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Precision measurement of Fifth and Sixth Order Cumulants and Factorial Cumulants of (Net-)proton Multiplicity Distributions in Au+Au Collisions from BES-II Program at RHIC-STAR

Hyper-order cumulants (C_n) of net-proton multiplicity distributions are sensitive observables for studying the QCD phase structure. At small baryonic chemical potential (μ_B), lattice QCD and QCD-based models predict a negative sign for the fifth- and sixth-order cumulants as a signature of quark-hadron transition to be a crossover. At large μ_B, the possibility of a first-order phase transition will result in a two-component structure in the proton multiplicity distribution. Consequently, the factorial cumulants (κ_n) will have large values, which increase in magnitude and alternate in sign with increasing order.

We report precision measurements of fifth and sixth-order cumulants and factorial cumulants of (net-)proton multiplicity distribution in Au+Au collisions at $\sqrt{s_{NN}}$ =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 $0.4 < p_T(GeV/\text{c}) <$ 2.0. The dependence of measured cumulants and factorial cumulants on the collision energy and centrality will be presented. The data will be compared with the corresponding calculations from the lattice QCD and QCD-based models. In addition, the data will also be compared with the hadronic transport model UrQMD and the thermal hadron resonance gas model calculations.

Category

Experiment

Collaboration (if applicable)

STAR

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