T 93: Top Physics IV (Misc.)

Time: Friday 9:00–10:00 Location: VG 1.103

T 93.1 Fri 9:00 VG 1.103

Studying Machine Learning Techniques to Improve Statistical Precision of Monte Carlo Samples in Top Quark Measurements — •Lennert Griesing, Hartmut Stadie, Peter Schleper, and Johannes Lange — Institute of Experimental Physics, Hamburg University, Germany

Precise measurements of top quark properties at the Large Hadron Collider (LHC) are crucial for testing the Standard Model and exploring new physics. In these measurements, Monte Carlo (MC) simulations are needed to compare theoretical predictions with experimental observables. To account for systematic uncertainties, MC samples are generated for different model parameters. Due to computational costs, these samples are produced with fewer events than the large default simulation sample. Thus, the smaller sample size limits their statistical precision and poses a challenge for nuisance parameter fits. A possible solution is to modify the large default simulation sample using machine learning techniques (ML) so that their distributions reflect the variations in the different model parameters. The aim is to evaluate the precision, accuracy, and potential biases introduced by applying these ML techniques to MC simulations of top quark pair production within the CMS experiment.

T 93.2 Fri 9:15 VG 1.103

Measurement perspectives of the top-antitop energy asymmetry in the production with an additional jet in the resolved topology with ATLAS — •Jessica Höfner, Annika Stein, Frederic Fischer, and Lucia Masetti — University Mainz, Insitute for physics

The top quark is the heaviest particle in the Standard Model (SM) of particle physics and the only quark which decays before hadronization can happen. The top quark is suitable for the search of physics beyond the SM of particle physics (BSM). There could be even heavier particles and they might become observable at higher center-of-mass energies, and the top quark could potentially interact with them. At the currently reachable center-of-mass energies, however, the impact of BSM physics might only be indirectly observable via the variation of properties of the production or decay of SM particles. In the production of a top-antitop pair with an additional jet at the LHC the energy asymmetry, complementary to the rapidity asymmetry, can be measured. The energy asymmetry is expected in the SM, but also sensitive to physics beyond the SM and therefore it is of high interest to measure this observable. After a first measurement of the energy asymmetry in the topology with a collimated hadronic top decay and a semileptonic decay with the ATLAS experiment, the future goal is to measure this observable in the full phase space. Therefore the event reconstruction in the resolved topology, in which the hadronic decaying top quark is reconstructed with several small-R jets, must be optimized. This presentation shows the current progress regarding this optimization.

T 93.3 Fri 9:30 VG 1.103

Optimal Observable Machine: The case of four top quark differential cross sections with SMEFT contributions. — •Alejandro Quiroga Trivino[1], Torben Mohr[1], Matteo Defranchis[2], Jan Kieseler[1], Ankita Mehta[2], Artur Monsch[1], and Markus Klute[1] — [1]Karlsruhe institute of technology — [2]CERN

Identifying optimal observables that are maximally sensitive to Standard Model Effective Field Theory (SMEFT) coefficients, while systematically accounting for uncertainties, is crucial for constraining new physics. This study focuses on developing strategies to determine such observables, with particular attention to minimizing total uncertainties and maximizing sensitivity to SMEFT effects. As a case study, we investigate four-top quark production in proton-proton collisions at a center-of-mass energy of 13.6 TeV. This rare process, characterized by an energetic final state and a tiny cross section, provides a unique testing ground for SMEFT contributions. Specifically, we analyze the effects of a heavy-quark operator with Wilson coefficient ctt1*, employing systematic-aware training to achieve precise constraints in ctt1. This talk will present our approach, highlight progress in identifying optimal variables, and discuss the implications for measuring SMEFT coefficients and uncovering potential new physics.

T 93.4 Fri 9:45 VG 1.103

Search for heavy right-handed Majorana neutrinos in the decay of top quarks produced in proton–proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector — •Diptaparna Biswas[1], Markus Cristinziani[1], Nikolina Ilic[2], Lianliang Ma[3], Oğul Öncel[4], Sebastien Roy-Garand[2], Mário José da Cunha Sargedas de Sousa[5,6], and Tongbin Zhao[1,3] — [1]Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen, Germany — [2]University of Toronto, Canada — [3]Shandong University, China — [4]Albert-Ludwigs-Universität Freiburg, Germany — [5]INFN Genova, Italy — [6]Università di Genova, Italy

A search for heavy right-handed Majorana neutrinos is performed with the ATLAS detector at the CERN Large Hadron Collider, using the Run-2 dataset. This search targets $t\bar{t}$ production, in which both top quarks decay into a bottom quark and a W boson, where one of the W bosons decays hadronically and the other decays into an electron or muon and a heavy neutral lepton. The heavy neutral lepton is identified through a decay into an electron or muon and another W boson, resulting in a pair of same-charge same-flavor leptons in the final state. This talk presents a search for heavy neutral leptons in the mass range of $15 - 75$ GeV using $t\bar{t}$ events. No significant excess is observed over the background expectation, and upper limits are placed on the signal cross-sections. Assuming a benchmark scenario of the phenomenological type-I seesaw model, these cross-section limits are then translated into upper limits on the mixing parameters of the heavy Majorana neutrino with Standard Model neutrinos.