

【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Mathematical and physical sciences)



Title of Project : The Origin of Morphologies of Galaxies : Explorations with Multi-Object and Integral-Field Spectroscopic Observations

Nobuo Arimoto

(National Astronomical Observatory of Japan, Optical and Infrared Astronomy Division, Professor)

Research Area : Astronomy

Keyword : Optical and Infrared Astronomy, Extragalactic Astronomy

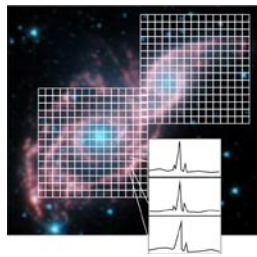
【Purpose and Background of the Research】

Red-shifted optical spectra of distant galaxies can be measured by infrared spectrographs. One of Subaru Telescope's major instruments, multi-object infrared camera and spectrograph (MOIRCS) has revealed some aspect of evolutionary behaviour of galaxies at $z=2-3$. It is still poorly understood, however, how these galaxies have evolved and have become the present day galaxies with well designed morphologies. To reveal the origin of galaxy morphologies, it is crucial to study the internal gas motion, such as the rotation and random motion, and to know the detailed star formation histories of galaxies.

We will upgrade MOIRCS with newly designed integral-field spectrograph (IFS) and new CCDs. With this upgraded MOIRCS, we will investigate the internal structure and gas motion and will carry out an intensive spectroscopic survey of star forming activity and metallicities of high- z galaxies to uncover how galaxies evolve from active star forming galaxies of irregular shapes to passive elliptical galaxies in the present Universe.

【Research Methods】

① **The origin of galaxy morphologies explored with multi-object and integral field spectroscopic observations** – We study the internal structure and gas motion of star forming galaxies at $z=0.5-1.5$, which is just after the period when the star forming activity of the Universe has attained the maximum peak and then declined gradually; at the same time, the regular morphologies of galaxies has appeared. With integral-field spectroscopy of galaxies at different redshift from $z=1.5$ to 0.5 , we will learn how dynamical mass controls star forming, and how gas flows in galaxies of various irregular morphologies. Systematic survey of galaxies will hopefully provide us a crucial key to open the door of mysterious box with a label written as “ galaxy evolution”.

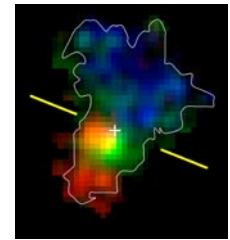


(Fig.1 IFS Spectroscopy)

② **Star formation and galaxy morphologies explored with multi-object spectroscopic observations** – We will measure the metallicities of large number of galaxies at $z=0.5-1.5$. The metallicities of galaxies, a fossil of star formation in the past, would uncover how galaxy morphologies correlate tightly with star formation histories.

【Expected Research Achievements and Scientific Significance】

Why the star forming activity of galaxies has peaked at around $z=2-3$ and then declined gradually? Why star forming massive galaxies with irregular morphologies have become grand designed spirals or ellipticals of the local Universe? These are the questions we wish to answer by spectroscopic survey with new MOIRCS.



(Fig.2 Rotating Disk Galaxy @ $z=2.4$)

Next generation telescopes such as TMT (30m) will fully use the power of IFS to reveal the details of galaxy formation. The IFS is the crucial technique for the next generation ground telescopes and this research will contribute a lot to develop such technique for Japanese astronomical community of post Subaru.

【Publications Relevant to the Project】

Onodera, M., Daddi, E., Gobat, R., Cappellari, M., Arimoto, N. et al. “A $z=1.82$ Analog of Local Ultra-Massive Elliptical Galaxies”, *ApJ* 715, L6-L11, 2010

Onodera, M., Arimoto, N., Daddi, E., Renzini, A., Kong, X. et al. “A Wide Area Survey for High-Redshift Massive Galaxies. II. Near-Infrared Spectroscopy of BzK-Selected Massive Star-Forming Galaxies”, *ApJ* 715, 385-405, 2010

【Term of Project】 FY2011-2014

【Budget Allocation】 165,600 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.naoj.org/Projects/newdev/nm/>