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Heavy Ion Collision Simulation using the Quark Meson Coupling Model

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Heavy-ion collisions, particularly those involving rare-isotope beams, provide a crucial opportunity to investigate properties of high-density nuclear matter. To study these collisions, we use the DaeJeon Boltzmann-Uehling-Uhlenbeck (DJBUU) transport model, which solves the Relativistic Boltzmann-Uehling-Uhlenbeck equation via the test-particle method. In this framework, nucleons propagate within relativistic mean fields and undergo collisions with their in-medium cross sections. Recently, we have incorporated the Quark Meson Coupling (QMC) model, which successfully describes nuclear matter and neutron stars, into DJBUU to enable its application to heavy-ion collisions. Compared with the previously implemented Quantum Hadron Dynamics (QHD) model, QMC employs quark-meson couplings to describe nuclear forces, offering advantages such as a more natural description of the effective mass of the Δ baryon. This turned out to be crucial for pion production.

In this work, we validate the QMC-based approach for heavy-ion collisions by comparing simulation results from QMC and QHD within the DJBUU framework. Preliminary results indicate that the overall trends for both models are similar, but QMC tends to yield slightly higher baryon densities and fewer pions than QHD.

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