华南数学应用与交叉研究中心
South China Research Center for Applied Mathematics and Interdisciplinary Studies

CAMIS-SCNU
Conference

偏微分方程的理论、数值方法及其应用国际学术会议

International Conference on Partial Differential Equations: Theories, Numerics and Applications

Conference Brochure

会议手册

South China Research Center for Applied Mathematics
and Interdisciplinary Studies (CAMIS), South China Normal University
华南师范大学华南数学应用与交叉研究中心

Guangzhou, China
November 18-23, 2018

Address: Zhong Shan Avenue West 55, Tianhe District, Guangzhou 510631, China
地址：广东省广州市天河区中山大道西55号 邮编：510631
Website: http://camis.scnu.edu.cn/

Contents

1. Information for Participants

1.1 Address

（1） **Conference Address:** South China Research Center for Applied Mathematics and Interdisciplinary Studies (CAMIS), South China Normal University, Zhong Shan Avenue West 55, Guangzhou 510631, China
会议地址：广东省广州市天河区中山大道西 55 号华南师范大学 邮编：510631

（2） **Hotel address:** No.69 Zhongshan Avenue West, Tianhe District, Guangzhou 510631,China

酒店地址： 广东省广州市天河区中山大道西 69 号华师大厦 邮编：510631

1.2 Travel Information

Guangzhou Baiyun International Airport—Huashi Hotel (华师大厦)

(1) **Taxi** (**Suggest**): Guangzhou Baiyun International Airport -- Airport Avenue -- Guangzhou Airport Expressway -- South China Expressway -- Zhongshan Avenue West – Huashi Hotel（华师大厦）
Distance: 43km Time: about 42 minutes **Fare: about RMB￥150**

(see Map-1.1)

(2) **Airport Bus** (Line 2B): Gate A4 station at Baiyun Airport A area arrival hall / Gate B11 station at Baiyun Airport B area arrival hall -- Huashi Hotel（华师大厦）
Distance: 43km Time: about 50 minutes **Fare: RMB￥24**

(see Map-1.1)

(3) **Metro**: Guangzhou Baiyun International Airport (633 meters walk) -- North extension of Metro Line 3 (Direction of Tiyu Xilu) -- Tiyu Xilu (14 stations) -- Transfer Line 3 (Direction of Tianhe Coach Terminal) -- Exit E of Huashi (3 stations) -- South China Normal University (300 meters)
Distance: 37km Time: about 1.5hours **Fare: RMB￥8**

(see Map-1.2)

(1) **出租车（建议）：**广州白云国际机场——机场大道——广州机场高速——华南快速干线——中山大道西——华南师范大学

距离：43 公里　　时间：42 分钟　　费用：约 150 元

(2) **机场快线（空港快线 2b 线 华师大厦酒店方向）：**广州白云国际机场 A 区到达大厅 A4 号门——B 区到达大厅 B11 号门——华师大厦

距离：43 公里　　时间：50 分钟　　费用：24 元

(3) **地铁：**广州白云国际机场（步行 633 米）——地铁 3 号线北延段（体育西路方向）——体育西路（14 站）——同站换乘 3 号线（天河客运站方向）——华师（3 站）E 出口——华南数学应用与交叉研究中心（300 米）

距离：37 公里　　时间：1.5 小时　　票价：8 元

1.3 Map

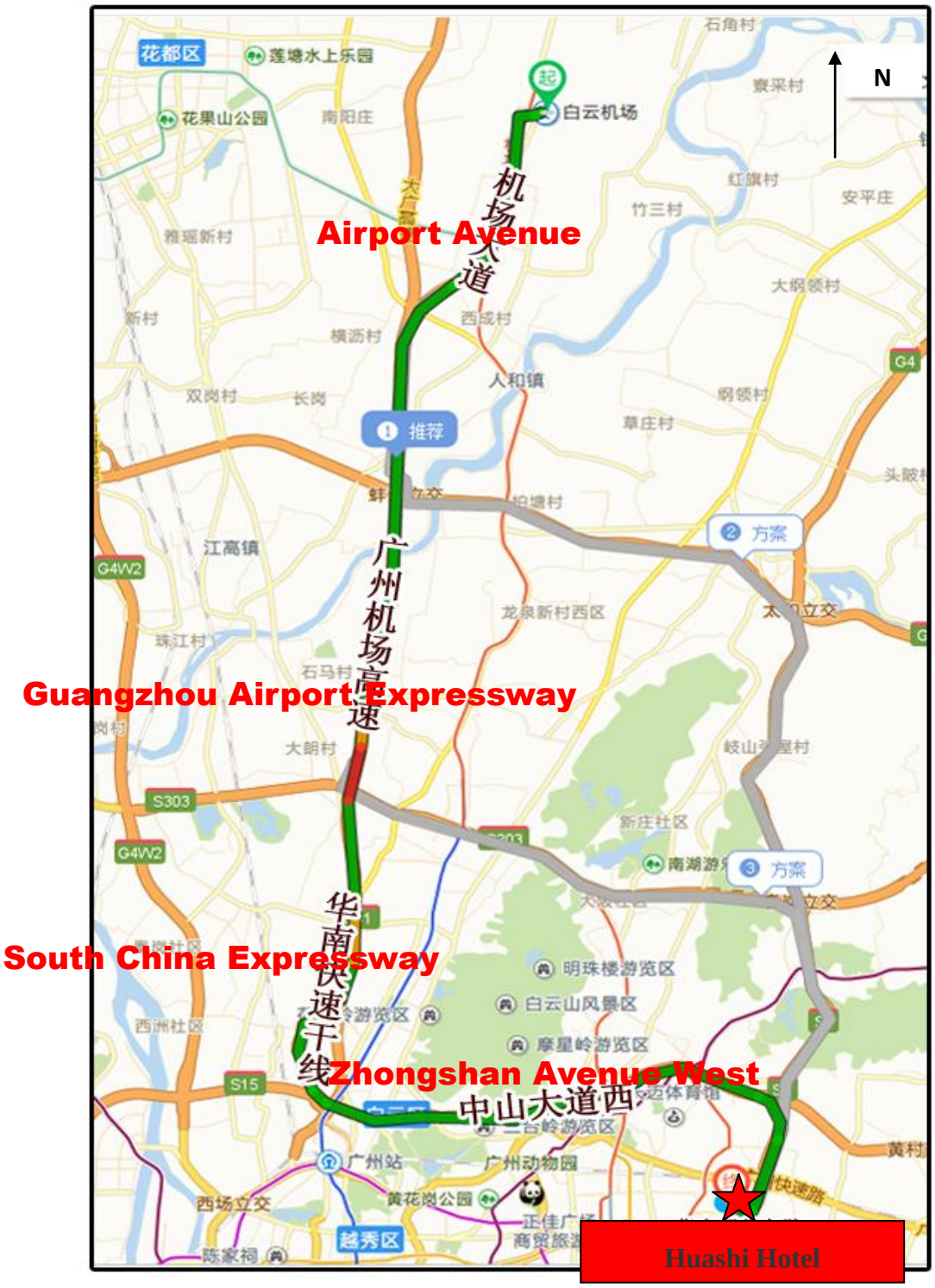
(1) Guangzhou Baiyun International Airport—Huashi Hotel(华师大厦)

①If you take taxi or airport bus please see Map-1.1

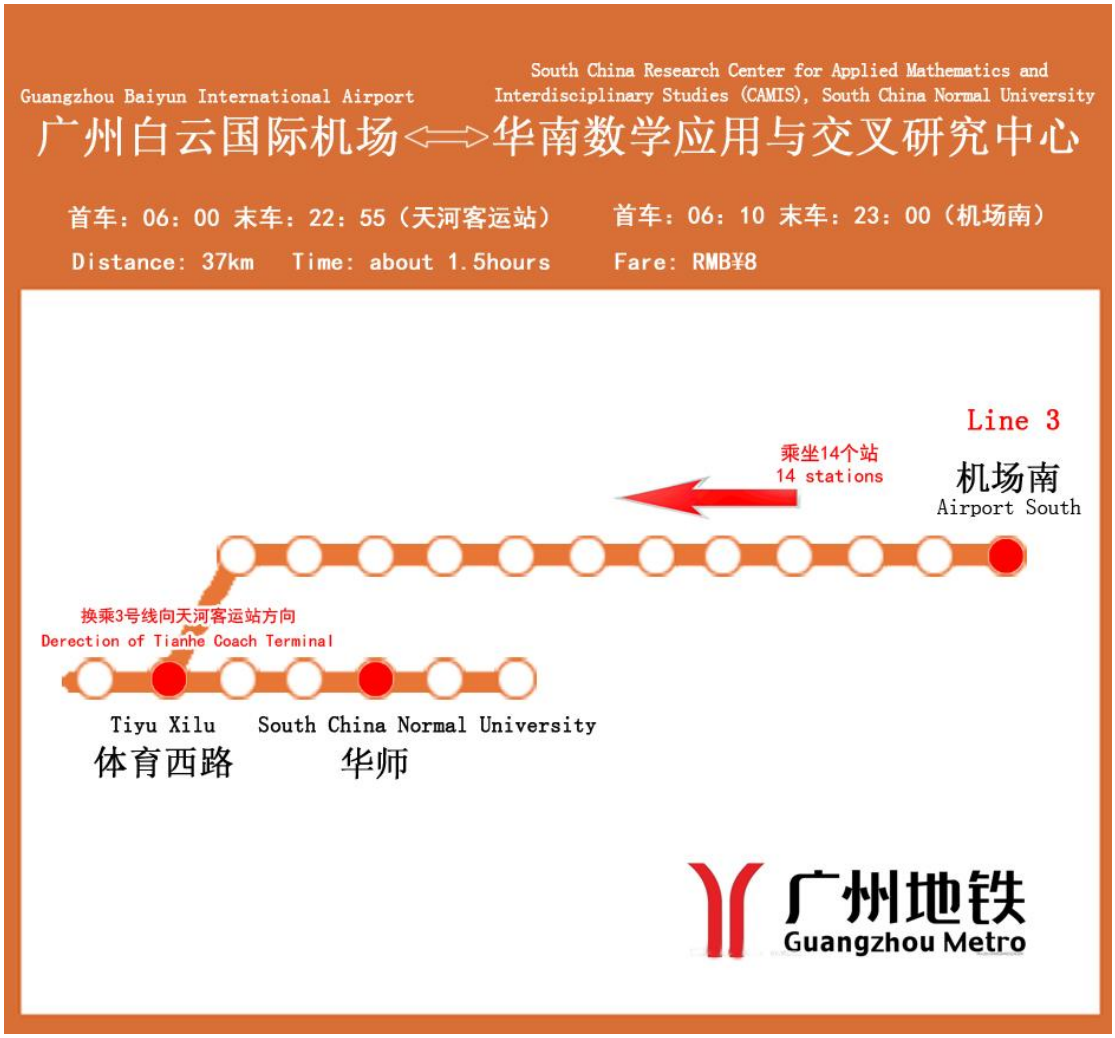
②If you take metro please see Map-1.2

(2) Huashi Hotel(华师大厦) —South China Research Center for Applied Mathematics and Interdisciplinary Studies (CAMIS)

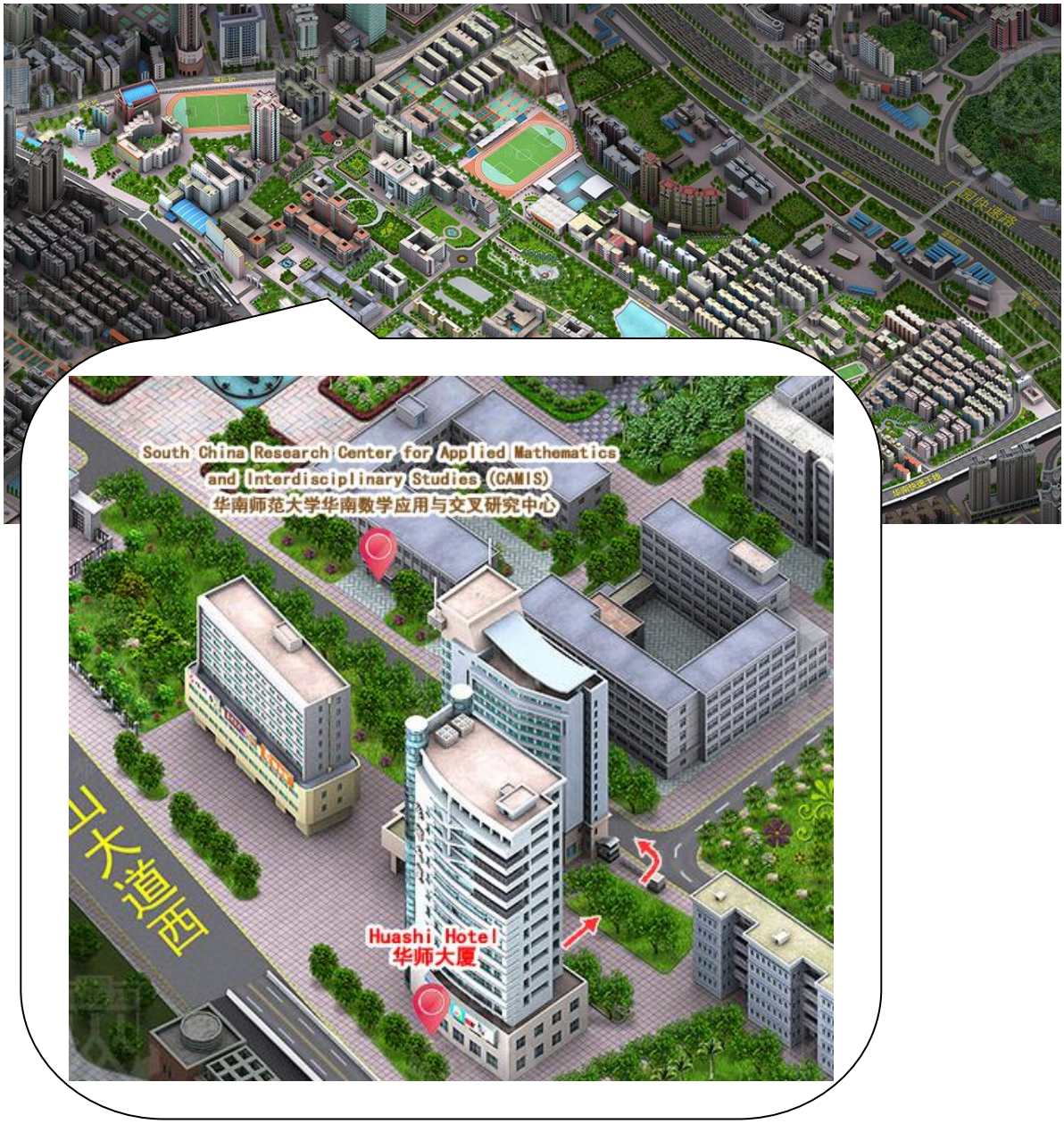
Please see campus map Map-1.3


Airport Avenue
Guangzhou Airport Expressway
South China Expressway
Zhongshan Avenue West
Huashi Hotel
N
花都区
白云机场
机场大道
广州机场高速
华南快速干线
中山大道西
推荐
方案
方案
江高镇
人和镇
广州站
广州动物园
越秀区
S303
S15
G4W2
G4

Map-1.1


Guangzhou Baiyun International Airport
South China Research Center for Applied Mathematics and Interdisciplinary Studies (CAMIS), South China Normal University
广州白云国际机场⟺华南数学应用与交叉研究中心
首车：06：00 末车：22：55（天河客运站）
首车：06：10 末车：23：00（机场南）
Distance: 37km Time: about 1.5hours Fare: RMB¥8
Line 3
乘坐14个站
14 stations
机场南
Airport South
换乘3号线向天河客运站方向
Derection of Tianhe Coach Terminal
Tiyu Xilu
体育西路
South China Normal University
华师
广州地铁
Guangzhou Metro

Map-1.2


South China Research Center for Applied Mathematics
and Interdisciplinary Studies (CAMIS)
华南师范大学华南数学应用与交叉研究中心
Huashi Hotel
华师大厦

Map-1.3

1.4 Notes

(1) Registration: Huashi Hotel 华师大厦酒店 (150 meters from CAMIS)

(2) Accommodation: Huashi Hotel 华师大厦酒店

(3) Meals: Huashi Hotel 华师大厦酒店

Tel: 020-85216888 020-85217223

(4) Telephone helplines:

①Health Center: 020-85211120

②Security Office: 020-85211100

③Contact the CAMIS staffs if necessary:

Qingrong Yang（阳青蓉）: jczx1@m.scnu.edu.cn 15898517230

Wenjing Liang（梁文静）: jczx1@m.scnu.edu.cn 13622866875

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Jinkai Li（李进开）: jklimath@m.scnu.edu.cn 13128801297

Shijin Ding（丁时进）: dingsj@scnu.edu.cn 13650861899

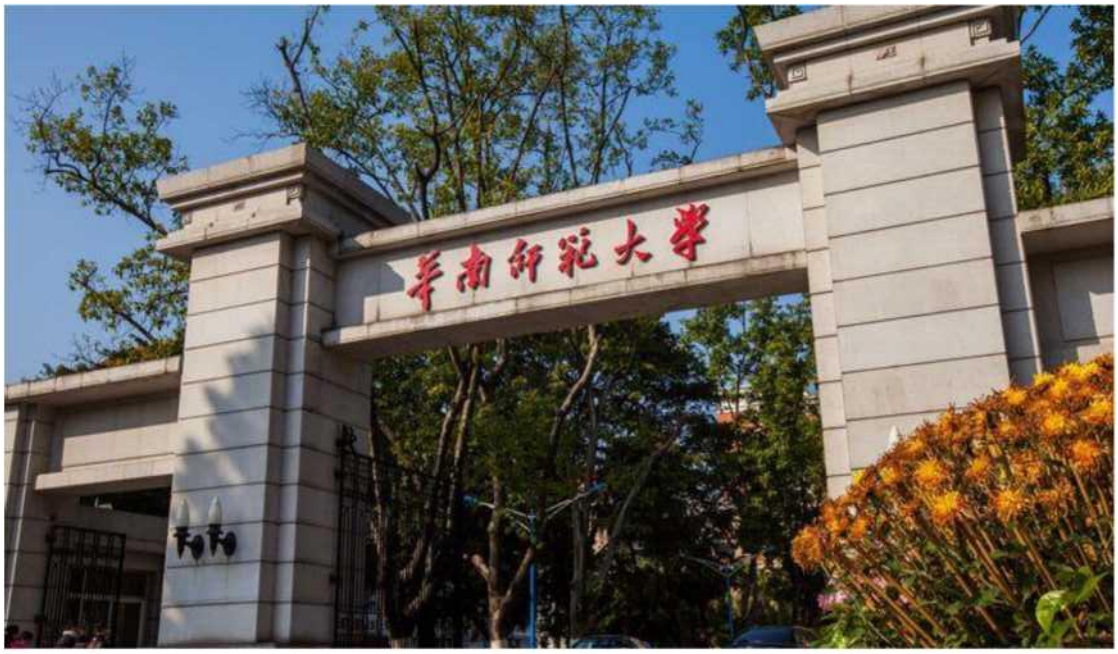
2. Organizing Committee

Zhouping Xin（辛周平）(Chair)，The Chinese University of Hong Kong and South China Normal University

Xiaoping Wang （王筱平）, Hong Kong University of Science and Technology and South China Normal University

Weizhu Bao（包维柱）, National University of Singapore and South China Normal University

Shijin Ding（丁时进）, South China Normal University


华南师范大学


知行荣新


华南数学应用与交叉研究中心


应用数学与交叉科学高端论坛暨华南师范大学华南数学应用
与交叉研究中心成立揭牌仪式 2018年5月11日——5月13日

3. Timetable

International Conference on Partial Differential Equations: Theories, Numerics and Applications Nov.18-23, 2018					
Time	**Monday(Nov.19)**	**Tuesday(Nov.20)**	**Wednesday(Nov.21)**	**Thursday(Nov.22)**	**Friday(Nov.23)**
8:30—8:40	opening ceremony		8:10—9:00**Ping Sheng**		**Departure**
8:40—9:30	**Bjorn Engquist**	**Edriss S. Titi**	9:00—9:50**Lingling Shui**	**Pierangelo Marcati**	
9:30—10:00	Coffee/tea break	Coffee/tea break	9:50—10:20Coffee/tea break	Coffee/tea break	
10:00—10:50	**Xi-Ping Zhu**	**Xiaoming Wang**	10:20—11:10**Hideo Kozono**	**Mayumi Shoji**	
10:50—11:40	**Huaiyu Jian**	**Qi Wang**	11:10—12:00**Chun Liu**	**Hisashi Okamoto**	
11:40—12:00	Group Photo	Poster Session			
12:00—14:00	Lunch				
14:00—14:50	**Claude Bardos**	**Tai-Ping Liu**	**Free discussion**	**Weiqing Ren**	
14:50—15:40	**Song Jiang**	**Jianguo Liu**		**Jie Shen**	
15:40—16:10	Coffee/tea break	Coffee/tea break		Coffee/tea break	
16:10—17:00	**Tong Yang**	**Tao Luo**		**Zuowei Shen**	
17:00—17:50	**Qingtang Su**	**Jinkai Li**		**Peter Markowich**	
17:50—18:00				Closing address	
18:00—20:00	Dinner	Banquet	Dinner	Dinner	

4. Conference Schedule

November 18, 2018 (Sunday)	
November 18, 2018	Registration (Huashi Hotel 华师大厦酒店)
November 19, 2018 (Monday) Venue: Room 111 of CAMIS	
8:30—8:40	**Opening ceremony**
Section Chair:	
8:40—9:30	**Bjorn Engquist** (University of Texas at Austin) **TBA**
9:30—10:00	Coffee/tea break
Section Chair:	
10:00—10:50	**Xi-Ping Zhu (**Sun Yat-sen University) Regularity of Harmonic Maps between Singular Spaces
10:50—11:40	**Huaiyu Jian** (Tsinghua University) **TBA**
11:40—12:00	Group Photo
12:00—14:00	Lunch (Huashi Hotel 华师大厦酒店)
Section Chair:	
14:00—14:50	**Claude Bardos** (Laboratoire J.-L. Lions) The Onsager Conjecture, the Kolmogorv 1/3 law and the 1984 Kato criteria in domains with boundaries.
14:50—15:40	**Song Jiang** (Institute of Applied Physics and Computational Mathematics) **TBA**
15:40—16:10	Coffee/tea break
Section Chair:	
16:10—17:00	**Tong Yang (**City University of Hong Kong**)** Justification of Prandtl ansatz for MHD system
17:00—17:50	**Qingtang Su (**University of Michigan**)** Long Time Behavior of the 2D Water Waves with Point Vortices
18:00—20:00	Dinner (Huashi Hotel 华师大厦酒店)

November 20, 2018 (Tuesday) Venue: Room 111 of CAMIS	
Section Chair:	
8:40—9:30	**Edriss S. Titi** (Texas A&M University and The Weizmann Institute of Science) Is dispersion a stabilizing or destabilizing mechanism? Landau-damping induced by fast background flows
9:30—10:00	Coffee/tea break
Section Chair:	
10:00—10:50	**Xiaoming Wang** (Fudan University) Coupling and decoupling of free flow and flow in porous media
10:50—11:40	**Qi Wang (**University of South Carolina**)** Numerical Approximations to Thermodynamically Consistent Models
11:40—12:00	**Poster Session**
12:00—14:00	Lunch (Huashi Hotel 华师大厦酒店)
Section Chair:	
14:00—14:50	**Tai-Ping Liu (Academia Sinica, Taipei)** On Well-posedness Theory for Weak Solutions of Evolutionary Partial Differential Equations.
14:50—15:40	**Jianguo Liu** (Duke University) Least action principle for incompressible flow with free boundary
15:40—16:10	Coffee/tea break
Section Chair:	
16:10—17:00	**Tao Luo (**City University of Hong Kong**)** Some Results on Fluids/MHD Free Boundary Problems
17:00—17:50	**Jinkai Li (**South China Normal University**)** Entropy-bounded solutions of the full compressible Navier-Stokes equations
18:00—20:00	Banquet (Huashi Hotel 华师大厦酒店)

November 21, 2018 (Wednesday) Venue: Room 111 of CAMIS	
Section Chair:	
8:10—9:00	**Ping Sheng** (The Hong Kong University of science and Technology) Non-Stokes drag in single particle electrophoresis
9:00—9:50	**Lingling Shui** (South China Normal University) Regulation of Liquid Crystal Topology in Confined Microspace
9:50—10:20	Coffee/tea break
Section Chair:	
10:20—11:10	**Hideo Kozono (**Waseda University**)** Wellposedness of the stationary Navier-Stokes in the homogeneous Besov space
11:10—12:00	**Chun Liu (**Illinois Institute of Technology**)** On General Diffusions: Energetic Variational Approaches and Thermal Effects
12:00—14:00	Lunch (Huashi Hotel 华师大厦酒店)
14:00—18:00	Free discussion
18:00—20:00	Dinner (Huashi Hotel 华师大厦酒店)

November 22, 2018 (Thursday) Venue: Room 111 of CAMIS	
Section Chair:	
8:40—9:30	**Pierangelo Marcati (**Universit à degli Studi dell'Aquila**)** **TBA**
9:30—10:00	Coffee/tea break
Section Chair:	
10:00—10:50	**Mayumi Shoji (**Japan Women's University**)** Numerical approach for water waves on rotational flow of two vortical layers
10:50—11:40	**Hisashi Okamoto (**Gakushuin University**)** Unimodal solutions of the equations of 2D incompressible fluid motion
12:00—14:00	Lunch (Huashi Hotel 华师大厦酒店)
Section Chair:	
14:00—14:50	**Weiqing Ren (**National Univeristy of Singapore**)** Computing committor functions for the study of rare events using deep learning
14:50—15:40	**Jie Shen (**Purdue University**)** A new and robust approach to construct energy stable schemes for gradient flows
15:40—16:10	Coffee/tea break
Section Chair:	
16:10—17:00	**Zuowei Shen (**National Univeristy of Singapore**)** **TBA**
17:00—17:50	**Peter Markowich** (Abdullah University of Science and Technology) **TBA**
17：50—18:00	**Closing address**
18:00—20:00	Dinner (Huashi Hotel 华师大厦酒店)
November 23, 2018 (Friday) Venue: Room 111 of CAMIS	
November 23, 2018	Departure

5. Titles&Abstracts

The Onsager Conjecture, the Kolmogorv 1/3 law and the 1984 Kato criteria in domains with boundaries

Claude Bardos (Laboratoire J.-L. Lions)

Several of my recent contributions , with Edriss Titi, Emile Wiedemann and others were motivated by the following issues: The role of boundary effect in mathematical theory of fluids mechanic and the similarity, in presence of these effects, of the weak convergence in the zero viscosity limit and of the statistical theory of turbulence. As a consequence. I will recall the Onsager conjecture and compare it to the issue of anomalous energy dissipation. Give a proof of the local conservation of energy under convenient hypothesis in a domain with boundary. Give sufficient condition for the global conservation of energy in a domain with boundary and show how this imply the absence of anomalous energy dissipation. Give several forms of a basic theorem of Kato in the presence of a Lipschitz solution of the Euler equations. Insisting that in such case the absence of anomalous energy dissipation is equivalent to the persistence of regularity in the zero viscosity limit.

Boundary Regularity for Degenerate-Singular Monge-Amp\`ere Equations

Huaiyu Jian (Tsinghua University)

In 1977, Cheng and Yau studied a class of Monge-Amp\`ere Equations from affine geometry which may be singular or degenerate on the boundary. They obtained the existence, uniqueness and interior regularity for the solution. In this talk, we will discuss the boundary regularity for the solution as well as for smoothness of the boundary of the affine hyperbolic sphere. As a by-product of the regularity, we improve the result of the existence.

Wellposedness of the stationary Navier-Stokes in the homogeneous Besov space

Hideo Kozono (Waseda University)

We consider the stationary problem of the Navier-Stokes equations in the whole space. We show existence, uniqueness, regularity and stability of solutions in the scaling invariant homogeneous Besov space. The self-similar solution is also discussed.For the proof, several bilinear estimates in homogeneous Besov spaces are established. The essential tool is based on the paraproduct formula, the imbedding theorem and the resolvent estimates in such spaces. This is the joint work with Prof. Senjo Shimizu and Dr. Kenta Kaneko.

Entropy-bounded solutions of the full compressible Navier-Stokes equations

Jinkai Li (South China Normal University)

The entropy is one of the fundamental states of a fluid and, in the viscous case, the equation that

it satisfies is highly singular in the region close to the vacuum. In spite of its importance in the gas dynamics, the mathematical analyses on the behavior of the entropy near the vacuum region, were rarely carried out; in particular, in the presence of vacuum, either at the far field or at some isolated interior points, it was unknown if the entropy remains its boundedness. We will show in this talk that the ideal gases retain their uniform boundedness of the entropy, locally or globally in time, if the vacuum occurs at the far field only and the density decays slowly enough at the far field. Precisely, we consider the Cauchy problem to the one-dimensional full compressible Navier-Stokes equations, and establish the local and global existence and uniqueness of entropy-bounded solutions, in the presence of vacuum at the far field only. It is also shown that, different from the case that with compactly supported initial density, the compressible Navier-Stokes equations, with slowly decaying initial density, can propagate the regularities in the inhomogeneous Sobolev spaces. These are joint works with Zhouping Xin.

On General Diffusions: Energetic Variational Approaches and Thermal Effects

Chun Liu (Illinois Institute of Technology)

Transport and diffusion of particles with microstructures are ubiquitous in our daily life. They are also of crucial importance in physical and biological applications. In this talk, I will discuss systems with involve the interactions between moving species and also with environments. In particular, I will introduce a general framework to incorporate the energetic variational approaches by Onsager in isothermal systems with general thermodynamical principle in the presence of thermal effects.

Least action principle for incompressible flow with free boundary

Jianguo Liu (Duke University)

In this talk I will describe a connection between Arnold's least-action principle for incompressible flows with free boundary and geodesic paths for Wasserstein distance. The least‐action problem for geodesic distance on the `manifold' of fluid ‐blob shapes exhibits instability due to microdroplet formation. Using a conformal map formulation we investigate singularity formation in water-wave dynamics neglecting gravity. A connection with fluid mixture models via a variant of Brenier's relaxed least ‐ action principle for generalized Euler flows will also be discussed.

Gas Dynamics and Kinetic Theory

Tai-Ping Liu **(**Stanford University)

We will survey the studies in recent decades on the well-posedness theory for weak solutions. There are few well-posedness theory, in fact, some of the recent results point to ill-poseness. Nevertheless, there is the spectacular well-posedness theory for hyperbolic conservation laws. We will recall this theory, as well as the recent one on compressible Navier-Stokes equations by the

author and Shih-Hsien Yu. Toward the end of this survey, we will propose a new way to view the well-posedness theory, one that differs strikingly from the traditional Hadamard's formulation.

Some Results on Fluids/MHD Free Boundary Problems

Tao Luo (City University of Hong Kong)

In this talk, some results on free boundary problems of fluids and MHD will be discussed. The emphasize will be on the estimates on Sobolev norms of fluid variables and geometry of the free surface such as the 2nd fundamental form for a highly subsonic heat-conductive inviscid fluid (joint with Huihui Zeng), and the discontinuous dependence of solutions on initial data for MHD (joint with Chengchun Hao)

Unimodal solutions of the equations of 2D incompressible fluid motion

Hisashi Okamoto (Gakushuin University)

We consider 2D Navier-Stokes equations and their models such as the Proudman--Johnson equation and generalized Constantin-Lax-Majda equations. Their steady states are computed and their existence and unimodality are discussed. In the case of Proudman-Johnson equation, we prove rigorously the unimodality via the interval analysis and the interval Newton method. By using both the multiple shooting method and multiple-precision arithmetic our verification succeeds up to the Reynolds number 5000.

Computing committor functions for the study of rare events using deep learning

Weiqing Ren (National Univeristy of Singapore)

The committor function is a central object of study in understanding transitions between metastable states in complex systems. It has a very simple mathematical description – it satisfies the backward Kolmogorov equation. However, computing the committor function for realistic systems at low temperatures is a challenging task, due to the curse of dimensionality and the scarcity of transition data. In this talk, I will present a computational approach that overcomes these issues and achieves good performance on complex benchmark problems with rough energy landscapes. The new approach combines deep learning, importance sampling and feature engineering techniques. This establishes an alternative practical method for studying rare transition events among metastable states of complex, high dimensional systems.

A new and robust approach to construct energy stable schemes for gradient flows

Jie Shen (Purdue University)

We present in this talk the scalar auxiliary variable (SAV) approach and the multiple scalar auxiliary variables (MSAV)approach, to deal with nonlinear terms in a large class of gradient flows. The technique is not restricted to specific forms of the nonlinear part of the free energy, it

leads to linear andunconditionally energy stable second-order (or higher-order with weak stability conditions) schemes which only require solving decoupled linear equations with constant coefficients. Hence, these schemes areextremely efficient as well as accurate. We apply the SAV approach to deal with several challenging applications which can not be easily handled by existing approaches, and presentconvincing numerical results to show that the new schemes are not only much more efficient and easy to implement, but also can better capture the physical properties in these models. We shall also present a convergence and error analysis under mild assumptions on the nonlinear free energy.

Non-Stokes drag in single particle electrophoresis

Ping Sheng (The Hong Kong University of science and Technology)

When immersed in an electrolyte solution, a charged particle would be enveloped in an ionic cloud of screening counter-ions, denoted the Debye layer. Application of an external electric field to a suspension of such charged particles can result in the steady motion of the solid particulates. The physical picture underlying this phenomenon, known as the electrophoresis effect, can be dated back to Smoluchowski in which the crucial element is the electroosmotic fluid flow in the Debye layer. Through clever mathematical manipulations, Smoluchowski has shown rigorously that electrophoretic mobility of the charged particle,, is directly proportional to the zeta potential (which is directly related to the surface charge density) on the surface of the solid particle, i.e., , whereis the applied electric field, is the electrophoretic velocity, and, with, being the solution viscosity and dielectric constant, respectively. The Smoluchowski relation is accurate in the limit of a>>, where is the Debye length and a the particle radius. In spite of this success one century ago, there has been little progress on either the experimental measurement or the theoretical derivation of the drag coefficient associated with the electrophoresis phenomenon, defined as , where F is the drag force. In this talk, I report on both the theory and the experimental results on the electrophoretic drag coefficient. By numerically solving the Poisson-Nernst-Planck equations coupled with the Navier-Stokes equation, we find the flow field to be divided into two regions. The outer flow field reproduces well the Smoluchowski flow field in the asymptotic limit, whereas the inner flow field region is governed by highly nonlinear partial differential equations, owing to the strong local electric field arising from the net charges in the Debye layer. The two flow regions are sharply separated by a slip surface; and the drag coefficient calculated on the slip surface agrees very well with the experimentally measured result. The electrophoretic drag coefficient is generally larger than the Stokes drag coefficient , with the peak ratio . The slip surface is generally at a distance of several Debye lengths from the liquid-solid interface. These results and their related physical picture represent a new discovery on a classical phenomenon. *Work done in collaboration with Maijia Liao, Ming-Tzo Wei, Shixin Xu, and H. Daniel Ou-Yang

Numerical approach for water waves on rotational flow of two vortical layers

Mayumi Shoji (Japan Women's University)

We consider progressive water waves with a piecewise constant vorticity distribution. Pure capillary, capillary-gravity, and gravity waves of finite depth are considered. This is a bifurcation problem of a complicated structure of solutions with many parameters and it is hard to classify the structures of solutions mathematically. We thus resort to a numerical method in order to see their bifurcating phenomena with systematic computations. Another concern of ours is to see whether and when stagnation points appear. The difficulties for numerical computations are that it is a free boundary problem and we need a formulation not to exclude stagnation points. We will show our numerical results with various values of parameters.

Regulation of Liquid Crystal Topology in Confined Microspace

Lingling Shui (South China Normal University)

Collective functions of materials are determined by both chemical structures in the molecular level and physical structures at the nano- and micro-scale. In this work, we investigate the nematic liquid crystal (NLC) molecules combined with additives (small molecules, nanoparticles with different geometries and sizes) in spherical microdroplet. The confinement in microdroplet induces reorganization of liquid crystal molecules at various angles to the spherical center. In this way, the assembled molecular structures produce optical property variation in light transmission and reflection, as shown in the following figure, being tuned by additives and environmental changes.

Long Time Behavior of the 2D Water Waves with Point Vortices

Qingtang Su (University of Michigan)

In this paper, we study the motion of the two dimensional inviscid incompressible, infinite depth water waves with point vortices in the fluid. We show that Taylor sign condition $-\frac{\partial P}{\partial \boldmath{n}}\geq 0$ can fail if point vortices are sufficient close to the free boundary, so the water waves could be subject to Taylor instability. Assuming Taylor sign condition, we prove that the water wave system is locally wellposed in Sobolev spaces. Moreover, we show that if the water waves is symmetric with a symmetric vortex pair traveling downward initially, then the free interface remains smooth for a long time, and for initial data of size $\epsilon\ll 1$, the lifespan is at least $O(\epsilon^{-2})$.

Is dispersion a stabilizing or destabilizing mechanism? Landau-damping induced by fast background flows

Edriss S. Titi (Texas A&M University and The Weizmann Institute of Science)

In this talk, I will present a unified approach for the effect of fast rotation and dispersion as an

averaging mechanism for, on the one hand, regularizing and stabilizing certain evolution equations, such as the Navier-Stokes and Burgers equations. On the other hand, I will also present some results in which large dispersion acts as a destabilizing mechanism for the long-time dynamics of certain dissipative evolution equations, such as the Kuramoto-Sivashinsky equation. In addition, I will present some new results concerning two- and three-dimensional turbulent flows with high Reynolds numbers in periodic domains, which exhibit "Landua-damping" mechanism due to large spatial average in the initial data.

Numerical Approximations to Thermodynamically Consistent Models

Qi Wang (University of South Carolina)

Thermodynamically consistent models are the ones that satisfy not only physical conservation laws, but also the thermodynamical principles, especially, the second law of thermodynamics or equivalently the Onsager maximum entropy principle for dissipative systems. How to numerically proximate the models so that the conservation laws as well as the thermodynamical laws are respected at the discrete level is a basic requirement for the schemes to be able to describe the correct physics described by the models. I will present a paradigm that outlines a systematic approach to derive thermodynamically consistent discrete schemes respecting the physical laws. Examples ranging from thermodynamical systems to hydrodynamical systems will be surveyed.

Coupling and decoupling of free flow and flow in porous media

Xiaoming Wang (Fudan University)

Many physical, biological and engineering processes involve the coupling of free flows with flows in porous media. Well-known examples include filtration processes, flows in karstic geometry, hyporheic flow, and PEM fuel cell among many others. We focus on three interrelated important issues associated with the coupled systems: (1) physically relevant interface boundary conditions that couple the free flow and the porous media flow; (2) accurate numerical schemes that are able to decouple the two sub-systems so that legacy codes can be utilized to efficiently simulate the long-time transport phenomena; and (3) physically important parameter regimes where the system can be reduced to decoupled effective systems. Analytically, numerical and experimental tools will be employed to demonstrate several recent results in these directions.

Justification of Prandtl ansatz for MHD system

Tong Yang **(**City University of Hong Kong)

We will first present a work about justification of the Prandtl ansatz for the MHD system with O(1) magnetic Prandtl number, when the initial tangential magnetic field is not degenerate on the boundary. And we will discuss the problem in different regimes. The talk includes some recent joint with Chengjie Liu and Feng Xie.

Regularity of Harmonic Maps between Singular Spaces

Xi-Ping Zhu (Sun Yat-sen University)

M. Gromov and R. Schoen in 1992 initiated to study the theory of harmonic maps into singular spaces. In 1997, J. Jost and F. H. Lin, independently proved that every energy minimizing harmonic map from an Alexandrov space with curvature bounded from below to an Alexandrov space with non-positive curvature is locally H\"older continuous. Meanwhile, F. H. Lin proposed an open question: can the H\"older continuity be improved to Lipschitz continuity? J. Jost also asked a similar problem about Lipschitz regularity of harmonic maps between singular spaces. In this talk I will present an affirmative answer to it. Moreover, I will discuss how to get quantitative gradient estimates in term of a lower bound of Ricci curvature. This is based on joint works with Hui-Chun Zhang and Xiao Zhong

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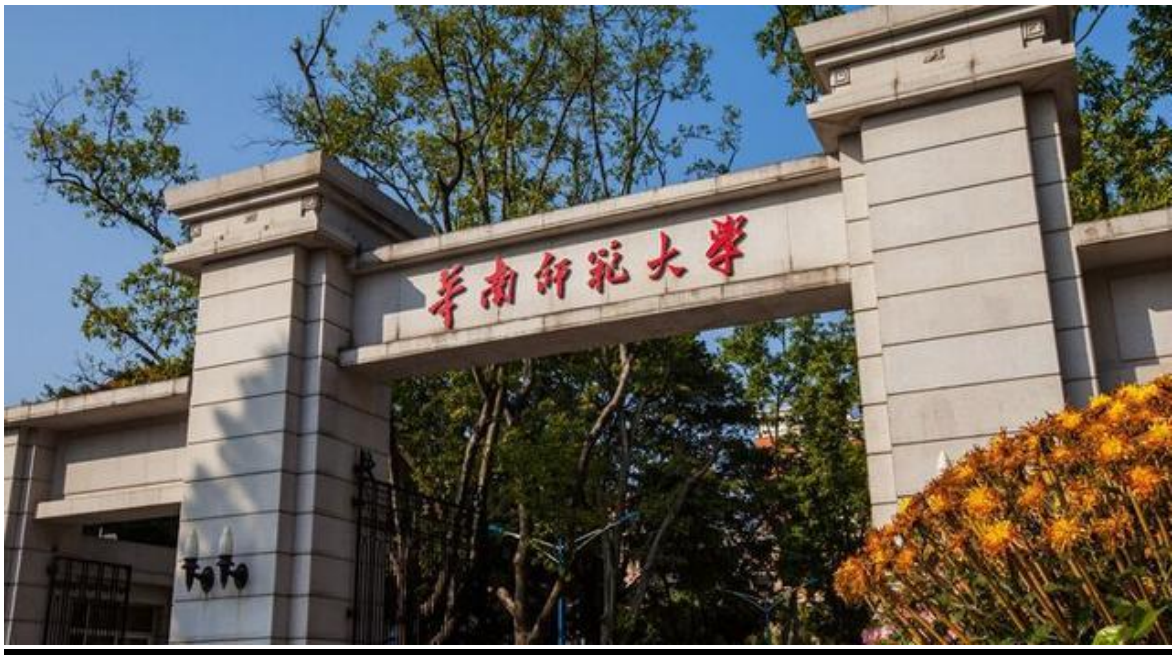

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