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Highlights in the Milky Way

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Abstract. We discuss some important topics concerning the chemical evolution of the Milky Way. In particular, we compare the predictions of theoretical chemical models for our Galaxy with the latest observational data in order to derive constraint on the formation and evolution of the various Galactic components.

Keywords. ISM: abundances - Galaxy: abundances - Galaxy: evolution.

1. The Galactic disc

Recent observational data (Mikolaitis *et al.* 2017) indicate two distinct sequences corresponding to thick and thin disc stars, with the thick disc stars showing higher [α/Fe] ratios. In Grisoni *et al.* (2017), we adopt two different approaches to model the evolution of thick and thin discs:

• a two-infall approach (Chiappini *et al.* 1997; Romano *et al.* 2010), where there are two main episodes of gas accretion: during the first one, the thick disc formed, while the second gave rise to the thin disc on a longer timescale;

• a parallel approach (Chiappini 2009; Anders *et al.* 2017), where the two discs form in parallel but at different rates.

The parallel approach can account for a group of α-enhanced metal rich stars present in the data, whereas the two-infall approach cannot explain these stars unless they are the result of stellar migration. In both approaches, the thick disc has formed on a timescale of accretion of 0.1 Gyr, whereas the thin disc formed on a timescale of 7 Gyr in the solar region. In the two-infall approach a gap in star formation between the thick and thin disc formation of several hundreds of Myr should be present, at variance with the parallel approach where no gap is present.

2. Abundance gradients

Radial gas flows are important for the creation of an abundance gradient in the gas along the thin disc. Other important parameters are: i) the inside-out formation of the disc, ii) the existence of a gas threshold for star formation. In Figure 2 (left panel), it is clear from the comparison with O abundance measured in HII regions, planetary nebulae and O, B stars that the model with inside-out formation and radial gas flows with variable speed best reproduces the observed gradient.

3. The Galactic bulge

The most recent data on abundance ratios in bulge stars (coming from high-resolution, high-S/N spectroscopic data) are from the Gaia-ESO survey (Rojas-Arriagada *et al.* 2017). In Figure 2 (right panel), we show these data together with the prediction of a

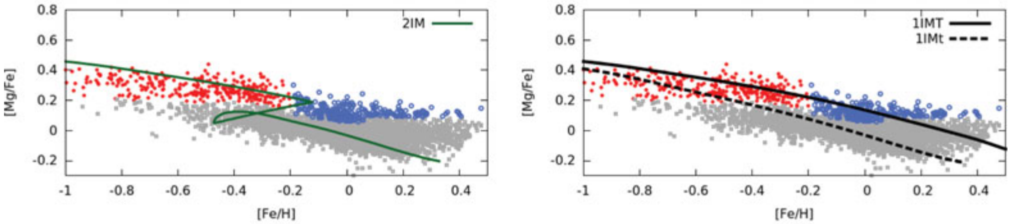

Figure 1. *Left panel:* Predicted and observed [Mg/Fe] vs. [Fe/H] in the solar neighborhood. The data are from the AMBRE Project (Mikolaitis *et al.* 2017) and the predictions are from the two-infall model (2IM). *Right panel:* Same as the left panel, but the predictions are from the parallel model (1IMT for the thick disc and 1IMt for the thin disc). Figures from Grisoni *et al.* (2017).

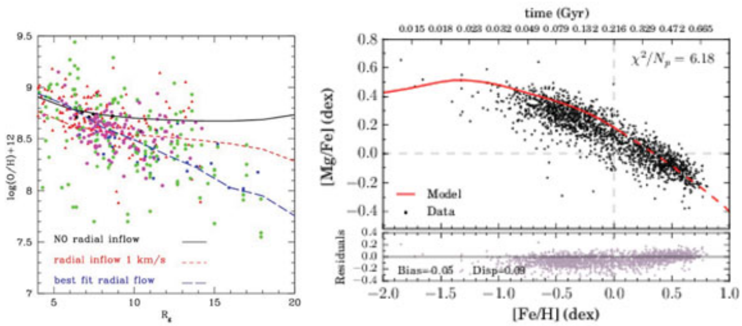

Figure 2. *Left panel:* Comparison between data and models about abundance gradients along the Galactic thin disc. References to the data can be found in Spitoni & Matteucci (2011). The continuous line is the result of a model without radial gas flows but including inside-out disc formation and gas threshold in the star formation. The short-dashed line is the same model with radial flows at constant speed (1 km/sec) and the long-dashed line is the same model with radial flows with variable speed. This model is clearly the best one. *Right panel:* Predicted and observed [Mg/Fe] vs. [Fe/H] in Galactic bulge stars from Rojas-Arriagada *et al.* (2017). The model assumes a fast bulge formation and a Salpeter IMF.

bulge model relative to the classical bulge population, assuming a very fast star formation rate with star formation efficiency of 25 Gyr^{-1} and timescale of accretion of 0.1 Gyr. As one can see, the model prediction fits well the data, thus confirming previous results (e.g. Cescutti & Matteucci 2011; Grieco *et al.* 2012) suggesting a very fast bulge formation, at least for the main population (the endemic metal-poor classical one).

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