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Higher-Order Cumulants of Net-Proton Multiplicity Distributions in Zr+Zr and Ru+Ru Collisions at $\sqrt{s_{\mathrm{NN}}}$ = 200 GeV by the STAR Experiment

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The Relativistic Heavy Ion Collider (RHIC) at Brookhaven is a facility to create and study the strongly interacting Quark-Gluon Plasma (sQGP). Higher-order cumulants of the conserved quantities and their ratios are powerful tools to study the properties of sQGP and explore the QCD phase structure, such as critical point and/or the first-order phase transition boundary. It has been reported by the STAR Collaboration that the fourth-order cumulant of the net-proton multiplicity distribution shows a non-monotonic energy dependence ($\sqrt{s_{\mathrm{NN}}}$ = 7.7 - 62.4 GeV). In addition, the comparison between the sixth-order net-proton cumulant results and Lattice QCD calculations suggests a smooth crossover transition in central Au+Au collisions at $\sqrt{s_{\mathrm{NN}}}$ = 200 GeV.

In this talk, we will present the net-proton cumulants and their ratios up to sixth-order as a function of multiplicity using high statistics data of Zr+Zr and Ru+Ru collisions at $\sqrt{s_{\mathrm{NN}}}$ = 200 GeV. The STAR experiment collected two billion events for each colliding system. We will compare the multiplicity dependence to the published net-proton cumulants in Au+Au collisions at $\sqrt{s_{\mathrm{NN}}}$ = 200 GeV. In addition, we will compare the results to Lattice QCD, the Hadron Resonance Gas model, and hadronic transport model calculations. The physics implications will be discussed.

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