Modelling the chemical evolution of the Milky Way disk

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1. Introduction

The study of the chemical evolution of galaxies allows us to understand how the chemical abundances of the chemical elements evolve in space and time in the interstellar medium. In particular, we will focus on the chemical evolution of our Galaxy, the Milky Way. The Milky Way has four main stellar populations:

1. The halo stars
2. The bulge population
3. The thin-disk stars
4. The thick-disk stars.

We will focus on the scenario of the disk formation, with particular attention to the distinct abundance patterns of the thick and thin disks which suggest a different origin for each of these components.

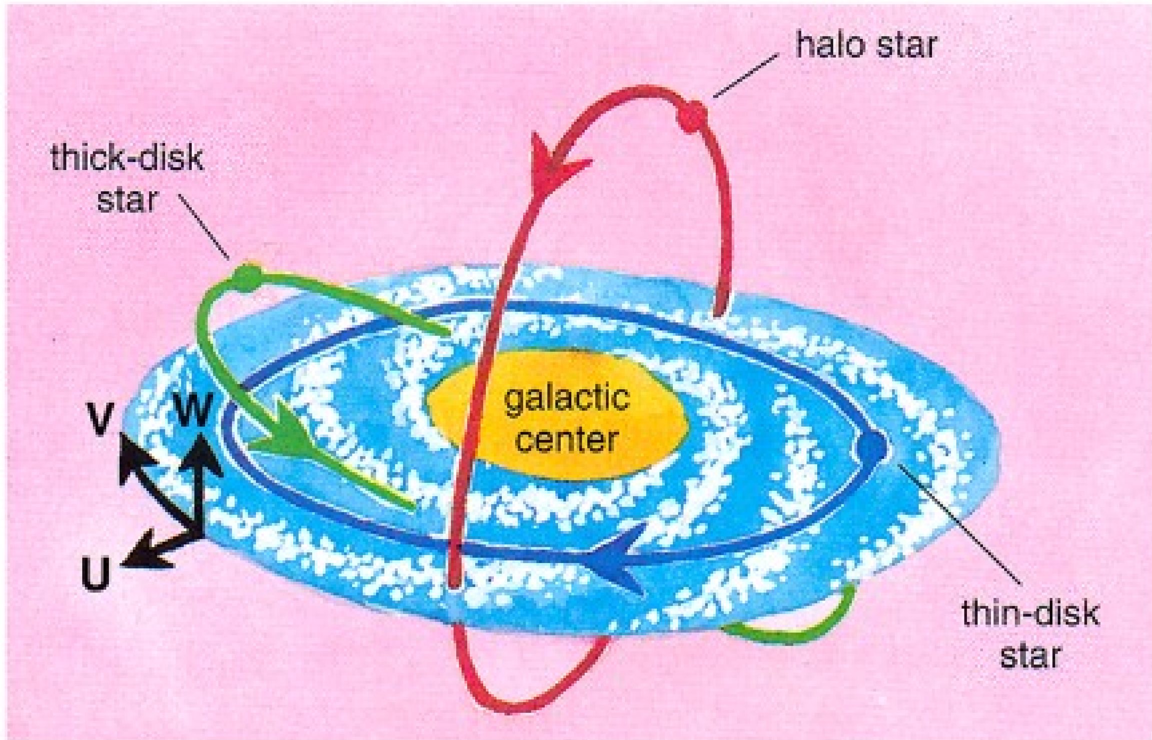


Illustration credit from Chiappini (2001)

2. The two-infall model

Generally, a good agreement between model predictions and observations is obtained by assuming that the disk formed by infall of primordial gas. In particular, the two-infall model (Romano et al., 2010) assumes two main infall episodes:

- During the first, the halo and the thick disk are formed
- During the second, delayed relative to the first one, the thin disk forms.

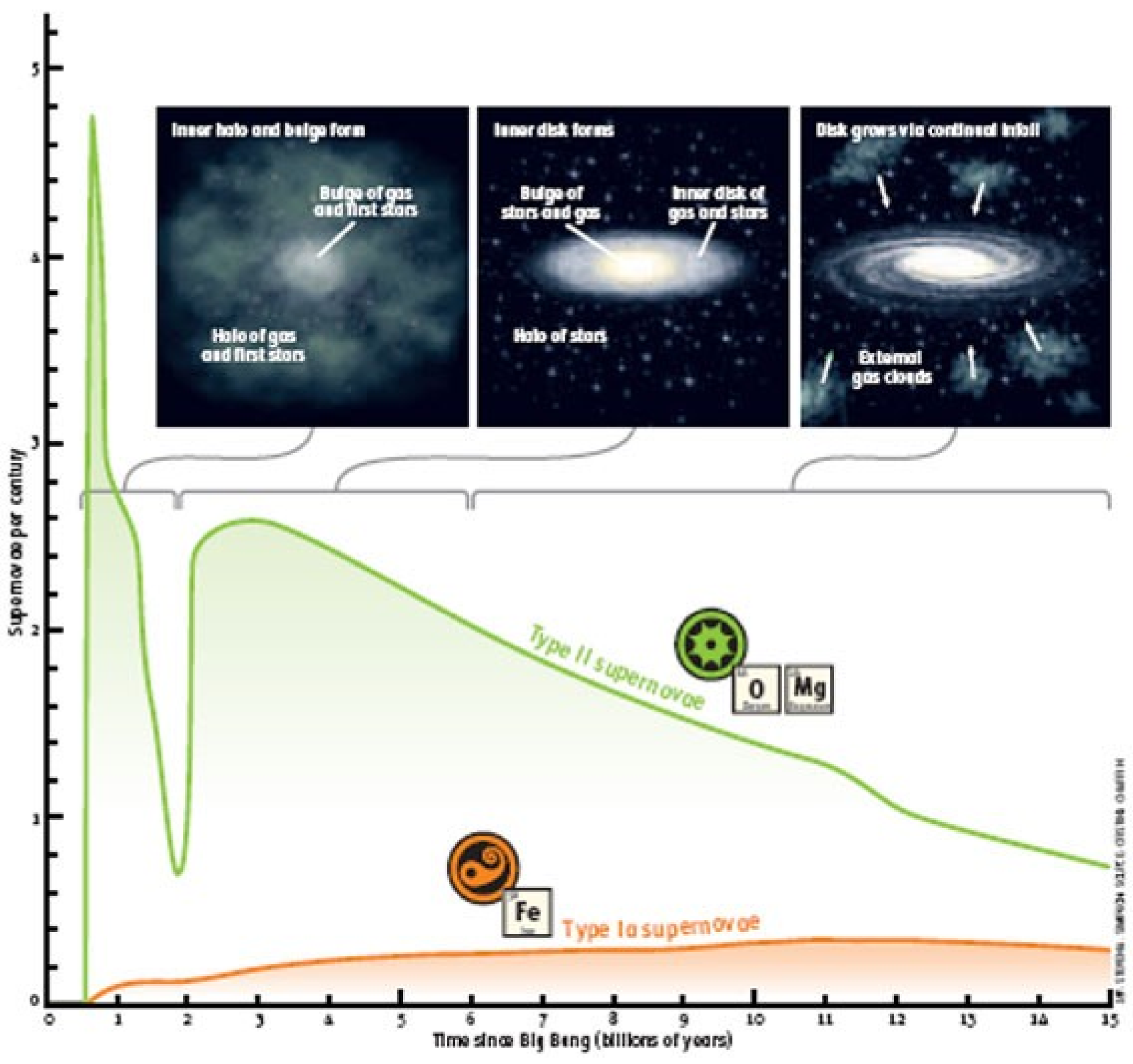
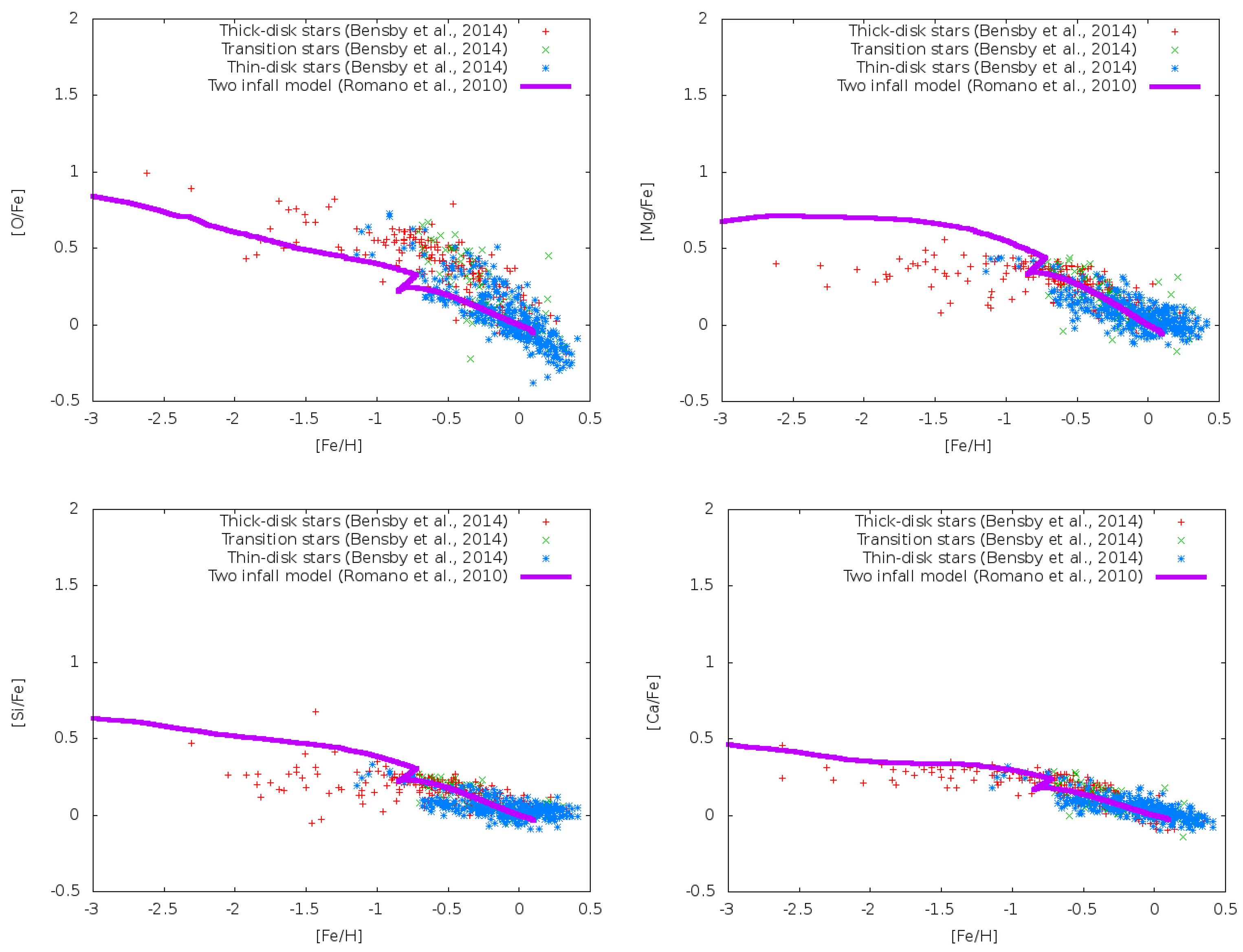


Illustration credit from Matteucci (2012)

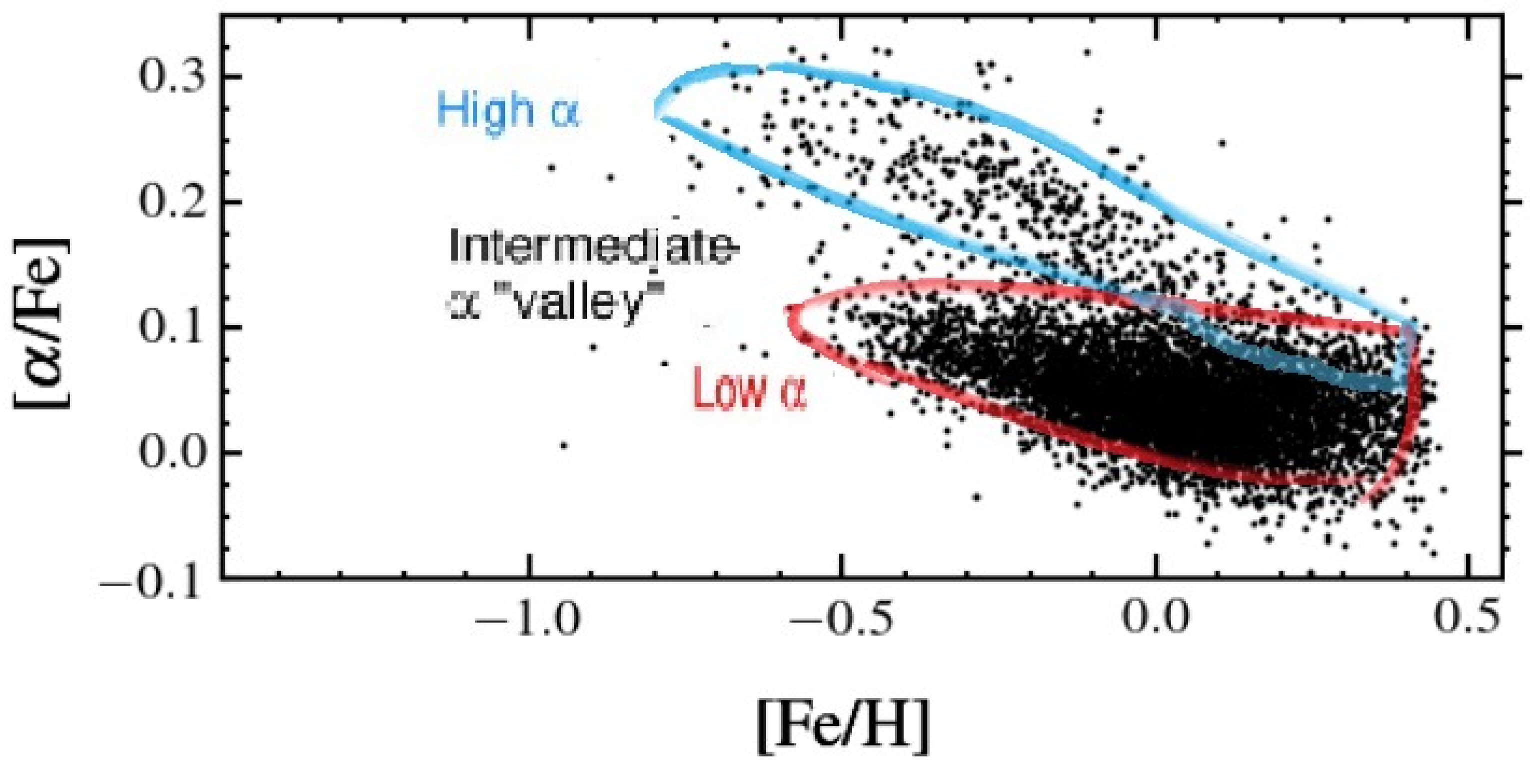
3. Two-infall model results

Here, we show the predicted behaviour of the relative ratios of O, Mg, Si and Ca to Fe as a function of the relative iron abundance for the two-infall model in the Solar neighborhood. Thick-disk, transition, and thin-disk data are taken from Bensby et al. (2014).



4. The APOGEE survey

Recent observational data reveal a clear distinction between the abundance patterns of the thick and thin disks, particularly for α-elements. As an example, we show the observed [α/Fe] vs. [Fe/H] plane distribution for the Solar neighborhood taken from Hayden et al. (2015), which uses a sample of stars coming from the SDSS-III/APOGEE Data Release 12.



Dataset from Hayden et al. (2015)

There are two sequences in the distribution of stars in the [α/Fe] vs. [Fe/H] plane, **one at solar-[α/Fe]** abundances, and **one at high-[α/Fe]** abundances that eventually merges with the solar-[α/Fe] sequence at [Fe/H]≈0.2. The presence of the two sequences suggests a different origin for the thick and for the thin disk.

5. Ongoing work

- So far, the two-infall model has proven to be the most reliable to reproduce the majority of the chemical properties of the Milky Way.
- However, recent observational data reveal a clear distinction between the abundance patterns of the thick and thin disks.
- Therefore, it seems appropriate to leave a sequential scenario like the one of the two-infall model, in favour of a picture which treats the thick-disk and the thin-disk stars as two truly distinct populations.

- **The aim of my Thesis is to perform a chemical evolution model which best reproduces the characteristics of the thin-disk and thick-disk stars observed by Hayden et al. (2015), including the abundance patterns and the metallicity distribution function.**

References

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