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Precision measurement of (Net-)proton Number Fluctuations in Au+Au Collisions from BES-II Program at RHIC-STAR

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Higher-order cumulants of (net-)proton multiplicity distributions are sensitive observables for studying the QCD phase structure. At low baryon chemical potential (μ_B), lattice QCD calculations establish the quark-hadron transition to be a crossover, while at large μ_B, QCD-based models predict a first-order phase transition that ends at a critical point.

Here, we focus on the search for the possible existence of the QCD critical point. We report precision measurements of cumulants (C_n) and factorial cumulants (κ_n) of (net-)proton multiplicity distribution upto fourth order in Au+Au collisions with $\sqrt{s_{NN}}$ =7.7 - 27 GeV measured by the STAR experiment from second phase of Beam Energy Scan program (BES-II) at RHIC. Using the high statistics data collected with upgraded detectors, we select protons and antiprotons at mid-rapidity $|y| < 0.5$ within $0.4 < p_T(GeV/\mathrm{c}) < 2.0$. The dependence of measured cumulants and factorial cumulants on the collision energy and centrality will be presented. The measured data will be compared with calculations from lattice QCD, and expectations from various non-critical point models, such as the transport model UrQMD and the thermal model HRG.

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