INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title:

Implications of Flavour Data on Dark Matter Phenomenology

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Thesis Submitted to the Department/ Center : Physics

Date of completion of Thesis Viva-Voce Exam : 16/02/2022

Key words for description of Thesis Work : Standard Model, Beyond the Standard Model, Dark Matter, Flavour Physics, B-decays, Lepton Flavour UniversalityViolation, Lepton Flavour Violation, Flavour Anomalies

SHORT ABSTRACT

The Standard Model of particle physics, with all its elegance, has survived most experimental tests at particle accelerators, but not all. This thesis arises in the context of dark matter phenomenology, whose ubiquitous existence cannot be explained within the Standard Model framework. The nature and particle content of dark matter is still a mystery, and proposing suitable models that can explain its properties would be of great value. In this thesis, we perform systematic studies of the phenomenology of dark matter models, focusing on the rich consequences the lepton and quark flavour physics can have for the dark sector. In this regard, we highlight the important observables that play a crucial role in identifying and quantifying possible new physics along with their present experimental status. This sets the essential background of the studies included in the thesis. We then move on to investigate two popular new physics models, the Inert Higgs Doublet model and the U (1) X extension of SM, that not only gives rise to a suitable DM candidate, but are also motivated by other general issues of the SM, such as light neutrino masses and lepton flavour violation etc. We quantify the contributions from new degrees of freedom to various flavour physics observables such as branching fractions of meson decays, meson-mixings etc. We have displayed the outcome of precise flavour data on the dark matter parameter space while simultaneously

explaining some anomalous results in low energy observables. We also highlight some interesting features of these models that allow us to probe our model parameters both in DM and high energy collider experiments using simple cut-based analysis. Further, we have shown how the mediators in WIMP-nucleon scattering can modify elementary quark vertices with the W-boson, which impacts the extraction of the CKM elements. Using the most up-to-date measurements, we successfully constrain the masses and couplings of mediators having scalar or pseudoscalar interactions with the dark matter and SM quarks. In summary, this thesis provides a comprehensive outlook towards the implications of flavour phenomenology on new physics models, with a particular focus on the dark sector.