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Directed Flow and Freeze-Out in Microscopic Models in A+A Collisions at BES-FAIR-NICA energies

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Rapidity, transverse momentum, and centrality dependencies of directed flow of identified hadrons in heavy-ion collisions at BES-FAIR-NICA energies are studied within the microscopic transport string models (UrQMD, DCM, QGSM) and 3-fluid hydrodynamic model (3FD). Both micro- and macroscopic models indicate changing of the sign of proton directed flow at midrapidity from antiflow to normal flow with decreasing energy of collisions. The origin of this effect in transport models is traced to hadron rescattering in baryon-rich remnants of the colliding nuclei, i.e. one has to take into account the influence of spectators at intermediate energies. To distinguish the effect of rescattering from the flow softening caused by creation of quark-gluon plasma we should compare heavy-ion and light-ion collisions at the same energy. Directed flows of main hadron species at midrapidity are formed within $t = 10 - 12$\,fm/c. The differences in the development of v1 of mesons and baryons can be explained by dissimilar freeze-out conditions, thus suggesting simultaneous study of particle collective flow and freeze-out.

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