HK 9: Heavy-Ion Collisions and QCD Phases II

Time: Monday 16:45–18:15 Location: HS 3 Chemie

HK 9.1 Mon 16:45 HS 3 Chemie

Accessing the p–Σ^+ interaction via femtoscopy with ALICE — •Benedict Heybeck for the ALICE Germany-Collaboration — Institut für Kernphysik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt, Germany

The Σ–nucleon strong interaction is an important ingredient to understand the composition of neutron stars and is also crucial for theoretical predictions on potential Σ-hypernuclei. Data on this interaction is scarce and purely based on scattering experiments. Since data points are only available at rather high relative momenta and their uncertainties are sizeable, theory calculations are not well constrained. Particularly the triplet channel is very uncertain and it is not yet clear if the interaction in this channel is attractive or repulsive. In this regard, two-particle intensity interferometry (femtoscopy) of Σ baryons and nucleons can provide valuable information. Σ^+ baryons decay into a proton and a neutral pion via the weak interaction with a branching ratio of 52%. The neutral pion decays electromagnetically almost exclusively into two photons which are challenging to measure with the ALICE apparatus. In this talk, a novel reconstruction method will be shown, which makes use of sophisticated reconstruction algorithms and machine learning techniques to improve the reconstruction efficiency and purity of the Σ^+ baryons and allow for the measurement of their correlation function with protons for the first time. The obtained correlation function will be discussed and related to latest theoretical calculations, providing new constraints on the Σ–nucleon interaction.

HK 9.2 Mon 17:00 HS 3 Chemie

Modeling charged-particle spectra in high-energy pp collisions with deep neural networks — •Maria Alejandra Calmon Behling, Jerome Jung, Mario Krüger, and Henner Büsching — Institut für Kernphysik, Goethe Universität Frankfurt

During the data-taking campaigns Run 1 and Run 2 of the Large Hadron Collider (LHC), the ALICE collaboration recorded a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This extensive dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a powerful regression tool to capture underlying multidimensional correlations inherent in the data. DNNs are used to parametrize recent ALICE measurements of multiplicity (N_{ch})- and transverse momentum (p_{T})-dependent charged-particle spectra. This new approach allows extrapolating the measurements towards higher N_{ch} and p_{T} values as well as to unmeasured $\sqrt{s}$, providing data-driven references for future heavy-ion measurements.

In this talk, we present the current status of the analysis. We discuss the potential and limitations of using DNNs to model complex multidimensional data and compare the results to those from event generators.

Supported by BMBF and the Helmholtz Association.

HK 9.3 Mon 17:15 HS 3 Chemie

Uniform description of multiplicity dependent particle p_{T} spectra with ALICE — •Joshua König — Institut für Kernphysik, Goethe-Universität Frankfurt

Identified particle transverse momentum (p_{T}) spectra in ultra-relativistic pp collisions are crucial for constraining fragmentation functions and parton distribution functions, thereby offering deeper insight into the particle production mechanisms in these collisions.

Universal scaling laws are often employed to identify commonalities in particle production mechanisms across different collision energies and across different charged particle multiplicities. Transverse Bjorken-x (x_{T}) scaling is used to showcase a uniform behavior for particle p_{T} spectra across different center-of-mass energies, while KNO scaling provides a framework to describe these spectra uniformly across varying charged-particle multiplicity classes.

Recent results from the ALICE collaboration present data for various identified particles at LHC energies and across different charged-particle multiplicity classes, offering an opportunity to study these scaling laws in great detail.

In this talk, the multiplicity dependence of identified particle p_{T} spectra is investigated by means of x_{T} and KNO scaling. A surprising similarity between the multiplicity dependence and the center of mass energy dependence is shown. Furthermore, these findings are applied to results from MC generators to gain insight into the initial state of the collision.

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HK 9.4 Mon 17:30 HS 3 Chemie

Differential measurement of the common particle emitting source using p–p correlations in pp collisions at 13.6 TeV with ALICE — •Anton Riedel for the ALICE Germany-Collaboration — Technische Unversität München, München, Deutschland

The minimum bias (MB) dataset of pp collisions at $\sqrt{\mathrm{s}} = 13.6$ TeV collected by ALICE during Run 3 of the LHC enables the first study of transverse mass (m_{T}) scaling of the femtoscopic source across event multiplicities. Previously observed in high-multiplicity pp collisions, the m_{T} dependence of the source size, linked to collective phenomena, is now extended to the low-multiplicity regime. The resonance source model, which accounts for the effects of strong-decaying resonances, allows comparison of source size dependence on multiplicity in pp collisions with results from larger systems, like Pb–Pb collisions. These results provide a new framework for exploring radial flow effects on source scaling and offer a benchmark for theoretical models on collective phenomena in small colliding systems. They are also essential for coalescence models addressing nuclear cluster production and serve as a crucial reference by fixing the emission source for high-precision studies of interaction potentials in hadron-hadron pairs with strangeness and charm using ALICE Run 3 data. This contribution presents the measurement of m_{T} scaling of the femtoscopic source of proton-proton pairs as a function of event multiplicity using ALICE Run 3 data. This project is funded by DFG (EXC2094 - 390783311) and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 9.5 Mon 17:45 HS 3 Chemie

Neutral-meson production in pp collisions at $\sqrt{s} = 13.6$ TeV with the ALICE experiment — •Youssef El Mard Bouziani for the ALICE Germany-Collaboration — University of Frankfurt, Germany

The ALICE experiment at the LHC aims to explore the properties of the quark-gluon plasma (QGP), a state of matter characterized by extreme densities and temperatures and believed to be created in heavy-ion collisions. High-energy proton-proton (pp) collisions offer a unique environment for understanding related mechanisms within the framework of Quantum Chromodynamics (QCD). Measurements of π^0 and η mesons in such collisions deepen our understanding of hadronization processes and provide a baseline for the study of direct photons and dielectrons, which are essential observables in investigating the QGP.

In ALICE, decay photons can be reconstructed through either the energy they deposit in calorimeters or by tracking e^+e^- pairs resulting from photon conversion within the detector material, known as the Photon Conversion Method (PCM). The calorimeter-based technique provides high statistics and resolution for larger momenta, while PCM offers superior precision for studying neutral mesons at low momenta. To enhance the scope and precision of such investigations, significant upgrades to the detector systems were implemented for LHC Run 3.

In this talk, the current status of the measurements of neutral mesons produced in pp collisions at $\sqrt{s} = 13.6$ TeV is presented, highlighting particle p_{T} spectra over a broad p_{T} range.

HK 9.6 Mon 18:00 HS 3 Chemie

Hadron-photon correlations in pp collisions in ALICE using POWHEG and PYTHIA — •Peter Stratmann — Institut für Kernphysik, Universität Münster

Outgoing high-pT partons produced from hard scatterings early in high-energy collisions, such as occurring at A Large Ion Collider Experiment (ALICE) at the Large Hadron Collider, lead to the creation of jets. Photons are produced copiously in these interactions - directly emitted by the quarks as prompt photons, or through the decay of unstable particles. They are valuable probes to study jet fragmentation and nuclear parton distribution functions (nPDF).

Angular correlations between high-pT hadrons, which are likely the leading hadron of a jet, and their associated photons are extracted from ALICE simulations. The photons are reconstructed from conversions in the ALICE material into electrons and positrons using the Photon Conversion Method. Since direct photons cannot be distinguished individually, their spectra are derived using a statistical approach. The decay photon spectra are derived from neutral hadron measurements, and subtracted from the inclusive measurements to extract the direct photon spectra. In this analysis, proton-proton collisions are simulated in Monte Carlo, using stand-alone PYTHIA at leading order (LO), and PYTHIA in combination with POWHEG at next-to-leading order (NLO), and compared with each other. While prompt photons are well defined at LO, ambiguities are introduced at NLO. This analysis aims to understand better the production mechanisms of prompt photons and hence the nPDF at low pT.