# 論文の内容の要旨

論文題目　Effects of thermal fluctuations on phase transitions in the early Universe
(初期宇宙の相転移における熱的揺動の影響とその意義)

氏名　宮本 裕平

In this thesis, we study cosmological phase transitions with a hot thermal bath. We often use effective potentials in considering such phase transitions, which give a simple explanation of restoration of symmetry of the theory at high temperature. However, since the effective potential is a static and homogeneous limit of the effective action, the effective action plays an essential role in considering dynamical, inhomogeneous field configurations. It is known that the effective action based on the finite-temperature field theory generally contains an imaginary part, which can be rewritten by introducing stochastic noise terms. The equation of motion of the field of interest, derived from this effective action, becomes Langevin equation. Therefore, the thermal environment gives not only the correction to the effective potential but the thermal fluctuations as well. The thermal fluctuation term is one of the important information that the effective action includes. We review a method to extract thermal fluctuations for various interactions. Interestingly, all the interactions which have been considered so far leads to the same relation, known as fluctuation-dissipation relation. We verify this relation in scalar quantum electrodynamics, as a first step to fully understand the dynamics of scalar fields with general interactions including gauge theory.

We study the effects of thermal fluctuations on the phase transition at the end of thermal inflation late in this thesis. Thermal inflation is a short period of accelerated expansion after the primordial inflation, which can reconcile the theory of supersymmetry with cosmology by diluting dangerous particles predicted by the theory. The end of thermal inflation is just a phase transition in a hot environment created just after the primordial inflation. We study the scenario of thermal inflation taking thermal effects into account, and see that the scenario itself is not ruined but the phase transition at the end of thermal inflation proceeds through phase mixing, which is different from what has been expected. An observational consequences of this result is that even if thermal inflation has occurred in the early Universe, we cannot expect gravitational-wave production, which is a characteristic phenomenon with strong first-order phase transitions.