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Probing thermal nature of matter formed at RHIC via fluctuations

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Evidence for thermalization of the QCD matter created in high-energy nuclear collisions has dominantly come from the agreement of the measured yield of produced hadrons with those from statistical thermal models. Ideally for a thermalized system, in addition to mean, the higher orders of the moments of the multiplicity distribution of produced particles should also show agreement with thermal models. In this respect, studying the moments of the event-by-event distributions of conserved quantities like net-baryon, net-strangeness and net-charge number is best suited.

We have carried out a systematic study of comparing the results from a thermal hadron resonance gas model with data on higher moments of net-proton, net-kaon and net-charge distributions measured at RHIC beam energy scan program. The experimental acceptances in terms of rapidity and transverse momentum are used in the model calculations carried out for central Au+Au collisions at the centre of mass energies of 7.7, 11.5, 19.6, 27, 39, 62.4 and 200 GeV. For the first time, the hadron resonance gas model results are found to explain the measurements up to third order of moment with a common temperature and baryonic chemical potential. These calculations have tested the thermal nature of produced net-particle distributions up to third order, thereby providing evidence for thermalization of the QCD matter formed in high energy heavy-ion collisions at RHIC. Implications of the findings on our understanding of the phase structure of QCD matter will be discussed.

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