Massive Stars Near and Far
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Hot stars in the Gaia-ESO Survey

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Abstract. The Gaia-ESO Survey (GES) is a large public spectroscopic survey that has collected spectra of about 100,000 stars. The survey provides not only the reduced spectra, but also the radial velocities, stellar parameters and surface abundances resulting from the analysis of the spectra. We present the work of the groups that analysed the spectra of the hottest stars in that Survey. The large temperature range that is covered ($T_{\rm eff}$ = 7,000 to 50,000 K) requires the use of different analysis codes by the different groups. Eight groups each analysed part of the data, with significant overlap that allowed cross-checks. In total 17,693 spectra of 6,462 stars were analysed, most of them in 37 open star clusters. The homogenisation of all this information led to stellar parameters for 5,584 stars. Abundances for at least one of the elements He, C, N, O, Ne, Mg, Al, Si and Sc were determined for 292 stars. The GES hot star data, as well as the Survey data in general, will be of considerable use in future studies of stellar evolution and open clusters.

Keywords. Surveys, catalogs, stars: fundamental parameters, stars: abundances, stars: early-type, techniques: spectroscopic

1. The data and their analysis

The Gaia-ESO Survey (GES; https://www.gaia-eso.eu/) used the multi-fibre FLAMES instrument on VLT-UT2. Both GIRAFFE and UVES spectra were obtained, with a number of different settings. Not all clusters and stars were observed with all the

Table 1. The different groups that analysed the data.

Group	Analysis technique	Parameters determined	Abundances determined
ROBGrid	χ^2 minimisation with grid of theoretical spectra	$T_{\rm eff}$, $\log g$, [M/H], $v_{\rm rad}$, $v \sin i$	
ROB	Fe - Fe^+ ionisation balance of diagnostic photospheric lines	$T_{\rm eff}$, $\log g$, [Fe/H], ξ, $v \sin i$	C, O, Mg, Al, Sc, Fe
MGNDU	Principal Component Analysis and Sliced Inverse Regression	$T_{\rm eff}$, $\log g$, [M/H], $v_{\rm rad}$, $v \sin i$	
Liège	χ^2 minimisation with grid	$T_{\rm eff}$, $\log g$, $v_{\rm rad}$, $v \sin i$	He, C, N, Ne, Mg, Si
ON	Non-LTE synthesis and Si ionisation balance	$T_{\rm eff}$, $\log g$, $v \sin i$	C, O, Si
IAC	χ^2 minimisation with grid of FASTWIND models	$T_{\rm eff}$, $\log g$, $v \sin i$, $v_{\rm macro}$	He
Mntp	χ^2 minimisation with grid of CMFGEN models	$T_{\rm eff}$, $\log g$, $v \sin i$, $v_{\rm macro}$	
LiègeO	CMFGEN	$T_{\rm eff}$, $\log g$, $v \sin i$, $v_{\rm macro}$	He, C, N

settings. HR03, HR04, HR05AB, HR06, HR14AB were used for the hotter stars, HR09B for the cooler stars. The UVES fibres were set on the brighter stars in the cluster.

One of the aims of the GES is to cover a large range of cluster parameters: age, metallicity, radial distance, and mass. We analysed stars from 37 open star clusters. Although we were mainly focussed on hot stars, the age range of the clusters is from a few Myr to a few Gyr.

The general policy of the GES is that a number of groups each analyse the spectra independently. At a later stage, the results are then compared and a homogenisation procedure is applied, giving a single set of parameters and abundances for each star (the recommended values).

For the hot stars, the temperature range covered requires the use of different analysis codes by the different groups. Table 1 lists the analysis technique used by each group, as well as the parameters and abundances that they determined.

2. Some results

The data analysed here allow a comparison between the FASTWIND (IAC) and CMFGEN codes (Mntp, LiègeO). $T_{\rm eff}$ differs on average by -400 ± 1300 K (CMFGEN minus FASTWIND), in acceptable agreement with the results of Massey et al. (2013) and Holgado et al. (2018). For $\log g$, the difference is $+0.04 \pm 0.12$ dex on average, which agrees with the Holgado et al. result, and is somewhat better than the Massey et al. one. The comparison between the ON results and that of the other groups shows the other groups to have higher $T_{\rm eff}$, with the difference increasing with $T_{\rm eff}$. While the agreement in $\log g$ is good, a small linear trend remains in the differences.

The details of this work are published in Blomme et al. (2022). The data analysed in that paper are then further homogenised in the GES consortium, to combine them with results from groups working on cooler stars. The results of that homogenisation are publicly available via ESO; see `https://www.eso.org/sci/publications/announcements/sciann17497.html` for details. Papers on scientific results are in preparation (Berlanas et al., Morel et al., Santos et al.).

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