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The Role of Strange and Heavy Hadrons in Studying the Phase Diagram

This paper explores the critical role of strange and heavy hadrons in studying the phase diagram of strongly interacting matter. Strange particles, such as kaons, hyperons, and multistrange baryons, are sensitive probes of the dense and hot environment created in heavy-ion collisions. Due to their unique production mechanisms and short lifetimes, strange hadrons provide crucial insights into the dynamics of quark-gluon plasma (QGP) formation and the subsequent hadronization process.

Heavy hadrons, including charmed and bottomed mesons and baryons, serve as excellent tools for studying the properties of QGP due to their large masses and relatively low thermal production rates. Their behavior helps in understanding energy loss mechanisms, transport coefficients, and the degree of thermal and chemical equilibrium reached during the collision.

The report delves into experimental data from facilities like RHIC and LHC, highlighting how the yields, spectra, and flow of strange and heavy hadrons vary with collision energy and system size. These variations offer valuable clues about phase transitions, including the possible existence of a critical point and the boundaries between hadronic matter and QGP.

In addition, theoretical models, such as lattice QCD and hydrodynamic simulations, are discussed to show how they complement experimental findings. The study emphasizes the importance of multi-particle correlations and fluctuation analyses in improving our understanding of the phase structure of strongly interacting matter. Ultimately, the insights gained from studying strange and heavy hadrons contribute significantly to mapping the QCD phase diagram and understanding the early universe's evolution.

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