HK 33: Heavy Ion Collisions and QCD phases

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

Group Report HK 33.1 Tu 16:30 H-ZO 10

A globally invariant chiral model with (axial-)vector mesons — •Francesco Giacosa[1], Susanna Gallas[1,2], Achim Heinz[1], Stefan Strüber[1], Denis Parganlija[1], and Dirk H. Rischke[1,2] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Str. 1, Frankfurt am Main, D-60438 Germany — [2]Frankfurt Institute for Advanced Studies, Goethe University, Ruth-Moufang-Str. 1, Frankfurt am Main, D-60438 Germany

A model with linear realization of chiral symmetry and with the inclusion of vector and axial-vector mesons is presented in the two-flavor case. The nucleon and its chiral partner are introduced in the so-called mirror assignment. After a brief discussion about the motivation and the development of the model in the vacuum, the attention is focused on some hotly debated issues: (i) The nature of light scalar mesons and their role at nonzero temperature. (ii) The dependence of the ρ and the nucleon mass on the chiral condensate. (iii) An outlook on future research: inclusion of the scalar glueball, extension to three- and four-flavor cases and the quarkyonic matter at nonzero density. The aim is a simultaneous description of vacuum properties of hadrons, such as decays and scattering lengths, and the nonzero temperature and density behavior of a hadron gas.

Invited Group Report HK 33.2 Tu 17:00 H-ZO 10

Collective Phenomena in Heavy Ion Collisions — •Mihai Petrovici — National Institute for Physics and Nuclear Engineering, Bucharest

Detailed analysis of collective phenomena at baryonic level in highly central and mid-central heavy ion collisions and their sensitivity to the Equation of State of hot and compressed baryonic matter will be presented. Results of the same type of analysis applied to experimental data at RHIC energies and Monte Carlo simulated data for ALICE at LHC will be shown. A summary of our contributions to ALICE experiment during the construction phase and CBM experiment at FAIR during R&D phase will substantiate the initiative for a network of excellence at the European level including small size research institutes.

HK 33.3 Tu 17:30 H-ZO 10

Decreasing elliptic flow at the CERN Large Hadron Collider: Calculations in a parton recombination approach — •Daniel Krieg and Marcus Bleicher — Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany

We apply the colinear parton recombination approach to study the energy dependence of the mean elliptic flow, v_2 in heavy ion collisions from AGS to LHC energies. The relevant input quantities (T, μ_B, η_T) at the various center of mass energies are obtained from fits to the available data, while η_T is the only relevant quantity for the LHC prediction. The model yields a good description of the integrated v_2 data for charged particles at midrapidity from AGS to RHIC energies. In stark contrast to the current expectations, we observe a decrease of the integrated v_2 values above the highest RHIC energy. Thus, we predict a decrease of v_2 at LHC energies compared to the RHIC results [Phys. Rev. C 78, 054903 (2008)]. This drop is attributed to negative v_2 values for the underlying parton distributions at low to moderate transverse momenta that develops if the transverse flow velocity is high enough. At energies above the LHC regime, the present approach predicts even negative values for the integrated v_2. These negative values seem to be a general feature of the employed blast-wave parameterization for parton distributions and they have also been experimentally observed by the NA49 collaboration. These results are supported by the recent preliminary data on J/ψ elliptic flow from PHENIX and our corresponding calculations [arXiv:0806.0736].

HK 33.4 Tu 17:45 H-ZO 10

Finite lifetime effects on the photon emission from a quark gluon plasma — •Frank Michler[1], Björn Schenke[1,2], and Carsten Greiner[1] — [1]Institut für theoretische Physik, Johann Wolfgang Goethe Universität Frankfurt am Main, Max von Laue Straße 1, 60438 Frankfurt am Main, Germany — [2]Department of Physics, McGill University, H3A 2T8, Montreal, Quebec, Canada

Photons play an important role as electromagnetic probes from a quark gluon plasma created in heavy ion collisions. After being once produced, the leave the medium undisturbed an thus provide direct insight into the early stage of the collision. Here the question arises how non equilibrium effects such as a finite creation time influences the resulting photon spectra. One main result has been the occurrence of first order contributions that dominate over higher order equilibrium contributions for large photon momenta.

Describing this phenomenon in the real time Keldysh formalism is mainly accompanied by two problems, namely the correct treatment of the virtual photon cloud in the vacuum and to get the resulting photon spectra convergent in the ultraviolet domain. We provide an ansatz allowing for the unambiguous identification and thus renormalization of the virtual photon cloud of the vacuum. Furthermore, it renders the spectrum of emitted photons UV-finite if the time evolution of the medium is simulated in a suitable manner.

HK 33.5 Tu 18:00 H-ZO 10

Scaling Analysis for the chiral Phase Transition in two-flavor lattice QCD — •Bertram Klein[1] and Jens Braun[2] — [1]Physik Department, Technische Universität München — [2]TRIUMF, Vancouver, Canada

The question of the exact nature of the phase transition in QCD with two flavors of quarks is still not settled. QCD lattice simulations will ultimately have to decide this question, but due to the presence of a finite quark mass, which breaks chiral symmetry, and due to the finite volume, phase transitions are difficult to analyze in such numerical simulations.

To establish the presence of scaling behavior and to determine the universality class of the corresponding phase transition a scaling analysis is required. Such a scaling analysis in turn relies on the knowledge of critical exponents, the scaling functions and the finite-size scaling functions for the different possible universality classes for the transition. As an additional problem, only dimensionless, universal quantities can be used in such an analysis. This can require the determination of non-universal normalization constants.

We use scaling functions for finite quark mass and finite volume obtained from Renormalization Group calculations to analyze lattice results for QCD with two flavors. We find that current lattice simulations are in a region where finite-size scaling effects remain small, and where corrections to scaling due to the large quark masses become large.

HK 33.6 Tu 18:15 H-ZO 10

Dilepton production at HADES energies — Katharina Schmidt, •Elvira Santini, and Marcus Bleicher — Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main

Dilepton production in intermediate energies nucleus-nucleus and proton-proton collisions is analysed within the UrQMD transport model. Calculations for dilepton invariant mass spectra are compared with HADES data for C+C reactions at 1 and 2 AGeV and DLS data for proton-proton collisions at 1.04-4.88 GeV. We find that the experimental spectrum for C+C at 2 AGeV is slightly overestimated by the theoretical calculations in the region around the vector meson peak, but fairly described in the low mass region, where the data is satisfactorily saturated by the sources and parametrizations considered. On the contrary, an underestimation of the experimental data is found at 1 AGeV, pointing that at this energy the low mass region is not fully saturated by standardly parametrized Delta Dalitz decays alone. Predictions for dilepton spectra for proton-proton reactions at 1.25 GeV, 2.2 GeV and 3.5 GeV are presented.

HK 33.7 Tu 18:30 H-ZO 10

Reconstruction of π^0 and η mesons through photon conversions for *pp* data at LHC — •Kathrin Koch[1], Kenneth Aamodt[2], and Ana Marin[3] for the ALICE-Collaboration — [1]Univ. Heidelberg, Physik. Institut, Germany — [2]University of Oslo, Norway — [3]GSI Darmstadt, Germany

In 2009 the CERN LHC starts with a short run of *pp* collisions at the injection energy of $0.9TeV$ followed by a longer run of $10TeV$. First PbPb collisions at $\sqrt{s_{NN}} = 5.5TeV$ are expected at latest in 2010. The *pp* run provides important reference data for the heavy-ion runs. One of the most important observables in heavy-ion collisions are direct photons, because they give information about the high tem-

perature and the high density phase. The main background for direct photons are photons from π^0 and η decays. Therefore, high precision measurements of their spectra are necessary to extract the direct photon spectrum. Independent from electromagnetic calorimeters this can be done with the reconstruction of photon conversions in the high resolution central tracking system. This method gives a very good mass resolution on the order of $5MeV$. Simulations show that one month of *pp* minbias collisions results in a p_t reach of $25GeV$ for π^0 and $12GeV$ for η assuming an integrated luminosity of $13nb^{-1}$. The statistics are comparable to that reached with the PHOtonSpectrometer (PHOS), and the method can also be used for PbPb collisions. In this talk an overview will be presented about the reconstruction method and the expected p_t spectra for different integrated luminosity scenarios.

HK 33.8 Tu 18:45 H-ZO 10

Perspectives for the measurement of the χ_c radiative decay in the ALICE experiment at the LHC — •Ana Marin[1], Pedro Gonzalez[2], Pedro Ladron de Guevara[2], Ernesto Lopez Torres[3], and Eulogio Serradilla[2] — [1]GSI, Darmstadt (Germany) — [2]CIEMAT, Madrid (Spain) — [3]CEADEN, Ciudad Habana (Cuba)

Heavy quarkonia are considered as very promising probes for the deconfinement of the hot and dense matter formed in relativistic heavy-ion collisions. J/ψ suppression in central heavy-ion collisions beyond expectations from a pure nuclear absorption scenario has been observed at CERN SPS and RHIC energies. Measuring the fraction of J/ψ resulting from χ_c and ψ' decays in *pp* and in heavy-ion collisions would help further understanding the mechanism for the suppression.

The LHC will provide *pp* (*PbPb*) collisions up to $\sqrt{s}$= 14 TeV ($\sqrt{s_{NN}}$= 5.5 TeV). The three experiments (ATLAS, CMS and ALICE) have a large program devoted to quarkonia measurements (J/Ψ, Ψ', Υ). Moreover, Monte Carlo studies demonstrate that, with the ALICE detector, it should be possible to reconstruct and separate the χ_{c1} and χ_{c2} in the radiative channel $J/\Psi+\gamma$, as two separated peaks. The low momentum photon from the decay is measured by reconstructing in the central barrel the e^+e^- pairs from photons converted mainly in the ITS material. The overall efficiency expected for χ_c reconstruction is about 0.9%. For *pp* collisions, the rate of observable χ_c's is expected to be 1.2×10^{-3} per second, assuming a luminosity of 10^{30} cm^{-2}s^{-1} and a perfect trigger. An overview of the reconstruction method as well as expected results in *pp* collisions at LHC will be presented.