Precision Measurement of (Net-)proton Number Fluctuations in Au+Au Collisions at RHIC

Fan Si (for the STAR Collaboration)

The main goal of the RHIC Beam Energy Scan (BES) program is to explore the phase structure of strongly interacting nuclear matter and search for the possible QCD critical point (CP) in high-energy nuclear collisions. Over more than a decade, the Beam Energy Scan programs (BES-I and BES-II) at RHIC covered a wide range of collision energy, from $\sqrt{s_{\rm NN}}$ = 3.0 GeV to 200 GeV corresponding to a wide range of baryonic chemical potential μ_B = 750 MeV to 25 MeV. The STAR detector, with some crucial upgrades, was the main apparatus used in the scan. Higher-order fluctuations of (net-)proton numbers, serving as sensitive probes for the QCD phase structure including CP, have been measured with the highest precision to date.

In this talk, we will focus on the physics of phase boundary and QCD critical point. The precision measurement from BES-II, which examines net-proton, proton and antiproton number cumulants and factorial cumulants in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 7.7, 9.2, 11.5, 14.6, 17.3, 19.6 and 27 GeV, will be presented. Specifically, the collision centrality and energy dependence of the cumulants up to the fourth order will be included. The new experimental results will be discussed within the framework of non-critical model calculations.