

# Measurements of net-proton fluctuation for $p + p$ collisions at $\sqrt{s} = 200$ GeV from the STAR experiment

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In order to understand the QCD phase diagram, Beam Energy Scan program phase II is being carried out at RHIC-STAR. Recently, the higher-order fluctuations of net-proton multiplicity distributions in 0-5% central Au+Au collisions are found to behave non-monotonically with respect to the collision energy, which could be a signal from the QCD critical point. Moreover, the negative sign of the sixth-order fluctuations observed for Au+Au central collisions at  $\sqrt{s_{NN}} = 200$  GeV could be possibly related to the nature of a smooth crossover phase transition at small  $\mu_B$  as predicted by lattice QCD calculations..

In this study, cumulants of net-proton distributions for  $p + p$  collisions at  $\sqrt{s} = 200$  GeV are measured to determine a physics baseline compared to Au+Au collisions. Multiplicity dependence of the  $n$ th order cumulant,  $C_n$  ( $n \leq 6$ ), and their ratios will be presented. The new results of  $C_3/C_2$  and  $C_4/C_2$  with higher statistics data are compared to the published results from minimum bias  $p+p$  collisions. Furthermore, the first measurements of  $C_5$  and  $C_6$  for  $p+p$  collisions will be presented. Comparison with Pythia and thermal model calculations will be discussed.