T 79: Experimental methods IV

Time: Thursday 16:30–18:15 Location: H-ÜR 1

T 79.1 Thu 16:30 H-ÜR 1

Fast simulation of Electromagnetic Calorimeter using Variational Autoencoder — •Jubna Irakkathil Jabbar[2], Florian Bernlochner[1], Pablo Goldenzweig[2], and Jochen Gemmler[2] — [1]University of Bonn, Germany — [2]Karlsruhe Institute of Technology, Germany

The simulation of particle showers in electromagnetic calorimeters with high precision is a computationally expensive and time consuming process. Fast simulation of particle showers using generative models have been suggested to significantly save computational resources. In this study, electron showers simulated using the Geant4 simulation toolkit are used to train a variational autoencoder model. The model consists of an encoder, decoder and a latent noise vector. Once the model is trained, the decoder is used to generate particle shower simulations providing noise vectors as input. The generated particle showers are cross-checked with the Geant4 showers using various observables.

T 79.2 Thu 16:45 H-ÜR 1

Probing Non-Perturbative QED with LUXE — •Marius Hoffmann[1] and Beate Heinemann[1,2] — [1]DESY, Hamburg — [2]Albert-Ludwigs-Universität Freiburg

In the presence of very strong fields, quantum electrodynamics can not rely on perturbation theory. Instead, nonlinear effects have to be considered. The LUXE (Laser Und European XFEL) Experiment aims to use the high-quality electron beam of the XFEL accelerator to probe this strong-field regime.

With LUXE, field strengths above the Schwinger critical limit can be achieved in two different experimental setups: Interaction of the electron beam with a high-intensity laser or interaction of a photon beam, produced via bremsstrahlung, and the laser.

The two setups open up the possibility to measure both nonlinear Compton scattering and nonlinear Breit-Wheeler pair production. These processes are relevant for example around heavy astronomic objects or future particle colliders. In preparation for the experiment, physics simulations and design studies are performed for the different physics processes of interest.

After giving an introduction to the experiment and setups, this talk focuses on the simulation results for the Breit-Wheeler process after the laser-beam interaction.

T 79.3 Thu 17:00 H-ÜR 1

Studies on Monte Carlo tuning including correlation of uncertainties — •Salvatore La Cagnina, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

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 physics 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 out-of-the box solutions to 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. First results using this method on a MC tune will be presented.

T 79.4 Thu 17:15 H-ÜR 1

sPlot technique: Comparison of error correction methods in unbinned maximum likelihood fits with sWeighted events — Peter Buchholz, Siddardha Chelluri, Mazuza Ghneimat, •Tim-Philip Hücking, Iskander Ibragimov, and Wolfgang Walkowiak — Universität Siegen, Germany

The *sPlot* technique is used in HEP to e.g. separate signal and background events in control variable distributions on a statistical basis. Extracting *sWeights* from a fit to a discriminating variable distribution, the signal and background distributions of the control variable are constructed by weighting the events with the *sWeights*. If an unbinned maximum likelihood fit is performed on such a distribution, the covariance matrix returned by the minimization package Minuit needs to be corrected, as in the case of fits to weighted events in general. Different methods to correct the uncertainties in this case are discussed based on pseudo experiments, performed in RooFit.

T 79.5 Thu 17:30 H-ÜR 1

Bunch pattern dependency of the track counting luminosity measurement in the ATLAS experiment — •Paul Moder[1,2], Valerie Lang[2], Beate Heinemann[1,2], and Claudia Seitz[1] for the ATLAS-Collaboration — [1]DESY Hamburg — [2]Albert-Ludwigs-Universität Freiburg

The measurement of the integrated luminosity, delivered to the ATLAS experiment by the Large Hadron Collider (LHC) at CERN is a key parameter for every physics analysis. It describes the number of particle collisions over a certain time and area, and combined with the cross section, it can be used to predict the expected production rates for a particular process. The uncertainty in the luminosity measurement therefore plays an important role for the precision of physics analyses in ATLAS.
One of the methods for measuring the luminosity is called *track counting*. For this method, the reconstructed charged particle tracks in the ATLAS Inner Detector are counted where the average over several crossings of proton bunches is proportional to the number of simultaneous interactions μ and therefore the luminosity for a dedicated track selection. One challenge of the method, however, is the dependence on the pattern of proton bunches, which usually consists of trains - a number of consecutive filled bunches - and individual bunches with larger gaps in between. In this presentation, the studies of the dependency of the *track counting* luminosity measurement on the bunch position will be shown.

T 79.6 Thu 17:45 H-ÜR 1

Study of the detector occupancy and track selection efficiencies in $Z \to \mu\mu$ events for the track-counting luminosity measurement in ATLAS — •Surabhi Sharma[1], Valerie Lang[2], and Ingrid-Maria Gregor[1] — [1]DESY, Hamburg, Germany — [2]Albert-Ludwigs-Universität, Freiburg, Germany

Particle production at the Large Hadron Collider (LHC) is driven by two important parameters: the centre-of-mass energy and the luminosity. While the centre-of-mass energy is determined by the LHC accelerator, the luminosity delivered to the ATLAS experiment needs to be measured to very high precision, in order to fulfill the physics goals of the ATLAS. In order to provide an accurate and reliable luminosity measurement, ATLAS uses a variety of methods. One of these method is track-counting. The number of charged particle tracks in the inner detector of the ATLAS experiment is proportional to the number of simultaneous proton-proton collisions, and hence the luminosity. A reliable luminosity measurement using this technique requires high and stable tracking efficiencies for the selection of tracks.

In this work, $Z \to \mu\mu$ events are used to study the efficiencies for different track selections. These efficiencies can be used to correct inefficiencies of the track counting luminosity measurement, assuming if there is variation in track selection efficiencies same would be seen in luminosity measurement. This assumption is studied by establishing a method to directly monitor changes in the track-related occupancy of the detector.

T 79.7 Thu 18:00 H-ÜR 1

Detector-corrected Dark Matter search in topologies with missing energy and jets with the ATLAS detector — •Sebastian Mario Weber for the ATLAS-Collaboration — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

A powerful signature for dark matter production at the Large Hadron Collider is large missing transverse energy (MET) from the dark matter particles in association with one or more energetic jets. A Standard Model (SM) process with identical event topology is the Z boson decaying to neutrinos ($Z \to \nu\nu(+jets)$).

A measurement of this process is performed by selecting events with energetic jets and MET as well as events which are selected to enhance vector-boson fusion processes. To simplify later comparisons of the measurement with models for physics beyond the SM, detector effects are removed from the data using an iterative unfolding procedure. Experimental and theoretical uncertainties are constrained using a set of control regions (CRs). These CRs are based on different boson mediated processes, which ensures a high degree of correlation of the uncertainties between the different regions. A search for deviations from the SM is then performed on the detector-corrected results.

In this talk new results on the background estimation in the signal and control regions are presented.