New formulation of the compressible Navier-Stokes system with degenerate viscosity coefficient and the highly compressible limit

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Abstract

In this talk, we will study the highly compressible regime for global weak solution of Navier-Stokes equations with degenerate viscosity coefficient (it means when the Mach Number ϵ goes to $+\infty$). To do this we will propose a new formulation of compressible Navier-Stokes equations by introducing a suitable effective velocity v such that the system becomes parabolic on the density ρ and curlv and hyperbolic on divv. It allows us in particular to prove the existence of global strong solution with large initial data in one dimension for the viscous shallow water system. In a second time, we will show that for particular choice on the viscosity coefficients the solution of compressible Navier-Stokes equation converges to solution of the pressureless system when ϵ goes to $+\infty$. This limit solution is related to the fast diffusion, heat or porous medium equation, indeed the limit density ρ verifies these equations following the choice of the viscosity coefficients. We will particularly focus on the case of initial density with compact support, indeed "the speed of propagation" is finite for porous medium equation. Roughly speaking we will observe that the main part of the mass corresponding to solution ρ_ϵ is located in the support of the solution of the porous medium equation (which is compact). The mass outside of this support tends to be small in terms of $1/\epsilon$.

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