

[Y/Mg] stellar dating calibration with Gaia DR1

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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 HARPS spectra, in order to evaluate the [Y/Mg]-Age correlation for solar-type stars. We have applied the GAUGIN procedure (Guiglion et al. 2016) to derive the Mg and the Y abundances from the spectra of HARPS-archive. The cross-match of HARPS-archive with TGAS, for which isochrone fitting ages were derived, lead us to final sample of 450 stars.

1. Database & Method

The **AMBRE** (Archeologie avec Matisse Basee sur les aRchives de l'ESO) project, established by ESO and the Observatoire de la Côte d'Azur in 2009 (de Laverny et al. 2013), is parameterizing stellar spectra, collected by four high-resolution spectrographs (FEROS, HARPS, UVES & GIRAFFE), archived at ESO. We used the data from HARPS (R~110 000) in the 5165-6320 Å range, that leads us to 4350 final spectra.

To calculate the abundances we used GAUGIN code, developed in OCA (Guiglion et al. 2016), that is the part of the **GSP-Spec** (Global Stellar Parametrizer-Spectroscopy) module of the Gaia **DPAC APSIS** pipeline (Data Processing Centre C in Toulouse). It's in charge of deriving parameters and abundances from Gaia/**RVS** (Radial Velocity Spectrometer). We optimise the method to run Cycles 2&3 of the GSP-Spec for 820 000 spectra to get the abundances in **Sept 2017-2018** in order to prepare DR3.

2. Development & Optimization

We've fixed the next problems of GAUGIN:

1/ **Normalization** and 2/ **Interpolation** with the irregular synthetic grid. We added 3/ **Quality labels** for the calculated results and 4/ **Visualisation** option to control the results with the option to **save output results** (interpolated normalised observed spectrum).

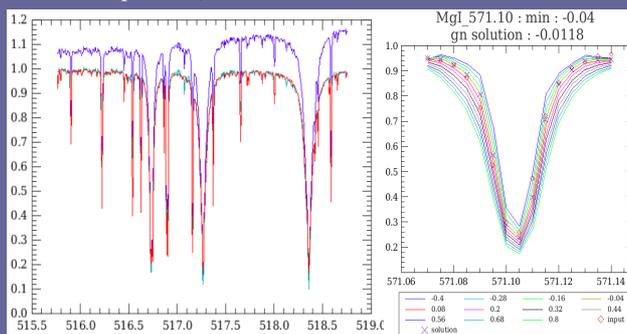


Fig. 1: Left. Example of initial observation (blue), calculated synthetic (red) and interpolated normalized (green) spectra. Right. Example of observational spectrum (points) for HD 294297, a set of synthetic spectra, and a solution with GAUGIN for MgI 5711 Å line.

3. Calculations & Calibrations

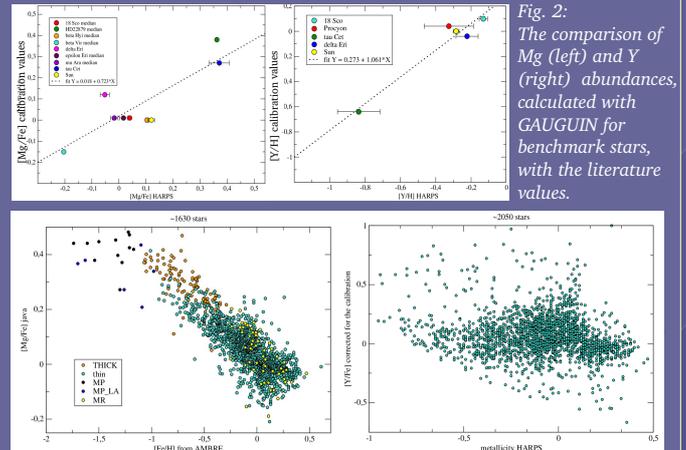


Fig. 2: The comparison of Mg (left) and Y (right) abundances, calculated with GAUGIN for benchmark stars, with the literature values.

Fig. 3: The face of [X/Fe] vs metallicity distribution for Mg and Y. The abundances for Mg colored with a different components of the Galactic disc.

4. Stellar clocks

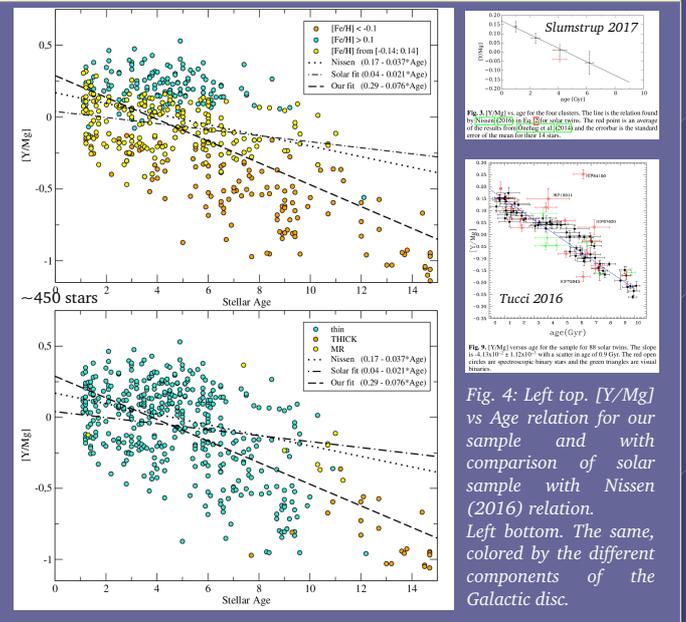


Fig. 4: Left top. [Y/Mg] vs Age relation for our sample and with comparison of solar sample with Nissen (2016) relation. Left bottom. The same, colored by the different components of the Galactic disc.

Conclusions & Perspectives:

- 1/ We've improved the GAUGIN code, that is the part of the **GSP-Spec** module of the Gaia **DPAC APSIS** pipeline in charge of deriving parameters and abundances from Gaia/**RVS** spectra. We applied this method to determine the abundances of MgI for 1630 stars and YII for 2050 stars from the ESO archive HARPS data.
- 2/ The sample of 450 turn-off stars with reliable ages shows a similar [Y/Mg] vs Age relation in the range of solar metallicities with one that presented in [1] & [2] for the solar twins, and in [3] for the giants, but extension of this relation in a wide range of metallicities gave us the other character of the relation (Titarenko et al., in prep.).
- 3/ This stellar clock can give us a possibility to estimate the ages for the AMBRE stars that are not inside Tycho-Gaia Astrometric Solution, extending the studies of the disc outside the solar neighborhood.

References:

- [1] Nissen P.E. 2015, A&A, 579, A52
- [2] Tucci et al. 2016, A&A, 590, A32
- [3] Slumstrup et al. 2017, A&A, 604, 85
- [4] Laverny et al. 2013, The Messenger, 153
- [5] Guiglion et al., 2016, A&A, 595, A18
- [6] Jofre et al. 2015, A&A, 582, A81