

Week 6 (Oct.16-Oct.20)

Topic: Free Boundary Problems

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

Lecture Series Speakers: Sijue Wu (University of Michigan)

Andrej Zlatos (UC San Diego)

Invited Speakers:

Chengjie Liu (Shanghai Jiaotong University)

Yuning Liu (NYU Shanghai)

Shuangjie Peng (Central China Normal University)

Aifang Qu (Wuhan Institute of Physics and Mathematics, CAS)

Jiajun Tong (Courant Institute of Mathematical Sciences)

Wei Wang (Zhejiang University)

Xiaoming Wang (Fudan University & Shanghai Center for Mathematical Sciences)

Yaguang Wang (Shanghai Jiaotong University)

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

For further information, please contact

Ke Han (hanke@fudan.edu.cn)

Zhen Lei (zlei@fudan.edu.cn)

Schedule

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

Week 6 (Oct.16-Oct.20)	
Topic: Free Boundary Problems	
Monday (October 16) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair: Fanghua Lin
9:35 – 10:50	Andrej Zlatos
10:50 – 11:00	Tea Break
11:05 – 11:10	Chair: Fanghua Lin
11:10 – 12:00	Andrej Zlatos
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: Sijue Wu
14:35 – 15:30	Shuangjie Peng
15:30 – 15:50	Tea Break
15:50 – 15:55	Chair: Renjin Jiang
15:55 – 16:50	Sijue Wu
17:00 – 17:50	Sijue Wu
Tuesday (October 17) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair: Andrej Zlatos
9:35 – 10:25	Yaguang Wang
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair: Renjin Jiang
10:50 – 11:40	Andrej Zlatos

Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: Andrej Zlatos
14:35 – 15:35	Sijue Wu
15:45 – 16:45	Sijue Wu
16:45 – 17:10	Tea Break
Group Photo 17:10 – 17:20	
Wednesday (October 18) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair: Fanghua Lin
9:35 – 10:25	Andrej Zlatos
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair: Andrej Zlatos
10:50 – 11:40	Chengjie Liu
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: -
14:35 – 15:25	-
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair: -
15:50 – 16:40	-
Thursday (October 19) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair: Fanghua Lin
9:35 – 10:25	Wei Wang
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair: Wei Wang
10:50 – 11:40	Aifang Qu
Lunch Break	

Afternoon Session	
14:30 – 14:35	Chair: Aifang Qu
14:35 – 15:25	Jiajun Tong
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair: -
15:50 – 16:40	-
Friday (October 20) Room 2201, Guanghua East Building, Fudan University	
Morning Session	
9:30 – 9:35	Chair: Fanghua Lin
9:35 – 10:25	Xiaoming Wang
10:25 – 10:45	Tea Break
10:45 – 10:50	Chair: Xiaoming Wang
10:50 – 11:40	Yuning Liu
Lunch Break	
Afternoon Session	
14:30 – 14:35	Chair: -
14:35 – 15:25	-
15:25 – 15:45	Tea Break
15:45 – 15:50	Chair: -
15:50 – 16:40	-

2017 Fall Program on Analysis of PDE

Week 6 (Oct.16-Oct.20)

Topic: Free Boundary Problems

Titles and Abstracts:

Speaker: Chengjie Liu

Title: Prandtl boundary layer theory for MHD equations in Sobolev spaces without monotonicity

Abstract: In the joint work with Feng Xie and Tong Yang, we study the validity of the Prandtl boundary layer theory for MHD equations in the half plane with no-slip boundary conditions on the velocity vector and the perfect conducting boundary conditions on the magnetic field. In the case that viscosity and magnetic diffusion tend to zero simultaneously, we derive the boundary layer problem and establish the well-posedness result in Sobolev spaces under the assumption of nonzero tangential magnetic field, without any monotonicity assumption on the velocity. Then, when the initial tangential magnetic field of MHD doesn't vanish at the boundary, we justify the validity of corresponding Prandtl boundary layer expansions in the Sobolev framework. This justifies the physical understanding that the magnetic field has a stabilizing effect on MHD boundary layer in rigorous mathematics.

Speaker: Yuning Liu

Title: Sharp Interface Limits for Diffuse Interface Models

Abstract: We consider the mathematical relation between diffuse interface and sharp interface models for the flow of two viscous, incompressible Newtonian fluids like oil and water. In diffuse interface models a partial mixing of the macroscopically immiscible fluids on a small length scale $\varepsilon > 0$ is taken into account. These models are capable to describe such two-phase flows beyond the occurrence of topological singularities of the interface due to collision or droplet formation. Both for theoretical and numerical purposes a deeper understanding of the limit $\varepsilon \rightarrow 0$ is of interest. We discuss a rigorous mathematical result on convergence of diffuse interface to sharp interface models in dependence of the scaling. This is a joint work with Helmut Abels in Regensburg university.

Speaker: Shuangjie Peng

Title:

Abstract:

Speaker: Aifang Qu

Title: Three-dimensional steady supersonic Euler flow past a concave cornered wedge with lower pressure at the downstream

Abstract: In this talk, we discuss the stability of the three dimensional jet created by a supersonic flow past a concave cornered wedge with the lower pressure at the downstream. The gas beyond the jet boundary is assumed to be static. It can be formulated as a nonlinear hyperbolic free boundary problem in a cornered domain with two characteristic free boundaries of different type. One is the rarefaction wave, while the other one is the contact discontinuity, which can be either vortex sheet or entropy wave.

Speaker: Jiajun Tong

Title: Solvability of the 2-D Stokes Immersed Boundary Problem

Abstract: In this talk, we consider a 1-D closed elastic string immersed and moving in the 2-D Stokes flow, which features singular forcing supported on a free-moving boundary. We first rewrite the problem into a contour dynamic formulation, which is a nonlinear integral evolution equation in the Lagrangian coordinate solely keeping track of the string configuration. Based on that, we will show its local well-posedness under mild regularity and geometric assumptions on the initial string configuration. When the initial string configuration is sufficiently close to an equilibrium, which is an evenly-parameterized circular configuration, we also show the global well-posedness as well as the exponential convergence of the string configuration to an equilibrium.

Speaker: Wei Wang

Title: On the current-vortex sheet and plasma-vacuum interface problems in ideal incompressible MHD

Abstract: It is well-known that vortex sheets for incompressible Euler equations are not stable (called Kelvin-Helmholtz instability). However, in 1953, Syrovatskij derived a stability condition which indicates that when the magnetic field is sufficiently strong, current-vortex sheets for MHD equations could probably be stable. In this talk, we will talk about the local-in-time existence of the solution for the incompressible current-vortex sheets under Syrovatskij's stability condition, which gives a rigorous confirmation of the stabilizing effect of the magnetic field on the Kelvin-Helmholtz instability. We will also discuss the local existence of the solution to the plasma-vacuum interface problem.

Speaker: Xiaoming Wang

Title: Phase field model for two-phase flow in porous media

Abstract: We discuss the Cahn-Hilliard-Hele-Shaw or the Cahn-Hilliard-Darcy system, a phase field model for two-phase flow in porous media or Hele-Shaw cell. We will cover the derivation, the connection to sharp interface model, the pros and cons of the phase-field approach, the well-posedness, and related numerical issues.

Speaker: Yaguang Wang

Title:

Abstract:

Speaker: Sijue Wu

Title: Water wave theory

Speaker: Andrej Zlatos

Title: Reaction-Diffusion Equations: An Introduction and Recent Advances

Abstract: We will start with a basic introductory lecture to the area of reaction-diffusion equations, which are used to model natural phenomena such as combustion, population dynamics, or chemical kinetics. In the following three lectures we will discuss some recent work on long-time dynamics of reactions propagating in heterogeneous media in one and several dimensions, including homogenization results in random media.

Participants:

Yuan Cai (Fudan University)
Tuowei Chen (Fudan University)
Xiufang Cui (Fudan University)
Hongjie Dong (Brown University)
Bobo Hua (Fudan University)
Renjin Jiang (Center for Applied Mathematics of Tianjin University)
Zhentao Jin (Fudan University)
Hui Li (Peking University)
Zhen Lei (Fudan University)
Zongyuan Li (Brown University)
Fanghua Lin (Courant Institute)
Chengjie Liu (Shanghai Jiaotong University)
Yuning Liu (NYU Shanghai)
Junren Luo (Fudan University)
Shuangjie Peng (Central China Normal University)
Yun Pu (Fudan University)
Aifang Qu (Wuhan Institute of Physics and Mathematics, CAS)
Peng Qu (Fudan University)
Jiajun Tong (Courant Institute)
Chenmu Wang (Fudan University)
Kunrui Wang (Brown University)
Wei Wang (Zhejiang University)
Xiaoming Wang (Fudan University & Shanghai Center for Mathematical Sciences)
Xuecheng Wang (Princeton University)
Yaguang Wang (Shanghai Jiaotong University)
Yanyan Wang (Fudan University)
Hao Wu (Fudan University)
Sijue Wu (University of Michigan)
Xiaochun Wu (Fudan University)
Yifei Wu (Center for Applied Mathematics of Tianjin University)

Meng Yuan (Nanjing University)
Jing Zhang (Fudan University)
Lan Zhang (Wuhan University)
Na Zhao (Fudan University)
Dengkun Zheng (Peking University)
Yi Zhou (Fudan University)
Andrej Zlatos (UC San Diego)