Stony Brook University
The Graduate School

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Abstract

Higgs collider phenomenology: important backgrounds, naturalness probes and the electroweak phase transition.

By

Harikrishnan Ramani

The Standard Model has survived intense scrutiny for three decades and was completed by the discovery of the Higgs. The Higgs might very well be the portal to new physics that answers many of the Standard Model inadequacies and pressing questions. We present work on a myriad of research problems loosely strung together by a common theme; the Higgs boson.

In order to study the Higgs, it is important to have a very good handle on Standard model(SM) backgrounds. One such background process, SM WW production, reported routine 3 sigma excesses in early run 1 of the LHC. We show that taking into account higher order Sudakov logarithms through transverse momentum and jet-veto resummation as an improvement over parton showers currently used. This reduces the theory-experiment discrepancy.

Next, we study an important consequence of precision Higgs studies; understanding the nature of the electroweak phase transition. Improvements to the state-of-the-art finite temperature field theory by relaxing certain approximations can have significant changes in the prediction for order of the phase transition generically making it weaker. This in turn reduces the baryon asymmetry created thus strengthening the case for building future colliders in the form of a no-lose theorem. Absence of deviation from the Standard model in Higgs precision physics can falsify the possibility of Baryogenesis across the electroweak phase transition.

Finally, we present another consequence of Higgs precision studies, limits on top partners predicted by theories that solve the Hierarchy problem while making minimal assumptions on the rest of the new physics particle spectrum. We find that generically, top-partner mass limits will reach a TeV just from Higgs precision in future colliders.

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