ID de Contribution: **271** Type: **Poster**

Rapidity scan approach for net-baryon cumulants with a statistical thermal model

mardi 4 juin 2024 19:05 (1 minute)

Utilizing rapidity-dependent measurements to map the QCD phase diagram provides a complementary approach to traditional beam energy-dependent measurements around midrapidity. The changing nature of thermodynamic properties of QCD matter along the beam axis in heavy-ion collisions at low collision energies both motivate and pose challenges for this method. In this study, we derive the analytical cumulant-generating function for subsystems within distinct rapidity windows, while accounting for global net-baryon charge conservation of the full system. Rapidity-dependent net-baryon cumulants are then calculated for a system exhibiting inhomogeneity along the beam axis, and their sensitivity to finite acceptances through changing rapidity bin widths is explored. We highlight the non-trivial behaviors exhibited by these cumulants, underscoring their importance in establishing a non-critical baseline for interpreting net-proton cumulants in the search for the QCD critical point. Finally, we discuss the implications of the rapidity scan for mapping the QCD phase diagram within the current context.

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Classification de Session: Posters

Classification de thématique: Bulk matter phenomena, QCD phase diagram and Critical point