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Nonuniform-temperature effects on the phase transition

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At RHIC, a fireball forms in the Au-Au collision and rapidly cools during expansion, inside which the QCD matter undergoes a phase transition from quark-gluon-plasma to the hadronic phase. The phase transition signals are expected to be observed via the measurement of fluctuations of conserved charges such as baryon numbers [1]. Indeed, both the dynamical evolution and the spatially-nonuniform-temperature (and chemical potential) distribution of the fireball
affect the fluctuations of QCD phase transition. However, the current studies of the QCD phase transition mainly focus on the dynamical effects [2], and the nonuniform-temperature effects are overlooked.

In this talk, we will present the spatially-nonuniform-temperature effects on the QCD phase transition temperature, the fluctuations, and the correlation length via a simplified Ising-like model [3]. Different from the dynamical effects, which delay the phase transition, we reveal that the nonuniform-temperature effects lead to higher phase transition temperature. Besides, the suppression of the critical fluctuation can be as stronger as the dynamical slowing down effects, and the nonzero-momentum modes of fluctuations play a crucial role. Our study presents a different perspective to understand the recent STAR data and lattice results [4], and can be further generalized to other temperature-nonuniform systems like the compact stars.

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