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Strangeness Enhancement via Color Ropes: A Comparison with Hydrodynamics

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Strangeness production is a key signature of the formation of a hot and dense medium in heavy-ion collisions. Understanding the enhancement of strange particles in such environments remains a central challenge. Hybrid approaches—combining transport theory and hydrodynamics within the core–corona framework—have been successful in describing this behavior.

At the same time, signs of collective behavior and enhanced strangeness production have also been observed in small systems such as proton–proton collisions. This raises the intriguing possibility that the phenomena observed in heavy-ion collisions could emerge from the coherent superposition of multiple nucleon–nucleon interactions.

One such approach is provided by the Pythia/Angantyr model, where overlapping color flux tubes (strings) lead to an increased color field strength (string tension), supported by lattice QCD calculations on Casimir scaling. This, in turn, enhances the production of strange quarks via the Schwinger mechanism. The resulting hadronization process is referred to as rope hadronization.

Earlier transport models, such as RQMD, have explored the use of color ropes to explain strangeness enhancement. In this work, we revisit the concept using the modern SMASH transport framework, implementing a dynamic string tension mechanism that responds to local string overlap, motivated by the Pythia/Angantyr approach.

We compare the rope-based mechanism to a hydrodynamical evolution using SMASH+vHLLE within the same transport framework, assessing whether microscopic string interactions alone can account for the strangeness production observed by NA49.

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