T 114: Standard model 4 (strong/QCD)

Time: Friday 9:00–10:30 Location: Geb. 30.23: 2/0

T 114.1 Fri 9:00 Geb. 30.23: 2/0

QCD cross-section measurements for astroparticle physics with the LHCb experiment — Johannes Albrecht, Hans Dembinski, and •Lars Kolk — TU Dortmund University, Dortmund, Germany

A long-standing issue in the field of cosmic-ray research is the discrepancy between the observed and simulated numbers of muons in cosmic-ray-induced hadronic showers in the Earth's atmosphere, which are called air showers. This discrepancy is referred to as the Muon Puzzle, as the required changes to existing models in simulation would either violate data constraints or the consistency between air shower simulations and other air shower features.
One explanation for this inconsistency lies in universal strangeness enhancement, which measurements from the ALICE and LHCb experiments show first evidence off. To further study the impact on forward-produced hadrons and to test this universality, proton-ion data from the LHCb fixed target mode are analysed. Of particular interest are proton-oxygen collisions, as they are a good proxy for air showers. Since proton-oxygen data are not yet available, the first step is to bracket oxygen with helium and neon. The current status of this analysis is presented.

Supported by DFG (SFB 1491)

T 114.2 Fri 9:15 Geb. 30.23: 2/0

Observation of antihelium and antihypertriton in *pp* collisions with LHCb — •Hendrik Jage, Dan Moise, Valery Zhukov, and Stefan Schael — I. Physikalisches Institut B, RWTH Aachen

The first observation at the LHCb experiment of hypertritons and antihypertritons is reported. The used dataset consists of *pp* collisions at $\sqrt{s} = 13\,\text{TeV}$, collected between 2016 and 2018, and corresponds to an integrated luminosity of $5.5\,\text{fb}^{-1}$. The hypertriton candidates are reconstructed via the two-body decay into helium-3 and a charged pion. The corresponding helium nuclei are identified with a technique that is innovative at the LHCb experiment and mainly exploits ionisation losses in the LHCb silicon sensors. A total of 1.1×10^5 prompt helium and antihelium candidates are identified with negligible background contamination and 107 ± 11 hypertriton candidates are found, paving the way for a rich programme of precise measurements of QCD and astrophysical interest to be performed on the available data.

T 114.3 Fri 9:30 Geb. 30.23: 2/0

Triple differential Z+Jet cross section measurement — •Cedric Verstege, Maximilian Horzela, Klaus Rabbertz, and Günter Quast — Karlsruhe Institute of Technology, Karlsruhe, Germany

The differential cross-sections of Z($\mu\mu$)+jet events is presented using the data recorded at 13 TeV center-of-mass energy by the CMS detector during Run 2. The cross-sections are measured as a function of the Z boson transverse momentum p_T^Z, the rapidity separation y^* of the Z boson and the leading jet, and the boost in rapidity y_b of their center-of-mass system in the lab frame. The observables y^* and y_b enhance the sensitivity to different parton initial-state and momentum contributions, and thus to the parton distribution functions.

The measured cross-sections are unfolded for detector effects in all three dimensions simultaneously. The resulting cross-sections at stable particle level are compared to precise theory predictions calculated at next-to-next-to-leading order in perturbative QCD corrected for electroweak and non-perturbative effects.

T 114.4 Fri 9:45 Geb. 30.23: 2/0

Measurement of jet substructure observables on Z+bb events with the ATLAS Experiment — •Alberto Lorenzo Rescia — Dipartimento di Fisica, Università di Genova, Genova, Italy — Deutsches Elektronen-Synchrotron, Hamburg, Germany

The study of jet substructure provides valuable insight into the underlying physics of particle interactions. In particular, through the study of the radiation pattern surrounding heavy flavour quarks, jet substructure studies can clarify the nature of strong interactions. In this work, we present a measurement of jet substructure observables on b-jets produced in Z+bb events at a center-of-mass energy of 13 TeV utilising data collected by the ATLAS experiment at the Large Hadron Collider (LHC). Our analysis focuses on the primary Lund Jet Plane as well as other jet substructure observables which aim to discriminate colour singlet decays, such as those of the Higgs boson, from colour octect decays.

T 114.5 Fri 10:00 Geb. 30.23: 2/0

Measurement of differential ϕ production cross-sections in 13 TeV proton-proton collisions at the LHCb experiment — •Donata Osthues, Johannes Albrecht, and Hans Dembinski — TU Dortmund University, Dortmund, Germany

Traditional models of hadronization in proton-proton and proton-ion collisions are based on effective non-perturbative theories and successfully describe many phenomena. However, their predictions have recently been challenged by the observation of multiplicity-dependent strangeness production at mid-rapidity by the ALICE collaboration. Since this discovery, enhanced strangeness production was also found in the forward rapidity region. Enhanced strangeness production is a key observable to understand the Muon Puzzle, which is a phenomenon seen in high-energy air-showers. The LHCb experiment is ideally suited for studies on strangeness production at the LHC in the forward region, thanks to its particle identification capabilities and low p_T threshold. We studied ϕ mesons via the decay $\phi \to K^+K^-$, which consist of a strange-anti-strange quark pair and are abundantly produced. This makes ϕ mesons perfect candidates for these kind of studies. Thus, a measurement of their production cross-section in bins of transverse momentum and rapidity is performed. The data used for this analysis was collected during proton-proton collisions by the LHCb detector in 2015 and corresponds to an integrated luminosity of 4.6 n/b. This contribution presents the current status of the measurement.

T 114.6 Fri 10:15 Geb. 30.23: 2/0

Early measurement of strange-hadron production ratios at LHCb in Run 3 — Johannes Albrecht[1], •Noah Behling[1], Lukas Calefice[2], Hans Dembinski[1], and Biljana Mitreska[1] — [1]TU Dortmund University, Dortmund, Germany — [2]Universitat de Barcelona, Barcelona, Spain

Hadron production ratios are a useful probe to test and improve hadronisation models. In this work, the production ratios of K^0_S, Λ^0, and $\bar{\Lambda}^0$ are studied with the upgraded LHCb experiment using early data recorded in 2022. These studies are also essential to calibrate and validate the performance of the upgraded detector. The proper operation of all subsystems needs to be validated step-by-step to carry on precise measurements with data recorded recently and in the future. The performance of the tracking system can be validated with the measured ratios.

The meson-to-baryon ratios and strangeness production in general contribute to the understanding of hadronic processes in cosmic-ray-induced extensive air showers, which are dominated by soft-QCD effects in the forward region. In air-shower data, an excess of muons produced with respect to Monte Carlo event generators has been observed, which could originate from mismodelling of the hadronisation process. The LHCb experiment offers a unique environment to test hadronic models in the forward region.

The current status of the analysis pipeline and recent studies on detector performance will be presented. Additionally, a bridge between collider and air-shower experiments will be built.