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Carbon enhanced metal poor (CEMP) stars and the early stellar population of the Galaxy

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Abstract. In recent years, with massive spectroscopic surveys it is possible to probe the chemical/star-formation history of the early Galaxy. In this work, we derive carbon abundances and kinematics for a subset of 30,000 stars from SDSS-DR7 calibration sample. We confirm the increase in the CEMP fraction at low metallicities. The analysis showed that the CEMP fraction of the outer Halo stars is almost twice the CEMP fraction of the inner Halo stars (Carollo et al. 2011). Similar enhancement of carbon is also seen among the stars of ultra faint dwarf satellites (Lai et al. 2011). This subject recieved an increased attention after the recent discovery of the C-rich metal poor ([Fe/H] < -3.0) DLA, at a redshift of z= 2.3 (Kobayashi et al 2011), with abundance ratios similar to CEMP stars. This indicate contributions from Pop-III faint first supernovae to the early carbon production.

Keywords : Metal poor stars: abundances – carbon, Galaxy: inner/outer Halo

1. Introduction

Spectroscopic surveys of metal poor stars have found a large number of carbon rich stars at low metallicities ([Fe/H] < -2.0). The fraction of such stars with [C/Fe] > 1.0, is 10-20% at [Fe/H] < -2.0) and increases to even higher values below [Fe/H] < -3.0 (Beers & Christlieb 2004). Tumlinson (2007), proposed CMB based IMF at low metallicities and redshifts z>2.0 to explain the increase in CEMP fraction. He also

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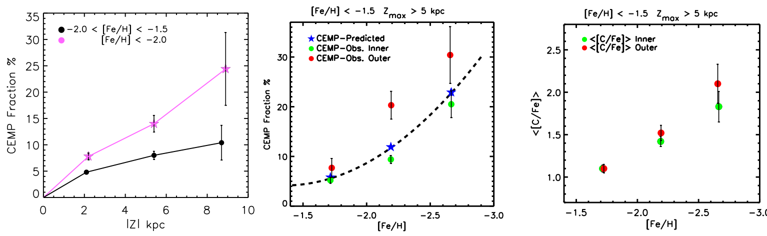

Figure 1. CEMP star fraction as a function of Galactic scale height Z (left) and [Fe/H] (middle) is shown. The dashed line is a polynomial fit of the global trend. The right-most plot shows the mean carbon abundance as a function of [Fe/H].

proposed, spatial variations of CEMP fraction in the Galaxy at a given metallicity. About 80% of CEMP stars also show s-process enhancement (CEMP-s) indicating AGB carbon production, and they have a metallicities between -1.5 to -2.5. However the origin of carbon in CEMP-no stars(with no s-process enhancement and [Fe/H] < -3.0) is still unclear.

2. CEMP stars in the inner and outer halo

The figure shows an increase of CEMP fraction with Galactic scale height Z, for a given metallicity, suggesting that the halo CEMP population is not driven by metallicity alone. CMB based IMF can explain Z and metallicity dependence of CEMP-fraction. However the increased CEMP-fraction of the outer halo and the high mean carbon abundance suggests that it could be also driven by the different origin of the stellar population of the inner and outer halo. Additional constraints from s-process and nitrogen abundances of CEMP stars of the inner/outer halo will place important constraints on the primordial IMF of the sub-systems responsible for the formation of the Galaxy halo.

3. Conclusion

We have tried to explain the origin of high CEMP frequency at low metallicity through the kinematic origin of the samples, demonstrating that it arises from the differing nature of the stellar populations associated with the inner/outer halo. Further exploration of the CEMP stars, in particular the CEMP-no sub-class, will be of interest.

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