論文の内容の要旨

Visible and dark matter genesis through the Affleck-Dine mechanism

(アフレック・ダイン機構を通じた物質および暗黒物質生成)

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The origins of baryon asymmetry and dark matter are outstanding mysteries in cosmology and particle physics. In particular, the observed amount of energy densities of baryon and dark matter are equal to each other up to a factor of unity, which is known as the baryon–dark-matter coincidence problem. In this thesis, we investigate the Affleck-Dine baryogenesis in supersymmetric theories to account for the origins of baryon asymmetry and dark matter, and propose two scenarios to account for the coincidence between their energy densities. In the first scenario, we consider the case that non-topological solitons called Q-balls form after the Affleck-Dine baryogenesis and decay into baryons and light supersymmetric particles before the big-bang nucleosynthesis epoch. The light supersymmetric particles then decay into the lightest one, which is the candidate of dark matter. Thanks to the fact that the branchings of Q-ball decay are determined by the Pauli blocking effect, there is a natural coincidence of energy densities of baryon and dark matter. The second scenario is based on our new scenario of the Affleck-Dine baryogenesis, where the baryon asymmetry is generated just after the end of inflation in contrast to the ordinary scenario. When inflaton decays mainly into gravitinos, the subsequent decay of gravitinos is a non-thermal source of dark matter. We find that the resulting baryon-to-dark-matter ratio is naturally of order unity in hybrid inflation models. As a result of these two scenarios, we conclude that the Affleck-Dine baryogenesis is a promising mechanism to explain the origins of baryon asymmetry and dark matter and the coincidence between their energy densities. Those scenarios would be tested by future collider experiments and direct and indirect dark-matter searches.