

Probing the Dark Age: From First Generation Objects to Primordial Galaxies

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【Outline of survey】

The objective is to probe the dark age in the universe, using a Cosmo-Simulator "FIRST" that has been developed by Specially Promoted Research in Grants-in-Aid for Scientific Research (2004-2007). We explore the physical processes of the formation of first generation objects in dark matter and the subsequent formation of primordial galaxies, by performing large-scale simulations, where self-gravity, hydrodynamics, radiation transfer, and non-equilibrium chemistry of primordial gas are consistently incorporated in the system composed of dark matter, baryonic gas, and stars. In particular, we scrutinize the first star formation induced by the collapse of cold dark matter density fluctuations, the metal enrichment of intergalactic medium by supernova explosions in first generation objects, the reionization history through the formation of luminous sources, the galaxy formation in a reionized universe, the formation of globular clusters in ultraviolet radiation, and the evolution of primordial galaxies via supernova explosions.

【Expected results】

We aim at establishing the physical picture of the dark age in the universe, by performing integrative cosmological simulations on the star formation history in first generation objects and the galaxy formation in a reionized universe. This research brings us understanding of the missing history of galaxy formation, and also elucidation of the physical state of Lyman alpha emitters with redshifts higher than 6, and the contribution of first generation objects and primordial galaxies to the metal enrichment of intergalactic medium. Furthermore, the event rate of gamma ray bursts at high redshifts, and the origin of globular clusters are illuminated.

【References by the principal investigator】

- M. Umemura, H. Susa, T. Suwa, D. Sato, and FIRST Project Team, FIRST Project: Formation and Feedback of First Stars, *First Stars III*, 386-389 (2008)
- H. Susa and M. Umemura, Secondary Star Formation in a Population III Object, *Astrophysical Journal Letters*, **645**, L93-L96 (2006)
- M. Mori and M. Umemura, The Evolution of Galaxies from Primeval Irregulars to Present-day Ellipticals, *Nature*, **440**, 644-647 (2006)

【Term of project】 FY2008—2012

【Budget allocation】

73,100,000 yen (direct cost)

【Homepage address】 Under construction