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Updating the DAML02 catalog using Gaia data

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Reliable fundamental parameters of open clusters such as distance, age and extinction are key to our understanding of the Galactic structure and stellar evolution. In this work we present astrometric and fundamental parameters for thousands open clusters investigated using Gaia data, based on memberships determined using a combination of methods applied to Gaia astrometric data as well as obtained from other authors in the literature. Mean radial velocities were also determined for 47% of the clusters, many of which had no previous published values. The distances and ages determined through our improved isochrone fitting, now takes into account the interstellar extinction using an updated extinction polynomial for the Gaia photometric band-passes. A Galactic abundance gradient has also been used as a prior for metallicity along with an extinction prior based on the 3D structure of the Local Galaxy. The updated procedure was validated with a sample of clusters with high quality [Fe/H] determinations. Based on this catalog we present a critical review of the literature showing that our cluster parameter determinations represent a substantial improvement in fundamental parameter estimates. This has allowed us, for example, to re-estimate the rotation velocity of the arms of the Galaxy (28.5 +/- 1.0 km/s/kpc) from the clusters birthplaces, implying that the corotation radius is close to the solar Galactic orbit (R_c/R_0 = 1.01 +/- 0.08).

METHODS

The code interpolates on the Padova (PARSEC version 1.2S) database of stellar evolutionary tracks and isochrones (Bressan et al.2012), which uses the Gaia filter passbands of Maíz Apellániz & Weiler (2018), scaled to solar metal content with Z=0.0152. The grid used is constructed from isochrones with steps of 0.05 in log(age) and 0.002 in metallicity.

QUICK FACTS

> **1750** open clusters studied

> Isochrone fits done with a robust global optimization method

> **Priors for Av and [Fe/H]** used in the isochrone fits.

> **Updated** extinction polinomial taking into account the Gaia Passbands.

> **198** new radial velocities determined.

A search for the best solutions is performed in the following parameter space:

- age: from log(age) =6.60 to log(age) =10.15 dex;
- distance: from 1 to 25000 parsec;
- A_V: from 0.0 to 5.0 mag;
- [Fe/H]: from -0.90 to +0.70 dex

To account for the extinction coefficients dependency on colour and extinction due to the large passbands of Gaia filters, we used the most updated extinction polynomial for the GaiaDR2 photometric band-passes, as presented in detail by Monteiro et al. (2020).

RESULTS

> Distribution of fundamental parameters of OCs as a function of height relative to the plane of the Galaxy;

> Isochrone fits for thousands of OCs;

> Metalicity gradient and some of the sample properties of [Fe/H] with relation to the log(age) obtained from fits;

> Currently working on eDR3 update

> **for more details and references: DOI:**
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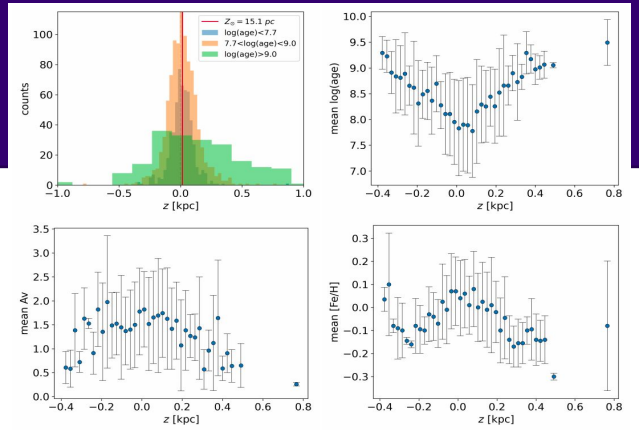

Figure 1: Distribution of the open clusters and their parameters as a function of height relative to the plane of the Galaxy

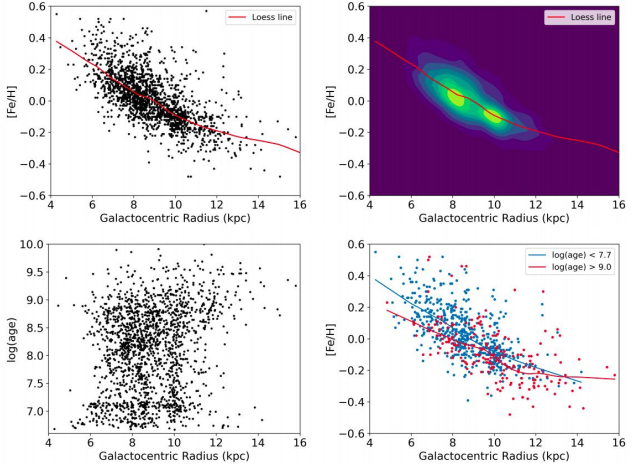

Figure 3: (a) Metallicity [Fe/H] normalized to the Solar value as a function of Galactic radius. In the upper left panel we show all individual points with a non-parametric regression LOESS line over-plotted. In the upper right panel a kernel density estimate in ([Fe/H],radius) space is shown. A gap at 9 kpc can be seen, as well as a slight flattening of the gradient beyond 10 kpc. In the lower left panel the log of the age of the clusters is presented as a function of the Galactic radius, showing a prevalence of old clusters with radii larger than 11 kpc. In the lower right panel the distribution of the old and young population of clusters is shown with their respective non-parametric regression LOESS line over-plotted.