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Top-induced NLO electroweak corrections to di-Higgs boson production

Understanding the Higgs boson self-coupling is fundamental to uncovering the structure of the Higgs potential and testing the Standard Model (SM) at a deeper level. Among the various processes that probe this coupling, Higgs boson pair production *via* gluon fusion—a loop-induced mechanism—is among the primary ones. In particular, the electroweak (EW) sector plays a pivotal role in reducing theoretical uncertainties and enhancing the accuracy of the precision predictions for this process. Notably, next-to-leading-order (NLO) EW corrections calculated using the heavy top-quark mass expansion have demonstrated significant impacts, with corrections reaching as high as 65% at a partonic center-of-mass energy of around 260 GeV. Therefore, such predictions are essential for minimising theoretical uncertainties and improving predictions for the Large Hadron Collider (LHC) and its high-luminosity upgrade (HL-LHC).

In this talk, I will present our comprehensive calculation of the full top-induced NLO EW corrections to di-Higgs boson production *via* gluon fusion. Our calculations account for mixed NNLO QCD-EW contributions and focus on the top-Yukawa-induced corrections. The presence of multiple mass scales and complex hierarchies introduces ultraviolet and infrared divergences and numerical instabilities near virtual thresholds. This complexity necessitates specialised analytical and numerical methods. By retaining symbolic mass parameters and avoiding traditional reduction techniques, we achieve a level of precision and flexibility that is critical for future investigations. In my talk, I will cover all these aspects of our calculation. I will discuss the methods, results, and implications of our work, highlighting its relevance to current and future collider experiments. Therefore, our work aims to enhance the precision of theoretical tools needed to test the SM and explore the potential for new physics.

Primary authors: Dr BHATTACHARYA, Arunima (IFIC, University of Valencia); Prof. CAMPANARIO, Francisco (IFIC, University of Valencia-CSIC); CHANG, Jamie (PSI, Villigen); MAZZITELLI, Javier (PSI, Villigen); RONCA, Jonathan (Rome III U. and INFN, Rome3); SPIRA, Michael (Paul Scherrer Institut); MUEHLLEITNER, Milada (Karlsruhe Institute of Technology); Mr CARLOTTI, Sauro (Karlsruhe Institute of Technology)

Presenter: Dr BHATTACHARYA, Arunima (IFIC, University of Valencia)

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