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The 166th HENPIC seminar by Dr. Kaijia Sun, Texas A&M University, June 9th, 2022, Thursday, 10:30 am (Beijing time)

Title: Spinodal Enhancement on Light Nuclei Yield Ratio in Relativistic Heavy Ion Collisions

Abstract: The search for a first-order phase transition and the critical point (CP) in the phase diagram of Quantum Chromodynamics (QCD) is the central goal of the beam energy scan (BES) program in relativistic heavy ion collisions. Due to the composite structures of loosely bound nuclei, their yields are expected to carry important information on the baryon density fluctuation and correlation developed during the possible non-smooth QCD phase transitions in relativistic heavy ion collisions. In this talk, I will report our recent progress and findings in this direction.

Specifically, we develop a novel relativistic transport model with a first-order phase transition incorporated into the partonic dynamics, which enables us to 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). With this approach, we demonstrate for the first time 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. Moreover, 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.