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Dynamical modeling of particle production, flow correlations, and baryon distributions in heavy-ion collisions from GeV to TeV

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Building upon Ref. [1], we present an improved three-dimensional dynamical initialization model for heavy-ion collisions, implementing local energy-momentum conservation and baryon charge fluctuations at string junctions [2]. These improvements lead to an excellent description of the charged hadron and net proton rapidity distributions in Au+Au collisions from 7.7 to 200 GeV [3]. Based on these results, we quantify the amount of baryon stopping at the initial impact and baryon transport during the hydrodynamic evolution and hadronic scattering phases. The effects of strangeness neutrality and the finite overlap time at low collision energies on hadronic flow observables are quantified. We further expand the model description to asymmetric p+Al and (p, d, 3He, Cu)+Au collisions at the top RHIC energy and p+Pb and PbPb collisions at LHC energies. The particle rapidity distributions in asymmetric collision systems can provide additional constraints on modeling the early-time longitudinal dynamics. Enabled by this 3D framework, we quantify the rapidity (de)correlation of anisotropic flow in large and small systems.

[1] C. Shen and B. Schenke, "Dynamical initial state model for relativistic heavy-ion collisions," Phys. Rev. C97 (2018), 024907
[2] D. Kharzeev, "Can gluons trace baryon number?,"Phys. Lett. B 378, 238 (1996)
[3] C. Shen, "Dynamic modeling for heavy-ion collisions," arXiv:2108.04987 [nucl-th]

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