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Weak Atomic Diffusion Trends in NGC 6752

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Atomic diffusion (AD) is a slow continuous process that depletes heavy elements such as Fe from the surface layers during the MS lifetime of a star. As the star evolves to the RGB the effect of depletion disappears as its deep outer convection zone restores the original composition in the atmosphere. Mixing processes at work below the outer convection zone reduce the effect of AD as they hinder the downward diffusion of heavy elements, and thus a more efficient mixing will cause flattened diffusion trends. Such additional mixing (AddMix) seems to be needed to reproduce observed abundance trends. Although the inclusion of extra mixing in a layer just below the convective envelope is remarkably successful in describing the observed abundance trends in NGC 6397 ([Fe/H] = −2.1), the description applied is in no way unique or physically satisfying. To better understand the physics and place additional constraints on the possible variation of extra mixing with stellar parameters such as metallicity, we conducted a study, similar to that presented in Korn *et al.* (2007), of another metal-poor GC NGC 6752 ([Fe/H] = −1.6). In Fig. 1 we show the results, published in Gruyters *et al.* (2013), which shows weak yet systematic abundance trends with evolutionary phase for Fe, Sc, Ti and Ca. The trends are best explained by stellar structure models including AD with efficient AddMix. As a consequence sub-primordial stellar lithium abundances of the stars on the Spite plateau can be brought up to match the WMAP-calibrated Big Bang nucleosynthesis predictions to within the mutual 1-sigma errors.

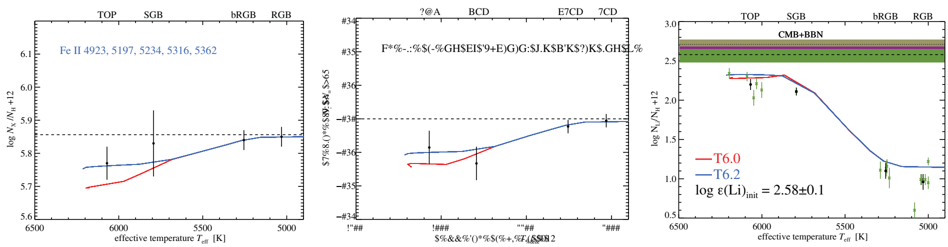

Figure 1. Observed diffusion trends with evolutionary stage. Each point represents the abundance derived from the co-added spectra within each group as a function of $T_{\rm eff}$. Overlaid are predictions from stellar evolution models including AD and AddMix with two different efficiencies, at 13.5 Gyr. The blue curve represents high-efficiency mixing ($\log T_0 = 6.20$) while the red curve corresponds to low-efficiency mixing ($\log T_0 = 6.00$). *Left:* Fe trend. *Center:* Mean trend by normalising the observations and models for Ca, Sc, Ti and Fe to the primordial abundances given by the models and afterwards averaging these normalised observations and model trends. *Right:* Li trend. Green crosses indicate individual stellar abundances, while black bullets represent the mean abundance. Figures from Gruyters *et al.* (2013).

References

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