INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Devabrat Mahanta
Roll Number	:	176121007
Programme of Study	:	Ph.D.
Thesis Title:	:	Aspects of Low Scale Leptogenesis and Connection to Dark Matter
Name of Thesis Supervisor(s)	:	Dr. Debasish Borah
Thesis Submitted to the Department/ Center	:	Physics
Date of completion of Thesis Viva-Voce Exam	:	June 26, 2023
Key words for description of Thesis Work	:	Baryon asymmetry, dark matter

SHORT ABSTRACT

The observed baryon asymmetry and dark matter (DM) in the universe have been two longstanding puzzles in particle physics and cosmology. While the standard model (SM) of particle physics can neither satisfy the required criteria to generate the observed baryon asymmetry of universe (BAU) dynamically nor offer a viable DM candidate. Among several popular mechanisms put forward to explain these observed phenomena, leptogenesis is one of the most popular one to explain the origin of BAU whereas particle DM of thermal or non-thermal origin having mass around the electroweak scale has been a popular DM paradigm. In this thesis, we aim to study a few leptogenesis scenarios which can also shed light on the origin of DM. A common framework for explaining both the BAU and DM is motivating due to its minimal and predictive nature. We consider a few realistic particle physics models where there exist new particles and symmetries beyond those in the SM. While canonical neutrino mass models, also known as seesaw models, predict high scale leptogenesis out of reach from direct search experiments, we focus on leptogenesis and DM scenarios where scale of leptogenesis can be brought down to TeV corner such that these scenarios can be tested at near future experiments. After giving introduction to the observed evidences and popular theoretical mechanisms for BAU and DM in chapter 1, we consider a radiative seesaw, known as the minimal scotogenic model in chapter 2, to study the possibility of thermal as well as non-thermal fermion singlet DM with the heavier singlet fermions being responsible for successful leptogenesis. In chapter 3, we study a novel scenario where lepton asymmetry is generated from three-body decay of a heavy fermion with DM as one of the final states. While phase-space suppression and involvement of new parameters independent of neutrino mass lead to sub-TeV scale leptogenesis, the DM sector naturally emerges as a two-component type. In chapter 4, we study the possibility of having successful TeV scale leptogenesis with light Dirac neutrinos in a gauged B-L model. The symmetry and particle content of the model allow for lepton number violation by more than two units while keeping light neutrinos as purely Dirac. Apart from successful TeV scale leptogenesis and other phenomenological aspects of gauged B-L model, we also show that the model can be probed at future cosmology experiments capable of measuring additional relativistic degrees of freedom affecting cosmic microwave background power spectrum. Finally, in chapter 5, we consider the impact of non-standard cosmological histories on the production of BAU and DM in two different setups; one where lepton asymmetry arises from two-body decay similar to the minimal scotogenic model and the other where it arises from DM annihilations. Depending upon the type of non-standard epoch, the scale of leptogenesis can be lower compared to the standard cosmology in some cases, making the detection prospects more promising.