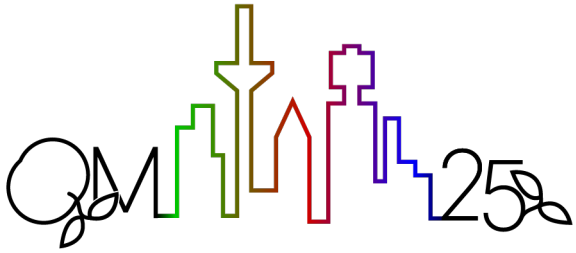

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Balance Functions for Charmed and Light Hadron Pair Correlations in PYTHIA

In high energy nuclear collisions, the majority of the charm and beauty quark production occurs via perturbative hard scattering on a short timescales and undergoes transport through a medium (which depends on the system), experiencing drag, diffusion, scattering, or recombination into bound states. Investigating these processes requires methods sensitive to both the production cross section and transport effects. Balance functions, first developed at RHIC and now used at the LHC, are statistical observables that measure correlations between particle pairs, capturing the final snapshot of accumulated charge-dependent interactions. Early-stage quarks have more time to separate, leading to a broader balance function, while late emission allows less time for separation, resulting in narrower correlations. Shifts in the \(\Delta \phi \) offers insights into the medium's expansion rate relative to particle initial momentum.
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Heavy-flavor hadrons can provide insights into pre{-}hadronization effects, while light hadrons tend to have their initial parton-level correlations diluted. We propose exploring the possibility of measuring balance functions for particle pairs, including charm particles, in pp collisions with PYTHIA, with the particle pairs to be studied including $p^{\pm}$, $^{\pm}_{c}$, ^{0}, $^{\pm}$, $D^{\pm}$, $\pi^{\pm}$, and $K^{\pm}$, to distinguish baryon number transport from electric charge effects. With Run 3 data, studying these observables in small systems is feasible. PYTHIA simulates both perturbative and non perturbative QCD effects in pp collisions, including multiparton interaction, color reconnection, and junction formation, impacting baryon transport through color line rearrangements. Mechanisms like shoving and ropes further modify balance functions by affecting final-state correlations. This study aims to compare the findings with competing models, including those that adopt a thermal approach, to assess their effectiveness in describing these correlations.

Category

Experiment

Collaboration (if applicable)

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