



山东科技大学
Shandong University of Science and Technology

2022 International Workshop on "Advances in Nonlinear Analysis and PDEs"

Program



Shandong University of Science and Technology

College of Mathematics and Systems Science

Qingdao, China. May 28-29, 2022

Conference Theme

The international workshop on " **Advances in Nonlinear Analysis and PDEs** " will be held from May 28 to 29, 2022 by the College of Mathematics and Systems Science, Shandong University of Science and Technology. The aim of this conference is to bring together some leading mathematicians in the fields of nonlinear analysis and partial differential equations in order to discuss recent advances and future perspectives, and stimulate collaborative research activities. Also, the conference is to celebrate **Professor Patrizia Pucci** from Universita degli Studi di Perugia of Italy on her 70th birthday.

Organizing Committee

Zhanbing Bai (Shandong University of Science and Technology, China)

Lili Chen (Shandong University of Science and Technology, China)

Yujun Cui (Shandong University of Science and Technology, China)

Huanhe Dong (Shandong University of Science and Technology, China)

Shuai Xi (Shandong University of Science and Technology, China)

Binlin Zhang (Shandong University of Science and Technology, China)

Organization

College of Mathematics and Systems Science, Shandong University of Science and Technology

Financial Support

Cultivation Project of Young and Innovative Talents in Universities of Shandong Province

Conference Date

May 28-29, 2022

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Schedule of Talks

May 28, 2022 Tencent Meeting ID: 875 5951 9510 (pw: 202205)		
08:30 – 08:40	Opening speech: Professor Huanhe Dong (Head of College of Mathematics and Systems Science, Shandong University of Science and Technology, China)	
May 28, 08:40-11:50		
Chair: Shuangjie Peng (Central China Normal University, China)		
08:40 – 09:40	Nodal solutions for coupled elliptic equations	Zhi-Qiang Wang (Utah State University, USA)
Chair: Wenming Zou (Tsinghua University, China)		
09:50 – 10:50	Existence of a positive solution to a Schrödinger system with non-constant coefficients and critical exponent	Zhaoli Liu (Capital Normal University, China)
10:50 – 11:50	Uniqueness and symmetry of solutions to fully nonlinear elliptic equations and systems	Zhitao Zhang (AMSS of Chinese Academic of Science, Jiangsu University, China)
May 28, 14:30-17:30 Tencent Meeting ID: 875 5951 9510 (pw: 202205)		
Chair: Yongqiang Fu (Harbin Institute of Technology, China)		
14:30 – 15:30	Hardy-Littlewood-Sobolev, Stein-Weiss, and beyond	Vicentiu D. Radulescu (University of Craiova, Romania)
Chair: Runzhang Xu (Harbin Engineering University, China)		
15:30 – 16:30	A detour on Sobolev type inequalities in the Heisenberg group and applications to critical subelliptic problems	Patrizia Pucci (Università degli Studi di Perugia, Italy)
Chair: Xianhua Tang (Central South University, China)		
16:30 – 17:30	On a class of nonlocal Schrödinger equations	Giovanni Molica Bisci (Università degli Studi di Urbino "Carlo Bo", Italy)
May 29, 09:00-12:00 Tencent Meeting ID: 875 5951 9510 (pw: 202205)		
Chair: Dehua Wang (University of Pittsburgh, USA)		
09:00 – 10:00	On the global existence or blowup of solutions to the generalized Tricomi equations and some related problems	Huicheng Yin (Nanjing Normal University, China)
Chair: Yachun Li (Shanghai Jiao Tong University, China)		
10:00 – 11:00	Inflow/outflow problem for two-phase flow	Hailiang Li (Capital Normal University, China)
Chair: Yuejun Peng (University of Clermont Auvergne, France)		
11:00 – 12:00	Global solutions to a radiation hydrodynamic model	Huijiang Zhao (Wuhan University, China)
May 29, 14:30-17:40 Tencent Meeting ID: 875 5951 9510 (pw: 202205)		
Chair: Zhi-Qiang Wang (Utah State University, USA)		
14:30 – 15:30	Existence and stability of smooth traveling circular pairs for gSQG equation	Daomin Cao (AMSS of Chinese Academic of Science, China)
Chair: Zhitao Zhang (AMSS of Chinese Academic of Science, Jiangsu University, China)		
15:30 – 16:30	Construction of solutions via local Pohozaev identities	Shuangjie Peng (Central China Normal University, China)
16:30 – 17:30	Least energy positive solutions for d -coupled Schrödinger systems with critical exponent in dimension three	Wenming Zou (Tsinghua University, China)
17:30 – 17:40	Closing ceremony	

Abstract of Talks

Existence and stability of smooth traveling circular pairs for gSQG equation

Daomin Cao, AMSS of Chinese Academic of Science, China

Abstract: The Lamb dipole is a well-known traveling circular pairs solution for incompressible 2D Euler equation. In this talk, I will introduce some results on the existence and stability of traveling vortex pairs for the generalized surface quasi-geostrophic equation, which is the analogue of the Lamb dipole. We also will talk about highly concentrated traveling vortex pair solutions gSQG equation. The content of this talk is based on joint papers with Guolin Qin, Weicheng Zhan and Changjun Zou.

Inflow/outflow problem for two-phase flow

Hailiang Li, Capital Normal University, China

Abstract: In this talk we present recent investigation on inflow/outflow problem for full two-phase flow, which consists of two compressible Navier-Stokes equations coupled each other through the drag force relaxation mechanisms and is derived by the Chapman-Enskog expansion from the Vlasov-Navier-Stokes for mixed fluid-particle motion. The existence of unique steady-state is shown respectively corresponding to supersonic, sonic, and subsonic flow state at far field. The nonlinear stability and long time convergence rates are also established. Meanwhile, the comparison of full two-phase flow with one phase compressible viscous equations and drift-flux two-phase flow models are made. This is joint with Shuang Zhao.

Existence of a positive solution to a Schrödinger system with non-constant coefficients and critical exponent

Zhaoli Liu, Capital Normal University, China

Abstract: In this talk, I shall talk about how to obtain a positive solution at high energy level to the Schrödinger system of two equations with non-constant coefficients and critical exponent

$$\begin{cases} -\Delta u + V_1(x)u = \mu_1 u^3 + \beta v^2 u, & \text{in } \mathbb{R}^4, \\ -\Delta v + V_2(x)v = \mu_2 v^3 + \beta u^2 v, & \text{in } \mathbb{R}^4, \\ u(x) \rightarrow 0, v(x) \rightarrow 0, & \text{as } |x| \rightarrow \infty, \end{cases}$$

where $V_1, V_2 \in L^2(\mathbb{R}^4)$ are nonnegative functions and are such that $\|V_1\|_{L^2(\mathbb{R}^4)} + \|V_2\|_{L^2(\mathbb{R}^4)}$ is positive and sufficiently small. Our result extends the result of [Benci-Cerami, JFA, 1990] from a scalar field equation to a system. This is joint work with Haidong Liu.

On a class of nonlocal Schrödinger equations

Giovanni Molica Bisci, Università degli Studi di Urbino "Carlo Bo", Italy

Abstract: We consider the following singularly perturbed Schrödinger equation involving the N/s -fractional Laplacian operator,

$$\varepsilon^N (-\Delta)_{N/s}^s u + V(x) |u|^{\frac{N}{s}-2} u = f(u) \quad \text{in } \mathbb{R}^N,$$

where ε is a positive parameter, $s \in (0,1)$, the potential V is positive and away from zero, and f is a Trudinger-Moser type nonlinearity. By using penalization methods and Lusternik-Schnirelmann's theory, we examine existence, multiplicity and concentration of non-trivial non-negative solutions for small values of ε .

Construction of solutions via local Pohozaev identities

Shuangjie Peng, Central China Normal University, China

Abstract: We consider a type of nonlinear elliptic equation with critical exponent and a bounded potential. By combining a finite reduction argument and local Pohozaev type of identities, we prove that if the function related to the potential has a stable critical point, then the problem has infinitely many solutions. We overcome the difficulty appearing in using the standard reduction method to locate the concentrating points of the solutions.

A detour on Sobolev type inequalities in the Heisenberg group and applications to critical subelliptic problems

Patrizia Pucci, Università degli Studi di Perugia, Italy

Abstract: Motivated by important applications to geometric control theory and PDEs, great attention has been recently devoted to the study of geometric inequalities in the context of stratified Lie groups. In the first part of the talk, we present some classical results and open problems related to the Sobolev type inequalities in the Heisenberg group. In the second part, we apply these inequalities to obtain existence results for nonlinear problems involving subelliptic operators of Marcellini's type in the Heisenberg group.

Hardy-Littlewood-Sobolev, Stein-Weiss, and beyond

Vicentiu D. Radulescu, University of Craiova, Romania

Abstract: I shall report on some recent joint results with Xianhua Tang, Minbo Yang and Youpei Zhang on some classes of non-symmetric singular inequalities with variable potential, which extend the classical contributions of Hardy-Littlewood-Sobolev and Stein-Weiss. These abstract results are applied to the qualitative analysis of solutions to some anisotropic Choquard problems.

Nodal solutions for coupled elliptic equations

Zhi-Qiang Wang, Utah State University, USA

Abstract: We present recent work for constructing multiple nodal solutions having componentwisely-shared nodal numbers for coupled elliptic equations. This is done by further developing critical point theory with built-in flow invariance which has been a useful tool to give locations of critical points by minimum methods. We briefly survey results on nonnegative solutions first. Then we discuss the methods in general using gradient flows for constructing invariant sets of the flow. Our work uses the parabolic flow as a deformation combining with minimax methods under permutation symmetry.

On the global existence or blowup of solutions to the generalized Tricomi equations and some related problems

Huicheng Yin, Nanjing Normal University, China

Abstract: In this talk, at first, we give a survey on the backgrounds of some degenerate hyperbolic equations. Secondly, for a class of semilinear Tricomi equations, the systematic results are established for the global existence or blowup. These works are joint with Prof. Ingo Witt, Prof. Ruan Zhuoping, and Dr. He Daoyin.

Uniqueness and symmetry of solutions to fully nonlinear elliptic equations and systems

Zhitao Zhang, AMSS of Chinese Academic of Science, Jiangsu University, China

Abstract: We use topological methods, bifurcation theory and moving plane methods to study fully nonlinear elliptic equations and systems, e.g. Monge-Ampère equations and k -Hessian equations, for uniqueness of solutions, number of solutions, and symmetry of solutions in different domains.

Global solutions to a radiation hydrodynamic model

Huijiang Zhao, Wuhan University, China

Abstract: In this talk, we are concerned with the global regularity for a one-dimensional radiation hydrodynamic model with viscosity and thermal conductivity and large initial data and the construction of global smooth solutions to a multidimensional radiation hydrodynamic model with small initial data.

Least energy positive solutions for d-coupled Schrödinger systems with critical exponent in dimension three

Wenming Zou, Tsinghua University, China

Abstract: I will talk about the coupled Schrödinger systems with critical exponent:

$$\begin{cases} -\Delta u_i + \lambda_i u_i = \sum_{j=1}^d \beta_{ij} |u_j|^3 |u_i| u_i & \text{in } \Omega, \\ u_i \in H_0^1(\Omega), \quad i = 1, 2, \dots, d. \end{cases}$$

Here, $\Omega \subset \mathbb{R}^3$ is a smooth bounded domain, $d \geq 2$, $\beta_{ii} > 0$ for every i , and $\beta_{ij} = \beta_{ji}$ for $i \neq j$. We study a Brézis-Nirenberg type problem: $-\lambda_1(\Omega) < \lambda_1, \dots, \lambda_d < -\lambda^*(\Omega)$, where $\lambda_1(\Omega)$ is the first eigenvalue of $-\Delta$ with Dirichlet boundary conditions and $\lambda^*(\Omega) \in (0, \lambda_1(\Omega))$. We acquire the existence of least energy positive solutions to this system for weakly cooperative case ($\beta_{ij} > 0$ small) and for purely competitive case ($\beta_{ij} \leq 0$) by variational arguments. The proof is performed by mathematical induction on the number of equations, and requires more refined energy estimates for this system. Besides, we present a new nonexistence result, revealing some different phenomena comparing with the higher-dimensional case $N \geq 5$. It seems that this is the first paper to give a rather complete picture for the existence of least energy positive solutions to critical Schrödinger system in dimension three. This is joint work with T. Liu, S. You.