Hydrodynamic Evolution near the QCD Critical End Point and Its Consequences

Chiho NONAKA[a], Masayuki ASAKAWA[b] and Shin MUROYA[c]

[a] *Radiation Laboratory, RIKEN (The Institute of Physical and Chemical Research)*
[b] *Department of Physics, Kyoto University*
[c] *Tokuyama Women's College*

Recently, the possibility of the existence of the critical end point (CEP) in the QCD phase diagram has attracted a lot of attention and several experimental signatures have been proposed for it [1 – 3]. However, there has been, so far, no quantitative study on the hydrodynamic evolution near CEP.
To this end, we first construct an equation of state that includes CEP, and the first order phase transition and cross over between the hadron phase and quark-gluon plasma phase on the basis of the Ising universality class, which QCD is believed to belong to. We then carry out, for the first time, an extensive study on the hydrodynamical evolution of systems that pass near CEP, using the above equation of state and a full 3D hydrodynamics code. Since our code is based on Lagrangian hydrodynamics, it is possible to follow the time evolution of each volume element on the T-μ plane. Taking advantage of this feature, we shall, in particular, discuss the focusing (or squeezing) of the time evolution trajectory on the T-μ plane, caused by the critical behavior of the thermodynamical quantities near CEP, and its possible relevance to the HBT puzzle and apparently low kinetic freezeout temperature at RHIC. In addition, we shall also discuss the possible dependence of the kinetic freezeout temperature on the size and expansion speed of the system.

References

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