T 151: Exp. Methods IV

Time: Thursday 17:30–19:00 Location: WIL/C129

T 151.1 Thu 17:30 WIL/C129

Evaluating new triggers for ATLAS HH(4b) analysis in LHC Run 3 data — •Abdullah Nayaz[1], Teng Jian Khoo[2], and Cigdem Issever[3] — [1]Humboldt University, Berlin, Germany — [2]Humboldt University, Berlin, Germany — [3]Humboldt University, Berlin, Germany

The diHiggs (HH) study plays a central role in probing both the Standard Model and new Physics. The dominant higgs decay to a pair of b quarks (h->bb) makes the 4b final state one of the most significant signatures to look for a di-Higgs system.The small cross section of the process plus the existence of a huge QCD background make the trigger (selecting signature-relevant events) extremely challenging.

For Run 3, ATLAS has designed new triggers that use better reconstruction and selection, in order to improve the efficiency at which we record HH4b events. In this study, the efficiency of these triggers as well as the existing run-2 triggers are studied and compared using the hh4b MC samples and LHC run-3 data. Several factors such as improvement in jet calibration, b-tagging and optimized selection for hardware and software triggers are expected to boost the efficiency of over all run-3 triggers. The study, in particular, quantifies these improvements which is crucial for understanding the effectiveness of each trigger. In addition, since simulation is not a perfect reflection of real data, the measured detailed trigger performance in data and simulation will then help us to determine the parameterized correction factors needed to make simulation match the data.

T 151.2 Thu 17:45 WIL/C129

Prospects for machine-learning based unfolding techniques with a focus on the measurement of differential Higgs boson production cross sections — Johannes Erdmann, •David Kavtaradze, and Jan Lukas Späh — III. Physikalisches Institut A, RWTH Aachen University

In high-energy physics experiments, measured distributions are the result of Poissonian fluctuations around expectation values that are obtained from folding the underlying distribution with detector effects. The inference of the underlying distribution from the measurement in cases where no parametric form is available is known as "unfolding".

Traditional unfolding methods rely on a categorisation of events in a certain binning scheme. This limits the flexibility of the unfolding and does not allow for a simultaneous deconvolution of multiple observables.

An alternative approach, termed "Omnifold" in the literature, does not have these restrictions and benefits from machine-learning to take into account the whole information from each event. This approach is contrasted with the traditional approaches using a physically motivated example from a measurement of differential Higgs boson production cross sections in the diphoton decay channel.

T 151.3 Thu 18:00 WIL/C129

Studies on Monte Carlo tuning using Bayesian Analysis — •Salvatore La Cagnina[1], Andrii Verbytski[2], Kevin Kröninger[1], and Stefan Kluth[2] — [1]TU Dortmund, Fakultät Physik — [2]Max-Plank-Institut für Physik, München

Monte Carlo (MC) simulations are an essential aspect of data analysis at the LHC. One aspect of MC event generation involves hadronisation and parton shower models. Since these models are based on approximations, they introduce a number of parameters. These parameters cannot be inferred from first principles. Therefore, their values have to be optimized using numerical tools and experimental data (MC tuning). Generally, MC tuning is performed by choosing observables that are sensitive to the parameters. Afterwards, a fit of the parameters to data using a simplified MC response function derived from fits to MC events is performed. Though state-of-the-art methods for MC tuning exist, uncertainties are usually treated as uncorrelated. In this talk, MC tuning using a Bayesian approach will be discussed. The EFTfitter tool is used for fitting, which enables the implementation of correlations for different sources of uncertainties. In addition, the propagation of uncertainties with respect to the tune are discussed.

T 151.4 Thu 18:15 WIL/C129

Tuning Pythia8 for future e^+e^- colliders — •Zhijie Zhao[1,2], Mikael Berggren[1], and Jenny List[1] — [1]DESY, Hamburg, Germany — [2]Center for Future High Energy Physics, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China

The majority of Monte-Carlo (MC) simulation campaigns for future e^+e^- colliders has so far been based on the leading-order (LO) matrix elements provided by Whizard 1.95, followed by parton shower and hadronization in Pythia6, using the tune of the OPAL experiment at LEP. In this contribution, we test and develop the interface between Whizard3 and Pythia8. As a first step, we simulate the $e^+e^- \to q\bar{q}$ process with LO matrix elements, and compare three tunes in Pythia8: the standard Pythia8 tune, the OPAL tune and the ALEPH tune. At stable-hadron level, predictions of charged and neutral hadron multiplicities of these tunes are compared to LEP data, since they are strongly relevant to the performance of ParticleFlow algorithms.

Then events are used to perform a full detector simulation and reconstruction of the International Large Detector concept (ILD), as an example for a ParticleFlow-optimised detector. At reconstruction level, a comparison of the jet energy resolution in these tunes is presented. We found good agreement with previous results that were simulated by Whizard1+Pythia6. This modern MC simulation chain, probably with matched NLO matrix elements in the future, should be introduced to ILC or other future e^+e^- colliders.

T 151.5 Thu 18:30 WIL/C129

Geant4 Optimizations in ATLAS — •Mustafa Schmidt for the ATLAS-Collaboration — Bergische Universität Wuppertal

Production of Monte-Carlo simulations for ATLAS usually require large amount of computation time and result in huge memory consumption. In order to minimize the required resources, a dedicated Geant4 optimization task force works on optimizing the performance of the integrated Geant4 version in the ATLAS offline software framework Athena. After being founded in 2020, many optimizations have been implemented, mainly related to improvements of various physics lists, stepping parameters, and detector descriptions.

Recent developments cover a Woodcock tracking algorithm for improving the CPU time for photons in the calorimeter, and a proposal for a particle killer that stops propagating unimportant secondary particles in ATLAS. In addition, a Geant4 toolkit called FullSimLight has been developed which can run with various geometries including the most recent ATLAS detector geometry description. It contains many useful tools, such as a clash detection or a generator for geantino maps of the imported geometry. This talk covers the current status of the ongoing projects as well as an overview of future work packages.

T 151.6 Thu 18:45 WIL/C129

Monte-Carlo Generator Validation in ATLAS with JEM/PAVER — Frank Ellinghaus, Dominic Hirschbühl, Johanna Kraus, Joshua Reidelstürz, Jens Roggel, and •Mustafa Schmidt for the ATLAS-Collaboration — Bergische Universität Wuppertal

Periodic validation of available Monte-Carlo (MC) generators is crucial for obtaining reliable physics simulations, especially for the ATLAS experiment. Its main idea is to spot the origin of possible problems and unwanted features in generated MC events by comparing the shapes of various observables between the generated samples and their references. For that purpose, the existing job execution monitor (JEM), originally designed for monitoring grid jobs, has initially been used. However, due to many missing features, a new validation system, PMG Architecture for Validating Evgen with Rivet (PAVER), was recently developed based on the JEM infrastructure. It uses the ATLAS official Rivet analysis routines for validating specific physics processes, providing an automated and central MC event generator validation procedure that allows a regular evaluation of new revisions and updates for commonly used MC generators in ATLAS. The result is a robust, flexible, and highly functional MC validation setup, that is constantly developed further, for efficiently detecting issues in generated samples within a restricted timescale. It turned out to be a very useful tool for determining several unexpected features related to MC generator behaviors that are regularly reported to the generator authors, which resulted in various bug-fix releases of external MC tools.