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Shear viscosity of nucleons and pions in heavy-ion collisions at energies of NICA

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The shear viscosity is calculated microscopically via the Green-Kubo relation in the various snapshots in the central region in an ongoing relativistic collision simulated via the UrQMD framework for various bombarding energies in the anticipated NICA experiments. In previous works the shear viscosity was calculated as function of temperature, while the chemical potential of baryon charge was kept constant. The original idea of this work is to extract, in various time windows, the average energy density, the net baryon density and the small though nonzero net strangeness density. By fitting these parameters to statistical model, we obtain temperature and chemical potentials of baryon charge and strangeness. Simultaneously, these parameters are used to start simulation in a box, again within the UrQMD transport model. From these simulations the autocorrelations in time of the energy stress tensor are extracted, and subsequently via the Green-Kubo identities the shear viscosity coefficient of that equilibrium hadronic system is obtained. Finally, the evolving and decreasing shear viscosity coefficient can be given as a function of time, temperature, and chemical potentials in the center of mass of the system. For all four collision energies from 10A GeV to 40A GeV a shear viscosity to entropy ratio (η/S) typically starts from 0.3 and then rapidly increases up to and even larger than 1. In addition, we calculate also partial viscosity both for nucleons and pions.

References:

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