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Energy dependence of higher moments of net-kaon, net-proton and net-charge multiplicity distribution at STAR

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The main goal of the Beam Energy Scan (BES) program at RHIC is to map the phase diagram of QCD. A critical point (CP) is expected at large baryonic chemical potential (μ_B) in the T vs. μ_B phase diagram. Its location experimentally will provide one of the most stringent tests of QCD calculations. In the BES program T and μ_B are varied by changing the center of mass energy ($\sqrt{s_{NN}}$) from 200 to 7.7 GeV. The observables chosen for CP search are the product of moments of conserved(like net-charge) multiplicity distributions or their proxies (such as net-kaon for net-strangeness and net-proton for net-baryons) measured in the experiments. The various moments (mean (M), standard deviation (σ), skewness (S) and kurtosis (κ)) are related to correlation length (ξ) of the system (variance: $\sigma^2 \sim \xi^2$; skewness: $S \sim \xi^{4.5}$ and kurtosis: $\kappa \sim \xi^7$) [1] and are expected to show a non-monotonic variation with beam energy in the presence of CP.

We report new measurements of product of moments: σ^2/M, $S\sigma$ and $\kappa\sigma^2$ of net-kaon distributions (ΔN_K = N_K^+ - N_K^-) obtained by the STAR detector at midrapidity for various centrality in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39, 62.4 and 200 GeV. These results will be presented along with the corresponding results from net-charge [2] and net-proton distributions[3]. All the results are corrected for particle reconstruction efficiency and will be compared to baseline distributions constructed following Poisson and Negative Binomial/Binomial statistics. They will also be compared to calculations from HIJING, AMPT and UrQMD models, which do not include a CP. Deviations from some of the baseline measures and model calculations are observed for net-kaon and net-proton distributions. The implications of the observation to CP physics will be presented.

References

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