HK 19: Schwerionenkollisionen und QCD Phasen

Zeit: Dienstag 14:00–16:00 Raum: HZ 6

Gruppenbericht HK 19.1 Di 14:00 HZ 6

Anisotropic flow measurements with ALICE — •Ilya Selyuzhenkov for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

Anisotropic transverse flow is sensitive to the QCD equation of state which governs the evolution of the medium produced in a heavy-ion collision, as well as, to the transport properties (e.g. viscocity) of matter in a deconfined phase.

Results from the anisotropic flow measurements since the first heavy-ion run at the LHC in 2010 will be reviewed. The anisotropic flow harmonics are measured for charged hadrons and for a wide spectrum of identified particles with the light, strange, and heavy quark content. The measurements are performed for particles produced over a wide range of (pseudo-)rapidity and transverse momentum for various collision centrality classes. The progress stimulated by these measurements in our understanding of the initial conditions and properties of the matter created in nucleus-nucleus and proton-nucleus collisions at relativistic energies will be discussed.

HK 19.2 Di 14:30 HZ 6

Initial state properties in heavy ion collisions at RHIC and LHC energies — •Rudy Marty[1,2], Elena Bratkovskaya[1,2], Wolfgang Cassing[3], and Jörg Aichelin[4] — [1]FIAS, Frankfurt, Germany — [2]ITP, Frankfurt, Germany — [3]ITP, Giessen, Germany — [4]Subatech, Nantes, France

The issue of initial conditions in relativistic heavy ion collisions is a subject of intensive debate. Especially the assumption of thermal equilibrium after ∼1 fm/c is currently not supported by microscopic transport approaches. In our study we compare the Parton-Hadron-String Dynamics (PHSD) with new transport approach RSP based on the Nambu-Jona-Lasinio (NJL) model, applying the same initial conditions from PHSD, which have a 'lumpy' energy density profile. The comparison of final hadronic observables shows that the initial parton distribution must be out of equilibrium in order to reproduce the multiplicity spectra dN/dp_T and $dN/d\eta$ and the elliptic flow v_2 for Au+Au at RHIC energies. We also discuss the applicability of an equation of state and the applicability of a hydrodynamics for relativistic high energy collisions.

HK 19.3 Di 14:45 HZ 6

Investigating the transition between hydrodynamics and transport in heavy ion collision simulations — •Dmytro Oliinychenko and Hannah Petersen — Frankfurt Institute of Advanced Studies

One of the established ways to describe the dynamical evolution of heavy ion collisions theoretically is hydrodynamics with subsequent switching to transport, i.e. so-called hybrid models [1]. The switching process itself is organized as follows: at some predefined hypersurface the hydrodynamic evolution is stopped and particle distributions are generated according to the Cooper-Frye formula. Unavoidably, some particles from these distributions fly back into the hydrodynamic region. Such particles, which are also refered to as "negative contributions", are usually neglected in current hybrid approaches [2].

In the present study we present a systematic investigation of the negative contributions in a coarse-grained transport approach. Many UrQMD (Ultra-relativistic Quantum Molecular Dynamics) events are generated and the negative contributions calculated in a Cooper-Frye prescription are compared to the negative contributions based on the actual underlying particles. The other crucial point in hybrid approaches is the assumption of local equilibrium in the early stages of the collision. Therefore, we also show how fast local thermal equilibrium is reached in the UrQMD transport approach. The goal of this study is to extract a criterion for local thermalization.

[1] P. Huovinen, H. Petersen; EPJ A48 (2012)171 [2] H. Petersen, et al.; Phys.Rev. C78 (2008) 04490

HK 19.4 Di 15:00 HZ 6

Studying the collision energy dependence of elliptic and triangular flow with a hybrid model — •Jussi Auvinen[1] and Hannah Petersen[1,2] — [1]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany

Elliptic flow has been one of the key observables for establishing the finding of the quark-gluon plasma (QGP) at the highest energies of Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). As a sign of collectively behaving matter, the elliptic flow is expected to decrease at lower beam energies, where the QGP is not produced. However, in the recent RHIC beam energy scan, it has been found that the inclusive charged hadron elliptic flow changes relatively little in magnitude within the energy range 7.7 - 39 GeV per nucleon-nucleon collision.

We study the collision energy dependence of the elliptic and triangular flow utilizing a Boltzmann+hydrodynamics hybrid model described in [1,2]. Such a hybrid model provides a natural framework for the transition from high collision energies, where the hydrodynamical description is essential, to smaller energies, where the hadron transport dominates. This approach is thus suitable for investigating the relative importance of these two mechanisms for the production of the collective flow at different beam energies.

References: [1] H. Petersen, J. Steinheimer, G. Burau, M. Bleicher and H. Stocker, Phys. Rev. C78, 044901 (2008). [2] J. Auvinen and H. Petersen, arXiv:1310.1764.

HK 19.5 Di 15:15 HZ 6

Charge-dependent azimuthal correlation measurements in Pb-Pb collisions with ALICE — •Jaap Onderwaater for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

Parity violation in strong interactions is predicted to be observable in relativistic heavy-ion collisions. The occurrence of parity-odd domains may result in charge separation along a strong magnetic field created by moving ions – a phenomenon dubbed the chiral magnetic effect (CME). Sensitive experimental observables include two particle azimuthal correlations and correlation of particle pairs relative to the reaction plane. A challenge is to separate contributions to these correlations from background sources, which include local charge conservation and initial density fluctuations. Correlations for lead-lead collisions at $s_{NN} = \sqrt{2.76}$ TeV measured with the ALICE detector are presented as a function of centrality, average and relative transverse momentum, and separation in pseudorapidity, providing additional constraints for models.

HK 19.6 Di 15:30 HZ 6

Transport Coefficients of Relativistic Systems — •Moritz Greif — Goethe Universität Frankfurt

It becomes increasingly important to know the strength of dissipative effects in relativistic hydrodynamics. Recently, scientists have strongly focused on shear viscosity. Nevertheless, heat flow, being proportional to spatial gradients of e.g. chemical potential over temperature, can also be an important effect in studies of relativistic fluid dynamics. We investigated the heat conductivity coefficient for an ultrarelativistic Boltzmann-gas, using our partonic transport model BAMPS. BAMPS solves the relativistic Boltzmann-equation numerically for arbitrary different particle species. We use pQCD scattering cross-sections. Furthermore, the response of a charged, relativistic gas onto an external electric field determines the electric conductivity. We investigated the electric conductivity of different model systems using three different methods: analytic transport theory, linear response via Green-Kubo formulae in equilibrium BAMPS-setups, and applying the textbook-picture of linear response to BAMPS. We plan to investigate the electric conductivity with the recently improved 2 <-> 3 processes from BAMPS and compare the results with lattice QCD.

HK 19.7 Di 15:45 HZ 6

Investigation of Mach cones and the corresponding two-particle correlations in a microscopic transport model — •Ioannis Bouras[1], Barbara Betz[1], Zhe Xu[2], and Carsten Greiner[1] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany — [2]Department of Physics, Tsinghua University, Beijing, China

Using a microscopic transport model we investigate the evolution of

conical structures originating from the supersonic jet through the hot matter and dense matter of ultra-relativistic heavy-ion collisions. We found that the Mach cone angle is influenced by the source term properties, energy deposition and viscosity. While in a static medium a possible double-peak structure is overshadowed by the diffusion wake and head shock, it turns out that in central heavy-ion collisions due to the radial flow of the expanding medium a double-peak structure is visible. On the one hand this is mainly contributed from Mach cones propagating into the opposite direction of the radial flow, while on the other hand deflected jets may also contribute to a final double-peak structure. The corresponding double-peak structure is observed insofar the shear viscosity over entropy density ratio is sufficiently small, while a larger dissipation destroys any kind of Mach cone and/or double-peak structure.