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What carries baryon number? Simulations of baryon and electric charge stopping in isobar collisions.

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It is a fundamental question to understand what is the effective carrier of conserved quantum charges inside a proton at high energy. The net baryon and electric charge rapidity distributions in relativistic heavy-ion collisions can elucidate how different
conserved charges are transported along the longitudinal direction during the collision. Recent preliminary measurements in isobar collisions at the Relativistic Heavy Ion Collider (RHIC) show that the scaled net-baryon to net-electric charge number ratio at midrapidity ($B/\Delta Q * \Delta Z/A$) is between 1.2 and 2, in line with predictions from the string junction model. This measurement is compatible with the picture where the baryon number is carried by gluon junctions. In this work, we develop a comprehensive (3+1)D relativistic hydrodynamic framework with multiple conserved charge currents. We employ the 3D MC-Glauber model for the initial conditions, which allows for modeling baryon stopping separately from electric charge stopping within the string junction picture. Simulating the coupled propagation of net baryon and electric charge currents including the charge-dependent lattice-QCD-based equation of state, we study how net baryon and electric charges are evolved during different stages of heavy-ion collisions. We make predictions of net baryon and net electric charge rapidity distributions for Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\rm NN}} = 200$ GeV, which can be compared with STAR measurements.

Category

Theory

Collaboration (if applicable)

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