외부은하 / 은하단

[구 GC-01] Satellites of Isolated Early-type Galaxies and the Missing Satellite Galaxy Problem

Changbom Park[1], Ho Seong Hwang[1], Hyunbae Park[2], Jong Chul Lee[2]
[1]Korea Institute for Advanced Study, [2]Korea Astronomy and Space Science Institute

The standard hierarchical galaxy formation scenario in the popular LCDM cosmogony has been very successful in explaining the large-scale distribution of galaxies. However, one of the failures of the theory is that it predicts too many satellite galaxies associated with massive galaxies compared to observations, which is called the missing satellite galaxy problem. Isolated groups of galaxies hosted by passively evolving massive early-type galaxies are ideal laboratories for finding the missing physics in the current theory. We discover through a deep spectroscopic survey of galactic satellite systems that bright isolated early-type galaxies have almost no satellite galaxies fainter than the r-band absolute magnitude of about Mr=-14. The cutoff is at somewhat brighter magnitude of about Mr=-15 when only early-type satellites are used. Such a cutoff is not observed in the luminosity function of galaxies in the field. Physical properties of the observed satellites depend sensitively on the host-centric distance. All these are strong evidence that galactic satellites can become invisible due to astrophysics of satellite-host galaxy interaction. A recent state-of-the-art hydrodynamic simulation of galaxy formation does not reproduce such a cutoff in the satellite galaxy luminosity function. But the past history of the simulated satellites shows that many satellite galaxies near or somewhat fainter than the cutoff magnitude have recently become extinct through fatal encounters with the host or other satellite galaxies. Our observation indicates that the missing satellite galaxy problem could be mitigated if the astrophysics of galaxy interaction is more elaborated in the theory.

[구 GC-02] A Hyper Suprime-Cam View of the Interacting Galaxies of the M81 Group - Structures and Stellar Populations

Nobuo Arimoto[1,3] and Sakurako Okamoto[2]
[1]Seoul National University
[2]Shanghai Astronomical Observatory
[3]Subaru Telescope, NAOJ

Over the last decade, deep studies of nearby galaxies have led to the discovery of vast stellar envelopes that are often rich in substructure. These components are naturally predicted in models of hierarchical galaxy assembly, and their observed properties place important constraints on the amount, nature, and history of satellite accretion. One of the most effective ways of mapping the peripheral regions of galaxies is through resolved star studies. Using wide-field cameras equipped to 8 m class telescopes, it has recently become possible to extend these studies to systems beyond the Local Group. Located at a distance of 3.6 Mpc, M81 is a prime target for wide-field mapping of its resolved stellar content.

In this talk, we present the detailed results from our deep wide-field imaging survey of the M81 group with the Hyper Suprime-Cam (HSC), on the Subaru Telescope. We report on the analysis of the structures, stellar populations, and metallicities of old dwarf galaxies such as NGC3077, IKN, KDG061, as well as young stellar systems such as Arp's Loop and Holmberg IX. Several candidates for yet-undiscovered faint dwarf galaxies and young stellar clumps in the M81 group will also be introduced. The peculiar galaxy NGC3077 has been classified as the irregular galaxy. Okamoto et al. (2015, ApJ 809, L1) discovered an extended halo structure with S-shape elongated tails, obvious feature of tidal interaction. With a help of numerical simulation by Penarrubia et al. (2009, ApJ 698, 222), we will demonstrate that this tidal feature was formed during the latest close encounters between M81, M82, and NGC 3077, which induced star formation in tidally stripped gas far from the main bodies of galaxies. It is not clear whether the latest tidal interaction was the first close encounters of three galaxies. If NGC3077 is still surrounded by the dark matter halo, it implies that NGC3077 has undergone the first tidal stripping by larger companions. Kinematic studies of inter galactic globular clusters and planetary nebulae would tell us the past history of tidal interaction in this group of galaxies.

[구 GC-03] Revealing Natures of Ultra-diffuse Galaxies: Failed Giant Galaxies or Dwarf Galaxies?

Jeong Hwan Lee[1], Jisu Kang[1], Myung Gyoon Lee[1], and In Sung Jang[2]
[1]Department of Physics and Astronomy, Seoul