Workshop for young scientists with research interests focused on physics at FAIR

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Book of Abstracts

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Quarkyonic matter: theory, and phenomenology at FAIR and neutron stars

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We examine the quark percolation transition at finite density, discovered in [1] and generalized to the full phase diagram in [2].
We show that this transition has many of the characteristics claimed for quarkyonic matter as defined in [3]. The percolation transition should arise, in our physical world (3 colors, 2-3 flavors) at densities parametrically larger than normal nuclear density but smaller than the densities required for deconfinement. Both FAIR and neutron stars are therefore ideal laboratories for looking for such a percolation transition.
We sketch the effective theory of the percolating Yang-Mills matter and suggest phenomenological signatures in both neutron stars and
FAIR-energy collisions.

Based on [1] and [2].

[1] S.Lottini and G.Torrieri, Phys.Rev.Lett. 107 (2011) 152301
[2] S.Lottini and G.Torrieri, http://arxiv.org/abs/1204.3272
[3] L.McLerran and R.Pisarski http://arxiv.org/abs/0706.2191

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High Precision Gamma Spectroscopy of double Lambda Hypernuclei at the PANDA Experiment

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Hypernuclear research will be one of the main topics addressed by the PANDA experiment
at the planned Facility for Antiproton and Ion Research FAIR at Darmstadt (Germany).
Thanks to the use of stored antiproton beams, copious
production of double Lambda hypernuclei is expected at the
PANDA experiment, which will enable high precision gamma
spectroscopy of such nuclei for the first time.

At PANDA excited states of Xi- hypernuclei will be used
as a starting point for the formation of double Lambda hypernuclei. In order to predict the yield of particle stable double hypernuclei a microcanonical decay model was developed.
For the detection of these nuclei, a devoted hypernuclear detector setup is planned. This set-up consists, in addition to the general purpose of the PANDA set-up, of
a primary nuclear target for the production of Xi- + Xibar pairs, a secondary active target for the hypernuclei formation and the identification
of associated decay products and a germanium array detector to perform gamma spectroscopy. Furthermore,
the presence of Xibar can be used as an alternative to tag the strangeness
in the Xi- + Xibar production channel. Moreover, one of the most challenging issues of this project is the fact that all detector systems need to operate in the presence of a high magnetic field and a large hadronic background.

In the present talk details concerning
the identification procedure of double hypernuclei and the suppression of background will be presented.
In addition, the current status of the activities related to the detector developments for this challenging programme will be briefly given.

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Monte-Carlo simulation of lepton pair production in "p pbar –> mu+mu- + X" events at E_beam = 5 GeV

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The lepton pair production in PANDA experiment in collisions of antiproton beam (E_beam = 14 GeV) with proton target is studied on the basis of event samples simulated with PYTHIA6 generator. The considered quark level subprocesses goes through the production of virtual photon which converts into lepton pair (q qbar –> gamma* –> mu+mu-) having a continuous energy spectrum of the final lepton pair invariant mass.
Quark-antiquark annihilation process of hadron-hadron collision may provide an interesting information about the quark dynamics inside the hadron. The measurement of the total transverse momentum of a lepton pair as a whole may provide an important information about the intrinsic transverse momentum k_T that appears due to the Fermi motion of quarks inside the nucleon.
The distributions of different kinematical variables of final muons are presented. The problems due to the presence of fake leptons that appear from meson decays, as well as due to the background caused by minimum bias events and other QCD processes, are also discussed. The set of cuts which allows one to separate the signal events with lepton pairs from this kind of background events is proposed.

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Time-dependent Hartree-Fock approach to nuclear pasta at finite temperature

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We present simulations of neutron-rich matter at subnuclear densities, like supernova matter, with the time-dependent Hartree-Fock approximation at temperatures of several MeV. This matter evolves into spherical rod-like and slab-like shapes and mixtures thereof.
The simulations employ a full Skyrme interaction in a periodic three-dimensional grid. With an improved Minkowski analysis, all eight pasta shapes can be uniquely identified by the sign of only two values, namely the Euler characteristic and the integral mean curvature.
The initial state consists of alpha particles randomly distributed in space and with a Maxwell-Boltzmann distribution in momentum space. Adding a neutron background initialized with Fermi-distributed plane waves the calculations reflect a reasonable approximation of astrophysical matter.

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Dilepton production at SIS energies with the GiBUU transport model

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We investigate dilepton production at SIS energies with the GiBUU transport code [1] in a resonance model approach. In a first step, we fix the model parameters via dilepton spectra from elementary NN collisions (as measured by the DLS and HADES collaborations). We argue that a large part of the so-called 'DLS puzzle' is due to an improper understanding of the elementary reactions, and that the elementary HADES data can only be explained by the inclusion of 'baryonic' contributions, e.g. via a coupling of the baryonic resonances to the ρ meson [2].
Further we show that light nuclear systems such as C+C and p+Nb can be described in first approximation by a 'vacuum' cocktail and without significant in-medium modifications. On the other hand, there are indications that the dilepton spectra of heavier systems such as Ar+KCl exhibit major medium effects, signaled by a clear excess over the vacuum sources [3]. We conclude by discussing possible scenarios which could explain such an excess in systems like Ar+KCl and Au+Au.

[1] http://gibuu.physik.uni-giessen.de
[2] J. Weil et al., arXiv:1203.3557 [nucl-th] (2012).
[3] G. Agakishiev et al., Phys. Rev. C 84, 014902 (2011).

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Equation of state for core collapse supernova simulation and neutron star core

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The Equation of state (EoS) of hot and dense matter plays a fundamental role in the understanding of core-collapse supernova. A phase transition from hadronic to exotic phases might occur
in the early post-bounce phase of a core collapse supernova. We investigate the emergence of strange hyperons in the dynamical collapse of a non-rotating massive star to a black hole. We follow the dynamical formation and collapse of a proto neutron star (PNS) from
the gravitational collapse of a massive star adopting the Shen hyperonic EOS. We also study the neutrino signals that may be used as a probe to core collapse supernova. We compare the results with those of Shen nuclear EoS and understand the role of strange hyperons in the core collapse.

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Dilepton production at SIS energies with the UrQMD model

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Dilepton production in the SIS energy regime is analysed with the Ultra-relativistic Quantum Molecular Dynamics model. Invariant mass and transverse momentum spectra of electron-positron pairs in elementary and nucleus-nucleus collisions calculated with our transport approach are compared to the different experimental results published by the HADES collaboration. The model results give a good description of the data, however they show still discrepancies between experiment and theory. Therefore the dilepton contributions from mesonic and the Delta Dalitz decays are examined more deeply, and the different production channels as well as the respective cross-sections are investigated. A special focus is set on the rho meson properties and its production, as it is assumed to significantly change its properties in a medium as produced in nucleus-nucleus collisions.

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Model studies of QCD in perturbative and non-perturbative regions

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There is a range of QCD phenomena beyond the reach of first-principles QCD. The well-known running of the strong coupling induces a strongly bound, non-perturbative regime of QCD in which hadrons are formed. The non-perturbativity forces us to reach for effective approaches in order to understand hadron structures and interactions.
These structures and interactions are particularly important in vacuum because: (i) first-principles calculations fail in vacuum and (ii) vacuum observables, once extended to non-vanishing T and \mu, give us remarkable insight into very important phenomena such as deconfinement and the chiral transition. An effective approach of QCD will, therefore, ideally provide us with insight into both perturbative as well as non-perturbative regimes of QCD.
I will give an overview of an effective approach that does exactly that: the Linear Sigma Model with scalar, pseudoscalar, vector and axial-vector mesons, glueball and baryons. I will discuss what has already been done in vacuum and the many extensions of the model to finite temperatures and densities.

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The Micro-Vertex-Detector for the PANDA experiment

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PANDA is a fixed target experiment that will be carried out at the future FAIR facility. PANDA will provide an excellent tool to address fundamental questions in the field of the hadronic physics, with a physics program that extends from the investigation of QCD to the test of fundamental symmetries.
The Micro-Vertex-Detector (MVD) located in the innermost part of the central tracking system will be composed by hybrid pixel and double-side micro-strip silicon detectors. The MVD will play an important rule for the PANDA physics goals. The possibility to reconstruct the secondary vertices and the applicability of a precise D meson tagging is essential for the spectroscopy in the open charm

sector and the charmonium mass region. To this aim the MVD features a spatial resolution better than 100 micrometers, a time resolution better than 10 ns, a limited material budget, and a high data rate capability in a triggerless environment.
An overview of the Micro-Vertex-Detector related to the physics goals will be presented.

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Spectra and flow of thermal and non-thermal photons at FAIR energies

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Photons, as all electromagnetic probes, can give direct access to the hot and dense phase of a heavy-ion reaction. We show calculations of direct photon emission at SiS100- and SiS-300 energies with the UrQMD-hybrid model. UrQMD is a full microscopic+macroscopic transport/fluiddynamics hybrid model with hadron- and string-driven equilibration phase, a full (3+1)-dimensional fluiddynamic hot and dense phase and a hadronic after-burner. Unequilibrated matter at high rapidity is preserved during the fluid phase. A strong emphasis is set on the impact of viscosity and Equation of State at zero and non-zero baryon density to the spectra and flow patterns of thermal and non-thermal photons in A+A-collisions at the colliding systems relevant for FAIR.

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Meson Production in Antinucleon Annihilation on Nuclei

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A central activity of the upcoming FAIR@GSI facility will be the use of antiprotons for a large variety of investigations at PANDA detector and AIC storage ring. The focus of the studies is on the one hand to understand antimatter-matter interactions and on the other hand to use antiproton beams for spectroscopic studies of hadrons. The aim of our work is to understand antinucleon-nucleon (NbarN) and antinucleon-nucleus (NbarA) interactions theoretically. A consistent theoretical description for the whole reaction process is desired. This includes the initial state interactions, the particle production in the reaction stage and the interactions of the emitted mesons with the residual nucleus. For the initial state interaction we use the t-rho approximation, where the NbarN t-matrix is folded with microscopical densities taken from self-consistent Hartree-Fock Bogoliubov (HFB) calculations. To describe the NbarN t-matrix we closely follow existing approaches, e. g. the Juelich-Bonn model and the Paris model. The final state meson-nucleus interactions are described with optical potentials. Adopting this ansatz we presently focus on two meson, particularly two pion production in the exit channel. Since they are required over wide energy ranges, we have extended the pion optical potentials by explicitly including nucleon resonances beyond the Delta(1232)-resonance. Results for

NbarA elastic scattering and PiA elastic scattering, reaction cross sections and meson production on neutron- or proton-rich nuclei are presented. As an interesting mechanism for single meson production Pontecorvo-type reactions are discussed.

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Electromagnetic baryon form factors measurements at BES-III and BaBar

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Electromagnetic form factors (EMFFs) are key ingredients to the understanding of the internal structure of composite particles like baryons, since they contain information about the spatial distributions of charge and current inside the particle. Thus, they are a physical and measurable manifestation of the nature of the baryon constituents and the dynamics that binds them together.
Electromagnetic form factors can be measured in the space-like region in electron scattering experiments, and also in the time-like region through the creation or annihilation of baryon-antibaryon pairs. In this presentation, I will focus on the time-like region, where experiments like BABAR and more recently BES-III have access to unprecedented accuracy in the measurement of EMFF by means of the initial state radiation technique.

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Hadron phenomenology in the Dyson-Schwinger approach

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I discuss recent progress for hadron properties that are obtained from solving Dyson-Schwinger, Bethe-Salpeter and Faddeev equations. The topics that will be addressed include: results for the nucleon's electromagnetic and axial form factors, for the nucleon-delta electromagnetic and pseudoscalar transition form factors, and a tetraquark interpretation of the lowest-lying scalar meson. A systematic description of nucleon Compton scattering, pion electroproduction and nucleon-pion scattering will be outlined.

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Virtual photons and rare strange probes in resonance matter

Author: Manuel Lorenz[1]

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The HADES experiment, installed at the Helmholtzzentrum für Schwerionenforschung (GSI) accelerator facility in Darmstadt,
investigates dielectron emission and strangeness production in various collision systems (p+p, p+n, p+A and A+A) in the 1-3.5 AGeV regime.
The observed low-mass dielectron and cascade enhancement in intermediate heavy-ion collisions indicates the onset of medium effects, on the one hand, and underlines the importance of a solid knowledge of contributions of baryon resonances on the other hand.
The latter turned out to be of eminent importance for the interpretation of the spectral shape of the rho meson already in elementary data and moreover for the extraction of additional medium effects in p+A and A+A collisions. Such a knowledge is gained by the analysis of exclusive hadronic channels in elementary reactions.
In this contribution, we summarize the findings of HADES and implications, with a special emphasis on the baryon resonance contributions and comparison of particle yields to a statistical hadronization model.

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Effects of external magnetic fields on Nc=3 Nf=2 QCD from a Dyson-Schwinger perspective

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Strong magnetic fields, as produced during heavy ion
collisions, are expected to influence the QCD phase structure.
Therefore, theoretical investigations have been performed
within effective model calculations as well as within lattice gauge
theory and functional renormalization group frameworks.
The findings opened up intense discussions since they were rather different and even opposite regarding the chiral magnetic effect.
In this talk, I report on results obtained from an analysis of
Nc=3, Nf=2 QCD within the framework of (truncated) Dyson-Schwinger equations.

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A many-body approach to nuclear structure and astrophysics

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In this talk I will discuss both finite and infinite systems. The physical settings will range from heavy nuclei, to neutron stars, and down to ultracold atomic gases. More specifically, I intend to talk about quantum many-body theory in various forms, most notably energy-density functionals and microscopic Monte Carlo simulations on modern supercomputers. Touching upon many theoretical methods, I will attempt to show the unifying thread: experimental evidence that constrains both terrestrial and astrophysical systems.

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General relativistic effects on accretion disk neutrinos

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This talk will address the impact of astrophysical effects on terrestrial neutrino detectors. More specifically, the strong gravitational field around a black hole changes the neutrino fluxes emitted from the surrounding disk. We present effects of general relativity on the nucleosynthesis resulting from the interaction of the neutrinos emitted and matter outflowing such disks.

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Decays of the pseudoscalar glueball into scalar and pseudoscalar mesons

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We study a chiral Lagrangian which describes the two-body and three-body decays of a pseudoscalar glueball into scalar and pseudoscalar mesons. The branching ratios represent a clear and parameter free prediction of our approach. In agreement with Lattice simulations, we evaluate the decays for a pseudoscalar glueball with a mass of 2.6 GeV, which is in the reach of the future Panda experiment at the Fair facility. For completeness, we also repeat the calculation for a glueball mass of 2.37 GeV, which corresponds to the mass of the resonance X(2370) measured in the BESIII experiment.

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Hadronic resonances in heavy ion collisions at FAIR energies

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One of the fundamental objectives of experiments with ultra-relativistic heavy ions is the study of hadronic matter at high density and high temperature. Presumably matter at such high densities or temperatures shows effects like the restoration of chiral symmetry or the formation of a quark gluon plasma. In this presentation the information which can be obtained by analyzing baryonic and mesonic resonances in both hadronic and leptonic decay channels is discussed. The decay products of these resonances carry information on the resonance properties at the space time point of their decay.

We especially investigate the percentage of reconstructable resonances as a function of density for heavy ion collisions in the energy range between E_{lab} = 30~AGeV and $\sqrt{s}$ = 200~AGeV, the energy domain between the future FAIR facility and the present RHIC collider. We will show the

dependency of the chance to detect resonances as a function of transverse momentum, as well as density-dependent probability distributions of reconstructable resonances. We also will discuss the differences between the various resonances and the origin of those differences.

We conclude that the hadronic, as well as the leptonic decay channels only offer a restricted view on the high density zone of a heavy ion collision, however also discuss measurements which might circumvent those problems.

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The role of the \rho meson in the HADES dilepton mass spectra

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Photons and lepton pairs emerging from decays of virtual photons are
the most promising probes of dense hadronic matter. In the energy domain of 1 - 2 GeV per nucleon, HADES has measured electron pairs in C+C, Ar+KCl, p+p, d+p and p+Nb collisions. For the first time the
electron pairs were reconstructed from quasi-free n+p sub-reactions by detecting the proton spectator from the deuteron breakup. An experimentally constrained N+N reference spectrum was established. Moreover, for the first time at this energy the inclusive production cross sections for light vector mesons were extracted. This result allows putting tight constraints on vector meson production in heavy-ion collisions at beam energies of a few GeV per nucleon. In this contribution I will compare the HADES data to predictions from UrQMD microscopic transport model calculations and introduce an approach which will allow to separate in a transparent way the generation of the event background from the emission pattern of a physics observable under consideration.

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Transport properties of the QGP and hadronic phases from field-theory models

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In this talk I will review recent advances in the computation of transport coefficients of strongly-interacting theories using field-theory methods. In particular, I will make special emphasis on the computation of the shear and bulk viscosities, and aspects such as possible bounds in these coefficients, relationship with anomalies, sum rules, etcetera. The behavior of transport coefficients close to phase transitions will also be discussed. The latter is of important relevance in connection with the future heavy-ion program at the FAIR facility, since it may help to obtain a better understanding of the structure of the QCD phase diagram at finite density.

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Charmed hadron spectroscopy on the lattice for $N_f = 2{+}1$ flavours

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Quantum Chromodynamics (QCD) has been accepted as the theory that describes the strong interactions, i.e., the interactions between quarks and gluons. QCD is an asymptotically free theory, hence, perturbation theory can be applied in the high energy regime, where many successful quantitative predictions have been made.
The description of low energy QCD phenomena i.e, in the strong-coupling regime, for example, the spectrum of hadrons, poses the problem of solving the theory non perturbatively. Formulating the theory on a discrete

space-time grid enables numerical simulations to be performed using Monte Carlo techniques. Lattice
QCD makes it possible to study low energy properties of QCD from first principles.

Experimental observations of the spectroscopy of hadrons containing charm quarks have undergone a renaissance in recent years. The triggering point was the discovery of several new narrow charmonium resonances close to the $D\bar{D}$ thresholds and new narrow D_s mesons close to the DK thresholds. More results are expected to appear in the next few years from currently running experiments, e.g. Belle, BES-III and LHCb and the future PANDA experiment at the FAIR facility at the GSI.

We study the spectra of charmonium, charm-light mesons, singly and double charmed baryons using Lattice QCD.

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Investigation of the influence of the beam topology to microdosimetric results using Monte Carlo simulations

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The BIOMAT facility at FAIR will allow measurements of the physical and biological effects for heavy ion beams with energies up to 10A GeV [1]. The evaluation of space radiation effects through the irradiation with particles and energies similar to those found at cosmic rays is possible. Such experiments are becoming ever more important with the increase of the duration of space missions. The

biological effects due to a long time exposition to cosmic rays are not yet well known. Microdosimetry is a well-established experimental technique for measuring the dose deposition in the passage of fast particles through matter [2]. A tissue-equivalent proportional counter (TEPC) is usually applied to estimate the dose deposition in simulated volumes of micrometer dimensions when the detector is placed in a homogeneous radiation field. This condition is met by a detector embedded in the cosmic radiation. However, the topology of the accelerator-based radiation field can differ strongly from the homogeneous radiation situation. This can lead to wrong evaluation of microdosimetric quantities. With a Monte Carlo model [3] based on the Geant4 toolkit [4] we simulate the TEPC measurements for high energy iron beams. We investigate the influence of the beam topology to the microdosimetric measurements. The effects of several beam profiles are simulated. Changes in the probability distribution for the number of tracks and total track length inside the TEPC are presented. Modifications to the standard calculation procedure in microdosimetry are discussed.

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Status and first Results of the CBM TRD Development

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The decay of the D-Meson as well as the J/Psi are key measurements of the future CBM experiment at FAIR. To contribute to these measurements the Transition Radiation Detector of the CBM experiment will provide electron-pion separation and will contribute to the experiment-wide tracking in an environment of unprecedented high particle fluxes.

This talk will give an overview on the status of the CBM TRD development. First results from test beam data will be presented, focusing on the electron-pion separation for different conceptual approaches like TRDs with or without electron drift region. Moreover, the performance of a variety of radiator types and different chamber geometries will be discussed. An outlook on further measurements of the rate capability and the first measurement with a large scale demonstrator will be adumbrated.

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Propagators and phase structure of Nf=2 and Nf=2+1 QCD

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We investigate the phase structure of QCD at finite temperature and chemical potential by solving a coupled set of truncated Dyson-Schwinger equations for the quark and gluon propagator. We take into account the full back-reaction of the quarks onto the Yang-Mills sector and we include the effects of strange quarks. We discuss the resulting thermal mass of the unquenched gluon propagator and extract order parameters for the chiral and deconfinement transition from the quarks.

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The Micro-Vertex-Detector of the CBM-Experiment

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The Compressed Baryonic Matter Experiment (CBM) will explore the phase diagram of hadronic matter in the regime of highest baryon densities. Nuclear fireballs created in heavy ion collisions of 8-45 AGeV beam energy will be studied with numerous probes, among them open charm and light vector mesons.
Reconstructing those rare probes requires a vacuum compatible micro vertex detector (MVD) with unprecedented properties. Its sensor technology has to feature a spatial resolution of <5μm, a radiation tolerance of >10e13 n/cm² and a time resolution of few 10 μs. The detector station must combine an active cooling of the sensors
(~1W/cm²) with a material budget below few 0.1% radiation length.

To match those requirements, we rely on the CMOS Monolithic Active Pixel Sensors provided by the IPHC Strasbourg. The highly granular and 50μm thin sensors will be mounted on a cooling support made from CVD diamond. The readout of the sensors will be done by means of ultra-thin flex print cables. We discuss the concept of the CBM MVD and report about the status of sensor R&D and our prototyping

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Production and Dalitz decays of baryon resonances in proton-proton interaction at sqrt(s) = 3.16 GeV with HADES

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One of the main physics goals of HADES is to investigate spectral modifications of light vector mesons in strongly interacting matter via their dilepton (e+e−) decay channel. Theoretical models predict such modifications due to strong meson-baryon resonance coupling which can be also probed in elementary collisions. In 2007 electron-positron pair production has been measured in p+p reactions with beam kinetic energy of 3.5 GeV. One of the basic observables in this measurement is inclusive e+ e− mass distribution. The expected e+e− production channels are given by Dalitz decays of π0, η, ω mesons and Δ(1232) resonance.
Indeed, the experimental data can be described by simulation of the aforementioned components, everywhere but not in the mass region below vector meson pole (M_inv ∈ (0.5 − 0.7)). We present analysis results of the exclusive channels ppπ0, pnπ+, ppe+e−, which might indicate contributions of higher lying resonances. In order to estimate production cross sections of the baryonic resonances for hadronic channels, the results have been compared to Monte-Carlo calculations based on the resonance model assuming incoherent sum of various four stars resonances. To convert obtained resonances cross sections into e+ e− yield, two models of dΓ(R⟶pe+ e−)/dM(e+e-) are applied in the simulation.

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The Ring Imaging Cherenkov detector for the CBM-Experiment

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The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) at Darmstadt will be a dedicated heavy-ion experiment for the investigation of baryonic matter at highest net-baryon densities. The measurement of some of the key observables of the physics program of CBM requires clean and efficient electron identification which will be performed by the Ring Imaging CHerenkov detector (RICH). It will consist of a gaseous radiator volume, high UV-reflectivity mirrors, and a photo-detector which is foreseen to be built of Hamamatsu H8500 multianode photomultiplier tubes. A real-size prototype RICH detector with self triggered readout electronics has been built and was succesfully tested at the CERN PS/T9 beamline. We will discuss the performance of the prototype with emphasis on the photo-detector, as well as the status of R&D activities concerning the usage of wavelength-shifting films and the evaluation of glass mirrors.

Talks / **44**

Signals for the QCD phase transition and critical point in a Langevin dynamical model

Author: Christoph Herold[1]

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The search for the critical point is one of the central issues that will be investigated in the upcoming FAIR project. For a profound theoretical understanding of the expected signals we go beyond thermodynamic studies and present a fully dynamical model for the chiral and deconfinement phase transition in heavy ion collisions. The corresponding order parameters are propagated by Langevin equations of motions on a thermal background provided by a fluid dynamically expanding plasma of quarks. By that we are able to describe nonequilibrium effects occurring during the rapid expansion of a hot fireball.
We observe several critical phenomena like the enhancement of long wavelength fluctuations and critical slowing down near the endpoint of the first order transition line. For an evolution through the phase transition the formation of a supercooled phase and its subsequent decay lead to a significant reheating of the quark medium. We find an enhancement of density fluctuations along the first order phase transition line within single events. Furthermore, we provide a study of event-by-event fluctuations of several observables like the average chiral condensate or the baryon number.

Talks / **45**

A Langevin approach for heavy quark propagation at FAIR energies

Author: Thomas Lang[1]

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We implemented a Langevin approach for heavy quarks to the UrQMD hybrid model, which provides a realistic background medium for the evolution in heavy ion collisions at FAIR energies.
Here we used two different sets of drag and diffusion coefficients, a T-Matrix approach and a resonance model.
In case of the resonance model we also implemented different decoupling temperatures of the heavy quarks from the hot medium between 130 MeV and 180 MeV.
In our calculations we evaluate the nuclear modification factor R_{AA} as well as at the elliptic flow v_2.
We find that our results depend on the decoupling temperature strongly.
Additionally we investigate the influence of a coalescence versus a fragmentation approach for the heavy quark fragmentation.
Predictions for FAIR energies are calculated and an outlook for RHIC and LHC energies is given.

Talks / **50**

J/ψ production in Pb-Pb collisions at $\sqrt{s_{NN}}$ =~2.76 TeV

Author: Ionut Cristian, on behalf of the ALICE Collaboration Arsene[None]

The hot and dense nuclear matter created in nuclear collisions at relativistic energies consists of a plasma of deconfined quarks and gluons.
Due to their large mass, the charm quarks are mainly formed in the first instants of the nuclear collision and will consequently experience the full history of the system.
It was predicted that the strongly bound J/ψ state will be suppressed in the hot and deconfined quark-gluon plasma due to the color screening effect. This effect was already observed in Pb-Pb and In-In collisions at the SPS and in Au-Au collisions at RHIC.
It was also predicted that
high production yields of charm quarks in nucleus-nucleus collisions at RHIC and especially at LHC energies will
make possible (re)combination posible, thus leading to J/ψ enhancement compared to lower energy nuclear collisions and to pp collisions.
ALICE measures the J/ψ at mid-rapidity ($|y| < 0.9$) and at forward-rapidity ($2.5 < \eta < 4.0$) down to zero transverse momentum. The reconstruction
is performed using the J/ψ decay into the di-electron and di-muon channels at mid- and forward-rapidity respectively.
The electron identification is done using
energy loss in gaseous detectors (the Time Projection Chamber and the Transition Radiation Detector)
and the time-of-flight method (Time Of Flight detector). The muons are reconstructed using the Forward Muon Spectrometer.
We will present the J/ψ nuclear modification factor as a function of the collision centrality, transverse momentum and rapidity.
Discussions and comparisons to theoretical calculations will be provided.
First results and perspectives on the J/ψ production with respect to the event plane (elliptic flow) will also be shown.

Talks / **51**

Identified hadron multiplicity fluctuations at the CERN SPS

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The study of event-by-event fluctuations of chemical (particle type) composition in high-energy nucleus-nucleus collisions is a helpful tool to pin-down the properties of strongly interacting matter. Indeed, according to theoretical calculations, the QCD critical point may be signalled by a characteristic pattern in the measured fluctuations. In this contribution a new method for event-by-event fluctuations of identified particles will be introduced. In particular, using this method, the energy dependence of multiplicity fluctuations in central Pb+Pb and proton-proton collisions, measured by NA49 and its successor NA61/SHINE, will be presented. Furthermore an outlook on the NA61/SHINE program will be given.

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The Beam Energy Scan at RHIC

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RHIC results at top collisional energy ($\sqrt{s_{NN}}$ = 200 GeV) suggest a strongly coupled partonic matter, namely the Quark Gluon Plasma (QGP), has been formed in central Au+Au collisions. With the RHIC Beam Energy Scan a wide range in the QCD phase diagram temperature vs. baryon chemical potential is covered. A phase transition between the QGP and the hadron gas phase is expected in this region of the QCD phase diagram. A critical endpoint of this phase transition line is likely to exist. STAR has recorded in the years 2010 and 2011 data from Au+Au collisions at $\sqrt{s_{NN}} = 7.7$, 11.5, 19.6, 27, 39 and 62.4 GeV with the goal to find signatures for the QCD phase transition and the critical point.
STAR has a large and uniform acceptance for all beam energies and the capability for particle identification at all momenta. Recent results from hadronic spectra, di-lepton spectra, directed and elliptic flow, and event-by-event fluctuation analyses will be presented. Furthermore we compare the data to several models and discuss their implications

Talks / 53

Azimuthal correlations and collective effects at RHIC and LHC

Author: Selyuzhenkov Ilya[None]

Introduction to the main ideas and highlights from recent measurements of the anisotropic flow and azimuthal correlations in a heavy-ion collisions by RHIC and LHC experiments will be presented.

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Fluctuation and Flow Probes of Relativistic Heavy Ion Collisions

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J/ψ reconstruction in the di-muon decay channel with CBM

Author: Valentina AKISHINA[None]