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Spinodal Enhancement of Light Nuclei Yield Ratio in Relativistic Heavy Ion Collisions

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Using a relativistic transport model to describe the evolution of the quantum chromodynamic matter produced in Au+Au collisions at $\sqrt{s_{NN}} = 3 - 200$ GeV, we study the effect of a first-order phase transition in the equation of state of this matter on the yield ratio $N_t N_p / N_d^2$ (tp/d^2) of produced proton (p), deuteron (d), and triton (t). We find that the large density inhomogeneities generated by the spinodal instability during the first-order phase transition can survive the fast expansion of the subsequent hadronic matter and lead to an enhanced tp/d^2 in central collisions at $\sqrt{s_{NN}} = 3 - 5$˜GeV as seen in the experiments by the STAR Collaboration and the E864 Collaboration. However, this enhancement subsides with increasing collision centrality, and the resulting almost flat centrality dependence of tp/d^2 at $\sqrt{s_{NN}} = 3$ GeV can also be used as a signal for the first-order phase transition.

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