【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Mathematical and physical sciences)

Title of Project：Stellar evolution and chemical enrichment from the first stars to the Milky Way formation

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Research Area：Astronomy
Keyword：Optical-infrared astronomy, Theoretical astronomy

【Purpose and Background of the Research】

Since the Big Bang of the universe 13.7 billion years ago, a variety of elements have been synthesized by stars and supernova explosions. The first generations of stars are believed to have key to understanding of such history of the universe. Among such stars formed from the gas clouds including only hydrogen and helium, massive stars that are much heavier than the Sun are dominant, and have provided amount of heavy elements through supernova explosions.

The dust grains formed from the heavy elements should have promoted the next generations of stars including less massive stars. The long lifetime of low-mass stars enables some of them survive until now.

Such objects still contain smaller amount of heavy elements than the Sun, and can be distinguished by measurements of chemical compositions based on stellar spectroscopy. The purpose of our project is to investigate such old stars in the Milky Way and surrounding small galaxies to understand the star formation and supernova explosions in the early universe, as well as subsequent chemical enrichment, dust formation, and formation of small galaxies.

【Research Methods】

We have been working on the survey and chemical abundance measurements for old stars in the Milky Way using the spectrograph mounted on the Subaru Telescope (NAOJ). We will extend such studies to objects in dwarf galaxies around the Milky Way. The efficiency of the observations for such objects will be enhanced by upgrading the instrument through this project.

Observational results will be combined with previous studies by constructing a database of metal-poor stars. Theoretical studies for supernova nucleosynthesis, dust formation after supernovae, low-mass star formation at low metallicity, and formation of dwarf galaxies will be conducted.

The dwarf galaxy Sextans A (observed with the Subaru Telescope. Such small galaxies would have been formed in the early Galaxy.

The Subaru Telescope (NAOJ)

【Expected Research Achievements and Scientific Significance】

Recent studies for limited number of stars in dwarf galaxies around the Milky Way suggest that the chemical composition of such small galaxies show unexpectedly large variations. Our project will conduct such observations for significantly large number of objects and will reveal the variations of dwarf galaxies and their similarity to, or differences from, the Milky Way stars. Our observations and theoretical studies will contribute to understanding the first generations of massive stars and their supernova explosions, as well as the low mass star formation and evolution through the history of the Galaxy formation.

【Publications Relevant to the Project】

"Nucleosynthesis signatures of the first stars" Frebel, A., Aoki, W., et al., 2005, Nature 434, 434, 871-873

"The first chemical enrichment in the universe and the formation of hyper metal-poor stars" Iwamono, N., Umoede, N., Tominaga, N., Nomoto, K. Maeda, K., 2005, Science 309, 451

"Formation and evolution of dust in type IIb supernovae with application to the Cassiopea A supernove remnant" Nozawa, T., Kozasa, T. Tominaga, N. et al., 2010, Astrophy. J., 713, 356

【Term of Project】 FY2011-2015

【Budget Allocation】 90, 500 Thousand Yen

【Homepage Address and Other Contact Information】

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