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| **Session:** | **[B2A-4] S4 : Galaxies, AGN and Cosmology** |
| **Date:** | August 19, 2014 (Tuesday) |
| **Time:** | 11:00~12:25 |
| **Room:** | Room D (Room 105~106) |
| **Chair:** | Sascha Tripper (Seoul National University) |

**[B2A-4-1]** **11:00~11:20**

### [Invited] Evidence for the Luminosity Evolution of Type Ia Supernovae from Early-type Host Galaxies

Young-Wook Lee (Yonsei University, Korea), Yijung Kang, Young-Lo Kim, Dongwook Lim, and Chul Chung

Supernovae type Ia (SNe Ia) cosmology is providing the only direct evidence for the presence of dark energy. This result is based on the assumption that the look-back time evolution of SNe Ia luminosity, after light-curve shape correction, would be negligible. However, the most recent compilation of SNe Ia data shows systematic difference in the Hubble residual (HR) between the E and Sd/Irr galaxies, indicating that the light-curve fitters used by the SNe Ia community cannot quite correct for a large portion of the population age effect. In order to investigate this possibility more directly, we have obtained low-resolution spectra for 30 nearby early-type host galaxies. This data set is used to estimate the luminosity-weighted mean ages and metallicities of host galaxies by employing the population synthesis models. We found an interesting trend between the host galaxy age and HR, in the sense that younger galaxies have positive residuals (i.e., light-curve corrected SNe Ia luminosity is fainter). This result is rather independent of the choice of the population synthesis models employed. Taken at face value, this age (evolution) effect can mimic a large fraction of the HR used in the discovery of the dark energy, but further observations and analyses are required to confirm the trend reported here.

**[B2A-4-2]** **11:20~11:40**

### [Invited] Sustaining Galaxy Evolution: the Role of Stellar Feedback

Atefeh Javadi (Institute for research in Fundamental Sciences, Iran), Jacco Th. Van Loon, and Habib Khosroshahi

We have conducted a near-infrared monitoring campaign at the UK InfraRed Telescope (UKIRT), of the Local Group galaxy M33. The main aim was to identify stars in the very final stage of their evolution, and for which the luminosity is more directly related to the birth mass than the more numerous less-evolved giant stars that continue to increase in luminosity. The pulsating giant stars (AGB and red supergiants) are identified and their distributions are used to derive the star formation rate as a function of age. These stars are also important dust factories; we measure their dust production rates from a combination of our data with Spitzer Space Telescope mid-IR photometry. The mass-loss rates are seen to increase with increasing strength of pulsation and with increasing bolometric luminosity. Low-mass stars lose most of their mass through stellar winds, but even super-AGB stars and red superginats lose ~40% of their mass via a dusty stellar wind. We construct 2-D map of the mass-return rate, showing radial decline but also local enhancements due to agglomerations of massive stars. By comparing the current star formation rate with total mass input to ISM, we conclude that the star formation in the central regions of M33 can only be sustained if gas is accreted from further out in the disc or from circum-galactic regions. Now we are extending our study to the other galaxies in Local Group including Small and Large Magellanic Clouds. Ultimately we will study the feedback of evolved stars in Virgo cluster of galaxies with ELT observations.

**[B2A-4-3]** **11:40~11:55**

### Molecular Gas Properties under ICM Pressure in the Cluster Environment

Bumhyun Lee (Yonsei University, Korea) and Aeree Chung

We present CO properties of four spiral galaxies (NGC4330, NGC4402, NGC4522, NGC4569) in the Virgo cluster that are undergoing different ram pressure stages due to the intra cluster medium (ICM). The goal is to probe the detailed properties of the molecular gas under strong ICM pressure. In this work, using high-resolution millimeter data taken with the Submillimeter Array (SMA), we investigate the CO morphology and kinematics of the sample. Also, combining with the Institut de RadioAstronomie Millimetrique (IRAM) data, we study spatially resolved temperature and density distributions of the molecular gas. Compared with multi-wavelength data (optical, HI, UV, Hα), we discuss how molecular gas properties and star formation activity change while a galaxy experiences HI stripping. This study suggests that ICM pressure can well modify the physical and chemical properties of the molecular gas even if stripping does not take place in the molecular gas. We discuss how this affects the star formation rate and galaxy evolution in the cluster environment.

**[B2A-4-4]** **11:55~12:10**

### Tracing Recent Star Formation of Red Early-type Galaxies

Jongwan Ko (Korea Astronomy and Space Science Institute, Korea), Ho Seong Hwang, Myungshin Im, and Jong Chul Lee

We study the mid-infrared (IR) and near-ultraviolet (UV) excess emissions of early-type galaxies (ETGs) on the optical red-sequence at z < 1 using a spectroscopic sample of galaxies in the Sloan Digital Sky Survey (SDSS) Data Release 7 and in the fields of Great Observatories Origins Deep Survey (GOODS). In the mass-limited GOODS sample of 1025 galaxies with Mstar > 1010.5M☉ and 0.4 < z < 1.05, we identify 696 Spitzer 24 μm detected (above the 5σ) galaxies and find them to have a wide range of NUV-r and r-[12 μm] colors despite their red optical u−r colors. Even in the sample of very massive ETGs on the red sequence with Mstar > 1011.2M☉, more than 18% show excess emission over the photospheric emission in the mid-IR. The combination with the results of SDSS red ETGs in the local universe suggests that the recent star formation is not rare among quiescent, red ETGs at least out to z ~1 if the mid-IR excess emission results from intermediate-age stars or/and from low-level ongoing star formation. Our color−color diagram including near-UV and mid-IR emissions are efficient not only for identifying ETGs with recent star formation, but also for distinguishing quiescent galaxies from dusty star-forming galaxies.

**[B2A-4-5]** **12:10~12:25**

### The Galactic-Scale Molecular Outflows in Starburst Galaxies NGC 2146 and NGC 3628

An-Li Tsai (National Centraul University, Taiwan) and Satoki Matsushita

In order to understand how the galaxies mass loss affects the galaxies evolution, I study how nearby galaxies loss their fuel, molecular gas, through galaxy activities. Starburst galaxies are good candidates to study the molecular gas consumption in galaxies. They are currently undergoing intense star formation in the central region of the galaxies, and their strong star formation produced galactic-scale outflow and ejected large amount of molecular gas. However, the accurate measurement of losing molecular gas are very rare because it is difficult to directly observe molecular outflows or due to their diffuse/extended nature and the poor instrumental sensitivities. So far there are only a few studies on galactic-scale molecular outflows due to the sensitivity limitation of telescopes. Our studies provides two samples of starburst galaxies, NGC 2146 and NGC 3628. We used Nobeyama Millimieter Array (NMA) data and Chandra soft X-ray data to study the molecular outflows and their interaction with ionized outflows. We found that the molecular gas are pushed by the hot ionized outflows due to their high pressure. Beside, the molecular outflows have larger mass loss rate than the star forming rate. This indicates that the molecular outflows dominate the gas consumption in starburst galaxies. Since the fraction of starburst galaxies is higher in distant universe than in the local universe, this study can bridge the gap between our knowledge between local and distant galaxies, and could help us to understand the galaxy evolution in the universe.