HK 34: Heavy-Ion Collisions and QCD Phases VIII

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 18

Group Report HK 34.1 Tue 17:30 HBR 62: EG 18

Real-time methods for critical dynamics — Mattis Harhoff[3], Frederic Klette[3], Patrick Niekamp[1], •Johannes Roth[1], Sören Schlichting[3], Leon Sieke[1], Lorenz von Smekal[1,2], and Yunxin Ye[3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen — [3]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany

In this group report, I will give an overview on the non-perturbative real-time methods we use to study the universal critical dynamics relevant for the chiral transition and the QCD critical point, following our general goal of bringing the phenomenology of heavy-ion collisions closer to the theory of the QCD phase diagram. In addition to the corresponding static universality classes, the relevant universal dynamics is believed to be given by that of a four-component Heisenberg antiferromagnet (Model G, in the classification by Halperin and Hohenberg) and of a single-component fluid (Model H). Our main calculational methods are the functional renormalization group, both directly formulated on the Schwinger-Keldysh contour or analytically continued from Euclidean spacetime, and ab-initio classical-statistical lattice simulations. I will show how our calculated real-time observables such as spectral functions can be used to gain insight into the universal dynamics of QCD matter close to a second-order phase transition.

HK 34.2 Tue 18:00 HBR 62: EG 18

Dynamic critical behavior of the chiral phase transition from the real-time functional renormalization group — •Yunxin Ye[1], Johannes Roth[2], Soeren Schlichting[1], and Lorenz von Smekal[2] — [1]Universitaet Bielefeld, D-33615 Bielefeld, Germany — [2]Justus-Liebig-Universitaet, Heinrich-Buff-Ring 16, 35392 Gießen, Germany

In the chiral limit the complicated many-body dynamics around the second- order chiral phase transition of two-flavour QCD can be understood by appealing to universality. We present a novel formulation of the real-time functional renormalization group that describes the stochastic hydrodynamic equations of motion for systems in the same dynamic universality class, which corresponds to Model G in the Halperin-Hohenberg classification. Our approach preserves all relevant symmetries of such systems with reversible mode couplings. We show that the calculations indeed produce the non-trivial value $z = d/2$ for the dynamic critical exponent, where d is the number of spatial dimensions. From the momentum and temperature dependence of the diffusion coefficient of the conserved charge densities, we extracted the dimensionless universal scaling function.

HK 34.3 Tue 18:15 HBR 62: EG 18

Dynamic critical behavior of the O(4) chiral transition — •Frederic Klette[1], Sören Schlichting[1], and Lorenz von Smekal[2] — [1]Bielefeld University, Bielefeld, Germany — [2]Justus Liebig University, Gießen, Germany

Evidence suggest that in the chiral limit, the QCD phase transition becomes a second order phasetransition in the Op4q universality class. Since real world QCD is not too far from the chiral limit, it is thus interesting to explore the consequences for static and dynamic correlation functions. Since, in the vicinity of the critical point, the physics is governed by universal scaling exponents and scaling functions, we can exploit this universality to address this question. We employ classical-statistical realtime simulations to extract the dynamic critical behavior of an O(4) linear sigma model in the static and dynamic universality class of QCD in the chiral limit. By comparing results for the dynamics with and without a conversed energy and O(4) charges, we can realize the Model A and Model G dynamic universality classes in the classification scheme of Halperin and Hohenberg, for which we compute the dynamic critical exponent z of and further extract the relevant dynamic scaling functions for the spectral function of the order parameter. Furthermore, we explore the intricacies of the dynamics of the charges in model G, focusing on the difference in the diffusive behaviour between vector and axial components, caused by the coupling between axial charges and the O(3) symmetric pion components of the order parameter field.

HK 34.4 Tue 18:30 HBR 62: EG 18

Bayesian inference of quark-gluon plasma transport coefficients from transverse momentum spectra and flow observables — •Rafet Kavak for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

Heavy-ion collisions provide a window into the properties of the quark-gluon plasma (QGP), a state of matter in which quarks and gluons are deconfined. Understanding the collective properties of the QGP is possible by comparing models of heavy-ion collisions to experimental measurements of the distribution of particles produced at the end of the collisions. Bayesian inference provides a rigorous statistical framework to constrain the properties of nuclear matter by systematically comparing models and measurements. In this talk, our latest analysis of the experimental data for transverse momentum spectra and flow observables of identified charged hadrons in Pb-Pb and Xe-Xe collisions at the LHC will be presented. Our Bayesian framework is used to constrain transport coefficients of the QGP, such as shear and bulk viscosities, initialization time, and kinetic and chemical freezeout temperatures.

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HK 34.5 Tue 18:45 HBR 62: EG 18

Description of p_{T} spectra of pions, kaons and protons in pp, p*Pb, and Pb*Pb collisions at the LHC with Pythia — •Tim Stellhorn and Anton Andronic — Institut für Kernphysik, Universität Münster

PYTHIA is a general-purpose Monte-Carlo event generator which is broadly used to generate high-energetic pp, p-Pb, and Pb-Pb collision events. In this study, p_T spectra resulting from PYTHIA simulations are compared with data from the ALICE experiment at CERN. A particular focus is placed on QGP-like effects such as collective flow which is schematically modelled in PYTHIA via the string shoving mechanism. This model extends the Lund string model by introducing a transverse effect in string interactions in densely populated regions of phase space.

A comparison shows that the MC-generated p_{T} spectra resulting from pp collisions reproduce the ones measured in ALICE within $\pm 30\,\%$ depending on p_{T} and particle species. With the string shoving model, the data-model comparison is partially improved but not consistently over p_{T} and particle species. A possible reason for this is an increased multiplicity due to the generation of excitation gluons in string interactions. One should note, that PYTHIA does not include a consistent tune for the string shoving model yet.