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The evolution of the Milky Way's radial metallicity gradient as seen by APOGEE, CoRoT, and Gaia

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Abstract. The time evolution of the radial metallicity gradient is one of the most important constraints for Milky Way chemical and chemo-dynamical models. In this talk we reviewed the status of the observational debate and presented a new measurement of the age dependence of the radial abundance gradients, using combined asteroseismic and spectroscopic observations of red giant stars. We compared our results to state-of-the-art chemo-dynamical Milky Way models and recent literature results obtained with open clusters and planetary nebulae, and propose a new method to infer the past history of the Galactic radial abundance profile.

Keywords. stars: asteroseismology, stars: late-type, stars: abundances, stars: distances, stars: ages, Galaxy: stellar content, Galaxy: evolution

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In Anders *et al.* (2017), we used combined asteroseismic CoRoT and spectroscopic APOGEE observations of 418 red giants located close to the Galactic disc plane (6 kpc $< R_{\rm Gal} <$ 13 kpc) to derive the age dependence of the Milky Way's radial metallicity gradient. The radial iron gradient traced by the youngest red-giant population ($-0.058 \pm 0.008 \pm 0.003$ dex/kpc) reproduces the results obtained with young Cepheids and HII regions, while for the 1-4 Gyr population we obtain a slightly steeper gradient ($-0.066 \pm 0.007 \pm 0.002$ dex/kpc). For older ages, the gradient flattens again to reach values compatible with zero at around 10 Gyr.

While these measurements are in good agreement with other nebular and stellar tracers, the debate about the evolution of the Milky Way's radial metallicity gradient is still ongoing. It should be kept in mind, however, that the age dependence of the metallicity gradient is not the same as its evolution. The age dependence of the abundance profile is seriously affected by secular processes, in particular stellar radial migration.

As shown independently by Minchev *et al.* (2018) and Frankel *et al.* (2018), it is possible – and necessary – to infer both the evolution of the radial abundance profile and the stellar migration history at the same time. These measurements are crucially dependent on the availability of precise and accurate stellar ages for large samples of stars. We expect that ages for turn-off stars with precise *Gaia* DR2 parallaxes (Gaia Collaboration *et al.* 2018) and precise stellar parameters from spectroscopic surveys (and eventually the PLATO mission; see Miglio *et al.* 2017) will enable a much more detailed archaeological determination of the evolution of the Milky Way's radial abundance profile.

References

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