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Search for the QCD Critical Point by Higher Moments of Net-proton Multiplicity Distributions at STAR

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One of the main goals of the RHIC Beam Energy Scan (BES) Program is to search for the QCD Critical Point and the phase boundary in the QCD phase diagram. Higher moments of event-by-event net-proton multiplicity distributions have high sensitivity to the correlation length[1], and they are directly connected to the susceptibilities in the Lattice Gauge Theory (LGT) calculations and the Hadron Resonance Gas (HRG) model. Therefore, they are ideal tools to search for the QCD critical point[4]

In this talk, we will present various moments (variance [σ^2], skewness[S] and kurtosis [κ], moment products ($\kappa\sigma^2$, Sσ) and intensive normalized cumulants ($\omega3$ and $\omega4$) of net-proton and total-proton multiplicity distributions measured by the STAR detector at RHIC. The moment products ($\kappa\sigma^2$, Sσ) and intensive normalized cumulants are related to the volume independent susceptibility ratios. The data presented in this talk will include the measurements of centrality dependence for the net-protons and total-protons from Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39, 62.4 and 200 GeV. These results have been compared with a Poisson baseline. It is observed that the moment products ($\kappa\sigma^2$, Sσ) and intensive normalized cumulants of net-proton distributions in the 0-5% most central Au+Au collisions show significant deviations from the Poisson expectations around $\sqrt{s_{NN}}$ = 19.6 GeV. Those results will be also compared with UrQMD model calculations.

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