MEETING OF THE AMERICAN PHYSICAL SOCIETY DIVISION OF PARTICLES AND FIELDS

Contribution ID: **269** Type: **Poster**

Probing new physics scale through dimension-6 operator and enhanced $t\bar{t}h$ and hh production at the LHC

Monday, 31 July 2017 18:35 (1 minute)

No matter what the scale new physics is, deviations from the Standard Model for the Higgs observables will indicate the existence of such a scale. We consider effective six dimensional operators, and their effects on the Higgs productions and decays to estimate this new scale. Large uncertainties with the SM predictions still remains in some of the observables of these measurements. This encourages us to venture if there is a new physics scale that might be estimated from the uncertainty in these measurements, as well as if we can make make predictions which can be tested in the LHC. With this aim in mind, we consider the effect of a selected set of dimension six operators along with the SM. The dimension six operators related to Higgs physics can be introduced both in the strong sector, as well as in the electroweak sector. Such operators will make extra contributions for the Higgs productions, as well as for its various decay modes. In the most general case, for the effective dimension six operators, there are many operators, and involve large number of parameters. In order to reduce the number of parameters, we only consider a selected set of such operators in the gauge sector (both strong and electroweak (EW), as well as the Yukawa sector, which are responsible for larger effects, and do not affect the constraints from the EW precision tests in a significant way. Given the large uncertainties in the Higgs Productions and decays, we find that this scale can be as low as 500 GeV. We then calculate the $t\bar{t}h$ productions , as well as double Higgs using the effective couplings at the Large Hadron Collider, and show these can be much different than those predicted by the Standard Model, for an wide region of these parameters space. These predictions can be tested in the current or the future runs of the LHC.

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Session Classification: Poster Session and Reception

Track Classification: Beyond Standard Model