T 65: Experimental methods III

Time: Wednesday 16:00–18:30 Location: To

T 65.1 Wed 16:00 To

Performance of Top-quark Tagging using Unified Flow Object Jets — •Christof Sauer and André Schöning — Physikalisches Institut Universität Heidelberg, Deutschland

Algorithms that identify boosted hadronically decaying objects are used in a variety of physics analyses. The improvements of such *taggers* have a significant impact on the sensitivity of searches beyond the Standard Model (SM), but also allow for more precise SM measurements. Jets reconstructed from *Unified Flow Object* (UFO) are going to be the new baseline for large-$R(=1.0)$ jets due to their improved mass and substructure variable resolutions compared to jets built from other objects like, e.g., topological clusters, pFlow or TCCs.

The results shown in this talk are based on the optimization of two different taggers utilizing UFO jets that identify top quarks and reject QCD jets. A simple comparison of various jet substructure variables – in combination with a one-sided mass cut – has been performed to select a list of well discriminating variables for the new UFO jet collection. However, it was shown in earlier analyses that Deep Neural Networks (DNN) for top identification *significantly* outperform simple cut-based taggers that cut on two to three variables; hence, their usage is the primary consolidated recommendation for the upcoming release.

Finally, a comparison of both taggers (cut- and DNN-based) using UFOs as well as their performance improvement with respect to the previous baseline, i.e. LCTopo, will be presented along with an outlook regarding upcoming tagger concepts involving UFO jets.

T 65.2 Wed 16:15 To

Light flavour mistag calibration for ATLAS *b*-jet identification algorithms — •Angela Burger — Oklahoma State University, United States

Many analyses in ATLAS rely on the identification of jets containing b-hadrons (b-jets) with high efficiency while rejecting more than 99% of non-b-jets. Identification algorithms, called b-taggers, exploit b-hadron properties such as their long lifetime, their high mass, and high decay multiplicity. Recently developed ATLAS b-taggers using neural networks are expected to outperform previous b-taggers by a factor of two in terms of light jet rejection. Nevertheless, contributions from light jet mistags can be non-negligible in certain analyses phase spaces. It is therefore important to precisely measure the mistag rate of the light jets in both data and simulation to correct the corresponding rate in simulation. Due to the high light jet rejection of the b-taggers, the mistag rate cannot be measured directly but rather by means of a modified tagger, designed to decrease the b-jet efficiency while leaving the light jet response unchanged. This so-called "negative tag method" has been improved recently: uncertainties are reduced by constraining non-light flavour contribution with a data-driven method and the dominant systematic uncertainty has been reduced significantly, from 10-60% to 5-35% due to improved inner detector modeling. The method and a selection of results released recently to the ATLAS collaboration using pp collisions at $\sqrt{s} = 13$ TeV will be presented.

T 65.3 Wed 16:30 To

Data-driven corrections to shower shape variables for photon identification with the ATLAS detector — •Jan Lukas Späh, Björn Wendland, and Johannes Erdmann — TU Dortmund, Experimentelle Physik IV

Measurements of Standard Model processes, searches for new particles or processes forbidden in the Standard Model with photons in the final state play an important role in the physics programme of the ATLAS experiment. At hadron colliders, studies of photons are particularly challenging as large background contributions arise from jets, which can be misidentified as photons. This requires a method of identification providing high efficiency for genuine photons while ensuring an excellent background rejection for misreconstructed objects. By now, this method relies on rectangular cuts on so-called shower shape variables, which capture relevant information about the shape and evolution of the electromagnetic shower and the possible leakage into the hadronic calorimeter.

Monte Carlo samples with accurate simulations of the electromagnetic showers are required to interpret measurements with photons consistently. However, residual mismodelling, especially in the distributions of the shower shape variables, is observed. Therefore, these simulated distributions are corrected with a data-driven approach.

In this talk, studies of one-dimensional correction methods with the full Run-2 dataset are discussed and new approaches to improve these methods are presented.

T 65.4 Wed 16:45 To

Derivation of Custom b-Tagging Working Points — Arnulf Quadt, Elizaveta Shabalina, and •Yusong Tian — II. Physikalisches Institut, Georg-August-Universität Göttingen

The identification of jet flavours plays an important role in experimental particle physics research. It aims at identifying jets initiated by b, c and light hadrons. b-tagging is the centre of flavour tagging, due to the distinct features of b-jets. In many analyses, selecting a suitable b-tagging working point for jet selection is often one of the first steps. Currently there are four working points centrally provided by the ATLAS flavour tagging group, corresponding to the efficiency of 60%, 70%, 77% and 85%. However, some analyses could benefit from having non-standard working points. The work to automate the flavour tagging workflow from ntuple production to calibration is ongoing, and providing flexible working point definitions is one link of the chain. This talk presents the framework that allows a user to derive custom working points, and defines different working point profiles (fixed cut, flat efficiency, hybrid and flat rejection).

T 65.5 Wed 17:00 To

Non-collision Backgrounds in ATLAS — •Sergio Grancagnolo — Humboldt-Universität zu Berlin

Understanding events from proton interactions with residual gas in the beam pipe, with collimators, or from cosmic rays is of primary importance to evaluate backgrounds on non-conventional physics signatures, usually based on the primary interaction point. As an example, tracks not pointing to it, out-of-time energy deposits, or displaced decay vertices might come from signals released by long-living heavy particles, introduced by several extensions of the standard model. Last improvements in the characterization of backgrounds not coming from beam collisions will be illustrated.

T 65.6 Wed 17:15 To

Performance of forward electrons in the ATLAS experiment — •Manuel Hohmann and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universtät, Mainz

Electrons are important objects both for the search for new physics and for precision measurements. In some cases, such as the determination of the effective weak mixing angle, the additional use of forward electrons ($2.5 < |\eta| < 4.9$) can provide a large gain in sensitivity and accuracy. To achieve such a gain, it is necessary to better understand the reconstructed and identified forward electrons and their performance, such as their identification efficiency and energy calibration. However, this is challenging because the forward region does not have a tracking system, so only calorimeter information is available. In this contribution, the analysis strategies used to obtain information on forward electrons are discussed and the status of current studies is presented. For the studies, a sample of forward electrons is selected by the tag-and-probe method using data from pp collisions in the ATLAS experiment collected at $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 139 fb^{-1}.

T 65.7 Wed 17:30 To

Impact Parameter Resolution Studies in the ATLAS detector — •Supriya Sinha — DESY, Zeuthen

For many physics studies in ATLAS, b-quark identification emerges to be a very crucial component of the analysis. This is particularly useful in studies involving the selection of pure top quark samples, search for new physics, studying the Standard Model, etc.

The Impact Parameter (IP) is defined as the distance of closest approach of a track to the Primary Vertex (PV). It is the key-ingredient for discriminating the tracks originating from the PV, from the ones originating from displaced vertices, e.g. from decays of b-hadrons. Precise measurement of the IP of charged particle tracks and correct modelling in simulation is fundamental for b-tagging performance.

The resolution of the IP is effected by many factors: intrinsic single hit resolution, multiple scattering inside the detector material, etc.

These are difficult to simulate and hence, the track IP reconstruction performance in Monte Carlo (MC) may need additional tuning to reproduce the data precisely. However, the track IP resolution is contaminated by the PV resolution, which has to be eliminated to get the intrinsic (unfolded) IP resolution of the track. This talk shows the comparison of IP resolution for data and MC for different years. In addition, the comparison is done for different track qualities defined for the b-tagging purposes.

T 65.8 Wed 17:45 To

Improving truth smearing for tau leptons at the ATLAS detector — •Daniel Buchin and Alexander Mann — Ludwig-Maximilians-Universität München

Searches for physics beyond the Standard Model (SM) rely on Monte-Carlo simulations of the signal process to identify an excess with respect to the SM background. This simulation consists of two steps: the physical process itself (truth level) and the detector response (reconstruction level). For some large-scale studies of models beyond the SM, e.g. a scan of the parameter space of the phenomenological Minimal Supersymmetric SM, a full simulation of the supersymmetric processes of each model point is not feasible. To skip the reconstruction-level simulation, smearing functions are used to make truth-level objects resemble reconstruction-level objects as accurately as possible.

In this study, we are looking at ways to improve the accuracy of the truth smearing of tau leptons. To achieve this, we predict the efficiency of the tau reconstruction and identification using a Boosted Decision Tree (BDT) based on truth level variables. This efficiency parametrization can then be used to smear truth level objects.

T 65.9 Wed 18:00 To

Prospects of fast timing detectors for particle identification at future Higgs factories — •Bohdan Dudar[1,2], Rémi Ete[1], and Jenny List[1] — [1]DESY, Hamburg, Germany — [2]Hamburg University, Germany

Future e^+e^- colliders are excellent tools to probe fundamental physics beyond Standard Model via Higgs and electroweak precision measurements.

Modern silicon detectors are able to measure time-of-arrival with high precision of O(10 ps). This can be used to measure the time-of-flight (TOF) of the particles and improve their identification.

We develop reconstruction and calibration algorithms based on TOF information to separate $\pi^{\pm}$, $K^{\pm}$, p, $\bar{p}$ particles at future Higgs factory detectors. Furthermore, we study how to implement fast timing silicon layers in the tracking and/or calorimeter systems, in order to derive requirements on the time resolution. As an example case, the ILD detector concept is studied.

The $K^{\pm}$ mass measurement is a simple benchmark to test the performance of TOF algorithm. A precision at the level of 10 keV can be expected, which would significantly improve the knowledge of the $K^{\pm}$ mass.

T 65.10 Wed 18:15 To

Observation of an inactive region in irradiated silicon diodes — •Oscar Murzewitz, Erika Garutti, Mohammadtaghi Hajheidari, Robert Klanner, and Jörn Schwandt — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Deutschland

The Transient Current Technique (TCT) is used to investigate the response of silicon diodes. Electron-hole pairs are generated close to the surface by illuminating the diode with two sources: either a pulsed red-light laser or α-particles. These charge carriers drift in the electric field and induce transient currents on the diodes electrodes. The charge collection of a diode is determined by integrating these transients.

In this work, n^+pp^+ diodes irradiated with 23 MeV protons up until a 1 MeV equivalent neutron fluence of 1.2×10^{16} cm^{-2} are examined. The measurements are done at -20°C up to a bias voltage of 800 V. TCT observations show evidences for a region with zero charge collection at the n^+p interface. The thickness of this inactive region is determined by comparing charge collection measurements with the two sources. This talk presents the results for three diodes irradiated with varying degrees of fluence.