Week 3 (Sep.25-Sep.29)

Topic: Compressible Navier-Stokes Equations

Workshop Room: Room 2201, Guanghua East Building, Fudan University

Lecture Series Speakers: Hailiang Li (Capital Normal University)
Zhouping Xin (The Chinese University of Hong Kong)

Invited Speakers: Hua Chen (Wuhan University)
Bin Han (Hangzhou Dianzi University)
Xiangdi Huang (AMSS)
Jinkai Li (Chinese University of Hong Kong)
Chao Wang (Peking University)
Yi Wang (Chinese Academy of Sciences)

Organizing Committee:

Peter Constantin (Princeton University)
Yoshikazu Giga (University of Tokyo)
Hao Jia (University of Chicago)
Carlos Kenig (University of Chicago)
Zhen Lei (Fudan University)
Fanghua Lin (Courant Institute of Mathematical Sciences)
Gregory Seregin (University of Oxford)
Vladimir Sverak (University of Minnesota)
Edriss Titi (Texas A & M University)
Sijue Wu (University of Michigan)

Sponsored by

Shanghai Center for Mathematical Sciences
School of Mathematical Sciences, Fudan University

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Schedule

2017 Fall Program on Analysis of PDE (Sept. 11 – Dec. 2, 2017)

Week 3 (Sept.25-Sept.29)	
Topic: Compressible Navier-Stokes Equations	
Monday (September 25)	**Room 2201, Guanghua East Building, Fudan University**
Morning Session	
9:30 – 9:35	Chair：Fanghua Lin
9:35 – 10:25	Zhouping Xin
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair：Fanghua Lin
10:50 – 11:40	Zhouping Xin
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: Zhouping Xin -
14:35 – 15:25	Hailiang Li
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair：-
15:50 – 16:40	Free
Tuesday (September 26)	**Room 2201, Guanghua East Building, Fudan University**
Morning Session	
9:30 – 9:35	Chair：Zhen Lei
9:35 – 10:25	Zhouping Xin
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair：Zhen Lei
10:50 – 11:40	Zhouping Xin
Lunch Break	

Afternoon Session	
14:30 – 14:35	Chair: Zhouping Xin
14:35 – 15:25	Hailiang Li
15:25 – 15:45	Tea Break
Group Photo	**15:45 – 16:00**
16:00 – 16:05	Chair：-
16:05 – 16:55	Free
Wednesday (September 27)	**Room 2201, Guanghua East Building, Fudan University**
Morning Session	
9:30 – 9:35	Chair：Hailiang Li
9:35 – 10:25	Zhouping Xin
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair：Zhouping Xin
10:50 – 11:40	Hailiang Li
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: -
14:35 – 15:25	Free
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair：-
15:50 – 16:40	Free
Thursday (September 28)	**Room 2201, Guanghua East Building, Fudan University**
Morning Session	
9:30 – 9:35	Chair：Bobo Hua
9:35 – 10:25	Hua Chen
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair：Hua Chen
10:50 – 11:40	Hailiang Li
Lunch Break	

Afternoon Session	
14:30 – 14:35	Chair: Hailiang Li
14:35 – 15:25	Bin Han
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair：Hailiang Li
15:50 – 16:40	Xiangdi Huang
Friday (September 29) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair：Hao Wu
9:35 – 10:25	Yi Wang
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair：Yi Wang
10:50 – 11:40	Chao Wang
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: Zhouping Xin
14:35 – 15:25	Jinkai Li
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair：-
15:50 – 16:40	Free

2017 Fall Program on Analysis of PDE

Week 3 (Sep.25-Sep.29)

Topic: Compressible Navier-Stokes Equations

Titles and Abstracts:

Speaker: Hua Chen
Title: Asymptotic behavior and blow-up of solutions for infinitely degenerate nonlinear parabolic equations
Abstract: In this talk, we shall report some results on initial-boundary value problem for infinitely degenerate semi-linear parabolic equations with logarithmic nonlinearity. Using potential well method, we shall first prove the invariance of some sets and vacuum isolating of solutions. Then, by the Galerkin method and the logarithmic Sobolev inequality, we obtain the global existence and blow-up at $+\infty$ of solutions with low initial energy or critical initial energy. Also, we discuss the results on asymptotic behavior of the solutions.

Speaker: Bin Han
Title: Global well-posedness for compressible viscoelastic fluids with a class of large initial data
Abstract: This work is concerned with the global well-posedness for the compressible viscoelastic fluids with a class of large initial data in the whole space $\Real^d (d\geq2)$. The proof of the global well-posedness relies on dispersive estimates of the linearized hyperbolic system and the uniform energy estimate of the hyperbolic-parabolic system. By using the frequency decomposition, we get that the compressible viscoelastic fluids admits a unique global solution with the large initial data in the sense of critical framework.

Speaker: Hailiang Li
Title: Some aspects of kinetic equations and related topics
Abstract: In these talks, we shall review the recent analysis on the spectral analysis and the time asymptotical behaviors of global solutions for some kinetic equations of Vlasov type coupled with macroscopic effects, including Vlasov-Poisson(Maxwell)-Boltzmann equations, Vlasov-Navier-Stokes(Euler)-Fokker-Planck equations. Fianlly, we discuss the non-existence of finite energy solutions to compressible Navier-Stokes equations.

Speaker: Chao Wang
Title: Global stability of large solutions to the 3D compressible Navier-Stokes equations
Abstract: In this talk, I will talk about the global dynamics and strong stability of the compressible Navier-Stokes equation in the whole space. Suppose that the density is away from vaccum and bounded in any Holder space. Then we get the propagation of the regularity and the convergence to the equilibrium. More precisely, we obtain the uniform bounds for the regularity of the solution for all time and the explicit rate of the convergence to the associated equilibrium which is as the same as that for the incompressible Navier-Stokes equations. Also, we prove that any smooth and bounded solution to the CNS equations is stable, i.e., any small perturbation for a reference solution initially will generate a global solution to the equations and these two solutions will keep close to each other for all time. We remark that the perturbation is performed in L^p type critical spaces. It shows that the

set of the smooth and bounded solutions is an open set. This work is joint with J. Huang and L. He.

Speaker: Yi Wang

Title: Vanishing viscosity limit of the compressible Navier-Stokes equation to Euler equations in the settings of Riemann solutions

Abstract: I will talk about the recent progress on the vanishing viscosity limit of the compressible Navier-Stokes equation to Euler equations in the settings of 1D Riemann solutions, which includes the generic superposition of three basic wave patterns, shock and rarefaction waves and contact discontinuities, and the case of the rarefaction wave connecting the vacuum states continuously.

Speaker: Zhouping Xin

Title: Compressible Navier-Stokes Equations and Vacuum Dynamics

Abstract: The evolution of vacuum states is important not only in physical problems such as motions of gaseous stars, but also in the theory of well-posedness of solutions to the multi-dimensional compressible Navier-Stokes systems (or Euler systems). Due to the degeneracies and singularities in the presence of vacuum, there are many rich phenomena and challenging problems to be investigated. Many fundamental questions remain open, such as the validity of the Navier-Stokes models in the presence of vacuum; can vacuum state arise in finite time from non-vacuum data? The propagation of the so called physical vacuum; and qualitative behaviors of viscous (or ideal) fluids in the presence of vacuum, etc.

The goal of this short course is to give a brief introduction to the recent progress in the studies along these directions. We will try to illustrate some basic difficulties and new ideas involved in the recent main progress. As time allows, we will cover the following topics:

(1) Survey of the theory of small-amplitude non-vacuum smooth solutions and the existence theory of P. L. Lion’s weak solutions to multi-dimensional compressible isentropic Navier-Stokes systems.

(2) Finite-time blow-up of classical solutions to the full multi-dimensional compressible Navier-Stokes system for a class of data with vacuum.

(3) Global in time existence of smooth solutions to the multi-dimensional isentropic compressible Navier-Stokes system with possible large oscillations and vacuum.

(4) On the expanding of gases into vacuum with/or without self-gravitation, and nonlinear asymptotic stability of Lane-Emden solutions for the viscous gaseous star motions.

(5) Studies of the compressible Navier-Stokes systems with density-dependent viscosities.

(6) Open problems.

Speaker: Xiangdi Huang

Title: Global large solutions of two-dimensional barotropic compressible Navier-Stokes equations without size restriction

Abstract: For periodic initial data with density allowed to vanish initially, we establish the global existence of strong and weak solutions to the two-dimensional barotropic compressible Navier-Stokes equations with no restrictions on the size of initial data as long the shear viscosity is a positive constant and the bulk one is only the function of density with suitable structure condition.

Moreover, we also prove that the densities for both strong and weak solutions remains bounded from above independently of time. As a consequence, it is shown that both the strong and weak solutions converge to the equilibrium state as time tends to infinity.

Speaker: Jinkai Li

Title: Entropy-bounded solutions of the compressible Navier-Stokes equations with far field vacuum

Abstract: The entropy is one of the fundamental states of a fluid. In spite of its physical importance in the gas dynamics, the mathematical analysis on it in the presence of vacuum was rarely carried out. As the entropy is expressed as some combination of the logarithems of the temperature and the density, the entropy is not even well defined in the vacuum region, and the regularities of the temperature and density do not imply any desired uniform regularities of the entropy near the vacuum region from the non-vacuum side. It has been known that classical solutions to the full compressible Navier-Stokes equations may blow up in finite time, and may have no solutions in the class of inhomogeneous Sobolev space, if the initial density has nontrivial compact support. Different from the compact supported case, in this talk, we will show that the one-dimensional full compressible Navier-Stokes equations are globally well-posed in the inhomogenesous Sobolev spaces, and the corresponding entropy can be uniformly bounded from both above and below, if the initial density has no interior vacuum, but decays to vacuum slowly at the far field.

Participants:

Dongfen Bian (Beijing Institute of Technology)
Yuan Cai (Fudan University)
Hua Chen (Wuhan University)
Tuowei Chen (Fudan University)
Xiufang Cui (Fudan University)
Bin Han (Hangzhou Dianzi University)
Bobo Hua (Fudan University)
Xiangdi Huang (AMSS)
Zhentao Jin (Fudan University)
Zhen Lei (Fudan University)
Hailiang Li (Capital Normal University)
Jinkai Li (Chinese University of Hong Kong)
Fanghua Lin (Courant Institute)
Junren Luo (Fudan University)
Xiang Luo (University of Science and Technology of China)
Jianzhong Min (Fudan University)
Yun Pu (Fudan University)
Aifang Qu (Shanghai Normal University)
Peng Qu (Fudan University)
Jiawei Sun (Capital Normal University)
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Na Zhao (Fudan University)
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