HK 22: Heavy-Ion Collisions and QCD Phases IV

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 05

Group Report HK 22.1 Tue 15:45 HBR 62: EG 05

Recent developments in dissipative spin hydrodynamics — •Masoud Shokri[1], Annamaria Chiarini[1], Julia Sammet[1], Nils Sass[1], David Wagner[1], Ashutosh Dash[1], Enrico Speranza[2], Nora Weickgenannt[3], Hannah Elfner[1], and Dirk H. Rischke[1] — [1]Goethe University, Frankfurt am Main, Germany — [2]IPhT, Saclay, France — [3]CERN, Switzerland

Transport equations for particles with spin can be rigorously derived from quantum kinetic theory in an expansion in Planck's constant. At zeroth order, the standard Boltzmann equation is recovered. At first order, a nonlocal contribution to the collision term is found, which enables the mutual conversion of orbital angular momentum into spin and thus provides a microscopic mechanism for the time-honored Barnett effect. The method of moments is applied to derive second-order dissipative spin hydrodynamics. Investigating this theory in the linear regime confirms the need for a second-order theory. We computed the transport coefficients of this theory and found that spin diffusion happens on rather short time scales, while spin degrees of freedom approach local equilibrium on rather long time scales. This separation of time scales allows a simplification of the expression for the polarization vector and a numerical evaluation without explicitly solving the equations of motion for the spin degrees of freedom. While we find qualitative agreement with experimental data, a quantitatively reliable calculation requires the development of numerical simulations for spin hydrodynamics. Finally, an outlook for further theoretical and phenomenological developments is given.

HK 22.2 Tue 16:15 HBR 62: EG 05

Elliptic flow of non-prompt D^0 in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$= 5.02 TeV with ALICE — •Biao Zhang for the ALICE Germany-Collaboration — Physical Institute, Heidelberg, Germany

Heavy quarks (charm and beauty) are among the most interesting and powerful probes to investigate the properties of the quark-gluon plasma (QGP), because they are produced on a very short time scale in initial hard scattering processes and thus they experience the whole history of the collision. The elliptic flow (v_2) of heavy quarks can provide insight on their degree of thermalization in the medium. In this contribution we will present the first elliptic-flow measurement of non-prompt D^0 at midrapidity in semicentral Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$= 5.02 TeV with ALICE. Comparisons with measurements obtained from semi-leptonic decays and with theoretical models will be presented.

HK 22.3 Tue 16:30 HBR 62: EG 05

Extending the fluid dynamic description of heavy-ions collisions to times before the collision — •Andreas Kirchner[1], Federica Capellino[2], Alaric Erschfeld[3], Stefan Floerchinger[3], and Eduardo Grossi[4] — [1]ITP Heidelberg — [2]University Heidelberg — [3]TPI Jena — [4]Dipartimento di fisica e astronomia, Universita di Firenze and INFN Sezione di Firenze

It is well established that the late states of a high energy nuclear collision can be described in terms of relativistic fluid dynamics. An open problem in this context is how the actual collision and the early time dynamics, including the thermalization process, directly after it can be described. Phenomenological models are currently employed here and they have several parameters that need to be fitted to experimental data. Using relativistic fluid dynamics of second order we develop a new approach which addresses the entire collision event, and which gets initialized in fact already before the collision. This is based on the droplet model for the incoming nuclei and a state-of-the-art equation of state including the first-order liquid-gas phase transition. The physics picture we propose assumes that the soft features of a high energy nuclear collision can be fully described through the dynamics of the energy-momentum tensor and other conserved currents.

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HK 22.4 Tue 16:45 HBR 62: EG 05

Non-Hydrodynamic Modes from Linear Response in Kinetic Theory — •Stephan Ochsenfeld and Sören Schlichting — Universität Bielefeld, 33615 Bielefeld, Deutschland

Viscous hydrodynamics serves as a successful mesoscopic description of the QGP produced in relativistic heavy-ion collisions. In order to investigate, how such an effective description emerges from the underlying microscopic dynamics we calculate the non-hydrodynamic and hydrodynamic modes of linear response in the sound channel from a first-principle calculation in kinetic theory. We do this with a new approach wherein we linearize and discretize the collision kernel to calculate eigenvalues directly. This allows us to study the Green's functions at any point in time or frequency space. Our study focuses on scalar theory with quartic interaction and we find that the analytic structure of Green's functions in the complex plane is far more complicated than just poles or cuts which is the first step towards an equivalent study in QCD kinetic theory.

HK 22.5 Tue 17:00 HBR 62: EG 05

Differential multiharmonic flow correlations in ALICE and CBM — •Ante Bilandzic[1], ALICE Collaboration[2], and CBM Collaboration[2] — [1]Technical University of Munich — [2]N/A

Recently developed multiharmonic flow observables, Symmetric Cumulants (SC) and Asymmetric Cumulants (AC) of flow amplitudes provide independent constraints for properties of nuclear matter produced in heavy-ion collisions when compared to the traditional studies of individual flow harmonics.

This contribution will present the latest differential measurements of SC and AC observables obtained in Pb–Pb collisions in ALICE. The corresponding feasibility studies for the future CBM experiment will also be discussed. Two experiments probe different regions of the QCD phase diagram — ultrarelativistic heavy-ion collisions at the LHC at CERN explore the regime of very high temperatures (re-creating the conditions which existed in the very early Universe), while the experiments at FAIR at GSI explore the regime of very large net-baryon densities (re-creating the conditions which exist in the core of neutron stars). Multiparticle cumulant analysis is more challenging in CBM than ALICE due to the smaller center of mass collision energies and multiplicities.