T 82: B-Tagging

Zeit: Donnerstag 16:00–18:30 Raum: S09

T 82.1 Do 16:00 S09

Flavour tagging developments at LHCb — Alex Birnkraut, •Quentin Führing, and Kevin Heinicke — Experimentelle Physik 5, TU Dortmund

A crucial part of the LHCb physics programm is the indirect search for new physics. In this context, precision measurements of *CP* violation in neutral *B* mesons are performed. For such measurements the initial *B* flavour has to be known. At LHCb this is estimated by various algorithms in the so called flavour tagging.

The LHCb flavour tagging is challenged by the upcoming running conditions at LHC run III. As the mistag rate increases with a higher number of proton interactions per event, the flavour tagging performance is expected to decrease. One approach to preserve and to improve the flavour tagging performance is the development of new algorithms. In this talk the latest flavour tagging developments, like the development of the $SSK^{*0}(892)$ flavour tagging algorithm, will be presented.

T 82.2 Do 16:15 S09

Overview of *b*-tagging and its calibration in the ATLAS collaboration — •Matthieu Robin — DESY-Zeuthen, Germany

Flavour tagging is used to discriminate different flavours in jets. So called *b*-taggers are important tools for the identification of *bottom* quark jets (e.g.: Higgs measurements and SUSY searches).

These algorithms calculate a single discriminating variable based on *B*-hadron specific properties using a combination of different algorithms. This allows to estimate how likely a jet is to include a *b*-quark.

Discrepancies are observed between the Monte Carlo simulations and the data due to mismodelling. Therefore a calibration of the *b*-tagging algorithm is performed applying scale factors on the simulations. This ensures that the *b*-tagging response in Monte Carlo simulations agrees with the response in data. The algorithm output is used applying a fixed cut or in a binned distribution (5 bins). Several methods are performed for the calibrations of the *b*-tagging efficiency and the mistag rate of *light* and *charm* jets.

The aim is to present how the calibration scale factors are extracted from template fits to the data and made available for common ATLAS analysers in a dedicated format.

T 82.3 Do 16:30 S09

Multivariate classification of charged particle tracks for an improved *b*-tagging performance with the ATLAS detector — •Maximilian Klinke, Dominik Duda, Oliver Kortner, and Sandra Kortner — Max Planck Institut für Physik

The identification of jets containing *b*-hadrons, called *b*-tagging, is a key element for many precision measurements and searches for new physics. Heavy flavour tagging algorithms used in ATLAS are based on modern machine learning techniques that exploit characteristic features of tracks and displaced (secondary) vertices to distinguish *b*-hadron jets from *c*-hadron or light-flavour jets.

In particular, the ability to reconstruct secondary vertices dominates the performance of flavour tagging algorithms. However, for high transverse momenta, above $400\,GeV$, the efficiency to reconstruct a secondary vertex starts to decline significantly. One of the reasons for this degradation is the increase of track multiplicity inside a jet for high jet energies, leading to a degradation of vertex finding algorithms. It has been previously shown, that multivariate analysis techniques can be used to reduce the amount of tracks that do not carry any information from the *b*-hadron decay and thus help to recover the performance of the vertex finding at high p_T. The studies presented in this talk aim for an optimisation of these track classification taggers. In addition, the performance of such a technique and its input quantities are compared for various parton shower generators in order to gain a better understanding of model dependencies.

T 82.4 Do 16:45 S09

Track finding algorithm for the BelleII detector — •Thomas Lueck — LMU, Munich, Germany

BelleII is a multi-purpose detector which will collect data produced at the asymmetric e+e- collider SuperKEKB located in Japan. The goal of BelleII is to test the standard model (SM) of particle physics with measurements of unprecedented high precision. Possible contributions from physics beyond the SM can manifest theirselves as significant discrepancies among the SM predictions and the actual measurements. While BelleII already took data with a partially completed detector in 2018, the data taking with the full detector will start in early 2019. It is foreseen to collect a data sample corresponding to 50 ab^{-1} by 2025.

To achieve these physics goals it is required to have an efficient and precise track finding which has to cope with the higher background level at BelleII compared to its predecessors. The tracking devices of the BelleII detector consist of, from inner to outer, two layers of pixelated detectors, 4 layers of double sided strip detectors, and a drift chamber. In this contribution I will present the functionality and the performance of the BelleII track finding algorithms which reconstruct the tracks of charged particles in the tracking devices. These are direct input for the physics analyses.

T 82.5 Do 17:00 S09

Jet Residual Correction at CMS with data collected during 2017 — •Christoph Garbers, Anastasia Karavdina, Jens Multhaup, Arne Reinmers, and Peter Schleper — Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany

For most CMS analysis precise knowledge of the jet energies is of high importance. This is achieved by calibration of the reconstructed jet energies in different detector parts. The calibration is done with simulation as well as with data. In this talk the relative residual correction with di-jet events for the CMS pp-collision data recorded during 2017 is presented. The preparation of data for the analysis and tools introduced for monitoring of residual corrections are discussed in detail.

T 82.6 Do 17:15 S09

Double-b-tagging calibration in $g \to b\bar{b}$ events with the ATLAS experiment — •Ruth Jacobs, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Universität Bonn

In 2018, the ATLAS and CMS collaborations announced the discovery of the Higgs boson decay into two b-quarks with the main contribution from the vector boson associated production mode. To access other production modes, such as gluon gluon fusion, in connection with the $H \to b\bar{b}$ decay, it is useful to consider Higgs bosons with a large transverse momentum, as the relative background contribution is reduced in this kinematic regime. In boosted $H \to b\bar{b}$ decays, the b-quark fragmentation products are reconstructed using a single large-R jet. A Higgs boson identification algorithm ("Higgs tagging") can be used to decide whether a jet originated from a Higgs boson decay, based on the large-R jet properties. One of the main ingredients for Higgs tagging is the determination of the flavour content of the candidate large-R jet. This is achieved by the so-called double-b-tagging method where a b-jet identification ("b-tagging") algorithm is used on two small-R sub-jets associated to the large-R jet. Since b-tagging algorithms are optimized on simulated events only, they must be calibrated in data. In order to calibrate double-b-tagging directly, a data sample of close-by b-jet events is needed. One possibility is to use data events of gluons splitting into b-quark pairs, which are produced abundantly at the LHC. In my talk I will present the strategy and results of the first direct double-b-tagging calibration in $g \to b\bar{b}$ events with the ATLAS experiment using data collected at the LHC in 2015 and 2016.

T 82.7 Do 17:30 S09

Kalibration der Jetenergieskala von anti-k_T Jets mit Radiusparametern von $0,2$ oder $0,6$ am ATLAS-Detektor — •Lars Henkelmann und Oleg Brandt — Kirchhoff-Institut für Physik, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Deutschland

Hadronische Jets sind für eine Vielzahl von Standardmodellmessungen und Suchen nach Neuer Physik am Großen Hadronen-Beschleuniger (LHC) von zentraler Bedeutung. Einige der interessantesten Signaturen können an Präzision gewinnen, wenn andere Radiusparameter R zur Jetrekonstruktion verwendet werden als die Standardwerte von $R = 0,4$ und $R = 1,0$. So geben z.B. $R = 0,2$ anti-k_T Jets die Möglichkeit, Jetstrukturobservablen in Ereignissen mit hadronisch zerfallenden W, Z, oder Higgs-Bosonen, top-Quarks oder hypothetischen neuen Resonanzen, welche hadronisch zerfallen könnten, genauer zu messen.

Dieser Vortrag skizziert einen Überblick über das Kalibrationsverfahren für $R = 0,2$, und $R = 0,6$ anti-k_T Jets. Besonderes Augenmerk liegt auf den Unterschieden zu bestehenden Kalibrationen für $R =$

0, 4 Jets. Darüber hinaus werden ausgewählte Details der Kalibration angesprochen: die Monte-Carlo basierte Pile-Up-Residuumskorrektur, die statistische Kombination der verschiedenen Beiträge zur finalen Daten-basierten In-Situ Korrektur, sowie eine Studie des Einflusses zusätzlicher Nachbarjets in Regionen mit hoher Hadronendichte auf die Anwendbarkeit der Kalibration.

T 82.8 Do 17:45 S09

Tau Identification Efficiency Scale Factor Measurement using the $Z \to \tau\tau$ Tag & Probe method at ATLAS — •Lino Gerlach, Michel Janus, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

Tau leptons play an important role in many measurements and searches within and beyond the Standard Model at ATLAS. As these analyses use Monte Carlo generated events for both signal and background processes, scale factors should be determined to correct Monte Carlo predictions of the tau identification efficiency.
We present the precision measurement of these scale factors binned in the number of prongs, the transverse momentum, and the working point of the ID applied to the hadronically decaying tau lepton. To obtain a high purity sample of hadronically decaying tau leptons, a muon from a leptonically decaying tau lepton is used to tag $Z \to \tau_{\text{lep}}\tau_{\text{had}}$ events, and the hadronically decaying tau lepton is then used to measure the identification efficiency and determine the corresponding scale factors.

T 82.9 Do 18:00 S09

Energy Reconstruction with Software Compensation Techniques in a highly granular Scintillator - Tungsten Hadronic Calorimeter — •Christian Winter and Frank Simon for the CALICE-D-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

The CALICE Collaboration is developing highly granular calorimeters for future high-energy physics experiments. One of the technologies is the Analog Hadron Calorimeter (AHCAL), based on plastic scintillator tiles with SiPM readout. In the context of the multi-TeV e^+e^- collider CLIC, the performance of the AHCAL was studied with Tungsten absorbers. We study the hadronic energy resolution of this prototype with local software compensation techniques, which apply energy-density dependent weights on local energy deposits to improve the energy reconstruction, primarily by correcting for the difference in response to electromagnetic and purely hadronic components of the particle showers. Preliminary results of a study perfomed on pion data from 10 GeV to 80 GeV recorded at the CERN SPS will be presented.

T 82.10 Do 18:15 S09

The Track Classification Tool and the implementation of a new b-tagging algorithm for ATLAS — Carlo A. Gottardo, Sebastian Heer, Vadim Kostyukhin, •Ö. Oğul Öncel, Keshava Prasad, Andrea Sciandra, and Markus Cristinziani — Physikalisches Institut, Universität Bonn

Correctly identifying b-quark initiated jets (b-tagging) at large transverse momentum ($p_{\text{T}} > 1$ TeV) will become increasingly important as ATLAS accumulates more data. Currently used b-tagging algorithms distinguish b-jets against light-jets. This approach is effective for low- and medium-p_{T} jets, but results in performance degradation at high p_{T}, where fragmentation dominates.

Instead of distinguishing two sets of tracks, the b-tagging performance can be improved by introducing explicitly the most important track categories and classifying tracks before the b-tagging step itself. The Track Classification Tool (TCT) is a multi-class multivariate discriminator that classifies tracks into one of the following three categories: heavy flavour, fragmentation or hadronic interactions and pile-up.

A newly developed b-tagging algorithm in ATLAS uses the TCT to classify tracks in a jet and based on this information creates a b-tagging score. It is found to be enhancing the b-tagging performance, particularly in the high-p_{T} regime, in comparison to currently used b-taggers. The implementations will be described and comparative performance studies will be presented.