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Precision measurements of net-proton number fluctuations in Au+Au collisions at RHIC

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The main goal of the RHIC beam energy scan program (BES) is to study the strongly interacting nuclear matter phase structure and search for the possible QCD critical point in high-energy nuclear collisions. Over more than a decade, the scan (BES-I and BES-II) 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. Observables, for studying the physics of collectivity, chirality, criticality, involving light/strange hadrons, leptons, correlations, (hyper-)nuclei 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. Specifically, new BES-II data on collision energy and centrality dependence of proton, anti-proton and net-proton cumulants, up to the $4^{\rm th}$ order, 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. The new experimental results will be discussed within the framework of non-critical model calculations.

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