Contribution ID: **133** Type: **Poster**

The realistic QCD equation of state in relativistic heavy-ion collisions and the early Universe

The realistic equation of state of strongly interacting matter [1,2], that has been successfully applied in the recent hydrodynamic studies of hadron production in relativistic heavy-ion collisions at RHIC [3,4], is used in the Friedmann equation to determine the precise time evolution of thermodynamic parameters in the early Universe [5]. A comparison with the results obtained with simple ideal-gas equations of state is made. The realistic equation of state describes a crossover rather than the first-order phase transition between the quark-gluon plasma and hadronic matter. The numerical calculations show that small inhomogeneities of strongly interacting matter in the early Universe are moderately damped during such crossover.

The crossover character of the QCD transition indicates that there are small chances for observation of exotic phenomena connected with the first order phase transitions (quark nuggets, strangelets). Similarly, damping of the energy density perturbations suggests that no strong energy-density peaks are formed, that may lead to the formation of cold dark matter clumps discussed in earlier publications.

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Primary author: FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

Presenter: FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

Track Classification: QCD phase diagram