Workshop on Nonlinear Partial Differential Equations XV

Jan. 16-Jan. 19, 2022

1. Workshop Information

Announcement:

In order to enhance the communications among the mathematicians on the subject of partial differential equations, geometric analysis and related topics, we plan to hold "Workshop on nonlinear partial differential equations XV" on Jan.16 - Jan.19, 2022. We will invite some experts to share ideas and results on recent research, and discuss current challenging issues.

Arrangement:

Jan 16: Registration
Jan 17-18: Workshop
Jan 19: Departure

Organizing Committee:

Genggeng Huang, Fudan University
Xia Huang, East China Normal University
Mijia Lai, Shanghai Jiao Tong University
Congming Li, Shanghai Jiao Tong University
Yuan Lou, Shanghai Jiao Tong University
Yingshu Lü, Fudan University
Fang Wang, Shanghai Jiao Tong University
Chunqin Zhou, Shanghai Jiao Tong University

Venues:

Multi-function hall, 2nd floor, No. 5 Building,
Manhattan Hotel (Shanghai Minhang)
Address: No. 900 Heqing Road, Minhang District, Shanghai

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2. Schedule

Monday, Jan. 17	
Morning Session	
8: 50-9: 00	Opening ceremony
Chair: Congming Li	
9:00-9:45	Speaker: **Bo Liu (East China Normal University)** Title: Family APS index theorem and equivariant eta form
9:45-10:15	Tea break
Chair: Feng Zhou	
10:15-11:00	Speaker: **Chao Ji (East China University of Science and Technology)** Title: Some results on the nonlinear logarithmic Schrodinger equations
11:00-11:45	Speaker: **Ran Zhuo (Huanghuai University)** Title:Qualitative properties of solutions for a nonlinear system with fractional Laplacian
Lunch	
Afternoon Session	
Chair: Yuan Lou	
14:00-14:45	Speaker: **Chunyi Zhao (East China Normal University)** Title: Concentration on curves for nonlinear Schrödinger problems with electromagnetic potential
14:45-15:30	Speaker: **Lidan Wang (Fudan University)** Title: A class of nonlinear elliptic equations on lattice graphs
15:30-15:50	Tea break
Chair: Fang Wang	
15:50-16:35	Speaker: **Hao Liu (Shanghai Jiao Tong University)** Title:On the regularity structures and large time behaviors of conservative solutions to the Hunter-Saxton equation
16:35-17:20	Speaker: **Lun Guo (Fudan University)** Title: Multiplicity results for fractional Schrödinger equation with critical growth
Banquet	

Tuesday, Jan. 18	
Morning Session	
Chair: Dong Ye	
8:50-9:35	Speaker: **Meng Zhu (East China Normal University)** Title: Eigenvalue and heat kernel estimates on the canonical bundle of Kaehler manifolds
9:35-10:20	Speaker: **Siran Li (Shanghai Jiao Tong University)** Title:Existence Results on Isometric Immersions of Riemannian Manifolds with Weak Regularity
10:20-10:40	Tea break
Chair: Chunqin Zhou	
10:40-11:25	Speaker: **Lei Ma (University of Shanghai for Science and Technology)** Title: The incompressible flow past an elastic body
11:25-12:10	Speaker: **Chenkai Liu (Shanghai Jiao Tong University)** Title: Some observations about Poisson kernel for the fractional Laplacian
Lunch	

3. Titles and Abstracts

Multiplicity results for fractional Schrödinger equation with critical growth

Lun Guo (Fudan University)

In this talk, we shall introduce some recent results on the existence and multiplicity of positive solutions for critical fractional Schrödinger equation with different potentials. The methods we used mainly are degree theory, blow-up analysis and Krasnoselskii's genus theory.

Some results on the nonlinear logarithmic Schrodinger equations

Chao Ji (East China University of Science and Technology)

In this talk, we are concerned with the nonlinear logaritimic Schrodinger equations. When the potential satisfies a global assumption, we give the multiple solutions. When the potential satisfies a local assumption, due to del Pino and Felmer, we consider the existence and concentration of positive solutions. Then, based on some new estimates from previous research, the multi-bump solutions are obtained for a logarithmic Schrodinger equation with deepening potential well. Finally, we shall show the multiplicity of multi-peak positive solutions for the logarithmic Schrodinger equation with a multi-well potential. This talk is based on joint works with Professor Claudianor O. Alves.

Existence Results on Isometric Immersions of Riemannian Manifolds with Weak Regularity

Siran Li(Shanghai Jiao Tong University)

We report some of our recent work on a classical geometric problem: isometric immersions of Riemannian manifolds. The underlying PDE is the Gauss-Codazzi-Ricci equations. This talk focuses on existence theorems of isometric immersions under weak regularity assumptions:

(1) C^3 -isometric immersions for homeomorphic S^2 into simply-connected 3-manifolds, with positive or non-negative relative Gauss curvature—we shall discuss the J-holomorphic curve approach à la F. Labourie (1989) and Harnack estimates;

(2) $C^{1,1}$ -isometric immersions of negatively curved surfaces into R^3 —we utilise the

fluid formulation of Gauss-Codazzi equations by G.Q. Chen, M. Slemrod, &D. Wang (2010);

(3) $W^{2,p}$ -isometric immersions via fundamental theorem of submanifolds with L^p -extrinsic geometry in general dimensions and co-dimensions — we explore the connection between isometric immersions and the Coulomb-Uhlenbeck gauge equation, as well as a "nonlinear smoothing" technique introduced by S. Mardare (2005).

Family APS index theorem and equivariant eta form

Bo Liu (East China Normal University)

The general version of the family APS index theorem was established by Melrose and Piazza in 1997 by using the b-calculus and introducing the spectral section. The boundary term there is the eta form with perturbation. In this talk, we will generalize the spectral section and the eta form to the equivariant case for a fiberwise compact Lie group action and discuss the properties of the equivariant version of eta forms with perturbation.

Some observations about Poisson kernel for the fractional Laplacian

Chenkai Liu (Shanghai Jiao Tong University)

In our recent work, we study Dirichlet problems of fractional Laplacian on a general bounded domain in R^n . Poisson kernel is an important tool needed in our study. We establish the existence of Poisson kernel and observe several important properties of Poisson kernel. These observations not only enable us to study fractional Laplacian, but also provide us a different view of the ordinary Laplacian.

On the regularity structures and large time behaviors of conservative solutions to the Hunter-Saxton equation

Hao Liu (Shanghai Jiao Tong University)

The Hunter-Saxton equation is a one dimensional PDE used to study the nonlinear

instability in the director field of the nematic liquid crystal. In this talk, we discuss the regularity structure, the global in-time existence and uniqueness, the large time behaviors of the energy conservative solutions to the Hunter-Saxton equation. In particular, we show that the singularities for the energy measure may only appear at at most countably many times, and are completely determined by the absolutely continuous part of initial energy measure. The analysis is based on the method of characteristics in a generalized framework that consists of the evolutions of solution to the Hunter-Saxton equation and the energy measure. This generalized framework is also crucial for the analysis of the large time behaviors of the conservative solutions.

The incompressible flow past an elastic body

Lei Ma (University of Shanghai for Science and Technology)

In this talk, we study the three-dimensional steady irrotational Euler flows past an elastic body. For the elastic body, we assume that it is a St. Venant-Kirchhoff material, which is attached to a rigid body. In this case, we treat the problem as the Euler flows coupled with the elastic equations with free boundaries. The main goal is to show the well-posedness theory for the coupled system when the velocity of the flow at far fields is sufficiently small. First, we introduce a transformation in the reference domain which makes the coupled system possess fixed boundaries. Based on the elliptic theory, the well-posedness is achieved by the fixed point approach.

A class of nonlinear elliptic equations on lattice graphs

Lidan Wang (Fudan University)

In this paper, we study the nonlinear elliptic equation of the form

$$-\Delta u + a(x)|u|^{p-2}u - b(x)|u|^{q-2}u = 0$$

on lattice graphs Z^N, where $N \geq 3$ and$2 \leq p < q <+\infty$. We first prove the existence of positive solutions to the above equation with constant coefficients $\bar{a}$ and $\bar{b}$. Then by Brezis-Lieb lemma and concentration compactness principle, we prove the decomposition of bounded Palais-Smale sequences for the functional with variable coefficients, which tend to some constants $\bar{a}$ and $\bar{b}$ at infinity.

Concentration on curves for nonlinear Schrödinger problems with electromagnetic potential

Chunyi Zhao (East China Normal University)

我们将研究带磁薛定谔方程的解的曲线型集中现象, 讨论集中现象所在的曲线与电磁场之间的联系.

Eigenvalue and heat kernel estimates on the canonical bundle of Kaehler manifolds

Meng Zhu (East China Normal University)

Let M be an m dimensional closed Kaehler manifold. We will present certain eigenvalue and heat kernel estimates for the Hodge Laplacian acting on smooth sections of the canonical bundle of M, i.e., (m,0)-forms. The main results only rely on the bound of the Ricci curvature, and the volume and diameter of M, instead of the bound of the whole curvature tensor for general differential forms. This is a joint work with Zhiqin Lu and Qi S. Zhang.

Qualitative properties of solutions for a nonlinear system with fractional Laplacian

Ran Zhuo (Huanghuai University)

We study the following nonlinear system with fractional Laplacian:

$$\begin{cases} (-\Delta)^{\alpha/2} u_i(x) = f_i(u_1(x), \cdots, u_m(x)), & i = 1, \cdots, m, \\ u_i(x) \geq 0, & i = 1, \cdots, m, \end{cases} \tag{1}$$

where α is any real number between 0 and 2. We first establish the equivalence between (1) and the corresponding integral system. Combining this equivalence with the existing results on the integral system, we obtained much more general results on the qualitative properties of the solutions for (1).

4. List of Participants

Name	Affiliation
郭伦	复旦大学
韩敬文	上海交通大学
何小清	华东师范大学
黄侠	华东师范大学
黄耿耿	复旦大学
黄安祥	上海交通大学
姬超	华东理工大学
柯伟	复旦大学
来米加	上海交通大学
李从明	上海交通大学
李思然	上海交通大学
李振杰	上海交通大学
李水木	上海交通大学
李岩	上海交通大学
李若为	复旦大学
廉媛媛	上海交通大学
梁警琦	上海交通大学
刘博	华东师范大学
刘浩	上海交通大学
刘宸恺	上海交通大学
楼元	上海交通大学
吕英姝	复旦大学
马雷	上海理工大学
浦奕星	华东师范大学
沙凯健	上海交通大学
陶有山	上海交通大学
王芳	上海交通大学

王丽萍	华东师范大学
王丽丹	复旦大学
翁良俊	上海交通大学
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周春琴	上海交通大学
周风	华东师范大学
周刚龙	华东师范大学
周岩	上海交通大学
周辉煌	中国科学技术大学
朱萌	华东师范大学
卓然	黄淮学院