[구CD-01] Evidence for the Luminosity Evolution of Type Ia Supernovae from the Ages of Early-type Host Galaxies

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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. This result is significant at 1.4 - 3 sigma levels, depending on the light curve fitters adopted, and further observations and analyses are certainly required to confirm the trend reported here.

[구CD-02] A Topological Analysis of Large Scale Structure Using the CMASS Sample of SDSS-III

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We study the three-dimensional genus topology of large-scale structure using the CMASS Data Release 11 sample of the SDSS-III Baryon Oscillation Spectroscopic Survey (BOSS). The CMASS sample yields a genus curve that is characteristic of one produced by Gaussian random-phase initial conditions. The data thus supports the standard model of inflation where random quantum fluctuations in the early universe produced Gaussian random-phase initial conditions. Modest deviations in the observed genus from random phase are as expected from the nonlinear evolution of structure. We construct mock SDSS CMASS surveys along the past light cone from the Horizon Run 3 (HR3) N-body simulations, where gravitationally bound dark matter subhalos are identified as the sites of galaxy formation. We study the genus topology of the HR3 mock surveys with the same geometry and sampling density as the observational sample, and the observed genus topology to be consistent with LCDM as simulated by the HR3 mock samples.