Hydrodynamic Analysis of Relativistic Heavy-Ion Collisions at the RHIC Energy

Tetsufumi Hirano[a]

[a] *Physics Department, University of Tokyo*

We investigate the effect of early chemical freeze-out on radial flow, elliptic flow and HBT radii by using a fully three dimensional hydrodynamic model. In the conventional hydrodynamic analyses for relativistic heavy-ion collisions, one usually assumes not only thermal but also chemical equilibrium. However, the detailed analysis based on the statistical model indicates that there exists a kind of "new hadronic matter" which is thermally equilibrated but chemically frozen. It results from the fact that the time scale of the expansion of hot/dense hadronic matter is comparable with (or smaller than) that of inelastic processes between hadrons. We include the chemically non-equilibrium properties in the equation of state [1] and perform hydrodynamic simulations in full three dimensional space [2,3]. We find that, when we take account of the early chemical freeze-out, the space-time evolution of temperature in the hadron phase is considerably different from the conventional model in which chemical equilibrium is always assumed. See also Fig. 1. As a result, radial and elliptic flows are suppressed, the lifetime of the fluid is shortened and the spatial size of the fluid is reduced. To see this more clearly, we analyze the p_T spectrum, the differential elliptic flow and the HBT radii at the RHIC energy and compare these results between models with and without chemical equilibrium.

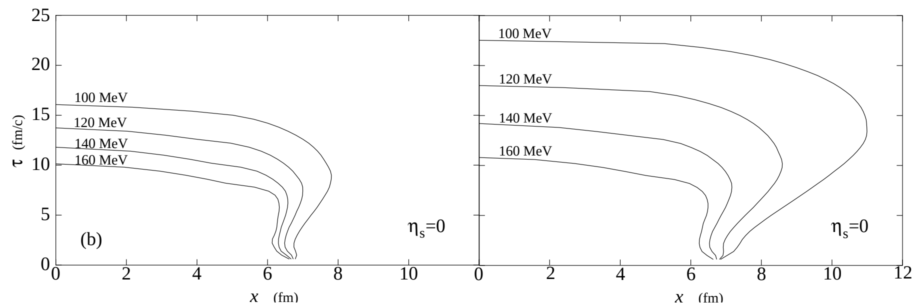

Figure 1: Space-time evolution of thermal freeze-out hypersurface in the reaction plane for the model without chemical equilibrium (left) and for the model with chemical equilibrium (right). Here τ and x are, respectively, the proper time and one of the transverse coordinates which is parallel to the impact parameter vector.

References

[1] T. Hirano and K. Tsuda, nucl-th/0202033 (to appear in the proceedings of 'Hirschegg 2002').
[2] T. Hirano, Phys. Rev. C **65** (2002) 011901.
[3] T. Hirano, Phys. Rev. Lett. **86** (2001) 2754.