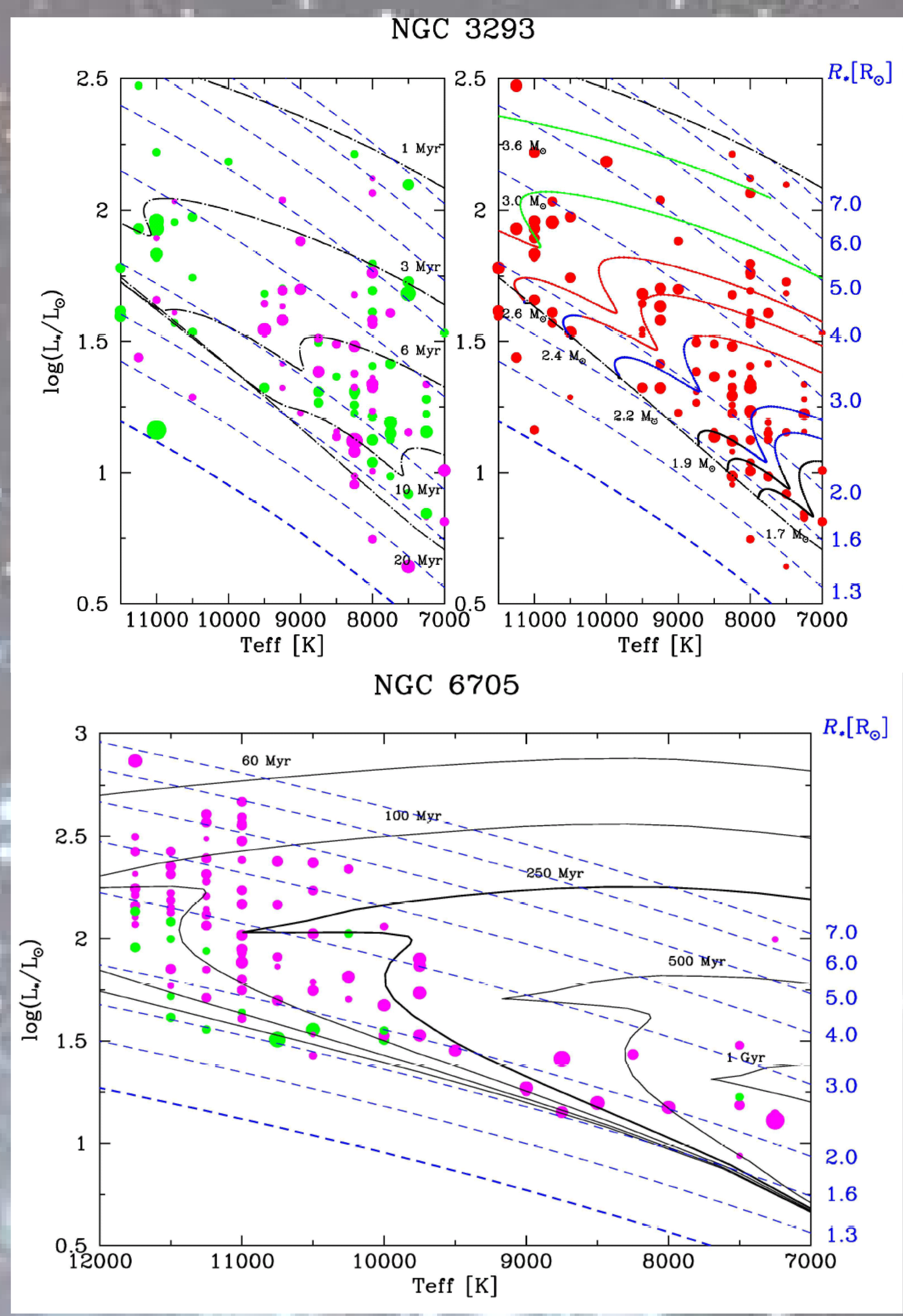
We report here on preliminary results for one of these clusters (NGC 3293; 530 stars observed) and an intermediate-age cluster (NGC 6705 = M 11; 168 stars).

Continuum normalization

In determining the stellar parameters for the stars, we take care that we improve the standard normalization of the pipeline. The left figure shows the fit of the Hδ line, based on the standard normalization, the right figure shows the improved version. Note the large difference in the derived stellar parameters!



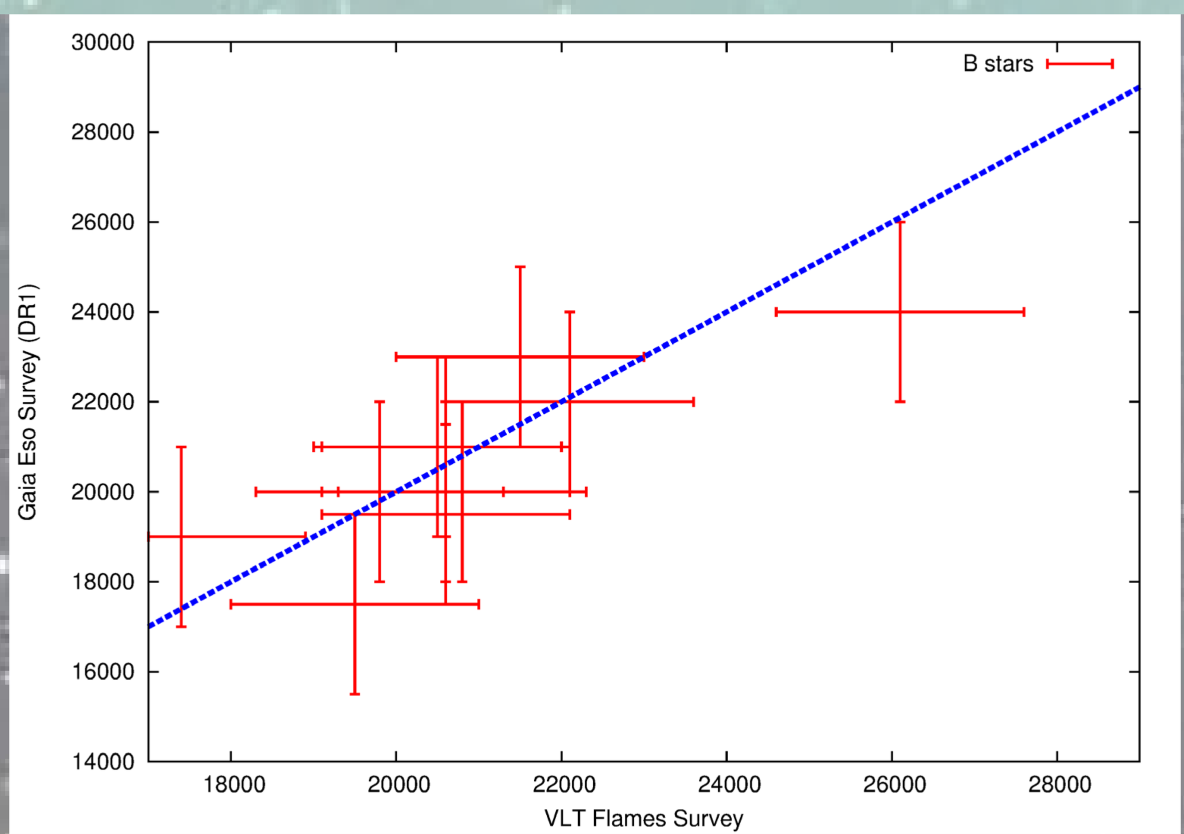
A-type stars in NGC 3293 and NGC 6705



The majority of stars we observe in NGC 3293 (top figure) are pre-MS stars contracting onto the ZAMS over 1 to 20 Myr (pre-MS isochrones are shown with dash-dotted lines). The bottom dash-dotted line marks the ZAMS, while the solid lines show pre-MS evolutionary tracks for 1.7 to 3.6 $M_{\odot}$.
The majority of the A stars in NGC 6705 (bottom figure) are already on (or closer to) the ZAMS. Since the age of this cluster is ~220 Myr, the evolutionary tracks (solid drawn lines are post-MS isochrones) indicate a number of early A stars that have already spent some time on the ZAMS.

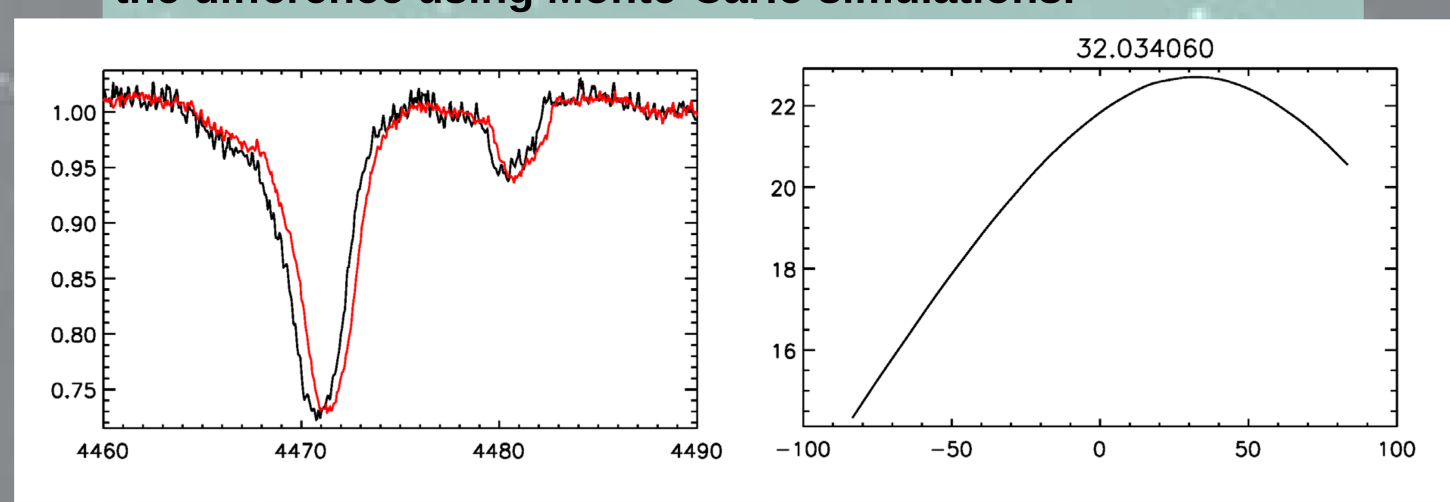
B-type stars in NGC 3293

We used GIRFIT (Frémat et al. 2005) to determine the astrophysical parameters of the B stars in NGC 3293. This program uses theoretical spectra computed with the SYNSPEC program on the basis of TLUSTY (Hubeny & Lanz 1995) and/or ATLAS (Kurucz 1993) model atmospheres.
On the figure we compare our results with those of Hunter et al. (2009) and we find good agreement between the two determinations.



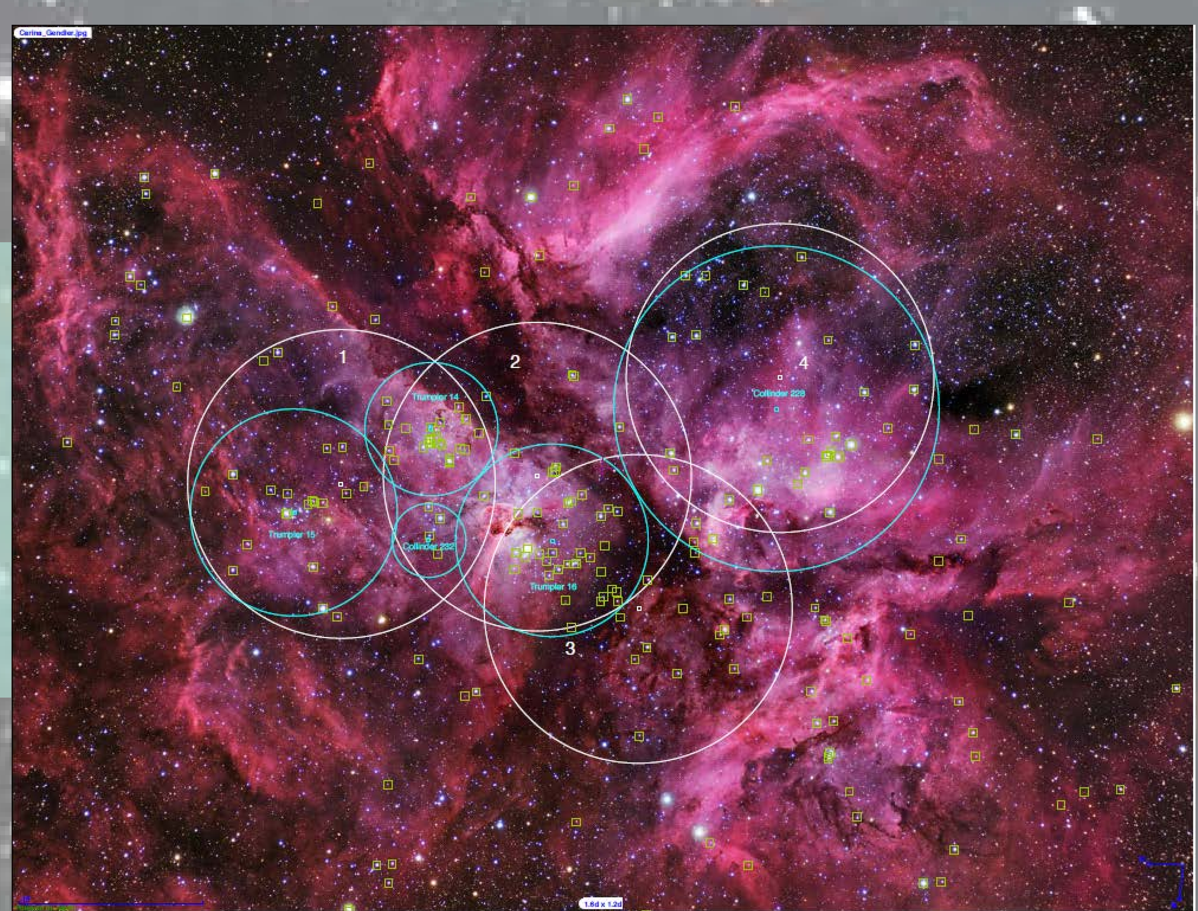
Binarity in NGC 3293

A repeat observation (for one Giraffe grating) made about 1 month later allows us to look for binarity in these clusters. We measure the radial velocity difference with a cross correlation technique and test the significance of the difference using Monte-Carlo simulations.



Future observations

Our future observing plans include the clusters that are found in the Carina nebula region. The figure outlines the fields we have chosen for observations.



Credit: Stéphane Guisard, Robert Gendler

Conclusions

Using the large number of spectra of massive stars to be collected by the Gaia-ESO Survey, we will be able to critically test stellar evolution modelling and constrain mixing theories through the study of some key elements. We will also constrain the upper part of the Initial Mass Function. We will improve our understanding of Be stars. Stellar wind clumping will be studied in those stars with strong Hα and Galactic abundance gradients will be derived.

Credit background image: James McHugh

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