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Probing the thermal state of the fireball at freezeout via isothermal compressibility and specific heat capacity

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The thermal state of the fireball at freezeout has been inferred from the mean hadron yields previously. In this study, we go beyond the mean hadron multiplicities and access the variances from multiplicity and transverse momentum distributions that provide us the thermodynamic responses of the fireball at freezeout –namely the isothermal compressibility (k_T) and specific heat capacity (c_v) that enable us to determine the thermodynamic state of the fireball at freezeout independently of the mean hadron yields. Further, in case the freezeout lies in the critical region of the QCD phase diagram, evidence of criticality could also show up in k_T and c_V.

We have for the first time estimated k_T of the system formed in heavy-ion collisions for energies from 7.7 GeV to 2.76 TeV, with the help of event-by-event multiplicity fluctuations. An estimate of the dynamical fluctuation has been made from the experimental data by subtracting the statistical fluctuation within the approximation of the participant model. For c_v, the experimental data on the event-by-event mean transverse momentum distributions are transformed to distributions of effective temperatures and the dynamical temperature fluctuations are obtained by subtracting the widths of the corresponding mixed event distributions. We have compared our results with model expectations based on the hadron resonance gas model as well as event generators. The estimation of k_T and c_v complements our previous understanding of the thermal state of the fireball at freezeout based on mean hadron yields.

Content type

Experiment

Collaboration

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