平成 30年度大阪市立大学数学研究所 専任研究所員 ：申請書

研究計画の要旨（英訳）

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研究課題名	Perturbation theory in the inhomogeneous isotropic universe model

Background of Research

The standard model of the cosmology can explain various observational data, but the assumption of the cosmology that the universe is homogeneous and isotropic on large scales is not observationally confirmed yet. The isotropy of the universe is implied by the observation of the cosmic microwave background radiation (CMBR). However, the homogeneity of the universe is not observationally confirmed yet. Thus, there is a possibility that there are non-negligible very large scale isotropic inhomogeneities in our universe. Observational verification of the homogeneity of the universe is becoming possible with the development of observation technology in recent years. Thus, investigation of the inhomogeneous isotropic universe model is important to predict observables. In the cosmology, the perturbation theory is useful to calculate various observables. However, the perturbation theory in the inhomogeneous isotropic universe model is difficult and has not yet fully studied. Hence, observables which do not require a analysis of the perturbation theory, such us the distance-redshift relation and the peak position and height of the angular power spectrum of CMBR, have been studied in the inhomogeneous isotropic universe model. In order to restrict isotropic inhomogeneities by using more observables, it is important to study the perturbation theory in the inhomogeneous isotropic universe model.

Purpose and Content of Research

In this study, in order to restrict isotropic inhomogeneities more strongly, we calculate observables which require the perturbation theory to calculate, such as the integrated Sachs-Wolfe effect, the polarization of the CMBR and the gravitational lens, and compare the theoretical prediction with observational data. The method of analyzing the metric perturbation in the inhomogeneous isotropic universe model is produced from recent study, but the method of analyzing equations which determine the motion of matters, such as the Boltzmann equations and the geodesic equations, have not been produced. In this study, I will work on analyzing these equations. To solve these equations easily, we assume that the inhomogeneous isotropic universe model is described as the isotropic homogeneous universe model with isotropic inhomogeneous perturbations, and we add inhomogeneous anisotropic perturbations to this universe model. We solve nonlinear perturbation equations up to the order that isotropic inhomogeneities and inhomogeneous anisotropic perturbations are coupled to calculate the time evolution of inhomogeneous anisotropic perturbations.

Feature of research

In this study, I work on studying the perturbation theory in the inhomogeneous isotropic universe model which has not yet fully studied so far. In particular, analyzing the Boltzmann equations and the geodesic equations which have not been solved in the inhomogeneous isotropic universe model so far is feature of this research. Due to the development of the perturbation theory various observables can be theoretically predicted, and we can observationally restrict isotropic inhomogeneities in the universe more strongly.