INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Production of Dark Matter and Baryon Asymmetry in Non-standard Cosmologies

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SHORT ABSTRACT

This thesis is devoted to the study of two long-standing problems of particle physics and cosmology: the origin of dark matter and the baryon asymmetry of our Universe, in the presence of a non-standard cosmological history in the first few seconds of the evolution of our Universe. We focus especially on early matter-dominated eras, considering two possible origins of them, one due to a long-lived particle (LLP), and the other from primordial black holes (PBH). Apart from investigating the standard dark matter (DM) and baryon asymmetry production mechanisms in the presence of these non-standard epochs, the thesis mostly touches upon dark matter scenarios beyond the conventional WIMP paradigm which has been searched for several years now in dark matter direct detection experiments like XENON, LUX etc. and also in collider search experiments like the large hadron collider (LHC), with no positive results so far. While the DM candidates we study are unlikely to show up in these conventional DM search experiments, we propose an alternative and novel probe to look for these DM candidates, which is through stochastic gravitational waves generated in the early Universe. The shape of such gravitational wave spectrum is determined by the non-standard cosmological background which in turn dictates the dark matter phenomenology. The setups we consider can also generate the baryon asymmetry of the Universe through leptogenesis (baryogenesis), which occurs at a very high scale that is out of direct reach from any current experiments, but can be probed indirectly through gravitational waves. The amplitudes and frequencies of these gravitational wave spectra are within reach of near-future gravitational wave detectors such as LISA, DECIGO, CE etc. In addition, the particle physics setups we have considered also have detection prospects on their own, which get modified in the presence of a non-standard cosmological epoch.