HK 28: Heavy-Ion Collisions and QCD Phases VI

Time: Wednesday 14:00–15:30 Location: SCH/A315

Group Report HK 28.1 Wed 14:00 SCH/A315

Transport Model Evaluation Project for Intermediate-Energy Heavy-Ion Collisions — •Hermann Wolter — University of Munich (LMU), unich, Germany

Transport models describing the evolution of a heavy-ion collision are indispensable to extract information on the equation-of-state of nuclear matter and medium properties of hadrons from such experiments in the intermediate energy range from several 100 MeV to a few GeV per nucleon. Of particular interest today is the high-density behavior of the nuclear symmetry energy, which is of great relevance for the understanding of astrophysical objects and processes. However, the highly complex and non-linear transport equations are commonly solved by simulations, which involve choices of strategies, which are not necessarily determined by the underlying equations. Thus it has occurred that studies using different transport models have deduced differing conclusions from the same data. In order to understand these differences and to reduce the systematical uncertainties of transport analyses of heavy-ion collisions, we have, within the TMEP collaboration, undertaken an extensive project of comparing many transport codes in different set-ups under controlled conditions (a review is given in H. Wolter et al., Progr. Part. Nucl. Phys. 125 (2022) 103962), also providing benchmark calculations. Here we will discuss the present status and future projects of this undertaking.

HK 28.2 Wed 14:30 SCH/A315

Mapping the quark-gluon plasma properties in Pb-Pb and Xe-Xe collisions at the LHC with FluiduM — •Luuk Vermunt[1,2], Yannis Seeman[1], Lukas Kreis[2], Christian Sonnabend[1], Andrea Dubla[2], Ilya Selyuzhenkov[2], and Silvia Masciocchi[1,2] — [1]Physikalisches Institut, Heidelberg, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

Fundamental properties of strongly-interacting matter under extreme conditions become accessible with ultra-relativistic collisions of heavy ions. We will present a phenomenological analysis of the experimental data for transverse momentum spectra of identified charged hadrons and (multi-)strange hyperons in Pb-Pb and Xe-Xe collisions at the LHC. The analysis is based on the relativistic fluid dynamics description implemented in the numerically efficient FluiduM approach. We separate in our treatment the chemical and kinetic freeze out, and incorporate the partial chemical equilibrium to describe the late stages of the collision evolution. We determine key parameters of the quark-gluon plasma evolution and its properties including the shear and bulk viscosity to entropy ratios, the initialisation time, initial density, and freeze-out temperatures. The physics parameters and their posterior probabilities are extracted using global search in multidimensional space with modern Machine Learning tools, such as ensembles of neural networks.

HK 28.3 Wed 14:45 SCH/A315

Global angular momentum generation in heavy-ion reactions within a hadronic transport approach — •Nils Sass[1], Oscar Garcia-Montero[1,2], Marco Müller[1], and Hannah Elfner[1,3,4] — [1]Goethe University Frankfurt — [2]University Bielefeld — [3]GSI — [4]FIAS

In 2017, the STAR collaboration at the Relativistic Heavy Ion Collider (RHIC) has measured finite global spin polarization of Λ hyperons. This measurement revealed a high angular momentum of the heavy ions and provided experimental evidence for vorticity in the quark-gluon plasma for the first time. In order to investigate the underlying mechanisms, a dynamic description of the transfer of angular momentum is required. In this work, the microscopic non-equilibrium transport approach SMASH is applied to study the generation of global angular momentum by the interaction of two nuclei. As SMASH provides access to the whole phase-space evolution of every particle at any given time, it allows to assess the fraction of angular momentum generated in the fireball by all participants. We confirm the previous modeling by Becattini within a geometric Glauber model approach, which found that the angular momentum transfer reaches a unique maximum in mid-central Au-Au collisions during time evolution. Even though angular momentum is not conserved locally in the transport approach a priori, we identify the contributions to the conservation violation and propose optimal setups for different energy regimes that recover conservation, based upon the test particle method and the treatment of Fermi motion.

HK 28.4 Wed 15:00 SCH/A315

First dielectron measurements in pp collisions at 13.6 TeV with ALICE in Run 3 — •Florian Eisenhut for the ALICE Germany-Collaboration — Goethe-Universität Frankfurt am Main

With the new and upgraded detectors of ALICE, the experiment is capable to read out collision data in a continuous mode. With a data acquisition rate 100 times larger than before, an integrated luminosity of more than 10 nb^{-1} is expected to be collected for Pb–Pb collisions during the Run 3 and 4 (2022-2032) data taking periods. Not only the improved readout of the detectors but also the reduced material budget, as well as the improved pointing resolution of the detectors, are crucial for the dielectron analysis. They will help to control the background from photon conversions and heavy-flavor hadron decays within the dielectron spectra.

This talk will give an overview of the first performance studies for dielectron analyses with the ALICE experiment based on data of pp collisions at 13.6 TeV in Run 3. It will summarize the techniques used to track, identify and select electrons and positrons. First results of the dielectron spectra and their corresponding signal-to-background ratios and significances will be presented together with a comparison to the results in Run 2.

HK 28.5 Wed 15:15 SCH/A315

Prompt and non-prompt J/ψ with machine learning and Kalman filter techniques with ALICE in Run 3 — •Pengzhong Lu for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — University of Science and Technology of China, Hefei, China

Quarkonium production offers an effective way to study the properties of the quark-gluon plasma (QGP) created in ultra-relativistic heavy-ion collisions. While the prompt J/ψ production provides information on suppression and (re-)generation mechanisms in the QGP, the non-prompt J/ψ component (from b-hadron decays) allows one to study heavy quark energy loss in the medium. J/ψ meson production measurements in pp collisions, besides providing a reference for the corresponding measurements in p-Pb and Pb-Pb collisions, are also crucial to better understand quantum chromodynamics.

In this talk, the performance of the combined usage of KFParticle and machine learning (ML) for the measurement of prompt and non-prompt J/ψ production will be presented. The KFParticle package, based on the Kalman filter algorithm, shows good performances in the reconstruction of particle decays. Combining it with ML techniques will significantly improve the signal reconstruction efficiencies and signal-to-background ratios. Results from the commissioning of this new methodology in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV from Run 2 will be shown, followed by the study of the first Run 3 data from pp collisions at $\sqrt{s} = 13.6$ TeV.