2018

The Conference on the Partial Differential Equations of Laboratory for General Applied Mathematics of Northeast Normal University

Laboratory for General Applied Mathematics

Northeast Normal University, Changchun, China

July 17-22, 2018

Welcome Letter

Distinguished professors, friends and fellow colleagues:

This letter is to extend our best wishes and sincere invitation to all of you.

Welcome to Changchun to attend the 2018 PDE Conference organized by Laboratory for General Applied Mathematics (LGAM) of Northeast Normal University.

This academic conference is held particularly to enhance international cooperation and communication in the field of partial differential equations, and to motivate the academic interaction among senior mathematicians, young scholars and graduate students. We hope this meeting will achieve desired results in some frontiers of partial differential equations, such as fluid dynamics, geometric analysis, biological mathematics, and semiconductor model analysis, etc.

Wish you all have a pleasant time in Changchun and enjoy this meeting.

Thank you all very much in advance for your supports!

Kaijun Zhang
School of Mathematics and Statistics
Northeast Normal University
July 9, 2018

Contents

Scientific Committee

Ling Hsiao	Chinese Academy of Sciences, China
Song Jiang	Institute of Applied Physics and Computational Mathematics, Beijing, China
Tong Yang	City University of Hong Kong, China
Zhouping Xin	Chinese University of Hong Kong, China

Organizing Committee

Hailiang Li	Capital Normal University, China
Ming Mei	McGill University & Champlain College, Canada
Kaijun Zhang	Northeast Normal University, China

Sponsors

National Natural Science Foundation of China

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Invited Speakers

George S. Chen	Cape Breton University, Canada
Min-Chun Hong	University of Queensland, Australia
Yuan Lou	Ohio State University, USA
Akitaka Matsumura	Osaka University, Japan
Kenji Nishihara	Waseda University, Japan
Ronghua Pan	Georgia Institute of Technology, USA
Yue-Jun Peng	Université Clermont Auvergne, France
Benoît Perthame	Université Pierre et Marie Curie, France
Ganturmur Tsogtgerel	McGill University, Canada
Dehua Wang	University of Pittsburgh, USA
Xuefeng Wang	Southern University of Science and Technology, China
Yau Shu Wong	University of Alberta, Canada
Baisheng Yan	Michigan State University, USA
Tong Yang	City University of Hong Kong, China

Program Schedule

Meeting Place	Junior Ballroom (the fifth floor in Hyatt Regency Hotel)	
July 17 Tuesday	Registration	
July 18 Wednesday	8:30 -8:45	Opening Ceremony Chair: Kaijun Zhang
	8:45-9:00	Group Photo
	9:00-10:00	Speaker: **Benoît Perthame** (Université Pierre et Marie Curie) Chair: Hailiang Li
	10:15-10:45	Tea Break
	10:45-11:45	Speaker: **Tong Yang** (City University of Hong Kong) Chair: Dehua Wang
	12:00-14:00	Lunch
	14:30-15:30	Speaker: **Dehua Wang** (University of Pittsburgh) Chair: Benoît Perthame
	15:45-16:15	Tea Break
	16:15-17:15	Speaker: **Yau Shu Wong (**University of Alberta) Chair: Ronghua Pan
	18:30-20:30	Dinner
July 19 Thursday	8:30-9:30	Speaker: **Min-Chun Hong** (University of Queensland) Chair: Tong Yang
	9:45-10:15	Tea Break
	10:15-11:15	Speaker: **Yue-Jun Peng** (Université Clermont Auvergne) Chair: Kenji Nishihara
	11:30-14:00	Lunch
	14:30-15:30	Speaker: **Ganturmur Tsogtgerel** (McGill University) Chair: Akitaka Matsumura
	15:45-16:15	Tea Break
	16:15-17:15	Speaker: **Ronghua Pan** (Georgia Institute of Technology) Chair: Yau Shu Wong
	18:30-20:30	Dinner

July 20 Friday	8:30-9:30	Speaker: **Akitaka Matsumura** (Osaka University) Chair: Ming Mei
	9:45-10:15	Tea Break
	10:15-11:15	Speaker: **Kenji Nishihara** (Waseda University) Chair: Baisheng Yan
	11:30-14:00	Lunch
	14:30-15:30	Speaker: **Xuefeng Wang** (Southern University of Science and Technology) Chair: Min-Chun Hong
	15:45-16:15	Tea Break
	16:15-17:15	Speaker: **Yuan Lou** (Ohio State University) Chair: Yue-Jun Peng
	18:30-21:00	Banquet
July 21 Saturday	8:30-9:30	Speaker: **Baisheng Yan** (Michigan State University) Chair: Xuefeng Wang
	9:45-10:15	Tea Break
	10:15-11:15	Speaker: **George S. Chen** (Cape Breton University) Chair: Yuan Lou
	11:30-11:45	Closing Ceremony Chair: Kaijun Zhang
	12:00-14:00	Lunch
	18:30-20:30	Dinner

Abstracts

Blow-up of positive solutions to a singular Gierer-Meinhardt system

George S. Chen

(Cape Breton University, Canada)

10:15-11:15 Jul.21

Abstract: This talk discusses the blow-up of positive solutions for a singular Gierer-Meinhardt system subject to zero Dirichlet boundary conditions. We first prove the existence of a local solution and then show blow-up solutions under certain conditions for parameters. We use a functional method to obtain a local solution which is bounded by the first eigenfunction both from upper and from below and then obtain the bound of a ratio of two solutions. This method is completely different than the traditional methods of sub and super solutions.

Convergence of the Ginzburg-Landau approximation for the Ericksen-Leslie system

Min-Chun Hong

(University of Queensland, Australia)

08:30-09:30 Jul.19

Abstract: We establish the local well-posedness of the general Ericksen and Leslie system in liquid crystals with the initial velocity and director field in $H^1 \times H_b^2$. In particular, we prove that the solutions of the Ginzburg-Landau approximation system converge smoothly to the solution of the Ericksen-Leslie system for any $t \in (0, T^*)$ with a maximal existence time T^* of the Ericksen-Leslie system. This is my joint work with Zhewen Feng and Yu Mei.

Asymptotic behavior of principal eigenvalue for elliptic operators

Yuan Lou

(Ohio State University, USA)

16:15-17:15 Jul.20

Abstract: We will consider the effects of diffusion and advection on principal eigenvalue of linear, second order elliptic operators. Various asymptotic behaviors of principal eigenvalue, as diffusion or advection coefficients approach zero or infinity, are discussed. Motivations of these studies come from the speedup of front propagation and enhancing invasion of populations.

Global asymptotic stability of constant states for the generalized Burgers equation with nonlinear viscosity

Akitaka Matsumura

(Osaka University, Japan)

08:30-09:30 Jul.20

Abstract: We consider the Cauchy problem for the generalized Burgers equation with nonlinear viscosity, in particular, of quasi-plastic fluid type. Under a condition on the nonlinearity, we show the global asymptotic stability of constant states by a technical energy method. This is a joint work with Natsumi Yoshida.

Large Critical exponents for the Cauchy problem to the semilinear damped wave equation

Kenji Nishihara

(Waseda University, Japan)

10:15-11:15 Jul.20

Abstract: We consider the Cauchy problem for the semilinear damped wave equation

$$u_{tt} - \Delta u + c(t,x)u_t = f(u), \ (t,x) \in \mathbf{R}_+ \times \mathbf{R}^N$$

with $f(u) = |u|^p (p > 1)$ etc. Our main concern is to observe the large-time asymptotics or finite-time blow-up of solutions, depending on the exponent p. When $c(t,x) = 1$ and $f(u) = 0$, the solution has the diffusion phenomenon. Hence, if the dissipation is effective, then the critical exponent p_c is expected to be the same as that for the corresponding parabolic equation, or the Fujita type equation. In the talk we will survey the recent developments of this topics.

Isentropic Approximation

Ronghua Pan

(Georgia Institute of Technology, USA)

16:15-17:15 Jul.19

Abstract: In the study of compressible flows, the isentropic model was often used to replace the more complicated full system when the entropy is near a constant. This is based on the expectation that the corresponding isentropic model is a good approximation to the full system when the entropy is sufficiently close to the constant. We will discuss the mathematical justification of isentropic approximation in Euler flows and in Navier-Stokes-Fourier flows. This is based on the joint work with Y. Chen, J. Jia, and L. Tong.

Local and global parabolic limits of partially dissipative hyperbolic systems

Yue-Jun Peng

(Université Clermont Auvergne, France)

10:15-11:15 Jul.19

Abstract: We consider smooth solutions for a first-order partially dissipative hyperbolic systems with relaxation term. The system is written in non-conservative form in several space dimensions. We show that in a slow time variable, the formal zero-relaxation limit of the system is of second-order parabolic type. Under stability conditions, the justification of the limit is done locally in a uniform time interval, or globally in time when initial data are close to constant equilibrium states. Examples of physical models are given an applications of the results.

Tumor growth: from compressible models to free boundaries

Benoît Perthame

(Université Pierre et Marie Curie, France)

09:00-10:00 Jul.18

Abstract: Tissue growth, as in solid tumors, can be described at a number of different scales from the cell to the organ. For a large number of cells, the 'fluid mechanical' approach has been advocated recently by many authors in mathematics or biophysics. Several levels of mathematical descriptions are commonly used, including possibly elasticity, visco-elasticlaws, nutrients, active movement, surrounding tissue, vasculature remodeling and several other features.

We will focus on the links between two types of mathematical models. The 'microscopic' or 'compressible' description is at the cell population density level and a more macroscopic or 'incompressible' description is based on a free boundary problem close to the classical Hele-Shaw equation. In the stiff pressure limit, we are going to derive a weak formulation of the corresponding Hele-Shaw free boundary problem and we will make the connection with its geometric form.

Including additional features also opens other questions as circumstances in which singularities and instabilities may develop.

Elliptic estimates for operators with nonsmooth coefficients

Ganturmur Tsogtgerel

(McGill University, Canada)

14:30-15:30 Jul.19

Abstract: We will discuss a possible approach to establish elliptic estimates for operators with barely continuous coefficients in a Sobolev-Besov and Triebel-Lizorkin scale. It is based on certain scaling properties of functions in the aforementioned scales. The problem is slightly nonlinear, and we use the Littlewood-Paley theory to establish the scaling properties. The results are mostly not new but the proposed approach is relatively elementary and therefore of interest.

Martingale Solutions for the Stochastic Navier-Stokes Equations

Dehua Wang

(University of Pittsburgh, USA)

14:30-15:30 Jul.18

Abstract: Stochastic problems arise in many applications including fluid dynamics and are challenging in mathematical modeling, analysis and computations. The talk will focus on the stochastic partial differential equations for the compressible flows in fluid dynamics. The known results on the stochastic partial differential equations in fluid dynamics will be surveyed, and new recent results on the martingale solutions will be presented.

Using effective boundary conditions to model fast diffusion on a road in a large field

Xuefeng Wang

(Southern University of Science and Technology, China)

14:30-15:30 Jul.20

Abstract: We consider a logistic diffusion equation on the plane consisting of two components, a straight “road” and a “field”, in each of which the diffusion rate differs significantly. Compared to the size of the field, the width of the road is assumed to be small. Thus in this diffusion equation multiple scales appear in two places: the spatial variable and

the diffusion parameter. Such an equation is not easy to solve numerically, and it is not easy to see the effects of the road. Recently, Berestycki, Roquejoffre and Rossi provide a model which is meant to resolve these issues. In this paper we first use the idea of effective boundary conditions (EBCs) to propose, rigorously, a different model: we study the limit of the solution of the original logistic equation as the width of the road approaches zero, obtaining a limiting model, in which the road now is the horizontal line with EBCs imposed on it. This effective problem has no multiple scales and hence should be easier to solve numerically. Moreover, to see the effects of the road, we further investigate the asymptotic propagation speed of the effective model, showing that the road indeed enhances the spreading speed along any direction within a certain angle with the road, provided that the diffusion rate on the road is of the order of the reciprocal of the width of the road.

Difference approximation of the Helmholtz equation

Yau Shu Wong

(University of Alberta, Canada)

16:15-17:15 Jul.18

Abstract: Helmholtz equation arises in problems related to wave propagations, such as acoustic, electromagnetic wave scattering and in many geophysical applications. Developing efficient and highly accurate numerical approximation for solving the Helmholtz equation at large wave numbers is a very challenging computational task and it has attracted a great deal of attention for a long time. The foremost difficulty in solving Helmholtz equation numerically is to eliminate or minimize the pollution effect which could lead to a serious problem as the wave number increases. Let k, h and n denote the wave number, the grid size and the order of a numerical scheme, it can be showed that due to the pollution effect, the computational error for many existing numerical solutions is proportional to $k(kh)^n$. It has been reported that it is impossible to eliminate the pollution effect for problems in two and three dimensions. Another difficulty is that the resulting linear system is indefinite and many efficient iteration schemes cannot be applied. In this talk, we present numerical algorithms based on global difference approximations. The most attractive feature of the developed numerical schemes is that they are pollution free and the error is bounded by Ch^n ,where C is a positive constant. Numerical simulations for multi-dimensional Helmholtz equation at high wave numbers will be reported.

Exotic Solutions for Forward-Backward Diffusion Equations

Baisheng Yan

(Michigan State University, USA)

08:30-09:30 Jul.21

Abstract: In this talk I discuss the general diffusion equations with nonmonotone diffusion flux. Such equations have many applications in phase transition for solids and fluids and image processing. We establish the general principle that certain geometric structures of nonmonotone flux function ensure the existence of infinitely many Lipschitz solutions exhibiting exotic behaviors to the diffusion equation. Relevant structures are characterized by certain bounded open sets satisfying the so-called chord condition, and sufficient conditions for such sets are also given. Our method relies on a modification of the convex integration and Baire's category methods.

Global well-posedness of the Non-cutoff Boltzmann Equation with Polynomial Decay Perturbations

Tong Yang

(City University of Hong Kong, China)

10:45-11:45 Jul.18

Abstract: The Boltzmann equation without angular cutoff is considered when the initial data is a perturbation of a global Maxwellian with algebraic decay in the velocity variable. Global solution is proved by combining the analysis in moment propagation, spectrum of the linearized operator and the smoothing effect of the linearized operator when initial data in Sobolev space with negative index. This is a joint work with Ricardo Alonso, Yoshinori Morimoto and Weiran Sun.

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About the Laboratory for General Applied Mathematics

The so called LGAM means the Laboratory for General Applied Mathematics, which was founded in December 2016. LGAM is subordinate to the Key Construction Project on Operational Research and Control Theory from Northeast Normal University.

The LGAM academic committee consists of forty-five well-known mathematicians and experts at home and abroad, whose academic director is a member of the Chinese Academy of Sciences. One of senior counselors of the academic committee is a fellow of the European Academy of Sciences.

The aim for LGAM is to train the ability of the applied mathematics to PhD students and graduate students as well as undergraduate students with the help of the general applied mathematics. In particular, LGAM will give more attention to students in four crucial aspects of the general applied mathematics such as mathematical thoughts, mathematical technology, mathematical modeling and large time effective education.

The LGAM will make progress and efforts in the construction of the world-wide first-class mathematics discipline and the cultivation of innovative talents in Northeast Normal University under the guidance of the highly international academic committee.