

## THE LUMINOSITY OF TYPE IA SUPERNOVA AND THE PROPERTIES OF THEIR EARLY-TYPE HOST GALAXIES

YIJUNG KANG<sup>1</sup>, YOUNG-LO KIM<sup>1</sup>, YOUNG-WOOK LEE<sup>1</sup>, DONGWOOK LIM<sup>1</sup>, CHUL CHUNG<sup>1</sup>, AND EON-CHANG SUNG<sup>2</sup>

<sup>1</sup>Center for Galaxy Evolution Research & Department of Astronomy, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul 120-749, Korea

<sup>2</sup>Korea Astronomy and Space Science Institute, 776 Daedeok-daero, Yuseong, Daejeon 305-348, Korea

*E-mail: yjkang@galaxy.yonsei.ac.kr, ywlee2@yonsei.ac.kr*

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### ABSTRACT

In type Ia supernovae (SNe Ia) cosmology, a well-established correlation exists between the mass of host galaxies and the Hubble residual (HR) of SNe Ia. In order to investigate the origin of this correlation, we used low-resolution spectroscopic data of early-type host galaxies obtained from our YOnsei Nearby Supernovae Evolution Investigation (YONSEI) project. We measured velocity dispersions and Lick/IDS absorption line indices from these fully calibrated spectra. These indices were used to estimate the luminosity-weighted mean age, metallicity and mass of host galaxies. We found a tight correlation between host mass and population age, which is consistent with the “downsizing” trend in early-type galaxies. This suggests that the well-established correlation between HR and host mass is most likely due to the difference in population age. More observations, which are in progress, are required to understand the impact of luminosity evolution on SNe Ia cosmology.

*Key words:* cosmology: observations - galaxies: abundances - galaxies: elliptical and lenticular, cD - supernovae: general

### 1. OBSERVATIONS

We selected a total of 64 early-type host galaxies at  $0.01 < z < 0.05$  to investigate the possible luminosity evolution of type Ia supernovae (SNe Ia). The SNe Ia sample was drawn from the YOnsei Nearby Supernovae Evolution Investigation (YONSEI) supernova catalogue, and morphological classification is adapted from the NASA Extragalactic Database (NED). Our host sample was confined to early-type galaxies because population ages and metallicities can be estimated from absorption line spectra with the Evolutionary Population Synthesis (EPS) models.

Early-type hosts have been observed using the B&C spectrograph at the du Pont 2.5m telescope of Las Campanas Observatory. High signal-to-noise ratio (S/N) spectra of 27 host galaxies were obtained during 6 observing runs.

### 2. DATA ANALYSES

Basic data reduction and analysis were performed using IRAF, including pre-processing, extraction, wavelength calibration, flux calibration, and heliocentric velocity correction. We also removed weak emission lines from absorption lines using pPXF+GANDALF (Cappellari & Emsellem, 2004; Sarzi et al., 2006). The `lick_ew`

code (Graves & Schiavon, 2008) was used to measure Lick/IDS indices and these were converted to the Lick system using mean offsets. We also compared our results to previous studies to check the consistency of our measurement of Lick indices. Comparison with previous studies for common galaxies confirmed that there is no difference.

Luminosity-weighted mean age and metallicity of host galaxies were determined using Lick indices by employing the EPS models (Chung et al., 2013; Thomas et al., 2003, 2011; Schiavon, 2007).

### 3. CONCLUSIONS

Our preliminary results show a tight correlation between host mass and population age, which is consistent with the “downsizing” (Cowie et al., 1996) trend in early-type galaxies. This suggests that the well-established correlation between HR and host mass is most likely due to the difference in population age. A larger sample is being obtained at higher S/N to determine the possible correlation between population age and HR. We will also observe host galaxies located at  $0.01 < z < 0.2$  using the MMT 6.5m telescope.

A detailed description and discussion of this work will be presented in our forthcoming paper, which is to be submitted to a refereed journal.

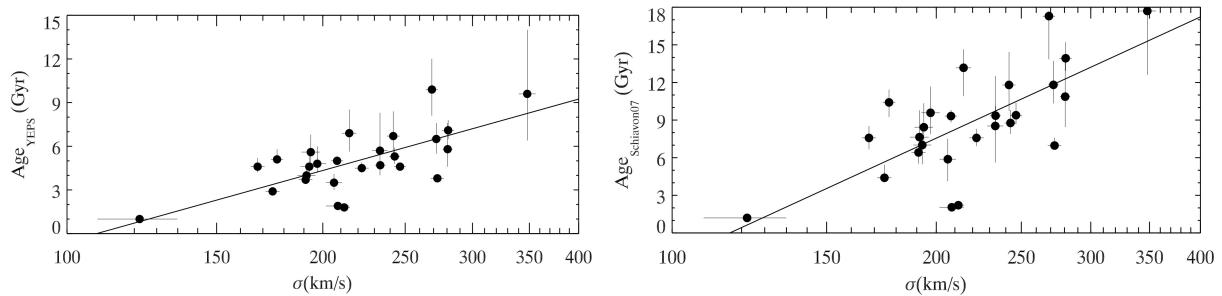


Figure 1. Velocity dispersion ( $\sigma$ ) of early-type host galaxies and their luminosity-weighted mean age derived using YEPS (Chung et al., 2013, top) and Schiavon (2007) (bottom) models. We found a strong correlation between velocity dispersion, which indicates galaxy mass, and age of stellar population. Population age of host galaxies is proportional to  $\sigma^{1.6 \pm 0.4}$  (left) and  $\sigma^{2.0 \pm 0.5}$  (right) at 3.4 sigma level from Markov Chain Monte Carlo (MCMC) analysis. Black solid lines indicate the posterior median estimate of the regression line. These preliminary results suggest that the well-established correlation between HR of SNe Ia and mass of host galaxies might be from the difference in population age.

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