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Theoretical Uncertainties in the Higgs Boson Pair Production in the $b\bar{b}\tau\tau$ Decay Channel

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Higgs boson pair production (HH) is one of the more interesting processes to study at the LHC, as it allows us to probe Higgs Boson self-coupling and associated parameters of the Higgs potential, as well as search for physics beyond the standard model. The $b\bar{b}\tau\tau$ final state is one of the most sensitive channels for HH studies due to an appreciable branching ratio, and a relatively clean background. In this talk, the methods used in calculating a few of the more important theoretical uncertainties associated with this analysis are presented - in particular, perturbative QCD (pQCD) calculations and Parton Showers for single Higgs backgrounds. From pQCD, three main sources of uncertainties come from (i) missing higher orders in the perturbative expansion from the partonic cross section, (ii) parton distribution functions and (iii) experimental determination of the strong coupling constant. These uncertainties associated with pQCD correspond to parton-level final states. Since the simulated samples also pass-through showering and hadronization generators that convert the parton cross section to a hadron level cross section, additional uncertainties occur in (i) modelling parton shower and hadronization through the algorithm or parameters and (ii) matrix element next-to-leading-order calculations.

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