HK 23: Heavy-Ion Collisions and QCD Phases V

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 18

Group Report HK 23.1 Tue 15:45 HBR 62: EG 18

Superconducting Quark Matter Core in Neutron Stars including Mesonic Fluctuations — •Ugo Mire[1] and Bernd-Jochen Schaefer[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany

A nonperturbative equation of state for two-flavor superconducting quark matter is constructed by means of a functional renormalization group (FRG) method within a quark-meson-diquark truncation. The phase structure at finite temperature, charge and quark chemical potential is investigated. The effects of mesonic fluctuations including possible truncation artifacts are discussed. By considering a smooth transition between the normal and superconducting quark matter phase we obtain an electrically and color neutral as well as β-equilibrated equation of state. This enables a detailed analysis of the tidal deformabilities and mass-radius relations of hybrid stars with superconducting quark cores and hadronic shells. We find that already the mesonic fluctuations lead to significant modifications of the corresponding astrophysical observables in the mass region of $M \approx 1.5\,M_\odot$. However, the inclusion of additional interaction channels is mandatory in the present FRG truncation since the two-solar mass limit cannot be reached.

HK 23.2 Tue 16:15 HBR 62: EG 18

Renormalization Group Consistent treatment of NJL Color Superconductivity — •Hosein Gholami — TU Darmstadt

The Nambu-Jona-Lasinio (NJL) model and specifically its extension to color superconductivity is an effective model for investigating dense quark matter. However, the reliability of its results is challenged by cut-off artifacts emerging near cut-off energy scales. In this presentation we focus on a Renormalization Group (RG) consistent treatment that successfully eliminates these artifacts. Our study reveals a substantial change in the previously established phase diagram of neutral color superconducting matter. The RG-consistent treatment not only eliminates cut-off artifacts but also aligns with an earlier Ginzburg-Landau analysis, suggesting the appearance of a so-called dSC phase in the Color-Flavor Locked (CFL) melting pattern.

HK 23.3 Tue 16:30 HBR 62: EG 18

Strange Hadron and Hypernuclei Production in Dense Baryonic Matter — •Yue Hang Leung for the CBM-Collaboration — Im Neuenheimer Feld 226 69120 Heidelberg

Strange hadrons and hypernuclei have been have been suggested to be sensitive probes to the medium properties of the nuclear matter created in heavy-ion collisions. At low collision energies, the medium formed is dense and baryon-rich due to baryon stopping. Since strange hadrons are produced near or below threshold at low collision energies, their yields may give strong constraints on the equation-of-state of high baryon density matter.

In this presentation, recent results on strange hadron and hypernuclei production from intermediate to low energy heavy-ion collisions from STAR will be discussed. Future prospects at CBM will be discussed, with a special focus on the tracking capabilities of the ongoing mCBM project.

HK 23.4 Tue 16:45 HBR 62: EG 18

Accessing the $p-\Sigma^+$ interaction via femtoscopy with ALICE — •Benedict Heybeck — Institut für Kernphysik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt, Germany

The Σ-nucleon interaction is crucial for the description of neutron stars and potential Σ-hypernuclei. Since Σ-baryons have similar masses and quark content as Λ-baryons, their interaction might be similar. However, models do not even agree if the Σ-nucleon interaction is attractive or repulsive and scattering data is scarce. Thus, two-particle intensity interferometry (femtoscopy) of Σ-baryons and nucleons can provide valuable information.

Σ^+-baryons decay into a proton and a neutral pion via the weak interaction with a branching ratio of 51.57%. The neutral pion decays electromagnetically almost exclusively into two photons which are challenging to measure with the ALICE apparatus.

In this talk, a new reconstruction method will be shown which makes use of machine learning techniques and significantly improves the reconstruction efficiency of the Σ-baryons.

The obtained correlation function will be discussed and related to latest theoretical predictions and scattering data.

HK 23.5 Tue 17:00 HBR 62: EG 18

The nuclear structure from ultracentral symmetric heavy-ion collisions — •Seyed Farid Taghavi — Technical University of Munich, Munich, Germany

Heavy-ion collision experiments are a valuable tool for studying the properties of nuclei. One potential characteristic of the evolution process at its early stages is scale-invariance. This suggests that the produced entropy at the initial stages display similar scaling as the nuclei participants. By studying ultra-central symmetric heavy-ion collisions and assuming scale-invariance, we can directly connect the characteristics of heavy-ion collisions with those of nuclei, including their two-body correlations. We propose an analytical formula for the initial state eccentricity fluctuation using this property. Specifically, we use the cluster-expansion method to determine the functionality of two-body correlations. We validate our results with TRENTo event generator.