



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**  
**SHORT ABSTRACT OF THESIS**

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**SHORT ABSTRACT**

In this thesis we have studied the semileptonic  $b \rightarrow c \tau \nu_\tau$  decays which is found to be a sensitive probe of physics beyond standard model. Over the last few years, data for the semitaunic decays of  $B$  meson from different experimental collaborations have provided an excellent environment for testing the standard model in this sector. In particular, the measurements on  $R(D^{(*)}) = B(B \rightarrow D^{(*)} \tau \nu_\tau)/B(B \rightarrow D^{(*)} l \nu_l)$  by BABAR, Belle and LHCb have shown some significant deviations from their SM predictions, indicating an indirect hint of new physics in  $b \rightarrow c \tau \nu_\tau$  transitions. This thesis mainly focuses on two important aspects in the search of new physics via the above mentioned decays. First, the test of the new physics sensitivities of different observables associated with these decays in the future high luminosity experiments. In this regard, we have used the Optimal Observable technique which has been proven to be an useful tool in the collider searches. Here, for the first time we have applied this technique in the context of flavour physics observables. We have compared the sensitivities of different observables in  $B \rightarrow D^{(*)} \tau \nu_\tau$  decays towards various new interactions. It has been also shown that the decay rate distributions could be an useful probe in discriminating different new interactions, in particular at very high luminosity. Secondly, we look for possible new physics scenarios in  $b \rightarrow c \tau \nu_\tau$  decays that are most compatible with the available data using the Akaike Information Criterion. We have also updated the standard model predictions of the asymmetric and angular observables in  $b \rightarrow c \tau \nu_\tau$  decays using the results of the recent up-to-date analysis in  $B \rightarrow D^{(*)} l \nu_l$ . Furthermore, in the selected scenarios with Akaike Information Criterion, best-fit values and correlations of the new parameters are extracted. Using these results, predictions are made on various observables in the exclusive and inclusive semitaunic  $b \rightarrow c$  decays which can then be further checked for consistency with the future measurements. The graphical correlations among these observables are shown as well. These are found to be useful in discriminating various new physics scenarios.