**Viscous compressible Navier-Stokes-(Fourier) system coupled to the radiative transfer equation**

We consider relativistic and "semi-relativistic" models of radiative viscous compressible Navier-Stokes-(Fourier) system coupled to the radiative transfer equation extending the classical model introduced in [2]. We concentrate on the problem of existence of weak solution of the problem. Secondly we will study some of its singular limits (low Mach and diffusion) in the case of well-prepared initial data and Dirichlet boundary condition for the velocity field. In the low Mach number case we prove the convergence toward the incompressible Navier-Stokes system coupled to a system of two stationary transport equations see [3]. Moreover, in the diffusion case we prove the convergence toward the compressible Navier-Stokes with modified state functions (equilibrium case) or toward the compressible Navier-Stokes coupled to a diffusion equation (non equilibrium case), see [4, 5].

**Motion of viscous compressible fluids in time dependent domains**

Second subject we consider the problem of the motion of compressible fluids in domain with varying boundary. We focus on the existence of weak solution and the singular limit in the low Mach number regime, [6, 7].

**Motion of rigid body in viscous fluid**

We shall consider the problem of the motion of a rigid body in an incompressible viscous fluid filling a bounded domain.This problem was studied by several authors. They mostly considered classical non-slip boundary conditions, which gave them very paradoxical result of no collisions of the body with the boundary of the domain. Only recently there are results when the Navier type of boundary are considered.

In our lecture we shall consider the Navier condition on the boundary of the body and the non-slip condition on the boundary of the domain. This case admits collisions of the body with the boundary of the domain. We shall prove the global existence of weak solution of the problem, [1]

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