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QCD equation of state at finite densities for nuclear collisions

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Elucidation of the quark matter properties at finite densities is one of the goals for the Beam Energy Scan (BES) programs at RHIC. For quantitative predictions and analyses of the experimental data, an equation of state at finite chemical potentials is needed as input to hydrodynamic models.

We construct the QCD equation of state at finite chemical potentials including net baryon (B), electric charge (Q) and strangeness (S) based on the results of state-of-the-art lattice QCD simulations and the hadron resonance gas model [1]. The situation of strangeness neutrality and matter with a fixed electric charge-to-baryon ratio, resembling that of heavy nuclei, is considered for the application to relativistic heavy-ion collisions. This increases the values of baryon chemical potential, modifying the fireball trajectory in the phase diagram. We perform (3+1)D viscous hydrodynamic simulations and demonstrate the importance of finite electric charge and strangeness chemical potentials for identified particle production as well as differences in the v_n coefficients of particles and anti-particles in heavy ion collisions at BES energies.

[1] A. Monnai, B. Schenke and C. Shen, arXiv:1902.05095 [nucl-th]

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