

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

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In order to understand the QCD phase diagram, Beam Energy Scan program phase II is being carried out in RHIC-STAR. Recently, the higher-order fluctuations of net-proton multiplicity distributions in 0-5% central Au+Au collisions are found to behave nonmonotonically with respect to the collision energy, which could be a signal from the QCD critical point.

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 dependences of  $C_n$  are measured up to the sixth-order and their ratios,  $C_2/C_1$ ,  $C_3/C_2$ ,  $C_4/C_2$ ,  $C_6/C_2$ , are calculated to suppress the volume effect. The results of  $C_3/C_2$  and  $C_4/C_2$  are compared with STAR published results in 2014. Further, charged particle (pions and kaons) multiplicity dependence of the cumulant ratios are compared to those for Au+Au collisions. The results will also be compared with Pythia and thermal model hadron resonance gas calculations.