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Search for critical parton density fluctuations through baryon clustering

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Phase transitions and/or critical phenomena are known to lead to local density fluctuations in the nuclear matter created in high-energy heavy-ion collisions. In the quark coalescence picture of particle production, the baryon formation probability can be influenced by these local parton density fluctuations that lead to clustering and voids in the distribution of hadrons in the phase space. We propose to use the normalized distribution of produced particles in coarse azimuthal angular bins to study the fluctuations. The shape of the normalized distribution is expected to be sensitive to clustering in the phase space. We use Poisson and Binomial distributions to generate reference comparisons. Clustering of particles is introduced empirically in the Monte Carlo to investigate the sensitivity of various moments of the normalized distribution. We compare our Monte Carlo results with the STAR Beam Energy Scan data to demonstrate deviations from Poisson/Binomial distributions and the sensitivity of our approach to possible clustering and parton density fluctuations in heavy-ion collisions.

On behalf of collaboration:

STAR

Primary author: ESHA, Roli (University of California - Los Angeles)

Presenter: ESHA, Roli (University of California - Los Angeles)

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