Ideal hydrodynamics for bulk and multistrange hadrons in $\sqrt{sNN}$ = 200 *A* GeV Au-Au collisions

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Relativistic hydrodynamics has been successfully applied to model the bulk evolution of the hot and dense matter created in relativistic heavy-ion collisions [1,2]. Hydrodynamic modeling now often includes viscous corrections [2]; however, it remains important to improve our understanding to which extent ideal hydrodynamics is capable of providing a realistic description of existing and new bulk-hadron data. This requires a consistent description of yields, transverse momentum spectra and elliptic flow for light, as well as multistrange, hadrons. The latter are interesting as they are expected to freeze out close to the phase transition from a quark-gluon plasma (QGP) to hadronic matter [3].

We have tuned the 2+1-D hydro code AZHYDRO [1] to reproduce bulk and multistrange hadron observables in nuclear collisions at the Relativistic Heavy Ion Collider [4]. We have used an equation of state based on recent lattice-QCD computations matched to a hadron-resonance gas with chemical decoupling at T_{ch}=160 MeV (see Fig. 1). We have also introduced a compact initial-density profile and an initial-flow field including azimuthal anisotropies, as motivated, e.g., by HBT analysis [5]. Our resulting hydrodynamic evolution features a fast build-up of radial flow, and the bulk elliptic flow saturates close to the phase transition temperature, T_c=170 MeV (see Fig. 2).

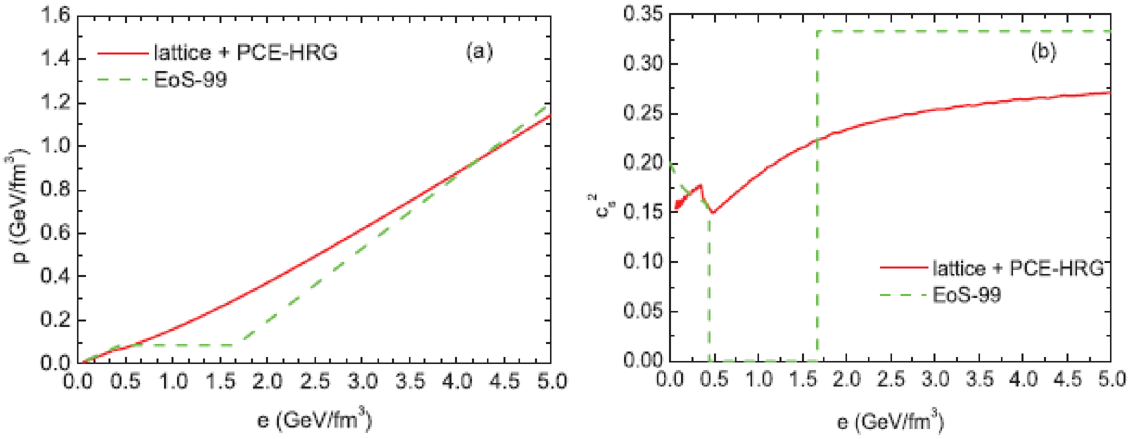

FIG. 1. Comparison of pressure (left panel) and speed of sound squared (right panel) vs. energy density as obtained from AZHYDRO with EoS-99 [1] (dashed lines) and our new equation of state (solid lines).

We find that this scheme allows for a consistent description of the observed chemistry, transverse-momentum spectra, and elliptic flow of light and multistrange hadrons (see Fig. 3) at a typical kinetic-freezeout temperature of T_{kin}=110 MeV and chemical-freezeout temperature T_{ch}=160 MeV, respectively. An important point is that the hydrodynamic evolution of the system is much more tightly constrained than if only light hadron data at T_{kin} are fitted. The thus constructed bulk-matter evolution model can be used as a realistic background medium in the exploration of heavy-flavor and electromagnetic probes of the quark-gluon plasma.

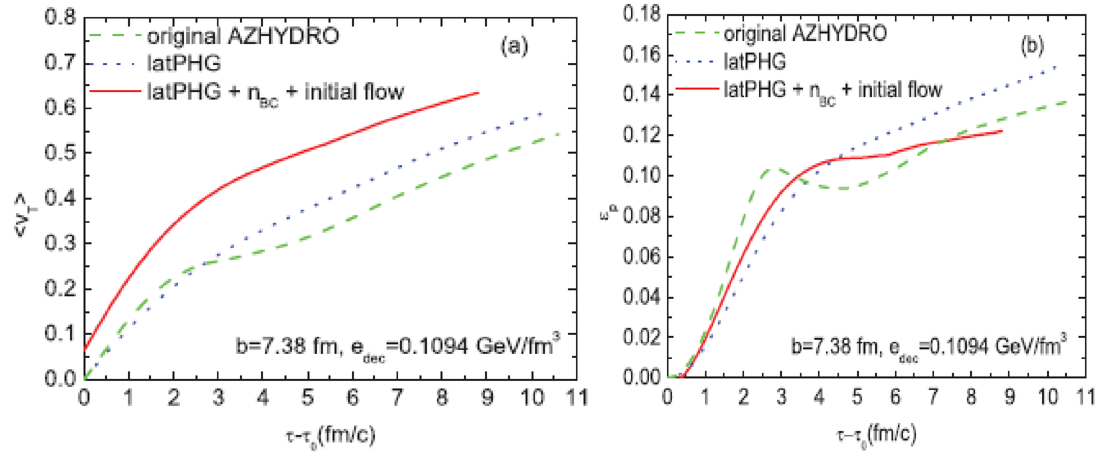

FIG. 2. (a) Proper-time evolution of the average transverse radial velocity for different hydrodynamics scenarios: default AZHYDRO with EoS-99 (green dashed curve), default AZHYDRO with the new EOS (blue dotted curve), and the new EoS with initial flow and compact initial density profile (red solid curve). (b) The same comparison for the time evolution of the energy-momentum anisotropy.

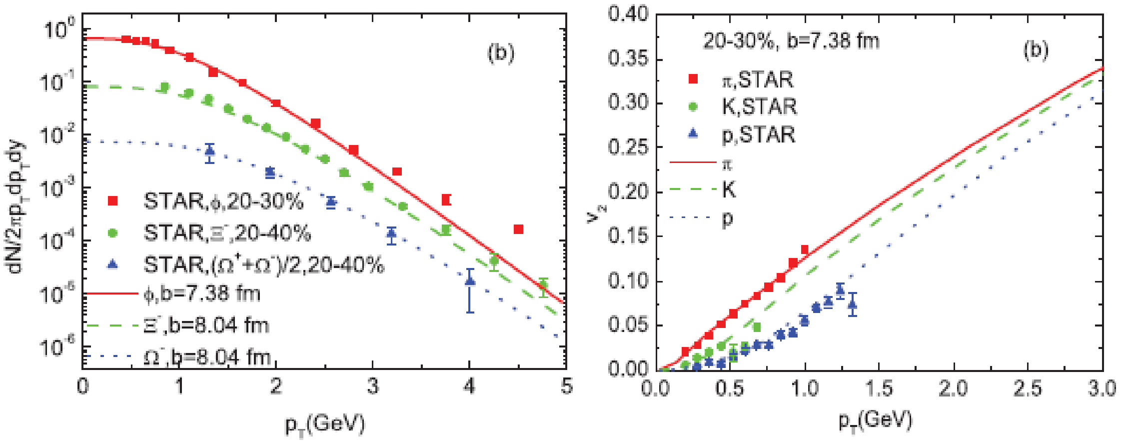

FIG. 3. Multistrange hadron transverse-momentum spectra (left panel) at T_{ch}=160 MeV and light hadron elliptic flow (right panel) at T_{kin}=110 MeV.

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