International conference on the recent progress of the fluid mechanics and related models

Beijing Institute of Technology
December 10th and 11th 2024

Organizers: Dongfen Bian and Emmanuel Grenier

December 10th

9:00 – 9:55 Yan Guo (Brown University)

Stability of Contact Lines

10:00 – 10:55 Yasuroni Maekawa (Kyoto University).

Local rigidity of the Couette flow for the stationary triple-deck equations

11:00 – 11:55 Xuecheng Wang (Tsinghua University)

Global solution of 2D hyperbolic liquid crystal system for small initial data

2:00 – 2:55 Tong Yang (Wuhan University)

An Approach to study compressible flow with strong boundary layer

3:00 – 3:55 Didier Bresch (Université de Savoie)

Compressible viscous flows and rheology

4:00-4:10 Break

4:10 – 5:05 David Gérard-Varet (Université de Paris)

Mathematical study of suspensions of non-spherical particles

5:10 – 6:05 Frédéric Charve (Université G. Eiffel, Paris)

New asymptotics for the strong solutions of the strongly stratified Boussinesq system with ill-prepared initial data

December 11

9:00 – 9:55 Benoit Pausader (Brown University)

Asymptotic for the Vlasov-Poisson in a convex domain.

10:00 – 10:55 Zhouping Xin (The Chinese University of Hong Kong)

On the Prandtl's Boundary Layer Theory for Steady Sink-Type Flows

11:00 – 11:55 Quoc Hung Nguyen (Chinese Academy of Sciences)

Nonlinear Landau damping for the Vlasov-Poisson system

Zoom link

Zoom: 860 7579 2575
Password: 241210

Abstracts

Didier Bresch

In this talk I will discuss recent mathematical results related to well posedness for different PDEs. Related to compressible viscous flows depending on the viscous stress tensors.

Frédéric Charve

It is known that when the Froude number ε tends towards zero, the solutions of the strongly stratified Boussinesq system tend towards those of a two-component Navier-Stokes system (but dependent on the three space variables). Surprisingly this limit system does not depend on the thermal diffusivity $\nu > 0$. In a previous work we obtained, for unconventional initial data, and in the framework of weak solutions, a general limit system dependent on all parameters: the two-component 3D Navier-Stokes system coupled with a heat equation in the vertical variable.
In this talk we focus on the same limit for strong solutions with unconventional and ill-prepared initial data. We manage to obtain global solutions when the Froude number is sufficiently small, as well as estimates (explicit in the small parameter ε) of convergence rates. These results can also be rewritten as an asymptotic expansion around explicit particular solutions for the classical Boussinesq system.

David Gérard-Varet

A popular model for suspensions of non-spherical particles in fluids is the so-called Doi model, which couples a Stokes equation for the fluid velocity $u(t,x)$ together with a transport equation for the distribution of particles in space and orientation $f(t,x,p)$. The Doi model comes from a formal mean-field limit of a system of particles interacting inside a Stokes flow. We will show in this talk that this formal limit is not accurate and will rigorously derive a correction to the model, under natural assumptions on the initial distribution of the particles. This is joint work with R. Höfer (Regensburg university).

Yan Guo

Dynamic of contact lines (e.g. where coffee meets the coffee cup) is important and challenging topic from both physical and mathematical standpoints, which is a basic PDE problem whenever a free surface meets a solid wall. We review recent progress in the study of dynamical stability of contact lines.

Yasunori Maekawa

The Triple-Deck equations are a classical boundary layer model which describes the asymptotics of a viscous flow near the separation point, and the Couette flow is an exact stationary solution to the Triple-Deck equations. In this talk we prove the local rigidity of the Couette flow in the sense that there are no other stationary solutions near the Couette flow in a scale invariant space. This provides a stark contrast to the well-studied stationary Prandtl counterpart, and in particular offers a first result towards the rigidity question raised by R. E. Meyer in 1983. This talk is based on a joint work with Sameer Iyer (University of California, Davis).

Quoc-Hung Nguyen

In this talk, I will present recent advances in the study of nonlinear Landau damping for the Vlasov-Poisson (VP) system, focusing on the asymptotic stability of the Poisson equilibrium under small perturbations. Building on the foundational work of Ionescu, Pausader, Wang, and Widmayer, I will introduce a new proof of nonlinear Landau damping for the 3D unscreened VP system. Our approach combines sharp decay estimates with novel decomposition techniques to demonstrate the stabilization of the particle distribution and the decay of the electric field. These results highlight the free transport-like behavior of the perturbed density and provide deeper insights into the mechanisms of Landau damping in an unconfined setting near stable equilibria.

Benoit Pausader

We consider the Vlasov-Poisson system for plasma physics in a convex, infinite domain. If the solution is a small perturbation of vacuum, we show that solutions are global and describe their asymptotic behaviour in terms of modified scattering. A novelty is the understanding of the asymptotic unknowns. This is a joint work with W. Huang (Brown) and M. Suzuki (NagoyaTech).

Xuecheng Wang

In this talk, we discuss the global stability of small perturbation near the constant equilibrium for the two-dimensional simplified Ericksen-Leslie's hyperbolic system for incompressible liquid crystal model, where the direction function of liquid crystal molecules satisfies a wave map equation with an acoustical metric. The main ingredient is that we uncover a null structure inside the velocity equation on the Fourier side for the nonlinear interaction between nonlinear heat equation and nonlinear wave equation.

Zhouping Xin

In this talk, I will present some results on the large Reynolds number limits and asymptotic behaviors of solutions to the steady incompressible Navier-Stokes equations in two-dimensional infinitely long convergent nozzles. The main results show that the Prandtl's laminar boundary layer theory can be rigorously established and the sink-type Euler flow superposed with a self-similar Prandtl's boundary layer flow is shown to be uniformly structurally stable as long as the viscous flow has a given negative mass flus and the boundaries of the nozzle satisfy a curvature decreasing condition. Furthermore, the asymptotic behaviors of the solutions at both the vertex and infinity can be determined uniquely which plays a key role in the stability analysis. Some of key ideas in the theory will be discussed. This talk is based on a joint work with Dr. Chen Gao.

Tong Yang

It is a classical problem in fluid dynamics about the stability and instability of different hydrodynamic patterns in various physical settings, especially in the high Reynolds number limit of laminar flow with boundary effect. In this talk, after reviewing the background and some recent main progress on boundary layer theory, we will present a new approach introduced by Yang-Zhu to study the compressible fluid both on the instability analysis for unsteady flow and high Reynolds number limit for steady problem. The talk is based on some recent joint work with Shengxin Li and Zhu Zhang.