T 48: Methods in Particle Physics III

Time: Wednesday 16:15–18:15 Location: KH 00.020

T 48.1 Wed 16:15 KH 00.020

Muon flux measurements at SND@LHC for the LHC p+O run — •Jannis Thienel, Heiko Lacker, and Eduard Ursov — Humboldt-Universität zu Berlin

The Scattering and Neutrino Detector at LHC (SND@LHC) has collected data from various runs of proton-proton (pp) collisions at the ATLAS interaction point (IP1) of the LHC in a previously unexplored pseudo-rapidity range of $7.2 < \eta < 8.4$. The analyses of these runs have successfully demonstrated the detection of (high-energy) neutrinos, including the first detection of muon-neutrino charged-current interactions. Muon flux measurements are essential to quantify one of the backgrounds to neutrino measurements and to verify Monte Carlo simulations. A dedicated investigation of the muon flux in the very forward direction from the p+O collisions at SND@LHC might be of interest for testing hadronic interaction models relevant for cosmic airshower physics. First preliminary results of these muon flux measurements will be presented.

T 48.2 Wed 16:30 KH 00.020

Supressing muon-induced background in SHiP with the Surrounding Background Tagger — •Jasmin Weiss — Humboldt-Universität zu Berlin

SHiP (Search for Hidden Particles) will be a fixed-target experiment at CERN's SPS designed to search for feebly interacting particles (FIPs) in the GeV range. Installed in a dedicated beam-dump facility in the ECN3 cavern, SHiP will use 400 GeV/c SPS protons to reach $6 \cdot 10^{20}$ on-target collisions over 15 years of data taking, while suppressing backgrounds from the intense muon and neutrino flux emerging from the beam dump. A key element is the Surrounding Background Tagger (SBT), which encloses the 50 m helium-filled decay volume and tags charged particles entering from the sides as well as inelastic interactions occurring inside the decay volume.

The contribution focuses on simulation studies evaluating muon-induced backgrounds and the performance of the SBT in rejecting these events, highlighting their impact on the overall background-suppression strategy.

T 48.3 Wed 16:45 KH 00.020

Muon Momentum Scale and Resolution Calibration for CMS in Run 3 — •Dorian Guthmann[1], Markus Klute[1], Filippo Errico[2], and Jost von den Driesch[1] — [1]Karlsruhe Institute of Technology — [2]INFN

Precise muon momentum calibration is essential for many analyses at the LHC, as detector misalignment and magnetic field uncertainties lead to systematic differences between data and simulation. Within the CMS experiment, updated scale and resolution corrections for Run 3 data were derived over the past year using the ScaReKIT framework, which was also optimized with a focus on performance and stability. These improvements streamline the calibration workflow and reduce the computational cost of producing accurate calibration factors. This presentation highlights the motivation, methodology, and recent progress in refining the CMS muon momentum calibration, as well as the outlook for further improvements in upcoming datasets.

T 48.4 Wed 17:00 KH 00.020

Calibrating Charm Jet Tagging in ATLAS — Diptaparna Biswas, Carolina Costa, Markus Cristinziani, Carmen Diez Pardos, Ivor Fleck, Gabriel Gomes, Jan Joachim Hahn, Nikolaos Kamaras, Vadim Kostyukhin, Nils Benedikt Krengel, Austin Olson, •Inês Pinto, Sebastian Rentschler, Elisabeth Schopf, Katharina Voss, Wolfgang Walkowiak, and Adam Warnerbring — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

Classifying jets according to the flavour of the initiating parton is essential for many ATLAS analyses involving b- and c-quarks. Recent developments employ end-to-end transformer architectures to improve jet flavour identification. In this talk, we present an alternative data-driven calibration of the c-jet tagging efficiency using the $W+c$ method, which selects $W+c$ events through a soft muon from the semi-leptonic decay of a charmed hadron. The charge correlation between the W boson and the charm quark strongly suppresses backgrounds, allowing a clean determination of the c-jet content. Unlike the standard $t\bar{t}$-based calibration, which is not suitable for Beyond the Standard Model top-quark studies, this method provides an independent and complementary handle on c-jet performance. We present current measurements of the c-jet efficiency, and the c-jet mis-identification efficiency in the case of b-jet identification, in data and simulation, and derive the corresponding scale factors.

T 48.5 Wed 17:15 KH 00.020

Finding Photon Fusion processes with a track veto — •Daniel Werner — DESY, Hamburg

Photon Fusion processes offer the possibility of studying QED production modes in the otherwise QCD dominated environment of the LHC. A key difference between the production of leptons via photo fusion or the Drell-Yan process is the presence of underlying events. To exploit this difference, a veto on any tracks near the primary vertex can be used.

This talk aims to introduce both photon fusion processes and the reconstruction of tracks in the ATLAS detector. A focus is put on tracks with a low transverse momentum that can boost the discrimination power of the veto. Reconstruction efficiencies are shown for low momentum tracks in Run 4.

T 48.6 Wed 17:30 KH 00.020

Calibration of the Photon Identification Efficiency in ATLAS — •Leonor Santos Pereira Trigo — Deutsches Elektronen-Synchrotron (DESY), Zeuthen, Germany

The accurate measurement of photon efficiency remains an essential ingredient of many physics analyses at the LHC and with the ATLAS detector. Considering the reliance of said analyses on simulation samples, the calculation of scale factors quantifying the differences in how accurately the ATLAS detector identifies real photons and fake photons between simulation and real data is an important task. One of the methods used to obtain these scale factors is the matrix method, which provides a data-driven estimate for the efficiency of the ATLAS detector in distinguishing photons of interest from other particles misidentified as photons. With the use of data regions enriched in either true or misidentified photons, it is possible to estimate the photon identification efficiency within ATLAS with minimal reliance on background simulation.

T 48.7 Wed 17:45 KH 00.020

Determining the τ-Lepton Efficiency in a Global Approach at the ATLAS Experiment — •Harilal Bhattarai, Philip Betchler, and Christian Grefe — Physikalisches Institut, Universität Bonn

The measurement of the hadronic τ-lepton identification efficiency at ATLAS is important for the proper modeling of signal and background processes, which directly impacts the sensitivity to Standard Model (SM) and BSM phenomena. In this approach, we will measure tau ID at a centre of mass energy $\sqrt{s} = 13$ TeV, across multiple channels such as $Z \to \tau\tau$ and $W \to \tau\nu$.

In this analysis, we use Run 2 data corresponding to an integrated luminosity of 139 fb^{-1} and applying optimized selections on lepton isolation, tau p_T, η, and charge requirements to suppress backgrounds. We perform a global measurement of tau ID efficiencies and the corresponding Data-to-MC scale factors at ATLAS for 1-prong and 3-prong τ candidates using the HAPPy and ROOT frameworks. In this talk, we will present the efficiencies and scale factors.

T 48.8 Wed 18:00 KH 00.020

Determination of Universal Tau Fake Factors for the Run 3 Data Taking Period of ATLAS — •Christian Schmidt, Arno Straessner, and Asma Hadef — Institut für Kern- und Teilchenphysik, Technische Universität Dresden

Tau leptons are an important product in collision events at the LHC; they primarily decay into a hadronic final state. Hadronic jets can easily produce similar signatures inside the ATLAS detector, leading to misidentified or "fake" taus, so it becomes necessary to estimate the fake tau background. The Fake Factor (FF) method estimates this background from data events with non-isolated tau candidates using a correction factor which depends on the transverse momentum of the tau candidate. In addition, the FF depends on the origin of the fake-

producing jets, such as quark or gluon jets. Instead of measuring the FFs in a separate control region for each physics analysis, the Universal Fake Factor (UFF) method uses an estimate of the jet composition to linearly interpolate the FFs.

This talk will present the general principles of the UFF method, the process and data preparation being used to determine the UFF parameters in ATLAS Run 3 data, and current results.