INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Over the past decades, the advancement in precision observational cosmology has widened the window to a great extent to look into the early universe. The early reheating phase is an integral part of the inflationary cosmology, which bridges the enormous gap in energy and time scales between the end of inflation and the beginning of the hot Big Bang nucleosynthesis (BBN). This phase not only generates initial conditions for the hot, thermal universe, but also produces various cosmological relics, namely, gravitational waves (GWs), Dark Matter (DM), Dark Radiation etc. The absence of direct observational evidence has left this important phase of the early universe poorly constrained, both at present and in the foreseeable future. However, the distinct imprints of this phase on cosmic relics offer us a promising avenue for its indirect probe through various cosmological observables. In this thesis, we have taken a little step towards this pursuit of deciphering the non-perturbative imprints of the reheating phase on various cosmological relics. We come across several non-equilibrium and highly non-linear phenomena at the early reheating phase, known as preheating, that occur at an incredibly high energy. For the proper investigation of this early reheating era, governed by various complex non-linear processes, an involved non-perturbative framework is indispensable. Another notable area where the non-perturbative dynamics inherently appear is the domain of Cosmological Gravitational Particle Production(CGPP). Of late, this gravitational particle production in the early era has gained significant attention. However, due to its pure gravitational nature, it becomes an unavoidable natural mechanism for producing dark matter, dark radiation, gravitational waves, and all sorts of fundamental particles. Throughout the present thesis, we have meticulously focused on these various non-perturbative aspects of reheating and their distinct signatures on cosmic relics.