

Seventh and eighth order cumulants of net-proton number distributions in heavy-ion collisions at RHIC-STAR

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Abstract

Higher-order cumulants of net-proton distributions are sensitive to the details of the phase structure of the QCD phase diagram. Lattice QCD and QCD-based model calculations indicate that the signs of sixth and eighth order cumulants have different combinations in the hadronic phase, partonic phase, and near the transition temperature.

We report the first measurements of seventh and eighth order cumulants of net-proton distributions in the high statistics Au+Au collisions at $\sqrt{s_{NN}} = 27, 54.4, \text{ and } 200 \text{ GeV}$. The measurements are performed at mid-rapidity $|y| < 0.5$ within $0.4 < p_T < 2.0 \text{ GeV}/c$ using the Time Projection Chamber and Time-of-Flight detector. The measurements in Au+Au collisions at 200 GeV will be compared to those from Zr+Zr and Ru+Ru collisions to understand the system size dependence. The signs of the measured sixth, seventh, and eighth order cumulants will be contrasted to those expected from the lattice QCD and QCD-based models. The ratios of the measured cumulants will also be compared with those obtained from the transport and thermal models to understand the role of baryon number conservation and the validity of the models.