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Four top final states - fixed order NLO vs. NLO+PS

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Upon the observation of the four-top (4t) production in both ATLAS and CMS and the expected increase in precision in the upcoming HL-LHC runs, we are motivated to revisit the theoretical calculations of the process. We study the calculations from fixed order perturbative QCD using HELAC-NLO, which employs the Narrow Width Approximation (NWA) at NLO accuracy in both production and decay, in comparison with methods which use matching to Parton Showers (PS), specifically POWHEG and MC@NLO methods. We also study the effect of including Matrix Element Corrections (MECs) in the NLO+PS methods. Such a comparison could assess the extent to which parton shower effects can reproduce all the contributions required at the NLO level in QCD for the 4t process. In addition, it could help to identify regions of phase space for specific observables that are indeed sensitive to parton showers, that are absent in our fixed-order predictions for this process. The study is made for the 4 lepton and 3 lepton channels.

Author: ALSAIRAFI, Manal (RWTH Aachen)

Co-authors: Mr DIMITRAKOPOULOS, Nikolaos (RWTH Aachen); Prof. WOREK, Malgorzata (RWTH Aachen)

Presenter: ALSAIRAFI, Manal (RWTH Aachen)

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