Review of Recent Results in Heavy Ion Fluid Dynamics

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Fluid dynamical phenomena in high energy heavy ion reactions were predicted in the 1970s and still today these are the most dominant and basic observables. With increasing energy and the reach of QGP the low viscosity of the plasma became apparent both theoretically [1] and experimentally and this brought a new revolution in the fluid dynamical studies. The high energy and low viscosity made it possible to observe fluctuations up to high multipolarity flow harmonics [2]. This is an obvious, direct proof of the low viscosity of QGP. Many aspects of these fluctuations are under intensive study today. The low viscosity opened ways to observe special fluid dynamical turbulent phenomena. These may arise from random fluctuations [3], as well as from the global symmetries of peripheral collisions. At LHC energies the angular momentum of the participant matter can reach $10^6\hbar$, which makes rotation [4] and turbulent instabilities, like the Kelvin-Helmholtz instability [5], possible. Low viscosity ensures that these remain observable at the final freeze-out stages of the collision. This leads to possible new investigations in addition to the standard flow analysis methods. Femtoscopy may also detect rotation and turbulence. The high thermal vorticity makes it possible that particle polarization and orbital rotation reach thermal and mechanical equilibrium [6]. This leads to baryon polarization which, in given directions may be detectable at the LHC. The role of the electromagnetic fields in the hydrodynamical evolution of the plasma is briefly addressed.

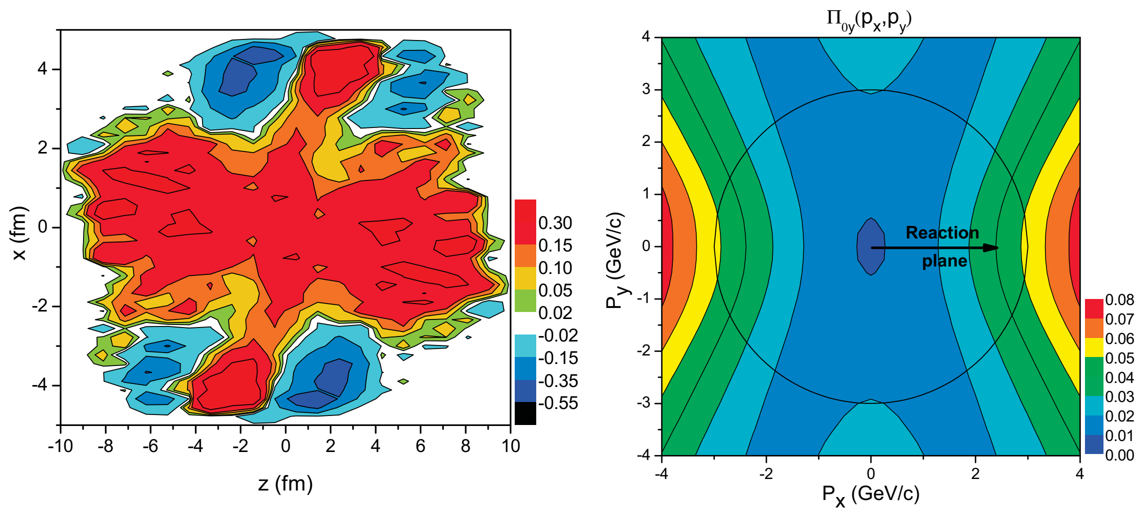

Figure 1: *The thermal vorticity of the flow projected to the reaction plane for a peripheral, LHC Pb+Pb collision at the freeze-out stage in a 3+1D fluid dynamical model (Left). The arising y-component of the polarization of* Λ*s emitted in the reaction plane, showing peaks in the* $\pm x$*-direction [6] (Right).*

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