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Directed flow and early thermalization

For the first time, the generation of the directed flow of particles emitted from the fireball created in heavy-ion collisions at RHIC is described using a 3+1D hydrodynamical model. The initial fireball density is constructed as a sum of contributions from forward and backward going participants. This asymmetry in the emission from the individual participants leads to a tilt of the source. Our model reproduces the experimentally observed negative directed flow in a wide range of central pseudorapidities and reproduces correctly the scaling of the directed flow when going from Au-Au to Cu-Cu systems [1]. We also propose to measure the thermalization time in the early stage of heavy-ion collisions using the directed flow of particles. We show that the directed flow
is a very sensitive measure of the pressure equilibration in the first fm/c of the evolution. We demonstrate in hydrodynamic calculations that the directed flow is strongly reduced in the presence of even a very short pressure anisotropy. Our calculations show that the system must thermalize fast (<0.25fm/c). This suggests that the matter behaves as a strongly coupled system already at the first stages [2].

[1] P. Bozek and I. Wyskiel, Directed flow in ultrarelativistic heavy-ion collisions, Phys. Rev. C 81 054902 (2010)
[2] P. Bozek and I. Wyskiel-Piekarska, Indications of early thermalization in relativistic heavy-ion collisions, Phys. Rev. C 83 024910 (2011)

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