論文の内容の要旨

論文題目

Baryon Asymmetry and Cosmological Moduli/Polonyi Problem

(物質・反物質非対称性と宇宙論的モジュライ問題)

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Supersymmetric models generally contain long-lived particles that could cause cosmological difficulties. In particular, moduli/Polonyi fields dominate total energy of the universe as coherent oscillation and spoil the success of the Big-Bang cosmology. It is known that the moduli/Polonyi abundance can be diluted sufficiently by thermal inflation. However, preexisting baryon asymmetry is also diluted in this scenario. In this thesis, we study whether it is possible to generate the observed baryon asymmetry with the dilution of the moduli/Polonyi abundance. When we consider baryogenesis before dilution of the moduli abundance, the Affleck-Dine mechanism is the most promising among known baryogenesis mechanisms. In gravity-mediated SUSY breaking models with the moduli mass of $\mathcal{O}(1)$ TeV, the Affleck-Dine mechanism before dilution cannot explain the observed baryon asymmetry. In gauge-mediated SUSY breaking models, the Affleck-Dine fields except for LH_u flat direction inevitably form into Q-balls after the onset of their oscillation. The produced baryon number is absorbed into Q-balls, and it is difficult to extract the baryon number from Q-balls. We show that the Affleck-Dine fields cannot provide sufficient baryon number with dilution of moduli abudnance because of Q-ball formation. In the case of the LH_u flat direction, μ-term prevents the Q-ball formation. We propose alternative scenario using the LH_u direction, but we show that it cannot explain the observed baryon asymmetry either. When the moduli/Polonyi field is as heavy as $\mathcal{O}(100)$ TeV, it can decay before the Big-Bang nucleosynthesis, but the lightest supersymmetric particles are generally overproduced from the decay. We show that the baryon asymmetry cannot be explained by the Affleck-Dine mechanism even if the moduli abundance is diluted by entropy production to prevent the LSP overproduction. In the case of the Polonyi field with a mass of $\mathcal{O}(100)$ TeV, on the other hand, we show that the observed baryon-to-dark matter ratio is explained in sequestering models with a (pseudo-)Nambu-Goldstone boson.