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Rapidity dependence study of charged pion production in relativistic nuclear collisions using Tsallis distribution

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Relativistic heavy-ion collisions provide a unique opportunity to study nuclear matter under extreme conditions. In such collisions, the created system exhibits strong collective behavior, and the shapes of particle transverse momentum spectra reflect the system's global properties, such as the temperature and flow velocity at kinetic freeze-out. To account for both equilibrium and non-equilibrium features of the p_T spectra, we employ the Tsallis distribution, a statistical distribution that generalizes the Boltzmann–Gibbs distribution to include deviations from thermal equilibrium. In this analysis, transverse momentum spectra of charged pions produced in relativistic nuclear collisions in a wide energy range from $\sqrt{s_{NN}}$ = 2.4 GeV to 200 GeV are studied using Tsallis distribution. The energy and rapidity dependence of the Tsallis fit parameters, Tsallis temperature and non-extensivity parameter, a parameter characterizing the degree of non-equilibrium for the systems produced in these collisions will be presented. The mean transverse momentum extracted in this analysis is studied in correlation with the temperature. The physics implications of these results on the collision dynamics and kinetic freeze-out will be discussed.

Collaboration

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