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(3+1)-D viscous hydrodynamics CLVisc at finite net baryon density: identified particle spectra, anisotropic flows and flow fluctuations across BES energies

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To study the bulk properties of the quark-gluon-plasma (QGP) produced at the beam energy scan (BES) energies at the Relativistic Heavy Ion Collider (RHIC), we extend the (3+1)-dimensional viscous hydrodynamics CLVisc [1,2,3] to include net baryon number conservation and Israel-Stewart-like equation for baryon diffusion with the NEOS-BQS equation of state, fluctuating initial conditions from Monte-Carlo Glauber model, and the afterburner SMASH. This integrated framework is shown to provide a good description of identified particle spectra, mean transverse momenta and anisotropic flows for different centralities and over a wide range of collision energies (7.7-62.4 GeV). It is found that the mean momenta of identified particles and anisotropic flows increases mildly with the collision energy due to larger radial flow. We further compute the multiple-particle cumulant ratio v2{4}/v2{2} of elliptic flow across BES energies, and find that the relative fluctuations of elliptic flow are insensitive to the collision energy, consistent with the preliminary STAR data. Our model provides a benchmark for understanding the RHIC-BES data and studying the critical properties and phase structure of hot and dense QCD matter.

References:

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[3] X.-Y. Wu, G.-Y. Qin, L.-G. Pang, and X.-N. Wang,(2021), arXiv:2107.04949

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