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Strangeness enhancement in PHQMD model

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Understanding the phase structure of Quantum Chromodynamics (QCD) remains the main goal of both experimental and theoretical studies of strongly interacting matter. Lattice QCD calculations at zero μ_B predict a smooth crossover between the hadronic phase and the quark-gluon plasma (QGP). One of the key experimental signatures of the formation of the QGP is the enhancement of strange particle production. In particular, the non-monotonic behaviour- commonly referred to as the "horn"- observed in the K+/π+ ratio as a function of collision energy is interpreted as a possible signal of the onset of deconfinement and chiral symmetry restoration.

In this work, we investigate the appearance and evolution of the horn structure in the context of strangeness enhancement in Au+Au collisions within the energy range of 3.5–14.5 GeV. The analysis is performed using the Parton-Hadron Quantum Molecular Dynamics (PHQMD) transport model, which combines the Parton-Hadron-String Dynamics (PHSD) for modeling partonic degrees of freedom with the Quantum Molecular Dynamics (QMD) approach for baryonic interactions. The model offers a dynamical treatment of QGP formation in regions with local energy densities exceeding 0.5 GeV/fm^3.

We compare results obtained with the QGP phase turned ON and OFF in PHQMD to explore the role of deconfinement dynamics in shaping the observed strange hadron yields. The dependence of the horn feature on both collision energy and centrality is studied. In addition to the strangeness-related observables, we also analyze overall particle production and particle ratios, providing a comprehensive view of the system's evolution across different energy regimes. Our results offer new insights into the interplay between chiral symmetry restoration, QGP formation, and strangeness enhancement, contributing to a deeper understanding of the QCD phase diagram at intermediate baryon densities.

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