HK 23: Heavy-Ion Collisions and QCD Phases III

Time: Wednesday 13:45–15:45 Location: PHIL C 301

Group Report HK 23.1 Wed 13:45 PHIL C 301

Probing charm and quarkonium dynamics in pp and OO collisions with ALICE — •Samrangy Sadhu, Ankur Yadav, Lubna Al-Rifaie, and Bernhard Ketzer for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn

We present recent and ongoing heavy-flavour measurements with the ALICE experiment at the CERN LHC, focusing on charm production in pp and quarkonium collectivity in OO collisions. We discuss recent open-charm results, including the D^{*+} production cross section in pp collisions at $\sqrt{s} = 5.36$ TeV and D^0 meson–charged particles azimuthal correlations in pp at $\sqrt{s} = 13.6$ TeV. Together, these measurements constrain charm-quark production, fragmentation, and charm-jet properties, and at the same time provide essential baselines for future heavy-ion studies at the corresponding energies. In addition, we present the first J/ψ flow measurement in OO collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV. The observed azimuthal anisotropy offers insight into possible collective behaviour and charm transport in a small, short-lived QCD medium. These results strengthen the understanding of heavy-flavour dynamics across collision systems and support the characterisation of QCD phenomena from pp to intermediate-size nuclei. Supported by BMFTR.

HK 23.2 Wed 14:15 PHIL C 301

Charm-baryon lifetime measurement in pp collisions at $\sqrt{s} =$ 13.6 TeV with ALICE — •Oleksii Lubynets for the ALICE Germany-Collaboration — Heidelberg university, Physics institute

The lifetimes of heavy-flavour hadrons provide a sensitive benchmark for the heavy-quark expansion (HQE) approach, in which the total decay width is expressed as a power series of heavy-quark mass. Different treatments of higher-order terms can lead to sizable variations in predicted lifetimes, making precise measurements of charm-baryon lifetimes crucial for validating and refining HQE approaches.

We present the implementation of a lifetime measurement for the Λ_c^+ baryon reconstructed via its decay channel $pK^-\pi^+$ with data collected at ALICE during Run 3 of the LHC. Charmed hadrons are reconstructed by their decay topology via a Kalman filter algorithm. The measured yield as a function of proper decay time is corrected for detector and reconstruction inefficiencies using dedicated Monte-Carlo simulations implemented with the Geant4 transport model. The effect of feed-down from beauty-hadron decays is corrected in a data-driven way. It allows us to build a corrected proper decay time distribution of prompt Λ_c^+ from which its lifetime is determined.

The described procedure demonstrates the capability of ALICE to deliver a competitive lifetime measurement of charm baryons, contributing to the global effort to constrain HQE parameters and improve theoretical understanding of charm-hadron decays.

HK 23.3 Wed 14:30 PHIL C 301

Measurement of ψ(2S) production at midrapidity in Pb–Pb Collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV with ALICE — •Jinjoo Seo for the ALICE Germany-Collaboration — Heidelberg University

Quarkonium is a sensitive probe of the quark-gluon plasma (QGP) created in ultra-relativistic heavy-ion collisions. In the QGP, color screening leads to the suppression of all charmonium states. However, the large charm production cross-section at LHC energies can also cause enhanced charmonium production at the phase boundary or (re-)generation throughout the QGP evolution. The interplay between suppression and (re-)generation mechanisms reflects the underlying charm-quark dynamics in the QGP and during hadronization. Studying the ψ(2S) is particularly interesting because of its weaker binding energy, larger spatial size, and smaller feed-down contribution compared to the J/ψ. Previous measurements have shown a stronger suppression of ψ(2S) relative to J/ψ and are compatible with both statistical hadronization at the phase boundary as well as a model with continuous breakup and formation in the QGP. To clarify the situation, data at low transverse momentum and midrapidity are necessary. In this contribution, we present the first results of inclusive ψ(2S) production at midrapidity in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV with the ALICE detector, together with the corresponding J/ψ measurements.

HK 23.4 Wed 14:45 PHIL C 301

J/Ψ measurement at midrapidity in Pb−Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV with the ALICE central barrel — •Jonathan Witte for the ALICE Germany-Collaboration — Universität Heidelberg

The interaction of heavy flavour quarks in the quark-gluon plasma has been under investigation for more than two decades. After the melting of bound charmonium states have been firmly established, the focus moved towards regeneration effects at higher collision energies. First results from Pb−Pb collisions at the LHC provided strong support for this picture, offering important experimental constraints for both thermal and transport hadronisation models. The newest ALICE data collected in LHC Run 3 - featuring a new time projection chamber and higher interaction rate - opens the door to precision measurements of J/Ψ production at midrapidity. The J/Ψ is reconstructed in the dielectron decay channel, with the two electrons measured in the central barrel. While the data taking is still in progress, the final analysis is under development. The current focus here is on the optimisation on the electron identification and the description of the background, increased due to the high interaction rates. In the talk I will present the analysis status and show the first stable J/Ψ signals from the Run 3 Pb−Pb data.

HK 23.5 Wed 15:00 PHIL C 301

Charmonium production as a function of multiplicity in pp collisions — •Alexander Tiekötter for the ALICE Germany-Collaboration — Institut für Kernphysik, Münster, Deutschland

Charmonium production happens at different energy scales. $c\bar{c}$ production occurs at perturbative energies, while the hadronization into colorless charmonium is a soft process. Models like the Improved Color Evaporation Model or Non-relativistic QCD describe the charmonium cross-section well, but fail at $p_{\rm T} < 3\,{\rm GeV}/c$. The color glass condensate (CGC) approach extends NRQCD to better describe the low $p_{\rm T}$ regime and implies a non-linear multiplicity dependence of charmonium production.
To investigate this effect, we measure the production of J/ψ and $\psi(2S)$ mesons at $\sqrt{s} = 13.6\,{\rm TeV}$ as a function of charged-particle multiplicity with the ALICE detector at mid-rapidity in the e^+e^- decay channel. The multiplicity is measured by using an iterative Bayesian unfolding algorithm to convert the number of tracks to a charged-particle distribution. Results are presented via self-normalized ratios so that experiment-dependent quantities cancel. Results of the inclusive J/ψ production as function of multiplicity show a stronger-than-linear increase and are in good agreement with the NRQCD+CGC model, while predictions from PYTHIA8 fail to describe the data. Measuring $N_{\psi(2S)}/N_{J/\psi}$ even shows a more complex behavior, where the CGC alone fails. Considering dissociation mechanisms for charmonium can qualitatively explain the shape of the ratio.
Supported by BMFTR

HK 23.6 Wed 15:15 PHIL C 301

J/ψ elliptical-flow v_2 analysis in O-O collisions at mid-rapidity using ALICE Run-3 data — •Ankur Yadav, Samrangy Sadhu, Lubna Al-Rifaie, and Bernhard Ketzer for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen und Kernphysik, Universität Bonn

The Large Hadron Collider (LHC) at CERN had first oxygen-oxygen (O-O) collisions at $\sqrt{S_{NN}} = 5.36$ TeV in 2025. This dataset provides a unique opportunity to study collectivity and quark-gluon-plasma (QGP) signatures in a smaller collision system compared to the heavy-ion systems such as Pb-Pb. The ALICE experiment has recorded this dataset with excellent precision, enabling the investigation of quarkonium production with a focus on the J/ψ meson.

This talk will present the first measurement of the azimuthal-anisotropy coefficient v_2 of inclusive J/ψ in O-O collisions at midrapidity. The v_2 values are extracted in several transverse-momentum and centrality intervals using the scalar product method. Comparing this measurement to existing results from larger collision systems allows us to probe the scaling of quarkonium collectivity with system size.

The talk will cover the analysis procedure, including signal extraction, and flow determination, as well as the resulting J/ψ elliptic flow values.

Supported by BMFTR.

HK 23.7 Wed 15:30 PHIL C 301

Collective effects in O-O and Ne-Ne collisions from a hybrid approach — •Lucas Constantin[1], Carl B. Rosenkvist[1], Niklas Goetz[1], and Hannah Elfner[3,1,2,4] — [1]Goethe University Frankfurt, Department of Physics, Institute for Theoretical Physics, 60438 Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum f*ur Schwerionenforschung, 64291 Darmstadt, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, 60438 Frankfurt am Main, Germany

Many features of heavy-ion collisions are well described by hybrid approaches, where the droplet of strongly coupled quark gluon plasma (QGP) is modeled by hydrodynamics and the subsequent dilute stage is performed with a hadronic transport model. Conventionally, the formation of a QGP is well established in larger collision systems like Lead and Gold. However, hints of collectivity were found even in proton-proton collisions, raising the question where the onset of QGP formation lays. This study aims at making predictions for the light ions run at the LHC in July 2025, in order to explore the applicability of hybrid approaches in smaller collision systems. We employ three different models, the SMASH-vHLLE-hybrid approach, the pure hadronic cascade of SMASH and Angantyr to simulate O-O collisions at a center of mass energy of * sNN=5.36TeV. This setup allows us to compare evolutions with and without a hydrodynamic description on an equal basis, while Angantyr serves as a baseline for no collective effects.