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[Y/Mg] stellar dating calibration

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Abstract. Gaia DR1 has opened a new era of stellar age dating, that is crucial for many astrophysical objectives. In addition, the Gaia based isochrone fitting ages can be compared to other chemical clocks like the [Y/Mg] one (Nissen *et al.* 2015). In our work we have used ESO archived data of the AMBRE project (de Laverny *et al.* 2013) for UVES spectra, in order to evaluate the age [Y/Mg] abundance correlation for turn off stars. 310 turn off stars of the UVES-archive (setups 564 and 580) are included in the TGAS database. Isochrone fitting ages were derived. We have applied the GAUGUIN procedure for those stars to derive the Mg and the Y abundances. As the result we present the [Y/Mg] vs stellar age dependence for ∼40 TO-stars.

Keywords. stars: abundances, atmospheres

1. Overview

The AMBRE (Archeologie avec Matisse Basee sur les aRchives de l'ESO) project, established by ESO and the Observatoire de la Cote d'Azur in 2009 (de Laverny *et al.* 2013), is parameterizing stellar spectra archived at ESO. In the AMBRE project, stellar spectra collected by four high resolution spectrographs were analysed (FEROS, HARPS, UVES and GIRAFFE). According to the selected MgI lines in the range of wavelength 5167-6319 Å, we used data from 2 setups of UVES data: RED564 [4583-6686 Å, gap 5644-5654 Å] and RED580 [4726-6835 Å, gap 5804-5817 Å], that leads us to a final number of 4156 spectra. We used GAUGUIN code, developed in OCA (Guiglion *et al.* 2016). After polynomial normalization for the continuum (if needed), it applies a Gauss-Newton method to get the final solution for the abundances. The GAUGUIN method is used also for Gaia RVS data within the DPAC/Apsis pipeline. In order to make a calibration of the method we used [Mg/Fe] values for benchmark stars from Jofre *et al.* 2015. A scientific validation was performed thanks to the abundances [Mg/Fe] from Mikolaitis *et al.* 2017 for HARPS and FEROS instruments that are inside AMBRE project. Using stellar ages, calculated by Hayden *et al.* (in prep.), we selected a sample of 80 turn off stars for UVES data with reliable ages. We selected [Y/H] abundances for 345 stars from Guiglion *et al.* (in prep.) based on 6 lines of YII in 4980-5820 Å wave range. The total number of stars for which the values [Mg/Fe], [Y/Fe] and robust ages are available is ∼40.

2. Conclusions

We determined the abundances of [Mg/Fe] for 590 stars (from the ESO archive data UVES setups 564 and 580) using the GAUGUIN code. On the other side, the cross match with TGAS gave us 310 stars with 80 of them with reliable values of ages. Using the strict selection of [Y/Fe] abundances calculated by 6 YII lines for these two UVES setups we got 345 stars. Collecting all the available data in order to get [Y/Mg] vs Age relation we find, that the final sample of ∼40 turn off stars shows a similar correlation

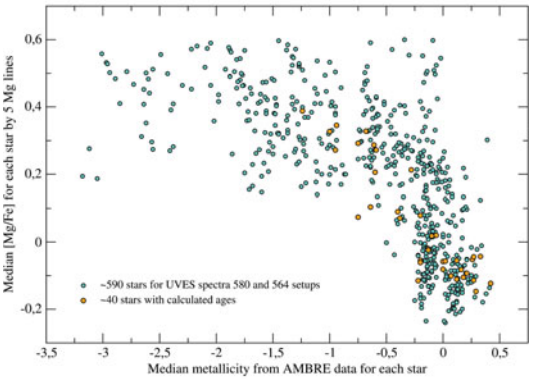

Figure 1. The relation [Mg/Fe] to metallicity for the final UVES sample. The stars for which we have reliable values of the ages are colored in orange.

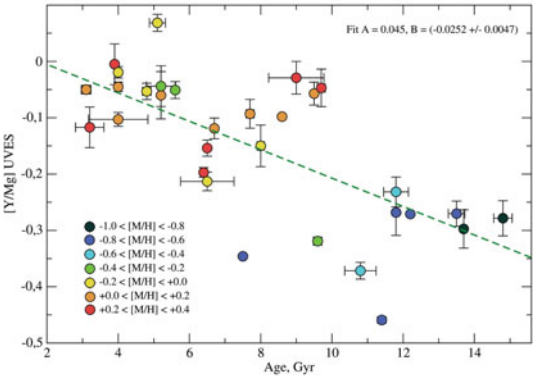

Figure 2. The [Y/Mg] vs stellar age relation for UVES TO-stars. Color code represents the stellar metallicity, the dashed line - linear fit with of the sample. The dached line represents the character of the one from Tucci *et al.* 2016.

that the one presented in Nissen 2015 and Tucci *et al.* 2016 for the solar twins. Our data allow to explore the character of the [Y/Mg] ratio as a stellar clock in a wide range of metallicities. Also we assume that the relation between [Y/Mg] and stellar age can give us a possibility to estimate the ages for the AMBRE stars that are not inside TGAS extending the studies of the disc outside the solar neighbourhood.

This work has made use of data from the European Space Agency (ESA) mission *Gaia* (`https://www.cosmos.esa.int/gaia`), here, processed by the *Gaia* Data Processing and Analysis Consortium (DPAC, `https://www.cosmos.esa.int/web/gaia/dpac/consortium`). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the *Gaia* Multilateral Agreement.

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