ON THE DYNAMICS OF VISCOUS COMPRESSIBLE FLUIDS

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The goal of this lecture series is to discuss the main ingredients of the mathematical theory describing the time evolution of a viscous, compressible, and heat conducting fluid. The principal topics can be specified as follows:

- A suitable *variational formulation* of the problem based on the second law of thermodynamics and the integral representation of balance laws.
- The *structural hypotheses* imposed through *constitutive equations* motivated by the behavior of *real fluids*.
- *A priori estimates* resulting from boundedness of the inital total energy and the initial total entropy of the system.
- Estimates ensuring *equi-integrability*, or weak L^1-compactness, of all densities and fluxes appearing in the corresponding balance laws.
- A rigorous justification of the *weak sequential stability* of the set of all variational solutions.

The main applications include:

- A rigorous existence theory for the full *Navier-Stokes-Fourier system* for any finite energy and finite entropy data.
- A complete description of the *long-time behavior* of solutions for the problem with conservative boundary conditions.
- Applications in the theory of gaseous stars in astrophysics.