

T 77: QCD II

Time: Thursday 16:00–18:00

Location: Tb

T 77.1 Thu 16:00 Tb

Measurement of inclusive jet production in deep inelastic scattering using ZEUS data — ●FLORIAN LORKOWSKI — DESY, Hamburg, Germany

The cross sections of deep inelastic scattering processes at electron-proton colliders are a well established tool to test perturbative QCD predictions. They can also be used to determine theory parameters, such as the strong coupling constant or the parton distribution functions of the proton.

In this talk, a measurement of inclusive jet cross sections in neutral current deep inelastic scattering using the ZEUS detector at the HERA collider is presented. The data was taken in the years 2003 to 2007 at a center of mass energy of 318 GeV and corresponds to an integrated luminosity of 372 pb^{-1} . Massless jets, reconstructed using the k_{\perp} -algorithm in the Breit frame, are measured as a function of the squared momentum transfer Q^2 and the transverse momentum of the jets in the Breit reference frame $p_{\perp, \text{Breit}}$, in a range of $125 \text{ GeV}^2 < Q^2 < 15000 \text{ GeV}^2$ and $p_{\perp, \text{Breit}} > 7 \text{ GeV}$. The measured cross sections are compared to previous measurements.

T 77.2 Thu 16:15 Tb

Event shape analysis in deep-inelastic $e^{\pm}p$ scattering — ●JOHANNES HESSLER, DANIEL BRITZGER, STEFAN KLUTH, and ANDRII VERBYTSKIY — Max Planck Institut für Physik, München

Event shape observables are sensitive to the strong coupling constant α_s and parton distribution functions (PDFs). A new measurement of the 1-jettiness observable τ_1^b in neutral-current deep-inelastic scattering will be performed. Data from the H1 experiment at the HERA electron-proton collider at DESY will be used. The data was taken in the years 2003 to 2007. It includes electron-proton and positron-proton scattering. Due to momentum conservation τ_1^b has an analogy to the observable thrust. Precise theoretical calculations are available for τ_1^b . The observable is defined in the Breit frame. Only the hadronic final state in the current hemisphere contributes. A triple differential measurement in the observables τ_1^b , x_{Bj} (momentum fraction of the scattered parton) and Q^2 (virtuality of the exchanged boson) will be performed. The sensitivity to the strong coupling constant α_s and to proton PDFs are explored. In the talk preliminary results for the triple-differential cross section measurement will be presented.

T 77.3 Thu 16:30 Tb

Measurements of the total charm and beauty cross sections with the CMS detector — ●JOSRY METWALLY, NUR ZULAIHA JOMHARI, and ACHIM GEISER — DESY, Hamburg, Germany

The aim of this project is the determination of the total cross section for inclusive charm and beauty production at the LHC with different center-of-mass energies down to very low transverse momentum, and the comparison with QCD predictions in next-to-next-leading order of perturbation theory. The measurement of the cross sections for the production of heavy quarks at the LHC are one important test of QCD, and can, as has already happened in the case of top production, be used for a measurement of the quark masses.

Other experiments as ATLAS and ALICE covered only small fractions of the available phase space while the LHCb experiment fully covered the forward region, $2.0 < y < 4.5$. For this project, we measure cross sections in the full phase space complementary to LHCb of prompt D mesons, and D mesons from b hadron decays through the decays $B \rightarrow D^* X \rightarrow D^0 \pi_s X \rightarrow K \pi \pi_s X$ and $B \rightarrow D^0 X \rightarrow K \pi X$. One of the challenges is the separation of prompt D mesons and D mesons from b hadron decays near the production threshold. In this talk, the details of this separation and the resulting cross sections will be presented.

T 77.4 Thu 16:45 Tb

First Belle II results on charmless B-decays and prospects — ●OSKAR TITTEL, MARKUS REIF, BENEDIKT WACH, and HANS-GÜNTHER MOSER for the Belle II-Collaboration — Max-Planck-Institut für Physik, München, Deutschland

In early 2019 the Belle II experiment at the SuperKEKB electron-proton collider started taking data on the $\Upsilon(4S)$ resonance. The expected large yields of charmless B decays at Belle II will enable significant advancements in the understanding of quark dynamics, in-

cluding a world-leading determination of the CKM phase α/ϕ_2 , and a conclusive understanding of the so-called K- π CP-puzzle. Using an early sample of 34.6 fb^{-1} recorded until mid-2020, we report on first measurements of branching ratio and direct CP violation of charmless B decays. The new results are compatible with the current state of knowledge and the ongoing data taking looks promising to deliver the most precise measurements on this field.

T 77.5 Thu 17:00 Tb

LHCb for astroparticle physics: Inclusive production of prompt charged particles — JOHANNES ALBRECHT¹, ●JULIAN BOELHAUVE¹, HANS DEMBINSKI¹, MICHAEL SCHMELLING², and BERNHARD SPAAN¹ — ¹TU Dortmund University, Dortmund, Germany — ²Max Planck Institute for Nuclear Physics, Heidelberg, Germany

A long-standing issue in the field of cosmic-ray research is the discrepancy in the number of muons produced in high-energy air showers between observations and simulations, referred to as the Muon Puzzle. Precision measurements of hadron production in the forward region need to be performed to validate and improve the hadronic-interaction models used in air-shower simulations and to solve the Muon Puzzle. For the achievement of these goals, measuring the differential cross-section of inclusive production of prompt charged long-lived particles as a function of transverse momentum and pseudorapidity has key importance.

An analysis in which this differential cross-section is determined based on a trigger-unbiased data sample of proton-proton collisions recorded with the LHCb experiment at a centre-of-mass energy of 13 TeV is presented in this talk. In particular, the efficiency determination and the construction of proxies that enable a data-adjusted quantification of the backgrounds are described.

T 77.6 Thu 17:15 Tb

Reconstruction of missing momentum in $\Lambda_b \rightarrow \Lambda_c \bar{D}^* 0 K$ decays — ●MINDAUGAS SARPIS for the LHCb-Collaboration — University of Bonn, Bonn, Germany

Charmonium-pentaquarks, P_c , were observed by LHCb in 2015 and 2019 as resonances in the $J/\psi p$ final state from $\Lambda_b \rightarrow J/\psi p K^-$ decays. The nature of these resonances is not yet fully understood, but their proximity to the $\Sigma_c \bar{D}^* 0$ thresholds motivate ‘molecular’ pentaquark models. These models predict large branching fractions of $P_c \rightarrow \Lambda_c \bar{D}^* 0$ decays. There is a large sample of $\Lambda_b \rightarrow \Lambda_c \bar{D}^* 0 K$ decays in the LHCb data acquired during Run 1 and Run 2 of the LHC, however the low-momentum π^0 or γ from the decay $\bar{D}^* 0 \rightarrow \bar{D}^0 \pi^0 / \gamma$ are difficult to reconstruct. Instead, the four-momentum of the $\bar{D}^* 0$ is found from a kinematic over-constraint method called Extended Cone Closure, which is the main topic of this talk.

T 77.7 Thu 17:30 Tb

Search for pentaquark states in $\Lambda_b^0 \rightarrow \Sigma_c^{++(*)} D^- K^-$ — ●ABHAY MEHTA¹, NICOLA SKIDMORE², and SEBASTIAN NEUBERT¹ — ¹Helmholtz Institute for Radiation and Nuclear Physics, University of Bonn, Germany — ²University of Manchester, United Kingdom

In 2015, LHCb first observed exotic hadronic objects consisting of five quarks [1]. So far, evidence for these pentaquarks has only been seen in the $J/\psi p$ decay and their nature is still obscure. (Non)-evidence in further decay processes is crucial to distinguish between the numerous theoretical models of pentaquarks. Hadronic molecular models, in particular, predict a strong coupling to the decay into $\Sigma_c^{++(*)} D^-$. This study uses the Run 1 and Run 2 dataset from the LHCb detector at the LHC.

The talk will cover preliminary selections and fits on the data in the given decay channel.

[1] Roel Aaij et al. "Observation of $J/\psi p$ Resonances Consistent with Pentaquark States in $\Lambda_b^0 \rightarrow J/\psi K^- p$ Decays". In: Phys. Rev. Lett. 115 (2015), p. 072001.

T 77.8 Thu 17:45 Tb

LHCb for astroparticle physics: The Muon Puzzle in air showers and its connection to the LHC — ●HANS DEMBINSKI¹, JULIAN BOELHAUVE¹, JOHANNES ALBRECHT¹, BERNHARD SPAAN¹, and MICHAEL SCHMELLING² — ¹Experimentelle Physik 5, TU Dortmund — ²Max Planck Institut für Kernphysik, Heidelberg

The Muon Puzzle is a central issue for the ground-based observation of astroparticles. It refers to a lack of muons produced in simulated air showers initiated by cosmic rays in comparison to measurements. Progress has been made in recent years to confirm the muon discrepancy with high significance and to theoretically trace its origin to features of hadron-nuclear interactions in air showers (most muons are produced at the end of a hadronic cascade). Air shower simulations use state-of-the-art hadronic models tuned to the latest LHC data, which cover hadron production at mid-rapidity in great detail. The tuning does not solve the puzzle, which suggests "missing physics" in

these models regarding the forward production of light hadron in high-energy hadron-nucleus collisions, which dominate the evolution of air showers but are not sufficiently studied at the LHC.

We will review evidence for the Muon Puzzle, the connection between muon production in air showers and hadron production, and which measurements at the LHC have the potential to solve the puzzle. The focus will be placed on the unique opportunities offered by LHCb measurements of proton-nucleus collisions. Running the LHC with oxygen beams to study proton-oxygen collisions is of key importance to achieve these goals.