HK 65: Schwerionenkollisionen und QCD Phasen IX

Time: Friday 14:00–16:00 Location: HS2

Group Report HK 65.1 Fri 14:00 HS2

Relativistische Schockwellen und der Vergleich von dissipativer Hydrodynamik fuer mehrkomponentige Systeme mit kinetischer Transport Theorie — •Ioannis Bouras[1], Andrej El[1], Zhe Xu[1,2] und Carsten Greiner[1] — [1]Insitut fuer theoretische Physik, Frankfurt am Main, Deutschland — [2]Frankfurt for Advanced Studies, Frankfurt am Main, Deutschland

Wir diskutieren die Herleitung dissipativer hydrodynamischer Gleichungen fuer ein mehrkomponentiges ultrarelativistisches System und Vergleichen die Ergebnisse mit dem numerischen Transportmodell BAMPS (Boltzmann Approach of MultiParton Scatterings), welches die Boltzmanngleichung für ein partonisches Gas löst. In eindimensionaler Geometrie stellen wir unter Benutzung von physikalischen Parametern, die speziell fuer RHIC relevant sind, eine gute Uebereinstimmung fest.

Des weiteren werden hochenergetische Jets innerhalb eines statischen Mediums mittels BAMPS untersucht. Verschieden Quellterme für den Jet werden miteinander verglichen. Die vom Experiment gemessene Doppel-Peak Struktur, welche auf die Bildung eines Mach'schen Kegels hindeutet, wird nur unter speziellen Bedingungen beobachtet.

HK 65.2 Fri 14:30 HS2

Relativistic fluid dynamics from the Boltzmann equation: A systematic derivation from the moments method — •Gabriel S. Denicol[1], Harri Niemi[2], Etele Molnar[3], and Dirk H. Rischke[1] — [1]Institute for Theoretical Physics, Max von Laue-Str. 1, D-60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Str. 1, D-60438 Frankfurt am Main, Germany — [3]MTA-KFKI, Research Institute of Particle and Nuclear Physics, H-1525 Budapest, P.O.Box 49, Hungary

Relativistic fluid dynamics has been applied with success to study the hot and dense matter created in relativistic heavy-ion collisions. Despite this success, the foundations of a relativistic theory of fluid mechanics are still controversial and subject of intense investigation. One of the reasons in particular is that the relativistic extension of Navier-Stokes theory was found to be intrinsically unstable and, consequently, unphysical.

In this work, we investigate this problem in the framework of kinetic theory. We consider relativistic dilute gases which are reasonably well described by the relativistic Boltzmann equation. We propose a new and systematic approach to derive fluid dynamics from the Boltzmann equation, using the moments method. We compute all the transport coefficients and compare to previous calculations, as the one of Israel and Stewart and the one from Chapman-Enskog theory. Furthermore, we compare the solutions of our macroscopic theory to numerical solutions of the Boltzmann equation and show that they are in very good agreement.

HK 65.3 Fri 14:45 HS2

Dynamical freeze-out criterion in heavy-ion collisions — •Pasi Huovinen — Johann Wolfgang Goethe-Universität, Frankfurt am Main, Germany

In a fluid dynamical description of relativistic heavy-ion collisions the system is said to freeze out when the collisions between particles become so rare that the system no longer behaves as a fluid, but as free particles instead. This is thought to happen when the scattering rate becomes smaller than the expansion rate, i.e. when local Knudsen number falls below one. In practice, however, freeze-out at constant temperature or density is used instead. In this contribution I study how the final spectra and anisotropy of particles is affected in an ideal fluid calculation if the freeze-out literally takes place when the scattering and expansion rates are equal.

Group Report HK 65.4 Fri 15:00 HS2

Scherviskosität in einer partonischen Kaskade — Felix Reining und •Christian Wesp — Institut für theoretische Physik, Goethe Universität Frankfurt am Main, Deutschland

Mit Hilfe der Parton Kaskade BAMPS wird ein ultrarelativistisches Gluonen Gas mit pQCD basierten Wechselwirkungen, unter Berücksichtigung von elastischen $2 \leftrightarrow 2$ und inelastischen $2 \leftrightarrow 3$ Prozessen, simuliert. Zur Extraktion der Scherviskosität werden unterschiedliche Methoden (Einstellung eines stationären Geschwindigkeitsgradienten, Green-Kubo Relation, Israel-Stewart-Theorie) vorgestellt und miteinander sowie mit publizierten Ergebnissen verglichen. Alle Methoden zeigen sehr gute Übereinstimmung bei der Untersuchung des Einflusses der QCD Kopplungskonstante α_s (im Bereich von 0.01 bis 0.6) auf die Scherviskosität $\eta(\alpha_s)$ des Partongases.

HK 65.5 Fri 15:30 HS2

Effects of a temperature-dependent shear viscosity-to-entropy density ratio on elliptic flow in heavy-ion collisions at RHIC and LHC — Gabriel Denicol[1,2], Pasi Huovinen[1], Etele Molnar[3], •Harri Niemi[2], and Dirk Rischke[1] — [1]Institute für Theoretische Physik, Johann Wolfgang Goethe-Universität, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Str. 1, D-60438 Frankfurt am Main, Germany — [3]MTA-KFKI, Research Institute of Particle and Nuclear Physics, H-1525 Budapest, P.O.Box 49, Hungary

We investigate, by using relativistic fluid dynamics, the effects of a temperature-dependent shear viscosity-to-entropy density ratio η/s on transverse momentum spectra and elliptic flow of hadrons in ultrarelativistic heavy-ion collisions.

We show that the elliptic flow coefficient in $\sqrt{s_{NN}} = 200$ GeV Au+Au collisions (i.e., at the Relativistic Heavy Ion Collider – RHIC) are insensitive to the value of η/s in the high-temperature quark-gluon plasma (QGP), as long as it has the same minimum value near the QCD phase transition. On the other hand, the elliptic flow is very sensitive to the η/s value of the hadron gas.

We find that the sensitivity of the elliptic flow to the high-temperature value of η/s increases with increasing multiplicity and simultaneously the sensitivity to the hadronic viscosity decreases. This makes Pb+Pb collisions at the Large Hadron Collider (LHC) more suitable to extract transport properties of QCD matter at high temperature.

HK 65.6 Fri 15:45 HS2

Glasma, Flow, and the Ridge in 7 TeV p+p collisions at the LHC — •George Moschelli[1] and Sean Gavin[2] — [1]Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe University, Ruth-Moufang-Str. 1, 60438 Frankfurt am Main, Germany — [2]Department of Physics and Astronomy, Wayne State University, 666 W Hancock, Detroit, MI, 48202, USA

Two particle correlation measurements in Au+Au collisions at the Relativistic Heavy Ion Collider find excess correlations that extend over causally disconnected rapidity ranges. Although this enhancement is broad in relative rapidity, $\eta = \eta 1$ - $\eta 2$, it is focused in a narrow region in relative azimuthal angle, $\phi = \phi 1$ - $\phi 2$. The resulting structure looks like a ridge centred at $\eta = \phi = 0$. The long range rapidity behaviour requires that the correlation originates in the earliest stage of the collision and probes properties of the production mechanism. Glasma initial conditions, predicted by the theory of Color Glass Condensate, provide an early stage correlation that naturally extends far in rapidity. We have previously shown that the ridge is a consequence of particles forming from an initial Glasma phase that experience a later stage transverse flow. The CMS experiment has measured a similar ridge structure in high multiplicity p+p collisions at the Large Hadron Collider. We examine this new data in the context of our model.