# Higher-Order Cumulants and Correlation Functions of Proton Multiplicity Distributions in Au+Au Collisions at $\sqrt{s_{\mathrm{NN}}} = 3\,\mathrm{GeV}$

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The higher-order fluctuations of conserved quantities such as net baryon number are predicted to be sensitive to the non-equilibrium correlation length, $\xi$, and thus serve as indicators of critical behavior. Experimentally, fluctuations of proton and anti-proton numbers have been shown to be reliable proxies for baryons and anti-baryons. In the first Beam Energy Scan (BES-I) at the Relativistic Heavy Ion Collider (RHIC), which was run from 2010-2014, the higher-order cumulant ratio, $C_4/C_2$, of the net-proton multiplicity distributions shows a non-monotonic energy dependence between the energies of 7.7 to 62.4 GeV with a significance of $3.1\sigma$. Motivated by the findings of BES I, the Solenoidal Tracker at RHIC (STAR) collaboration improved the detector performance of the STAR detector and began two additional physics programs: the BES-II and the fixed-target (FXT) program. While BES-II revisits the energies of BES-I with higher statistics and improved detector performance, the FXT program extends the lowest energy from $\sqrt{s_{\mathrm{NN}}} = 7.7$ GeV to $\sqrt{s_{\mathrm{NN}}} = 3.0$ GeV.

In this talk, we present the higher-order cumulants of proton multiplicity distributions of the FXT run in Au+Au collisions at $\sqrt{s_{\mathrm{NN}}} = 3.0$ GeV. The data, 140 million minimum bias events, were recorded with the STAR detector at the RHIC facility with a 250 $\mu$m thick target (1% interaction probability). The ratios of both cumulants and correlation functions are presented as a function of centrality, acceptance, and collision energy. We discuss the physics implications of these results with comparisons to results from the HADES experiment and a hadronic transport model.

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