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

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Establishing processes of galaxy structure revealed by a Subaru tomographic adaptive optics

Masayuki Akiyama
(Tohoku University, Astronomical Institute, Professor)

Research Project Number : 17H06129 Researcher Number : 50425401
Research Area : Astronomy
Keyword : Optical near-infrared astronomy, applied optics

【Purpose and Background of the Research】

How have been the structures of the galaxies with bulge and thin disk in the present-day universe established? Recent observations of the galaxies in the early universe reveal that young galaxies have surprisingly different structures than the present-day galaxies: turbulent gas disk with large velocity dispersion and compact central region, which has 3 orders of magnitude higher stellar number density than seen in the present-day galaxies. The purpose of this research is to observationally reveal establishment processes of the structure of galaxies seen today by observing distributions and dynamical motions of stars inside distant galaxies.

【Research Methods】

The spatial distribution of stars inside distant galaxies will be revealed by high spatial resolution imaging in the near infrared. Such observation can be achieved by installing a newly developed fiber-laser light source to the current Subaru telescope 188 element adaptive optics system. The observation will be conducted with the infrared camera and spectrograph (IRCS) on the Subaru telescope.

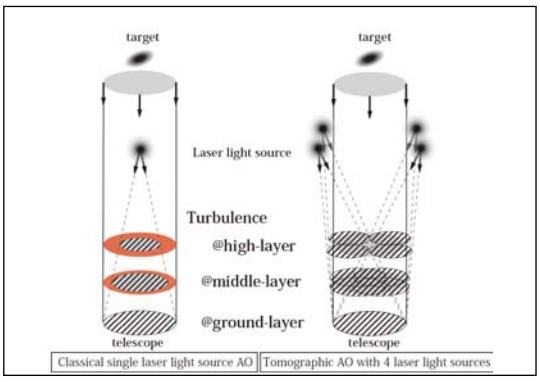

Figure. 1

On the other hand, stellar dynamical structure of the galaxies is revealed by visible redshifted absorption lines of distant galaxies seen in the visible wavelength. We achieve such observation by introducing a tomographic adaptive optics system. In the current AO system with a single laser light source, the performance of the AO is limited by the fact that the light source is at a finite distance and its light passes through a conical region as shown in figure 1. Introducing 4 laser light sources, we will cover the cylindrical light path of the astronomical targets at infinity. The measured wavefronts will be analyzed by a tomographic estimation method. With this tomographic adaptive optics system, we can achieve good AO correction in the visible wavelength range where laser AO systems have not been effective. The high spatial resolution integral field spectroscopy will be conducted with visible integral field spectrograph, 3DII.

【Expected Research Achievements and Scientific Significance】

High spatial observations in the visible and near-infrared provide us with the crucial information to understand the stellar distribution and dynamics inside distant galaxies.

AO system with laser light source is not operational in the visible wavelength all over the world, and this laser tomography AO system will open a new window to conduct a high-resolution observation.

【Publications Relevant to the Project】

"Multi time-step wavefront reconstruction for tomographic adaptive-optics systems", Ono, Y., Akiyama, M., Oya, S., et al., Journal of Optical Society of America, A., 2016, 33, 726

【Term of Project】

FY2017-2021

【Budget Allocation】

161,300 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.astr.tohoku.ac.jp/~akiyama/index_Res_TMTinst.html
akiyama@astr.tohoku.ac.jp