[α/FE] IN THE THIN AND THE THICK DISC TOWARDS AN AUTOMATIC PARAMETRIZATION OF STELLAR SPECTRA

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ABSTRACT

We test an automatic procedure to measure [Fe/H] and [α/Fe] on high resolution spectra. The test sample is the intersection of the ELODIE library and a catalogue of 830 stars having well determined abundances.

Key words: Methods: data analysis; Stars: abundances; Stars: fundamental parameters.

1. GOAL

In order to investigate the properties of the thick disc and its interface with the thin disc we have compiled a catalogue of elemental abundances of O, Na, Mg, Al, Si, Ca, Ti, Ni, Fe including 830 stars (Girard and Soubiran 2004). The classification of thin disc and thick discs stars has been performed on the basis of their (U,V,W) velocities. The two populations overlap greatly in metallicity but at a given [Fe/H] the thick disc shows on average an enhancement of 0.07 dex in [α/Fe] (Figure 1). In order to go further in this investigation we want to be able to measure [Fe/H] and [α/Fe] from a large collection of spectra with an automatic procedure.

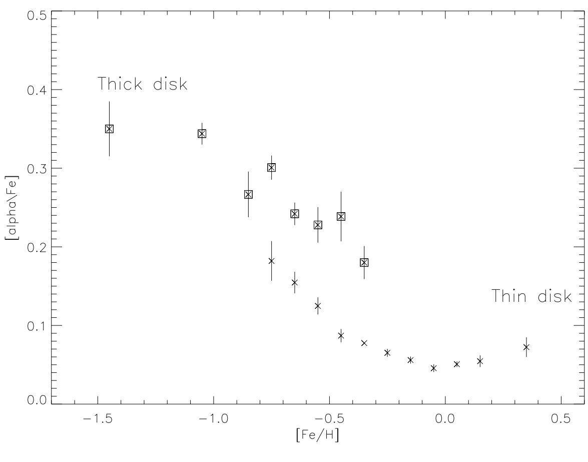

Figure 1. [α/Fe] vs [Fe/H]

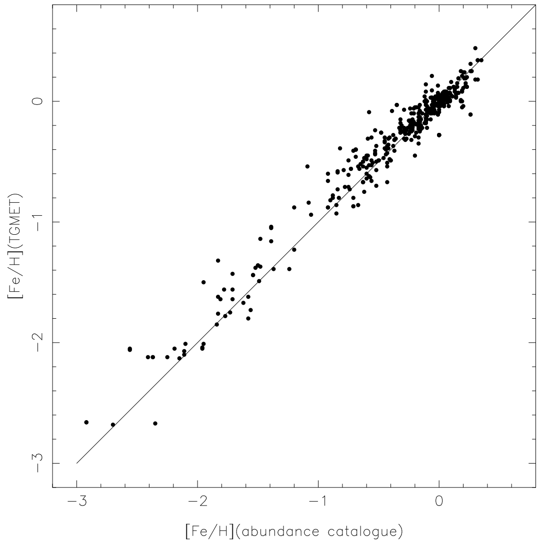

Figure 2. Comparison of [Fe/H] from the TGMET code with [Fe/H] from the catalogue of abundances. RMS = 0.11.

2. TOOLS AND MATERIAL

In this section we summarize the libraries and the codes used for this investigation:

- The ELODIE library of 1962 spectra ($\lambda\lambda$390.6–681.1 nm, R = 42 000) of 1388 stars with measured Lick indices (Prugniel & Soubiran 2004) and its intersection with the abundance catalogue: 449 spectra of 308 stars.
- The grid of synthetic spectra with 3 values of [α/Fe] (Barbuy et al. 2003).
- The TGMET code: a minimun distance algorithm to measure (Teff, log g, [Fe/H]) (Katz et al. 1998).
- The ETOILE code: a modified version of TGMET with determination of [α/Fe] (D. Katz, priv. com.).

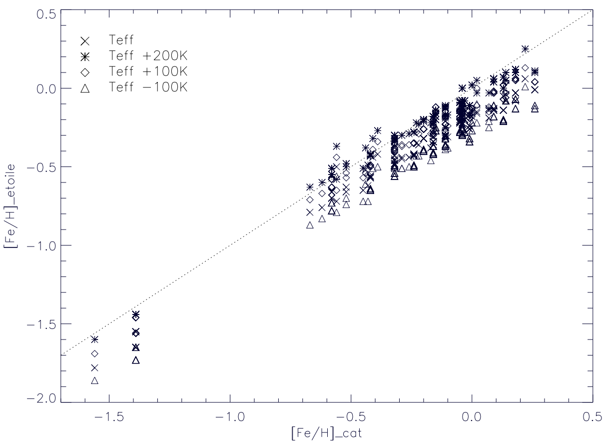

Figure 3. [Fe/H] from ETOILE vs [Fe/H] from the catalogue. The modification of $T_{\rm eff}$ in the input of the code provides a variation of [Fe/H].

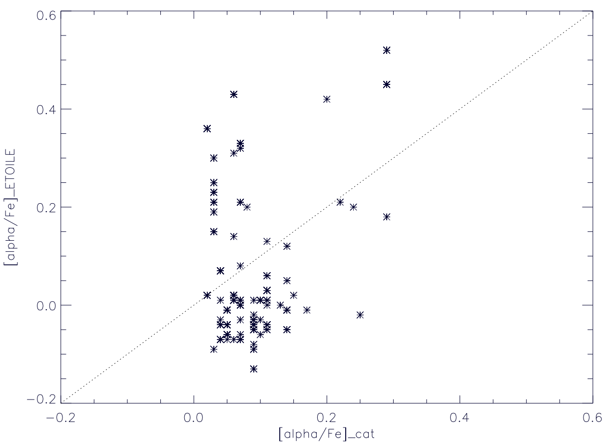

Figure 4. [α/Fe] from ETOILE vs [α/Fe] from the catalogue.

TGMET relies on the least-square comparison of an ELODIE spectrum of a target star to a library of ELODIE spectra of reference stars with well determined atmospheric parameters.

ETOILE is a minimum distance algorithm based on the perturbation method described in Cayrel et al. (1991). With this method, the reference library must sample the parameter space with regular steps. That is why synthetic spectra are used instead of empirical spectra.

We use the grid of synthetic spectra computed by Barbuy et al. (2003): $\lambda\lambda$460–560 nm, $4000 \leq T_{\rm eff} \leq 7000$K in steps of 250K, $0.5 \leq \log g \leq 5.0$ in steps of 0.5, [Fe/H]: -3.0, -2.5, -2.0, -1.5, -1.0, -0.5, -0.3, -0.2, -0.1, 0.0 and $+0.3$ and [α/Fe]: 0.0, $+0.2$ and $+0.4$.

A first step is to validate the grid, that is verify that computed spectra and observed ones with the same parameters match on the whole wavelength interval.

3. RESULTS

A bootstrap method is used to test the performances of TGMET. Based on 449 spectra, TGMET is able to retrieve the atmospheric parameters with a typical accuracy of 134K in $T_{\rm eff}$ and 0.11 in [Fe/H] (Figure 2). The main limitation of TGMET is its empirical reference library which does not sample perfectly the parameter space — a limitation overcome with the use of ETOILE and a grid of synthetic spectra.

As a starting point ETOILE uses the TGMET solution. Preliminary results from ETOILE suggest that the catalogue of abundances and the grid are not on the same temperature scale: metallicities are correctly recovered if a hotter temperature is given in input (Figure 3). [α/Fe] is not yet correctly estimated (Figure 4). Possible causes are currently being investigated.

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