HK 68: Heavy Ion Collisions and QCD phases

Time: Thursday 16:30–19:00 Location: H-ZO 10

Group Report HK 68.1 Th 16:30 H-ZO 10

The Compressed Baryonic Matter experiment at FAIR: Progress with feasibility studies and detector developments. — •Johann M. Heuser for the CBM-Collaboration — GSI Darmstadt

The CBM experiment is being planned at the international research center FAIR, under realization next to the GSI laboratory. Its physics programme addresses the QCD phase diagram in the region of highest net baryon densities. Of particular interest are the expected first order phase transition from partonic to hadronic matter, ending in a critical point, and modifications of hadron properties in the dense medium as a signal of chiral symmetry restoration.

Laid out as a fixed-target experiment at the synchrotrons SIS100/300, the detector will record both proton-nucleus and nucleus-nucleus collisions at beam energies up to 45 AGeV. Hadronic, leptonic and photonic observables have to be measured with large acceptance. The interaction rates will reach 10 MHz to measure extremely rare probes like charm near threshold. Two versions of the experiment are being studied, optimized for either electron-hadron or muon identification, combined with silicon detector based charged-particle tracking and micro-vertex detection.

The CBM physics requires the development of novel detector sytems, trigger and data acquisition concepts as well as innovative real-time reconstruction techniques. Progress with feasibility studies of the experiment and the development of its detector systems will be discussed.

* Supported by EU-FP6 HadronPhysics

HK 68.2 Th 17:00 H-ZO 10

Study of J/ψ production in $p+p$ collisions at $\sqrt{s} = 10$ TeV with the Transition Radiation Detector of ALICE using full simulations. — •Dirk Krumbhorn for the ALICE-TRD-Collaboration — Physikalisches Intitut, Heidelberg, Deutschland

The performance of J/ψ-production in $p+p$ collisions at $\sqrt{s} = 10$ TeV with the central barrel detectors in ALICE was studied. In particular, the decay channel $J/\psi \rightarrow e^+ + e^-$ (BR: 6%) with the electron and positron identified by the Transition Radiation Detector (TRD) using full Monte Carlo simulations was examined. Influences of different cuts on reconstructed single tracks as well as the software framework for particle identification with the TRD were carefully studied. We report on the overall J/ψ reconstruction efficiency at mid-rapidity, the J/ψ mass resolution and compare to results from earlier studies using fast simulations. An estimate of the combinatoric background from mis-identified particles and expectations for first year of data taking with ALICE is given.

HK 68.3 Th 17:15 H-ZO 10

Open charm measurement in the CBM experiment — •Vassiliev Iouri for the CBM-Collaboration — Kirchhoff-Institut für Physik, Heidelberg, Germany

One of the major experimental challenges of the CBM experiment is to trigger on the displaced vertex of the Open charm particle decays via hadronic decay modes in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms and high resolution secondary vertex determination. Particular difficulties in recognizing the displaced vertex of the rare D-meson and Λ_c decays are caused by weak K^0_S and Λ decays which produce displaced vertices 1 cm downstream the target, very low multiplicity of the D-meson production, low branching ratios and multiple scattering in the beam pipe and detectors.

The primary and secondary vertices have been reconstructed with high accuracy (5 μm and 50 μm respectively) from the tracks fitted in the STS with a non-homogeneous magnetic field by the Kalman filter procedure.

Two open charm trigger configurations have been proposed: Detached Kaon Trigger and Detached Vertex Trigger.

Progress with feasibility studies of the open charm measurements in the CBM experiment will be discussed.

* Supported by EU-FP6 HadronPhysics

HK 68.4 Th 17:30 H-ZO 10

Event-by-event particle yield ratio fluctuations in NA49 and the future CBM experiment — •Dmytro Kresan for the NA49 CBM-Collaboration — Gesellschaft für Schwerionenforschung (GSI)

Non-statistical event-by-event fluctuations are considered as an important signal for the critical endpoint of the QCD phase diagram. Event-by-event fluctuations of different observables are thus investigated in detail in current experiments but are also an important observable to be studied at the future CBM experiment at FAIR. In this contribution we present the energy and centrality dependence of event-by-event fluctuations of particle yield ratios measured by the NA49 experiment in Pb+Pb collisions at 20 - 158 AGeV. Systematic studies of the influence of the dE/dx resolution on the particle identification and the centrality bin size were performed. Results can be compared to event-by-event fluctuations measured by NA49 for different observables such as <pt> or the mean charged particle multiplicity. In future, the CBM experiment at FAIR will investigate the intermediate region of the QCD phase diagram in great detail searching for the first order phase transition line and the expected critical endpoint. It is therefore important to closely investigate its sensitivity towards particle ratio fluctuations in Au+Au collisions at 10-45 AGeV beam energy. Detailed simulation studies will be presented.

HK 68.5 Th 17:45 H-ZO 10

Heavy flavor electrons in pp collisions at 10 TeV with ALICE — •Raphaelle Bailhache[1] and Hongyan Yang[2] for the ALICE-TRD-Collaboration — [1]Institut für Kernphysik, Universität Frankfurt, Germany — [2]Physikalisches Institut, Universität Heidelberg, Germany

In nucleus-nucleus collisions, the formation time of heavy quarks (charm and beauty) is approximately $1/M_Q$ (0,1 fm/c for c and 0,02 fm/c for b), much smaller than the expected lifetime of the QGP at LHC (about 10 fm/c). Therefore heavy quarks are uniquely suited to probe the QGP over its whole lifetime. The $c\bar{c}$ and $b\bar{b}$ production in pp collisions serves as an important baseline for the nucleus-nucleus studies and allows to test pQCD calculations. The cross-sections can be measured indirectly with semi-electronic decays of heavy flavor hadrons. Compared to the direct measurements of heavy flavor hadrons via their hadronic decay channels the large branching ratios are an advantage. We present the expected performance of the measurement of the electrons from heavy-quark decays in pp collisions at 10 TeV with the first data planned to be collected at LHC in 2009 with the ALICE detector. Electrons are identified using both the Time Projection Chamber and the Transition Radiation Detector. The good resolution of the Inner Tracking System allows one to select electrons from B meson decays. The electron background, mainly from photon conversion and Dalitz decays of neutral light mesons, is also investigated.

HK 68.6 Th 18:00 H-ZO 10

A parton cascade calculation of heavy quark production and collective flow effects in the QGP — •Jan Uphoff, Oliver Fochler, Zhe Xu, and Carsten Greiner — Institut für Theoretische Physik, Goethe-Universität, Frankfurt am Main

We investigate heavy quark production and space-time evolution in heavy-ion collisions at RHIC energy with the partonic transport model BAMPS. The heavy quark yield from primary hard collisions between partons of the nuclei is obtained using the Monte Carlo event generator PYTHIA, comparing various parton distribution functions. Secondary production via $g + g \rightarrow c + \bar{c}$ and the evolution of heavy quarks are studied within a fully dynamic BAMPS simulation for central Au+Au collisions at RHIC energy. We estimate kinetic and chemical equilibration times in box calculations and then compare them to the relevant time scales in the QGP. Furthermore, we throw a first glance on collective flow and energy loss of heavy quarks.

HK 68.7 Th 18:15 H-ZO 10

Lattice simulation of a center symmetric three-dimensional effective theory for SU(2) Yang-Mills — •Dominik Smith[1], Stefan Schramm[1], and Adrian Dumitru[2] — [1]Universität Frankfurt, Institut für theoretische Physik, Germany — [2]Baruch College, Dept. of Natural Sciences, New York, USA

We perform simulations of an effective theory of SU(2) Wilson lines in three dimensions. Our action includes a kinetic term, the one-loop perturbative potential for the Wilson line, a non-perturbative "fuzzy-bag" contribution and spatial gauge fields. We determine the phase

diagram of the theory and confirm that, at moderately weak coupling, the non-perturbative term leads to eigenvalue repulsion in a finite region above the deconfining phase transition.

HK 68.8 Th 18:30 H-ZO 10

QCD thermodynamics and Monte-Carlo simulations with the PNJL model — •Marco Cristoforetti, Thomas Hell, Bertram Klein, and Wolfram Weise — Technische Universität München, James-Franck-Str. 1, D85747 Garching

Results of QCD thermodynamics from lattice computations can be reproduced surprisingly well within the Polyakov Nambu Jona-Lasinio model at the mean field level. The quasiparticle PNJL model combines the spontaneous breaking of chiral symmetry with the dymanics of the Polyakov loop as an order parameter for the confinement-deconfinement transition.

A deeper understanding of these results requires the investigation of quantum fluctuations in the PNJL model. This can be done by numerical simulations of the thermodynamic partition function using standard Monte-Carlo techniques. We present how, in the PNJL approach, the inclusion of fluctuations of the bosonic fields permits one to reproduce accurately lattice results (such as mixed quark susceptibilities) that vanish in the mean field approximation.

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HK 68.9 Th 18:45 H-ZO 10

Functional renormalization group approach to isentropes in chiral effective theory — •eiji nakano — GSI, Darmstadt, Germany

The isentropic trajectories in the QCD phase diagram are examined in the functional renormalization group (FRG) approach, where higher momentum modes of the fluctuation fields are integrated out, thus an low-energy effective potential is generated. In particular we compute the isentropes on the T-μ plane, near the anticipated critical end point (CEP) within the quark-meson model, which belongs to the same universality class as QCD. The numerical solution of the flow equations yields the thermodynamic pressure p, the entropy density s and the net baryon density n.

Contours of constant s/n in the T-μ plane correspond to trajectories of ideal hydrodynamic evolution of the interaction region in ultra relativistic heavy-ion collisions. We have especially examined the behavior of the isentropes near the CEP and close to the crossover line of the chiral transition. We find that the strong changes in s/n in the transition region, typically found in mean-field calculations, are removed by fluctuations. Only a very smooth behavior remains, which does not exhibit focussing towards the CEP.

The isentropes near the CEP do not exhibit a universal behavior. This is supported by arguments based on the scaling functions of the 3-d Ising model, to which the QCD CEP belongs. Since s and n both remain finite at the CEP, in contrast to the divergent susceptibilities, the smooth background (non universal) contribution may dominate.