[1]*Korea Institute for Advanced Study,*
[2]*Korea Astronomy and Space Science Institute*
[3]*University of Seoul*

We present our first attempt at understanding the dual impact of the large-scale density and velocity environment on the formation of very first astrophysical objects in the Universe. Following the recently developed quasi-linear perturbation theory on this effect, we introduce the publicly available initial condition generator of ours, BCCOMICS (Baryon Cold dark matter COsMological Inital Condition generator for Small scales), which provides so far the most self-consistent treatment of this physics beyond the usual linear perturbation theory. From a suite of uniform-grid simulations of N-body+hydro+BCCOMICS, we find that the formation of first astrophysical objects is strongly affected by both the density and velocity environment. Overdensity and streming-velocity (of baryon against cold dark matter) are found to give positive and negative impact on the formation of astrophysical objects, which we quantify in terms of various physical variables.

[구 CD-03] Current status of an interacting dark sector with cosmological observations

Jurgen Mifsud
Korea Astronomy and Space Science Institute

The cosmic dark sector, composed of dark energy and dark matter, might be coupled, and hence mediate a fifth-force which gives rise to distinctive cosmological signatures. I will consider an interacting dark sector, in which dark energy and dark matter are coupled via specific well-motivated coupling functions. After an overview of these coupled dark energy models, I will discuss the current model parameter constraints derived from the latest cosmological observations which probe the expansion history, and the growth of cosmic structures of our Universe. Moreover, I will demonstrate how different measurements of the Hubble constant, including the GW170817 measurement, influence the inferred constraints on the dark coupling. I will further discuss how one could put tighter constraints on such a dark sector coupling with the upcoming large-scale radio surveys.

[구 CD-04] Cosmological Parameter Estimation from the Topology of Large Scale Structure

Stephen Appleby
School of Physics, Korea Institute for Advanced Study, 85 Hoegiro, Dongdaemun-gu, Seoul, 02455, Korea

The genus of the matter density eld, as traced by galaxies, contains information regarding the nature of dark energy and the fraction of dark matter in the Universe. In particular, this topological measure is a statistic that provides a clean measurement of the shape of the linear matter power spectrum. As the genus is a topological quantity, it is insensitive to galaxy bias and gravitational collapse. Furthermore, as it traces the linear matter power spectrum, it is a conserved quantity with redshift. Hence the genus amplitude is a standard population that can be used to test the distance-redshift relation. In this talk, I present measurements of the genus extracted from the SDSS DR7 LRGs in the local Universe, and also slices of the BOSS DR12 data at higher redshift.

I show how these combined measurements can be used to place cosmological parameter constraints on m, wde.

[구 CD-05] A Deep Convolutional Neural Network approach to Large Scale Structure

Cristiano G. Sabiu
Yonsei University

Recent work by Ravanbakhsh et al. (2017), Mathuriya et al. (2018) showed that convolutional neural networks (CNN) can be trained to predict cosmological parameters from the visual shape of the large scale structure, i.e. the filaments, clusters and voids of the cosmic density field. These preliminary works used the dark matter density field at redshift zero. We build upon these works by considering realistic mock galaxy catalogues that mimic true observations. We construct light-cones that span the redshift range appropriate for current and near future cosmological surveys such as LSST, EUCLID, WFIRST etc.

In summary, we propose a novel multi-image input CNN to track the evolution in the morphology of large scale structures over cosmic time to constrain cosmology and the expansion history of the Universe.

[구 CD-06] Matter Density Distribution Reconstruction of Local Universe with Deep Learning

Sungwook E. Hong[1], Juhan Kim[2], Donghui Jeong[3], Ho Seong Hwang[4]
[1]*Natural Science Research Institute, University of*

Seoul, [2]Center for Advanced Computation, Korea Institute for Advanced Study, [3]Department of Astronomy & Astrophysics, Penn State University, [4]Korea Astronomy and Space Science Institute

We reconstruct the underlying dark matter (DM) density distribution of the local universe within 20Mpc/h cubic box by using the galaxy position and peculiar velocity. About 1,000 subboxes in the Illustris-TNG cosmological simulation are used to train the relation between DM density distribution and galaxy properties by using UNet-like convolutional neural network (CNN). The estimated DM density distributions have a good agreement with their truth values in terms of pixel-to-pixel correlation, the probability distribution of DM density, and matter power spectrum. We apply the trained CNN architecture to the galaxy properties from the Cosmicflows-3 catalogue to reconstruct the DM density distribution of the local universe. The reconstructed DM density distribution can be used to understand the evolution and fate of our local environment.

[구 CD-07] Model-independent constraints on the light-curve parameters and reconstructions of the expansion history from Type Ia supernovae

Hanwool Koo[1,2] (구한울), Arman Shafieloo[1,2], Ryan Keeley[1], Benjamin L'Huillier[3]
[1]Korea Astronomy and Space Science Institute (한국천문연구원), [2]University of Science and Technology (과학기술연합대학원대학교), [3]Yonsei University (연세대학교)

We use iterative smoothing reconstruction method along with exploring in the parameter space of the light curves of the JLA supernova compilation (Joint Light-curve Analysis) to simultaneously reconstruct the expansion history of the universe as well as putting constrains on the light curve parameters without assuming any cosmological model. Our constraints on the light curve parameters of the JLA from our model-independent analysis seems to be closely in agreement with results assuming ΛCDM cosmology or using Chevallier-Polarski-Linder (CPL) parametrization for the equation of state of dark energy. This implies that there is no hidden significant feature in the data that could be neglected by cosmology model assumption. The reconstructed expansion history of the universe and properties of dark energy seems to be in good agreement with expectations of the standard ΛCDM model. Our results also indicate that the data allows a considerable flexibility for expansion history of the universe.

고에너지천문학/이론천문학

[초 HT-01] Recent results on IceCube multi-messenger astrophysics

Carsten Rott
Department of Physics, Sungkyunkwan University, Suwon 16419, Korea

Mass and radius of a neutron star in low-mass X-ray binary (LMXB) can be estimated simultaneously when the observed light curve and spectrum show the photospheric radius expansion feature. This method has been applied to 4U 1746-37 and the mass and radius were found to be unusually small in comparison with typical neutron stars. We re-estimate the mass and radius of this target by considering that the observed light curve and spectrum can be affected by other X-ray sources because this LMXB belongs to a very crowded globular cluster NGC 6441. The new estimation increases the mass and radius but they do not reach the typical values yet.

[구 HT-02] A Model for Diffusive Shock Acceleration of Protons in Intracluster Shocks and Gamma-ray and Neutrino Emissions from Clusters of Galaxies

Ji-Hoon Ha[1], Dongsu Ryu[1] and Hyesung Kang[2]
[1]Department of Physics, School of Natural Sciences UNIST, Ulsan 44919, Korea
[2]Department of Earth Sciences, Pusan National University, Busan 46241, Korea

During the formation of large-scale structures in the universe, shocks with the sonic Mach number Ms <~ 5 are naturally induced by supersonic flow motions of baryonic matter in the intracluster medium (ICM). Cosmic rays (CRs) are expected to be accelerated via diffusive shock acceleration (DSA) at these ICM shocks, although the existence of CR protons in the ICM remains to be confirmed through gamma-ray observations. Based on the results obtained from kinetic plasma simulations, we build an analytic DSA model for weak, quasi-parallel shocks in the test-particle regime. With our DSA model, the CR acceleration efficiency ranges ~ 0.001 – 0.02 in supercritical quasi-parallel shocks with sonic Mach number Ms ~ 2.25 – 5, and the acceleration would be negligible in subcritical shocks wth Ms <~ 2.25. Adopting our DSA model, we estimate gamma-ray and neutrino