HK 5: Heavy-Ion Collisions and QCD Phases I

Time: Monday 16:30–18:00 Location: SCH/A216

HK 5.1 Mon 16:30 SCH/A216

Dilepton anisotropic flow in hadronic transport — •Renan Hirayama[1,2] and Hannah Elfner[1,2,3,4] — [1]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Frankfurt, Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

We present first calculations of dielectron anisotropic flow in heavy-ion collisions at HADES beam energies from a hadronic transport approach. The collectivity of the electromagnetic radiation produced during the evolution of these collisions has recently been dubbed as a barometer, serving as a probe for the flow velocity of the underlying hadronic matter. In particular, we study the elliptic flow coefficient v_2 of dileptons in different collisions systems, and its relation to the flow of hadrons.

HK 5.2 Mon 16:45 SCH/A216

Probing rapidity structure of A-A events with correlations of particle number ratios — •Igor Altsybeev for the ALICE Germany-Collaboration — Technische Universität München, James-Franck-Straße 1, 85748 Garching bei München

Measurements of fluctuations allow one to study phase transitions and other collective phenomena in systems formed in high-energy hadronic collisions. In this report, we will discuss properties of a recently proposed fluctuation observable, namely, the correlation coefficient between ratios of identified particle yields measured in two angular acceptance windows. With such an observable it is possible, for instance, to study the correlation between relative strangeness yield in separated rapidity intervals, which should be sensitive to the density of the fireball formed in A-A collisions. Such correlations are also sensitive to various short-range effects, in particular, they are affected by spin statistics. We will show first experimental measurements of particle ratio correlations in pp and Pb-Pb data recorded by ALICE, and compare with predictions from several models that include various physics effects. Such comparison allows one to exclude some of the models.

This work is supported by BmBf.

HK 5.3 Mon 17:00 SCH/A216

Elliptic flow of pions, kaons and protons relative to the spectator plane measured with ALICE at the LHC — •Michael Rudolf Ciupek[1,2], Lukas Kreis[1,2], and Ilya Selyuzhenkov[2] for the ALICE Germany-Collaboration — [1]Physikalisches Institut, Heidelberg, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

In relativistic heavy-ion collisions, the shape of the initial energy density in the overlap region of the colliding nuclei is asymmetric and fluctuates. Due to interactions, these fluctuations are transferred to the momentum distribution of particles in the final state which is quantified by the flow coefficients v_n. The thermodynamic expansion of the quark-gluon plasma (QGP) results in a specific particle mass dependence of the v_n coefficients as a function of the transverse momentum. The measurements of the v_n relative to the spectator plane is of special interest, since the spectators decouple very early in the collision. Comparison of the v_n measured relative to the participant and the spectator plane with the corresponding eccentricities allow constraining the initial state models. The particle-type dependence of these differences is sensitive to the viscous effects in the QGP expansion. ALICE measurements of the v_2 for pions, kaons and protons wrt. the spectator plane in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV are presented. The measurement of the particle-type dependent difference between v_2 relative to spectator plane and that of four-particle cumulants extends on previously published results for charged hadrons and allow to separate effects from QGP evolution and initial state fluctuations.

HK 5.4 Mon 17:15 SCH/A216

Equation of motion of the shear stress tensor in the moment approximation — •Timo Füle — FIAS, Frankfurt am Main, Germany

One of the most prominent theories for the evolution of the hot quark gluon plasma is kinetic theory. The common equations of motion (EOM) by Israel and Stewart lack a method for consistently increasing accuracy, namely a power counting scheme. This is due to a truncation of the expansion of the distribution function before deriving the EOM. But in fact the equations of motion can be derived without closing the expansion leaving infinitely many moments of the Boltzmann equation and being able to decide on the order of the approximation afterwards. This work revises the EOM derived by Denicol et al. at the example of the shear stress tensor. The truncation will be done afterwards to arrive at the EOM of the 14-moment approximation with the incorporated power counting scheme in the Knudsen- and inverse Reynolds-number.

HK 5.5 Mon 17:30 SCH/A216

Collective flow at SIS energies within a hadronic transport approach: Influence of light nuclei formation and equation of state — •Justin Mohs[2,3] and Hannah Elfner[1,2,3] — [1]Gesellschaft für Schwerionenforschung — [2]Goethe-Universität Fankfurt — [3]Frankfurt Institute for Advanced Studies

Collective flow observables are known to be a sensitive tool to gain insights on the equation of state of nuclear matter from heavy-ion collision observations. Towards more quantitative constraints one has to carefully assess other influences on the collective behaviour. Since the formation of light nuclei is important in low-energy heavy-ion collisions, two different approaches to take the formation of light nuclei into account are contrasted to each other within the hadronic transport approach SMASH: A clustering algorithm inspired by coalescence and microscopic formation of deuterons via explicit cross-sections. The sensitivity of directed and elliptic flow observables in Au+Au collisions at $E_{\mathrm{lab}} = 1.23A$ GeV to the strength of the Skyrme mean field is explored and we find that a stiff equation of state describes the measurement best if no momentum dependence is included in the nuclear potentials. This study establishes the current understanding of collective behaviour within the SMASH approach and lays the ground for future more quantitative constraints on the equation of state of nuclear matter within improved mean field calculations.

HK 5.6 Mon 17:45 SCH/A216

Collective flow measurements with HADES in Au+Au collisions at 1.23 AGeV — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron, hadron and light nuclei production in heavy-ion collisions with unprecedented precision. The high statistics measurements of flow coefficients for protons, deuterons and tritons in Au+Au collisions at 1.23 AGeV are presented here. In addition to the directed (v_1) and elliptic (v_2) flow components also the higher coefficients v_3, v_4, v_5 and v_6 are investigated for the first time in this energy regime. The multi-differential analysis in different centrality classes over a large region of phase space, i.e. as a function of transverse momentum p_t and rapidity, will be shown and various scaling properties will be discussed. This provides the possibility to characterise the production process of light nuclei, i.e. via coalescence, and puts strong constraints on the determination of the properties of dense matter, such as its viscosity and equation-of-state (EOS).

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