今後の研究計画（英訳）

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Ryusuke Nishikawa

Modern physical cosmologies commonly assume Cosmological Principle that our universe is spatially isotropic and homogeneous on large scales. Thanks to recent technological developments, we have begun to be able to test the Cosmological Principle observationally. Thus, theoretical studies of the inhomogeneous universe model which drop the Cosmological Principle are receiving much attention in recent years. In order to develop observational tests of the Cosmological Principle, we analyze observational quantities involved in the cosmic structure formation in the inhomogeneous universe model as follows.

Redshift Space Distortions

In redshift surveys of galaxy distributions, positions of galaxies are specified by the redshift that contains the effects of the cosmic expansion and the peculiar velocities of each galaxies. In the study of the homogeneous and isotropic universes, it is known that the peculiar velocities distort the clustering pattern of galaxies. This effect is called as Redshift Space Distortions, and has measured by observations of galaxy distributions with high accuracy.

In the case of the inhomogeneous universe model, it is known that galaxy clustering in the real space has a distortion due to the existence of the background tidal field, which was shown in our previous papers. Thus, we expect that the Redshift Space Distortions in the inhomogeneous universe are significantly different from those in the homogeneous and isotropic universes. In order to reveal the difference, we first compute the peculiar velocities in the inhomogeneous universe model based on a perturbative approach which was proposed in our previous work. Then we derive two-point correlation functions of density fluctuations in the redshift space, and compute the Redshift Space Distortions in the inhomogeneous universe model. We compare the results with observations obtained from galaxy surveys.

Baryon Acoustic Oscillations

Before the last scattering, the tightly coupled photon-baryon plasma oscillates under the competing effects of gravitational collapse and radiation pressure. This is called the Baryon Acoustic Oscillations (BAO), and the imprint of the BAO scales has been observed in the galaxy distributions. In the study of the homogeneous and isotropic universes, the BAO scales have been used to investigate the history of the cosmic volume expansion.

We study the evolution of the volume expansion in the inhomogeneous universe model by using the BAO scales. We first compute the growth of the BAO scales based on a perturbative approach which was proposed in our previous work. Then we reveal the effects of the volume expansion to the growth of the BAO scales in the inhomogeneous universe model. We compare the results with observations of galaxy surveys measuring the BAO scales. Since the volume expansion in the inhomogeneous universe model is anisotropic at off-central regions, we may test the inhomogeneous universe model by constraining the anisotropic volume expansion from the BAO observations.

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