HK 46: Heavy Ion Collisions and QCD Phases VII

Zeit: Donnerstag 14:00–16:00 Raum: HZO 60

Gruppenbericht HK 46.1 Do 14:00 HZO 60

Status of the CBM Experiment — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at FAIR will measure nucleus-nucleus collisions at beam energies up to 14 AGeV during the first stage and up to 45 AGeV in a second stage. The key objective of CBM is to investigate the QCD phase diagram in the region of the highest net-baryon-densities. A rich phase structure is conjectured in this region where chiral symmetry is expected to be restored and a first order phase transition could occur, representing a substantial discovery potential at FAIR energies.

As a fixed-target experiment CBM is consequently designed to cope with unprecedented interaction rates up to 10 MHz which will allow to study extremely rare probes with high precision. To achieve the high rate capability CBM will be equipped with fast and radiation hard detectors readout by a free-streaming data acquisition system transporting data with up to 1 Tb/s to a large scale computer farm providing a first level event selection. With *mCBM@SIS18* ("mini-CBM") we are presently constructing a CBM full-system test-setup at GSI/FAIR comprising final prototypes of all CBM detector subsystems. The primary aim is to study, commission and test the complex interplay of the different detector systems with the free-streaming data acquisition and the fast online event reconstruction and selection under realistic experiment conditions. A status of the CBM experiment as well as an overview on the *mCBM@SIS18* project will be given.

HK 46.2 Do 14:30 HZO 60

Nuclear and Quark Matter with Fluctuations beyond LPA — •Johannes Weyrich and Lorenz von Smekal — JLU, Gießen

We study the QCD phase diagram and its chiral phase transition in the low energy hadronic sector including quark and mesonic degrees of freedom at finite temperature and chemical potential. In a similar way the vicinity of the liquid-gas transition of nuclear matter is explored introducing nucleons as degrees of freedom. In our approach mesonic and fermionic fluctuations beyond mean-field are taken into account by means of the functional renormalization group (FRG). The systematic derivative expansion of the effective average action is taken beyond local potential approximation (LPA) including scale dependent wave function renormalization factors for both quarks/baryons and mesons, and the influence of this improved truncation on the first order critical lines is discussed.

HK 46.3 Do 14:45 HZO 60

Quarks and pions at finite chemical potential — •Pascal Gunkel and Christian S. Fischer — Institut für Theoretische Physik, Justus-Liebig Universität Gießen

We report on recent results on the the phase structure of strongly interacting matter, using the functional Dyson-Schwinger approach of QCD. Building upon previous works [1], we use different truncation schemes and explore their effects on the properties of the quark propagator and the resulting (pseudo-)scalar mesons at finite chemical potential. We discuss results for the masses, wave functions and decay constants below and above the first order transition at $T = 0$ and study the validity of the Silver Blaze property.

[1] C. S. Fischer, J. Luecker, C. A. Welzbacher, Phys. Rev. D 90 (2014) 34022

HK 46.4 Do 15:00 HZO 60

Taylor coefficients of the quark pressure from Dyson-Schwinger equations — •Philipp Isserstedt[1], Michael Buballa[2], and Christian Fischer[1] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen — [2]Institut für Kernphysik, Theoriezentrum, Technische Universität Darmstadt

We report on an investigation of the Taylor coefficients of the quark pressure using the non-perturbative framework of Dyson-Schwinger equations. The rainbow-ladder truncation is used to get a closed system of equations for the quark propagator and the derivatives of the latter with respect to the chemical potential are calculated self-consistently instead of using a difference quotient. We compare our results for the second and fourth coefficient to a previous Dyson-Schwinger study and results from lattice QCD.

HK 46.5 Do 15:15 HZO 60

Dynamic Critical Behaviour of ϕ^4 Theory — •Dominik Schweitzer[1], Sören Schlichting[2], and Lorenz von Smekal[1] — [1]Justus-Liebig-Universität, Gießen, Germany — [2]University of Washington, Seattle, USA

The theory of QCD is expected to have a critical point at the end of the chiral transition line at finite temperature and baryon chemical potential. To ultimately locate this critical endpoint, one will have to find signatures of critical behaviour in collision experiments. However, since collision experiments are of a very dynamic nature, one has to know about the dynamic critical behaviour of QCD to make accurate predictions. An interesting quantity in that respect is the dynamic critical exponent z.

The one-component ϕ^4 scalar field theory is perfectly suited to test numerical methods on it, since it is very well-known, easy to implement and can be efficiently simulated. Its static critical behaviour is contained in the Ising universality class, whose static critical exponents are known with great precision. Therefore we use it to test a method to calculate the dynamic critical exponent z from first principles.

The spectral function of the theory is calculated in the vicinity of the critical point, using a classical statistical approximation. We show that this approximation is valid in the critical regime, where low frequencies dominate. The shape of the spectral function is analyzed to extract an estimate for z by means of finite size scaling methods. The estimate is used to confirm that the critical dynamics of the theory is described by model C in the classification scheme of Halperin and Hohenberg.

HK 46.6 Do 15:30 HZO 60

Time-based reconstruction of free-streaming data in the CBM experiment. — •Valentina Akishina[1], Iouri Vassiliev[2], Ivan Kisel[1,2,3], and Maksym Zyzak[2] for the CBM-Collaboration — [1]Goethe-Universitat Frankfurt am Main — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH — [3]Frankfurt Institute for Advanced Studies

The CBM experiment at FAIR will focus on very rare probe measurements. In order to obtain sufficient statistics, the experiment will operate at high interaction rates of up to 10 MHz. In this case resolving different collisions, which overlap in time, is a nontrivial task. Moreover, most of the trigger signatures are complex and require information from several detector subsystems. This makes traditional trigger architectures inapplicable for the CBM experiment. Thus, CBM needs a novel data read-out and analysis concept based on free streaming front-end electronics. CBM will collect time-stamped data into a readout buffer and deliver it to a large computer farm called First Level Event Selection (FLES) for online reconstruction.

Event building requires full online event reconstruction taking into account not only space coordinates, but also time measurements, so-called 4D reconstruction. The FLES reconstruction package consists of several modules: track finding, track fitting, event building, short-lived particles finding, and event selection, which allow reconstructing time-slices in parallel (between processor cores). The reconstruction procedure and the obtained results for simulated collisions in CBM are presented.

HK 46.7 Do 15:45 HZO 60

The Kalman filter based track fit in TPC detector — •Artemiy Belousov[1,2], Yuri Fisyak[4], Ivan Kisel[1,2,3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe University Frankfurt — [2]FIAS, Germany — [3]GSI, Germany — [4]Brookhaven National Laboratory

Modern experiments in high energy physics tend to increase the amount of data to be processed, thus, the speed of the algorithms become crucial. However, the efficiency and precision of the applied procedures can not be compromised. Therefore, the Kalman filter method is usually used as the core for reconstruction of collisions, as it satisfies all the requirements.

Current implementation of the Kalman filter method for reconstruction of charged particle trajectories is added to the TPC CA track finder of the STAR experiment within the FAIR Phase 0 program. The algorithm will be applied in the High Level Trigger of STAR during the Beam Energy Scan II (BES II) program, which requires high operational speed. At the same time, quality of the fitting procedure should stay high. The developed Kalman filter based track fit is fully SIMDised and highly optimised, that allows to fulfil the speed requirements.

As a part of preparation to the BES II program the track fiting procedure is required to be extended to the outer ToF and MTD detectors, where the magnetic field and the TPC gas parameters are not homogeneous. The Kalman filter based track fit was modified to cope with these complicated conditions, it shows correct distributions of track parameter residuals and pulls, and χ^2.