XV Polish Workshop on Relativistic Heavy-Ion Collisions

Saturday, 24 September 2022 - Sunday, 25 September 2022

Institute of Theoretical Physics, University of Wroclaw

Programme

Saturday, 24 September 2022

Warm-up coffee (10:30 - 11:00)

Welcome, logistics (11:00 - 11:10)

- Presenter: TURKO, Ludwik (University of Wroclaw (PL))

What is CSSF? (11:10 - 11:20)

- Presenter: HUOVINEN, Pasi (University of Wroclaw)

The main sponsor of this meeting, "*Incubator of Scientific Excellence--Centre for Simulations of Superdense Fluids* (CSSF)" is a recently established research group in the University of Wrocław. It is dedicated to modeling of heavy-ion collisions at few GeV collision energy (FAIR, NICA, J-PARC) and exploring the properties of dense baryonic matter. In this talk I will briefly describe the physics goals and challenges of the Centre.

Concepts for unifying the description of hadronic and quark matter (11:20 - 11:40)

- Presenter: BLASCHKE, David (University of Wroclaw)

I will review a few historical steps in the description of the hadron-to-quark matter transition by constructions, starting from the seminal work by Hagedorn and Rafelski "From Hadron Gas to Quark Matter" (1980) to Baym et al. "From Hadrons to Quarks in Neutron Stars" (2018) and discuss some occasional attempts at unifying the description of hadronic and quark matter phases, whereby hadronic matter would appear as the limiting case of clustered quark matter. The latter approaches require two major ingredients: a description of hadron dissociation (Mott effect) at high phase space occupation and of quark and gluon confinement at low temperatures and densities.

Experiments (24 Sept 2022, 11:40 - 13:20)

[10] Recent studies of quark-gluon plasma and beyond from ALICE (11:40, 20 minutes)

Presenter: JANIK, Malgorzata Anna (Warsaw University of Technology (PL))

ALICE (A Large Ion Collider Experiment), one of the CERN Large Hadron Collider experiments, was originally designed to study the physics of heavy-ion collisions. It was designed to detect, track, and identify particles up to the largest particle multiplicities. In its first decade of activity, ALICE Collaboration studied the hot and dense medium formed in heavy-ion collisions, the quark-gluon plasma, as well as the proton-proton and proton-lead collisions through many observables, both hard and soft. In this overview, a selection of recent results obtained by the ALICE collaboration will be presented and discussed.

[3] Two-particle correlations at the Beam Energy Scan program at STAR (12:00, 20 minutes)

Presenter: ZBROSZCZYK, Hanna (Warsaw University of Technology (PL))

Geometry and dynamics of the particle-emitting source in heavy-ion collisions can be inferred via the femtoscopy method. Two-particle correlations at small relative momentum exploit Quantum Statistics (QS) and the Final State Interactions (FSI), which allow one to study the space-time characteristics of the source of the order of 10^{−15} m and 10^{−23} s. The RHIC Beam Energy Scan (BES) program covers a significant part of the QCD Phase Diagram using Au nuclei collisions for several beam energies from 3 to 200 GeV, where the baryon-rich region is studied via femtoscopy. Two-particle correlations can provide additional information regarding critical behavior (first-order phase transition). Together with meson ones, baryon measurements provide complementary information about sources created in the final stages of interactions. The results of non-identical particles enable studies of space-time asymmetries in the emission process. Besides, femtoscopy enables the investigation of FSI between hadrons. In this talk, the femtoscopic measurements of various particle combinations for different collision energies and centralities will be shown.

[7] News on strangeness production from HADES and global systematics at sqrt(s) <= 3 GeV (12:20, 20 minutes)

Presenter: PIASECKI, Krzysztof (University of Warsaw)

Recently the HADES Collaboration published the data on strangeness production in the medium-abundant Au+Au system at the deeply subthreshold beam energy of 1.23A GeV [1]. The conditions in this system provide a sensitive testing ground for the description of the strangeness dynamics in the nuclear medium. Therefore, several transport approaches were compared to the data, including IQMD, (P)HSD and UrQMD [1,2], and their results will be presented. First results of the strangeness production in the high-statistics run of Ag+Ag collisions at 1.58A GeV will be also shown. HADES also provided data on strangeness production from more elementary p+Nb collisions at 3.5 GeV [3], and π^- + C and π^- + W collisions at 1.7 GeV/c [4]. These systems permit for testing various scenarios of in-medium potentials of strange hadrons. Some of these tests will be presented in the talk.

The Glauber Monte-Carlo analysis of all the available experimental strangeness results at $\sqrt{s_{NN}} \leq 3$ GeV allowed to obtain the unified systematics of strangeness 4π yields in the hadronic sector. The $\langle A_{part} \rangle_b$ dependency of these yields will be also discussed. ____ [1] J. Adamczewski-Musch et al. (HADES Collaboration), Phys. Lett. B 793, 457 (2019); Phys. Lett. B 778, 403 (2018). [2] T. Song, L. Tolos, J. Wirth, J. Aichelin, E. Bratkovskaya, Phys. Rev. C 103, 044901 (2021) [3] G. Agakishiev et al. (HADES Collaboration), Phys. Rev. C 90, 054906 (2014) [4] S. Maurus, Ph. D. Thesis, Technische Universitaet Muenchen (2019)

[9] News from NA61/SHINE (12:40, 20 minutes)

Presenter: MARCINEK, Antoni (Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland)

The NA61/SHINE experiment is a fixed-target, broad acceptance facility at the CERN SPS. This contribution summarizes the most recent results from the strong interactions (SI) NA61/SHINE programme and presents news on the detector upgrade in preparation for the future data taking. The strong interactions programme consists in a two-dimensional scan in beam momentum (from 13A to 150A/158A GeV/c, $\sqrt{s_{NN}}$ from 5.1 to 17.3 GeV) and system size (p+p, Be+Be, Ar+Sc, Xe+La reactions). The experiment searches for the second-order critical end-point in the temperature versus baryo-chemical potential phase diagram and studies the properties of the onset of deconfinement discovered by its predecessor, NA49 at the CERN SPS. The presented new results include K/π multiplicity ratios as a function of energy as well as identified hadron spectra in Be+Be and Ar+Sc collisions, singly and multi-strange hadron production in p+p reactions, multiplicity and net-charge fluctuations measured by higher order moments in p+p, Be+Be and Ar+Sc collisions, proton and charged hadron intermittency in Ar+Sc and Pb+Pb reactions, two-particle correlations in Be+Be, HBT measurements in Ar+Sc and collective electromagnetic effects in Ar+Sc collisions.

[5] System size and energy dependence of proton rapidity spectra from NA61/SHINE at the CERN SPS (13:00, 20 minutes)

Presenter: PANOVA, Oleksandra (Jan Kochanowski University (PL))

NA61/SHINE is an experiment at the CERN Super Proton Synchrotron. The main goals of the experiment are the search for the critical point of strongly interacting matter and study the properties of the onset of deconfinement. In order to reach these goals, the two-dimensional scan in beam momentum (13A-150A GeV/c) and system size (p+p, Be+Be, Ar+Sc, Xe+La, Pb+Pb) was performed. In the final stage of the collision, when resonance decays and re-scattering are important, the spectra of protons are not as affected as of pions, due to the large difference in mass. Thus, proton rapidity distribution is especially sensitive to the onset of deconfinement. This contribution presents experimental results on proton production relevant for the onset of deconfinement. Experimental techniques and methods used to analyse hadrons will be reviewed. Examples of transverse momentum and rapidity spectra will be also shown. Moreover, a comparison with the existing data will be given.

Lunch break (13:20 - 15:00)

Experiments: Ideas (24 Sept 2022, 15:00 - 16:20)

[15] Femtoscopy at LHC: Lessons, Open Questions and Future (15:00, 20 minutes)

Presenter: KISIEL, Adam (Warsaw University of Technology (PL))

Femtoscopy has been a crucial element of the physics programme at the LHC in Run1 and Run2. Identical meson measurements have shown that we understand in detail various aspects of the collision dynamics in heavy ion collisions. In contrast, detailed results in pp collision still await proper explanation. Similarly non-identical particle femtoscopy results turned out to be sensitive to the duration of the hadronic rescattering phase, giving and independent cross-check of the system evolution description. In parallel femtoscopic measurements for baryons, especially ones including strangeness, as well as antibatyons provide a qualitatively new way to access parameters of the strong interaction between exotic and regular nuclear matter. These appear to be especially important in modelling of neutron star composition and mergers. This study stands to benefit a lot from significantly extended data collection capabilities in LHC Run3.

[13] Levy HBT correlation measurements from SPS to LHC energies (15:20, 20 minutes)

Presenter: LOKOS, Sandor (Institute of Nuclear Physics Polish Academy of Sciences (PL))

Femtoscopic correlation measurements can serve important information on the spatio-temporal structure of the particle emitting source that is created in high energy nuclear collisions. Detailed investigation of the shape of the correlation functions revealed that the statistically acceptable assumption is not Gaussian nor Cauchy distribution but a more general: the Levy distribtuion. In my presentation I will give an overview of the recent results from SPS, RHIC and LHC energies in various systems and I will present some of the possible theoretical interpretation of them.

[14] The Modular Cosmic Ray Detector (MCORD) at physics and astrophysics experiments. (15:40, 20 minutes)

Presenter: BIELEWICZ, Marcin Michal (National Centre for Nuclear Research (PL))

It has been proposed to design and build an modular, a simple and effective cosmic ray detector (muon detector) that can be used both in laboratory measurements and in great physics experiments. The main goal of this system is to provide information from cosmic muons that pass the other detector in both in-beam and off-beam experiments for testing and calibration. Moreover, observation of muons and muons pair originating from decays of collision products will also be possible. The proposed detector is called the Modular COsmic Ray Detector (MCORD). The MCORD is designed as a universal, fast triggering system built as a modular reconfigurable construction. We describes the second stage of the project (demonstrator) and potential use in different big experiments. The MCORD detector based on plastic scintillators with silicon photomultiplier photodetectors (SiPM) for scintillation readout with analog Slow Control electronic system and electronic data analyze system based FPGA electronic on MicroTCA crate.

[12] Triple high energy nuclear and hadron collisions - a new method to study QCD phase diagram at high baryonic densities (16:00, 20 minutes)

Presenter: VITIUK, Oleksandr (University of Wroclaw (PL))

We propose an entirely new method to study the phase diagram of strongly interacting matter by means of scattering the two colliding beams at the fixed target. Here we present the results of simulations of the most central triple nuclear collisions with the UrQMD-3.4 model for the beam center-of-mass collision energies $\sqrt{s_{NN}} = 2.76$ TeV and $\sqrt{s_{NN}} = 200$ GeV. The main outcome of our modelling is that even at these very high collision energies the initial baryonic charge densities are about 3 times higher than the ones achieved in ordinary binary nuclear collisions. For instance, the yields of protons and Λ-hyperons are strongly enhanced in triple nuclear collisions. The other prospective applications of this method are briefly discussed. We present the convincing arguments that the triple nuclear collisions method will allow the high-energy nuclear physics community to create a new frontier in the studies of the QCD phase diagram and to lift up these studies to an entirely new level.

Coffee break (16:20 - 16:50)

Phenomenology (24 Sept 2022, 16:50 - 18:10)

[4] Proton-deuteron and deuteron-deuteron correlation functions and origin of light nuclei from relativistic heavy-ion collisions (16:50, 20 minutes)

Presenter: SŁOŃ, Patrycja (National Centre for Nuclear Research)

Production of light nuclei in relativistic heavy-ion collisions is well described by the thermal model, where light nuclei are in equilibrium with all other hadron species present in a fireball, and by the coalescence model, where light nuclei are formed due to final state interactions after the fireball decays. A method is proposed to falsify one of the models. We suggest to measure a hadron-deuteron or deuteron-deuteron correlation function which carries information about the source of the deuterons and allows one to determine whether a deuteron is directly emitted from the fireball or if it is formed afterwards. The $□ \!− \!□$ and $□\!−\!□$ correlation functions are computed to illustrate the statement. For $□\!−\!□$ correlation function the source radius of deuterons formed due to final-state interactions is bigger by the factor of $\sqrt{4/3}$ than that of directly emitted deuterons and for $□\!−\!□$ the factor is $\sqrt{2}$. To check how sizable is the effect we compute the $□\!−\!□$ and $□\!−\!□$ correlation functions taking into account Bose-Einstein statistics of deuterons in case of the $□\!−\!□$ correlation function, □-wave scattering due to strong interaction and Coulomb repulsion. The correlation functions are shown to be sensitive to the source radius for sources which are sufficiently small with RMS radii smaller than 3.5 fm. Otherwise the correlation functions are dominated by the Coulomb repulsion and weakly depend on the source radius. Based on 1. St. Mrówczyński and P. Słoń, Acta Physica Polonica B **51**, 1739 (2020), 2. St. Mrówczyński and P. Słoń, Physical Review C **104**, 024909 (2021).

[8] Interpretation of particle yields in pp interactions at $\sqrt{s}$ = 8.8, 12.3 and 17.3 GeV within statistical hadronization model (17:10, 20 minutes)

Presenter: MATULEWICZ, Tomek (University of Warsaw (PL))

The statistical hadronization model ThermalFist was applied to numerous hadron yields measured in p+p collisions at $\sqrt{s}$ = 8.8, 12.3 and 17.3 GeV, including recently published yields of ϕ-mesons, measured by the NA61/SHINE Collaboration. We consistently used the energy-dependent widths of Breit-Wigner mass distributions of hadronic resonances, as this approach was generally found to provide better agreement with experimental data. The well-established experimental ϕ meson yields are consequently accounted for (although neglecting this particle was found to improve the fit quality). The canonical treatment of particles with open strangeness with the grand canonical approach for non-strange particles gave a moderately reasonable agreement with the measured yields, only when the volume of strange particles was allowed to vary freely. In all the studied cases this volume is found to be greater than the canonical one.

[11] Transport of hard probes through glasma (17:30, 20 minutes)

Presenter: CZAJKA, Alina (National Centre for Nuclear Research)

I will discuss the influence which the glasma, that is produced in the earliest phase of heavy-ion collisions, has on transport of hard probes. First, I will describe the method that we use to study the early time dynamics of the collision, which includes the expansion of the glasma fields in the proper time. Then, I will briefly discuss main characteristics of the glasma encoded in the energy-momentum tensor. Finally, I will focus on the transverse momentum broadening coefficient and collisional energy loss of hard probes moving through the glasma showing that the madium has sizeable impact on the transport coefficients.

[24] Formation of clusters and the chemical freeze-out in heavy-ion collisions (17:50, 20 minutes)

Presenter: LIEBING, Simon (TU Bergakademie Freiberg)

We discuss medium effects on light cluster production in the QCD phase diagram within a generalized Beth-Uhlenbeck (GBU) approach by relating Mott transition lines to those for chemical freeze-out. We find that in heavy-ion collisions at highest energies provided by the LHC light cluster abundances should follow the statistical model because of low baryon densities [1]. Chemical freeze-out in this domain is correlated with the QCD crossover transition. At low energies, in the nuclear fragmentation region, where the freeze-out interferes with the liquid-gas phase transition, selfenergy and Pauli blocking effects are important [2,3]. We demonstrate that at intermediate energies the chemical freeze-out line correlates with the Mott lines for light clusters provided their dependence on the cluster momentum relative to the medium is taken into account [4]. It is important to consider the nonzero thermal momentum because moving clusters are stabilized compared to those at rest in the dense medium. In this domain, the HADES, FAIR and NICA experiments can give new information. References 1 B. Dönigus, G. Röpke and D. Blaschke, [arXiv:2206.10376 [nucl-th]]. 2 G. Röpke, Phys. Rev. C 92 (2015) no.5, 054001; [arXiv:1411.4593 [nucl-th]]. 3 G. Röpke, D. Blaschke, Y. B. Ivanov, I. Karpenko, O. V. Rogachevsky and H. H. Wolter, Phys. Part. Nucl. Lett. 15 (2018) no.3, 225-229; [arXiv:1712.07645 [nucl-th]]. 4 D. Blaschke, S. Liebing and G. Röpke, in preparation (2022).

<u>Workshop dinner</u> (19:00 - 22:00)

Sunday, 25 September 2022

Theory: Hydro (25 Sept 2022, 09:30 - 10:50)

[25] Multicomponent relativistic dissipative fluid dynamics from the Boltzmann equation (09:30, 20 minutes)

Presenter: MOLNAR, Etele (University of Wroclaw)

We review the derivation of the fluid-dynamical equations of motion from kinetic theory. Applying this method we derive multicomponent relativistic second-order dissipative fluid dynamics from the Boltzmann equations for a reactive mixture of NS particle species with NQ intrinsic quantum numbers (e.g. electric charge, baryon number, and strangeness). The resulting transient fluid-dynamical equations are formally similar to those of a single-component system but feature different thermodynamic relations and transport coefficients, which contain the microscopic interactions of all components.

[2] Canonical and phenomenological formulations of spin hydrodynamics (09:50, 20 minutes)

Presenter: DAHER, Asaad (Institute of Nuclear Physics Polish Academy of Sciences (PL))

Two formulations of relativistic hydrodynamics of particles with spin 1/2 are compared. The first approach, dubbed the canonical one, uses expressions for the energy-momentum and spin tensors that have properties that follow a direct application of Noether's theorem, which yields a totally antisymmetric spin tensor. The other one is based on a simplified form of the spin tensor and is commonly used in the current literature under the name of a phenomenological approach. We show that these two frameworks are equivalent, i.e., they can be directly connected by a suitably defined pseudogauge transformation, only if the first framework is initially improved by a suitable modification of the energy-momentum tensor (addition of a divergence-free term that cannot be interpreted as a pseudogauge). Our analysis uses arguments related to the positivity of entropy production. The latter turns out to be equivalent for the improved canonical and phenomenological frameworks.

[17] Spin alignment of vector mesons as a probe of spin hydrodynamics and freeze-out (10:10, 20 minutes)

Presenter: GONÇALVES, Kayman (Universidade Estadual de Campinas)

We argue that a detailed analysis of the spin alignment of vector mesons can serve as a probe of some aspects of spin dynamics in the vortical fluid for which there have been quite a few theoretical developments but relatively little phenomenology: The degree of relaxation between vorticity and parton spin polarization, and the degree of coherence of the hadron wavefunction at freeze-out. We show, using a coalescence model, that local spin density and vorticity impact the hadron wavefunction in different ways, and this is much more straight-forward to disentangle for a vector meson than for a spin 1/2 baryon. We comment on the relevance of this issue for the current lack of consistency between experimental data on Lambda polarization and K*, phi spin alignment. Based on https://arxiv.org/abs/2104.12941.

[18] The hydrodynamic expansion through regularized moments (10:30, 20 minutes)

Presenter: TINTI, Leonardo (Jan Kochanowski University (PL))

Relativistic hydrodynamics is surprisingly predictive, even in the presence of large gradients and large deviations from equilibrium. In some of its incarnations, the method of moments can be used to justify the hydrodynamic behavior of a relativistic gas. However, it can't be directly generalized. If long range interactions are introduced through a medium-dependent mass or a semi-classical gauge field, some diverging integrals would appear at the higher orders after a naive, direct, application of the method [1]. Even if it is not necessary at the lowest orders, it has been shown that it is convenient to reorganize the expansion around resummed moments. In this way one avoids systematically, at all orders, any coupling with ill-defined moments [1]. If one uses the quantum precursor of the distribution function, that is the Wigner distribution, such ill-defined moments arise at the very first step, therefore a regularization scheme is needed from the very the lowest order (hydrodynamics). Even in a physical case that is arbitrarily close to the kinetic limit, some of the moments, which are otherwise well defined in kinetic theory, are divergent due to the off-shell nature of the Wigner distribution. However, in this case too, it is possible to introduce a set of regularized moments [2]. They are well defined at all orders, and they can be used to generalize the method of moments (and the hydrodynamic expansion) in the quantum case. In the kinetic limit they reproduce the ordinary expansion from the method of moments. More importantly, they can be used to estimate whether hydrodynamics is expected to work or to fail in the cases in which the naive generalization of the method is ill-defined and gives no answers. Finally, it can be checked in the exactly solvable (0+1)-dimensional expansion, that the approximate solutions from the regularized hydrodynamic expansion maintain the fast convergence to the exact solutions (already seen in relativistic kinetic theory) even for initial conditions which are very far from the kinetic limit [2]. [1]arXiv:1808.06436 [2]arXiv:2003.09268

Coffee break (10:50 - 11:20)

Theory (25 Sept 2022, 11:20 - 13:40)

[19] Novel features of energy fluctuations and baryon number fluctuations in a subsystem of hot and dense relativistic gas. (11:20, 20 minutes)

Presenter: DAS, Arpan (Institute of Nuclear Physics Polish Academy of Sciences Krakow, Poland)

We discuss the quantum fluctuations of energy in subsystems of hot relativistic gas for both scalar and spin half particles. For small subsystem sizes, we find a substantial increase of fluctuations compared to those known from standard thermodynamic considerations. However, if the size of the subsystem is sufficiently large, we reproduce the result for energy fluctuations in the canonical ensemble. Interestingly for spin half particles, the results for quantum fluctuation depend on the form of the energy-momentum tensor used in the calculations, which is a feature described as pseudo-gauge dependence. However, for sufficiently large subsystems the results obtained in different pseudo-gauges converge and agree with the canonical-ensemble formula known from statistical physics. Although different forms of the energy-momentum tensor of gas are a priori equivalent, our finding suggests that the concept of quantum fluctuations of energy in very small thermodynamic systems is pseudo-gauge dependent. On a practical side, our results can be used in the context of relativistic heavy-ion collisions to introduce limitations of the concepts such as classical energy density or fluid element. Also, the results of our calculations determine a scale of coarse-graining for which the choice of the pseudo-gauge becomes irrelevant. In a straightforward way, our formula for quantum fluctuation can be applied in other fields of physics, wherever one deals with hot and relativistic matter. Further using the formalism developed to obtain the fluctuation of energy we also estimated the quantum features of the baryon number fluctuations in subsystems of a hot and dense relativistic gas of fermions. Our results for the baryon number fluctuation also suggest that for small system size quantum mechanical effects can be significant. Such a system size dependence of quantum statistical fluctuation can be helpful to shed new light on the experimental data, particularly for a small system probed in the heavy-ion collision experiments.

[22] Thermodynamics of a coupled channel system (11:40, 20 minutes)

Presenter: LO, Pok Man (University of Wroclaw)

In this talk I will explore several theoretical issues in applying the S-matrix formulation of statistical mechanics to coupled channel scattering, e.g. dealing with inelasticity, treating overlapping resonances, and studying the influences from dynamical structures like poles and roots on thermal observables. As an application, I will discuss a coupled-channel model describing the S=-1 hyperon system and some ideas for incorporating $N>2$-body scatterings.

[20] A generalized Beth-Uhlenbeck approach to unified quark-hadron thermodynamics. (12:00, 20 minutes)

Presenter: CIERNIAK, Mateusz (University of Wrocław)

In this talk, I will present the outcome of our study on quark clusters at finite temperature and baryochemical potential. The properties of hadronic clusters are derived using generalized Beth-Uhlenbeck formulas with underlying quark degrees of freedom following from the PNJL model. This allows us to describe within a unified approach the transition from a hadronic phase where quarks are clustered into their hadronic bound states as composite objects to a phase where quarks are the only degrees of freedom above certain values of T and μ_B. We demonstrate how quark properties affect the clusters, most notably we show the effect of Polyakov-loop suppression on colored clusters (i.e. multiquark states that are not color-singlets). We also observe the reverse effect, where the presence of clusters impacts the suppression strength of the Polyakov-loop and, in turn, shifts the pseudocritical temperature of the PNJL model to lower values. We propose an effective cluster phase-shift ansatz, which allows us to simulate Mott dissociation of clusters at high temperatures while producing thermodynamic properties in good agreement with lattice-QCD calculations.

[21] Quark-gluon plasma and the charm quark production in the quasiparticle approach (12:20, 20 minutes)

Presenter: MYKHAYLOVA, Valeriya (University of Wrocław)

We study the production of charm quarks in a hot QCD medium composed of the dynamical quarks and gluons, dressed by the effective temperature-dependent masses. The temperature dependence is incorporated through the coupling deduced from the lattice QCD equation of state for $N_f=2+1$ [1]. For the time evolution of the QGP, we employ the hydrodynamic results [2] which involve the shear viscosity computed in the quasiparticle model [3]. [1] V. Mykhaylova, M. Bluhm, C. Sasaki, K. Redlich, Phys.Rev.D 100 (2019). [2] J.Auvinen, K. J. Eskola, P. Huovinen, H. Niemi, H.Paatelainen, Phys.Rev.C 102 (2020). [3] V. Mykhaylova, C. Sasaki, Phys.Rev.D 103 (2022).

[23] Driving chiral phase transition with ring diagram (12:40, 20 minutes)

Presenter: SZYMANSKI, Michal (University of Wroclaw)

We discuss the screening of a four-quark interaction by the ring diagram and its back-reaction on the quark gap equation in an effective chiral quark model. In consequence, a medium-dependent coupling is derived. This naturally reduces the chiral transition temperature in a class of models. It is also capable of generating the inverse magnetic catalysis at finite temperatures and magnetic fields. Our results provide a coherent description of inverse magnetic catalysis anchored to a reliable field-theoretical basis. We also demonstrate the important role of confining forces, via the Polyakov loop, in a positive feedback mechanism which reinforces the inverse magnetic catalysis.

[1] Reaching percolation and conformal limits in neutron stars (13:00, 20 minutes)

Presenter: MARCZENKO, Michał (University of Wrocław)

We statistically determine the properties of dense matter found inside neutron stars (NSs). We calculate the speed of sound and trace anomaly and demonstrate that they are driven towards their conformal values at the center of maximally massive NSs. The local peak of the speed of sound is shown to be located at values of the energy and particle densities which are consistent with deconfinement and percolation conditions in QCD matter. We also analyze fluctuations of the net-baryon number density in the context of possible remnants of critical behavior. We find that the global maxima of the variance of these fluctuations emerge at densities beyond those found in the interiors of NSs. based on arXiv:2207.13059

[27] Constraining the mass of sexaquark from neutron star observables (13:20, 20 minutes)

Presenter: SHAHRBAF, Mahboubeh (University of Wroclaw)

Following the idea that a stable sexaquark state with quark content (uuddss) would have gone unnoticed by experiments so far and that such a particle would be a good dark matter candidate, we investigate the possible role of a stable sexaquark in the physics of compact stars given the stringent constraints on the equation of state that stem from observations of high mass pulsars and GW170817 bounds on the compactness of intermediate-mass stars. We present for the first time a scenario for which early quark deconfinement in compact stars is triggered by the Bose-Einstein condensation (BEC) of a light sexaquark. We find that the observables of neutron stars put some limitations on the minimum and the maximum mass of sexaquark

Summaries, closing (25 Sept 2022, 13:40 - 14:20)