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The stellar initial mass function in the early universe revealed from old stellar populations in our neighbourhood

Yutaka Komiya[1], Shimako Yamada[2], Takuma Suda[1], and Masayuki Y. Fujimoto[2]

[1]National Astronomical Observatory of Japan,
Osawa, Mitaka, Tokyo 181-8588, Japan

[2]Dept. of Cosmophysics, Hokkaido University,
Sapporo, Hokkaido 060-0810, Japan

Abstract. We present a new method to investigate the IMF in the early universe from observations of extremely metal-poor (EMP) stars. EMP stars are the low-mass survivors of stars which are formed in the early universe. We can give constraints on the IMF from statistics of the elemental abundances of the EMP stars in the Galactic halo.

Keywords. stars: abundances, stars: Population II, binaries, Galaxy: halo, Galaxy: formation

1. Constraints on the IMF in the early universe

It is known that a large fraction ($10 - 25\%$) of metal-poor stars show carbon enhancement and many of them show enhancement of s-process elements. The abundance anomaly of these stars is thought to be due to the binary mass transfer from intermediate-mass stars. Abundances of s-process elements on their surface depend on the mass of formerly primary stars. Therefore, from the statistics of observed carbon-enhanced metal-poor stars, we can give constraints on the distribution of primary stars of binaries.

Another constraint is given by the total number of EMP stars which survive to date. We can estimate the averaged yield of iron per massive stars as a function of the IMF from the number density of observed EMP stars. Only a top-heavy IMF peaked around $10\,M_\odot$ predicts iron yields in agreement with theoretical studies of supernova nucleosynthesis (Komiya *et al.* 2009).

2. When and where did the IMF change?

We search for the signatures of IMF change on the abundance distribution of metal-poor stars. The fraction of carbon rich stars depends on the IMF. Observationally, the fraction of carbon-rich stars drops around [Fe/H]$= -2$.

Another signature is hypernova origin elements. Stars with $m > 20\,M_\odot$ are thought to explode as hypernovae with huge explosion energies and the production of large amounts of Zn (Umeda & Nomoto 2002). Observationally, the relative abundance of Zn decreases at [Fe/H]$\gtrsim -2.2$. These can be signatures of an IMF change at [Fe/H]~ -2.2.

References

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