# A Study on the First Stars in our Universe as a Probe into its Early History

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## 【Outline of survey】

The firsts stars in our Universe were born during 'dark age', ~100 Million years after the Big Bang when the temperature decreases to ~100 K as a result of the expansion; they released nuclear energy to illuminate the 'dark age' and re-ionize gas, and also, ejected nuclear products to enrich the Universe with carbon and heavier elements, which announced the beginning of the luminous era that lead to the formation of galaxies and finally gave birth to the lives. It is one of the central issues in Astrophysics nowadays to decode this early history of structure formation, and because of their long lives, the low-mass survivors of the first stars are thought as a unique probe into the early Universe that cannot be reach via optical observations. Recently the number of known extremely metal-poor stars has greatly increased thanks to the large-scale surveys of these survivors in the Galactic halo, and in particular, it is epoch-making that two stars showing the iron abundances below 1/100,000 of the solar have been discovered, one using VLT telescope in 2002, and the other by Subaru observation program organized by the participants of this project last year. In the present project, we first investigate the evolution and nucleosynthesis of extremely metal-poor stars and elucidate the characteristics of the stars born in early Universe. In combination of these theoretical results with the observational research such as the high-resolution spectroscopy by using the large telescopes, we then search for the population III stars, completely devoid of metals, and trace the formation process of the Galactic halo, to explore the early history of our Universe.

## 【Expected results】

In this study, we elucidate a general picture of the evolution and nucleosynthesis of the extremely metal-poor stars in the mass range from low-mass stars, surviving today as a probe into the era of their birth, to massive stars that have explored as supernova to enrich our Universe with metals. The supernova explosions may have left their imprints on the stars born from gas mixed with their ejecta, but on the other hand, the low-mass survivors may have suffered from the modification of surface characteristics during their long lives over ~13 Giga years by accreting interstellar gas enriched with metals, and also, though mass transfer in the binary systems from massive companions which developed the peculiar surface abundances. With these effects taking into account and in combination with the search for the Pop III stars and the close observations of extremely metal-poor stars in the Galactic halo, we explore the characteristics of stars born in the beginning of Universe, and draw a constraint on their initial-mass function.. Our study gives an insight into the formation of our Galactic halo and may present a new picture of interactions and evolution of matter in early Universe.

## 【References by the principal researcher】

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| 【Term of project】 FY2006－2010 | 【Budget allocation】 11,200,000 yen |
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| 【Homepage address】 | none |