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] Falsifying LCDM: model-independent tests of the concordance model of cosmology

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The concordance LCDM model has been very successful at reproducing a wide range of observations.

However, the nature of its main components, such as dark energy, dark matter, and inflation, are still unkown.

Therefore, it is of prime importance to question the underlying hypotheses of the model and tests there prediction.

While most constraints have been obtained assuming a LCDM universe, model-independent approaches, which do not make assumptions regarding the model, are a powerful approach.

To falsify the LCDM model, I applied model-indepedent methods to the latests available data to test different aspects of the concordance model, such as the FLRW metric, the curvature, dark energy as the cosmological constant, and gravity as general relativity.

The Universe is consistent with flat-LCDM with GR. However, at z>1, tensions start to appear, and more data are required.

[구 CD-04] Cosmological constraints using BAO – From spectroscopic to photometric catalogues

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Measurement of the location of the baryon acoustic oscillation (BAO) feature in the clustering of galaxies has proven to be a robust and precise method to measure the expansion of the Universe. The best constraints so far have been provided from spectroscopic surveys because the errors on the redshift obtained from spectroscopy are minimal. This in turn means that the errors along the line-of-sight are reduced and so one can expect constraints on both angular diameter distance D_A and expansion rate H^{-1}.

But, future surveys will probe a larger part of the sky and go to deeper redshifts, which correspond to more number of galaxies. Analysing each galaxy using spectroscopy, which is a time consuming task, will not be practically possible. So, photometry will be the most convenient way to measure redshifts for future surveys such as LSST, Euclid, etc. The advantage of photometry is measuring the redshift of vast number of galaxies in a single exposure, but the disadvantage are the errors associated with the measured redshifts.

Using a wedge approach, wherein the clustering is split into different wedges along the line-of-sight π and across the line-of-sight σ, we show that the BAO information can be recovered even for photometric catalogues with errors along the line-of-sight. This means that we can get cosmological distance constraints even if we don't have spectroscopic information.

[구 CD-05] H1R4: Mock 21cm intensity mapping maps for cross-correlations with optical surveys

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We are currently living in the era of the wide field cosmological surveys, either spectroscopic such as Dark Energy Spectrograph Instrument or photometric such as the Dark Energy Survey or the Large Synoptic Survey Telescope. By analyzing the distribution of matter clustering, we can use the growth of structure, in combination with measurements of the expansion of the Universe, to understand dark energy or to test different models of gravity. But we also live in the era of multi-tracer or multi-messenger astrophysics. In particular, during the next decades radio surveys will map the matter distribution at higher redshifts. Like in optical surveys, there are radio imaging surveys such as continuum radio surveys such as the ongoing EMU or spectroscopic by measuring the hydrogen 21cm line. However, we can also use intensity mapping as a low resolution spectroscopic technique in which we use the intensity given by the emission from neutral hydrogen from patches of the sky, at different redshifts. By cross-correlating this maps with galaxy catalogues we can improve our constraints on cosmological parameters and to understand better how neutral hydrogen populates different types of galaxies and haloes. Creating realistic mock intensity mapping

catalogues is necessary to optimize the future analysis of data. I will present the mock neutral hydrogen catalogues that we are developing, using the Horizon run 4 simulations, to cross-correlate with mock galaxy catalogues from low redshift surveys and I will show the preliminary results from the first mock catalogues.

[구 CD-06] Simulating the Lyman-Alpha Forest with Massive Neutrinos and Dark Radiation for Large-Volume Surveys

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In support of current and upcoming large-volume cosmological surveys such as the SDSS-IV eBOSS, LSST, and DESI, we present an extensive suite of high-resolution cosmological hydrodynamical simulations spanning a large range of cosmological and astrophysical parameters. We follow the evolution of gas, dark matter, neutrinos, and dark radiation, and consider several combinations of box sizes and number of particles - enhancing the resolution up to 3 x 33283 = 110 billion particles in a (100 h−1 Mpc)3 box size. We also provide 100,000 skewers for a variety of redshift slices and combination of cosmological and astrophysical parameters, useful for interpreting upcoming high-quality Lyman-α forest data. These novel simulations represent an improvement over our previous runs, and can be useful for a broader variety of cosmological and astrophysical applications, ranging from the three-dimensional modeling of the Lyman-α forest to cross-correlations between different probes, for studying the expansion history of the Universe including massive neutrinos, and for particle-physics related topics.

천문우주관측기술

[구 AT-01] Infrared Spectro-Photomeric Survey Missions: NISS & SPHEREx

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The NISS (Near-infrared Imaging Spectrometer for Star formation history) onboard NEXTSat-1 was successfully launched on last December and is now under the operation phase. The capability of both imaging and spectroscopy is a unique function of the NISS. It has realized the imaging spectroscopy (R~20) with a wide field of view of 2 x 2 deg. in a wide near-infrared range from 0.95 to 2.5μm. The major scientific mission is to study the cosmic star formation history in the local and distant universe. It also demonstrated the space technologies related to the infrared spectro-photometry in space. The NISS is performing the imaging spectroscopic survey for local star-forming galaxies, clusters of galaxies, star-forming regions, ecliptic deep fields and so on.

As an extension of the NISS, the SPEHREx (Spectro-Photometer for the History of the Universe Epoch of Reionization, and Ices Explorer) was selected as the NASA MIDEX (Medium-class Explorer) mission (PI Institute: Caltech). As an international partner, KASI will participate in the development and the science for SPHEREx. It will perform the first all-sky infrared spectro-photometric survey to probe the origin of our Universe, to explore the origin and evolution of galaxies, and to explore whether planets around other stars could harbor life. Compared to the NISS, the SPHEREx is designed to have a much wider FoV of 3.5 x 11.3 deg. as well as wider spectral range from 0.75 to 5.0μm. Here, we introduce the status of the two space missions.

[구 AT-02] Possible framework for East Asia Observatory (EAO) and Subaru partnership

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Recently, there have been discussions among national observatories in East Asia about the possibility of EAO and the Subaru observatory forming a partnership. The official EAO-Subaru partnership can make the powerful wide-field observation capabilities of Subaru available to Korean astronomers through EAO, and also can serve as an excellent platform to gather astronomers in East Asia together for flourishing regional collaboration activities. A working group