Nuclear modification factor of inclusive charged particles and strange hadrons in Au+Au collisions with the STAR experiment.

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Abstract

The exploration of the Quantum Chromodynamics (QCD) phase diagram via heavy-ion collisions is central to understanding the transition from hadronic matter to a deconfined quark-gluon plasma (QGP). The nuclear modification factor, particularly R_{CP}, serves as a key observable for probing parton energy loss and the properties of the created hot and dense medium. Simultaneously, strange hadrons provide unique insights into the QCD transition and chemical freeze-out conditions due to their sensitivity to strangeness enhancement – a proposed signature of QGP formation. The STAR experiment's Beam Energy Scan (BES) program offers a powerful opportunity to study these probes across a broad range of collision energies.

We present measurements from the STAR experiment on the nuclear modification factor (R_{CP}) for inclusive charged particles in Au+Au collisions at BES energies. These results, based on significantly enhanced statistics from BES-II, are compared to model calculations (e.g., URQMD) and earlier BES-I findings to critically evaluate theoretical descriptions of parton energy loss and medium effects at lower collision energies. The behavior of R_{CP} at higher transverse momenta (p_T) is analyzed to investigate potential jet quenching signatures in the BES energy regime.

Additionally, we extend our investigation to the nuclear modification of strange hadrons. The simultaneous study of charged particles and strange hadrons allows for a comprehensive comparison of medium modification effects. Precise measurements of strangeness production and its modification factor provide crucial information on the degree of strangeness enhancement, the dynamics of the hot medium, and the chemical freeze-out parameters, offering deeper insights into the formation and properties of QGP-like matter at the BES energies.