# Workshop on Nonlinear Partial Differential Equations XIII

Sep. 24-Sep. 26, 2021

## 1. Workshop Information

Organizing committee:

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|---|---|
| Mijia Lai, | Shanghai Jiao Tong University |
| Congming Li, | Shanghai Jiao Tong University |
| Yuan Lou, | Shanghai Jiao Tong University |
| Fang Wang, | Shanghai Jiao Tong University |
| Kai Zhang, | Shanghai Jiao Tong University |
| Chunqin Zhou, | Shanghai Jiao Tong University |

Venue:

Room 706, No. 6 Building, Science Buildings
Minhang Campus
Shanghai Jiao Tong University
800 Dongchuan Road

Hotel:

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## 2. Schedule

| | Sep. 25, Saturday<br>Room 706, No. 6 Building, Science Buildings (理科楼群 6 号楼, 706) |
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| 8: 50-9: 00 | Opening ceremony |
| 9: 00-9: 50 | **Speaker**: Shujing Pan (潘淑婧)<br>**Chair**: Chunqin Zhou (周春琴)<br><br>**Title**: Free-boundary constant p-mean curvature surfaces intersecting the Pansu sphere |
| 10: 00-10: 50 | **Speaker**: Yingshu Lv (吕英姝)<br>**Chair**: Jiayu Li (李嘉禹)<br><br>**Title**: The uniqueness and existence of steady solutions for the Euler system in an infinitely long nozzle |
| 10: 50-11: 10 | Tea break |
| 11: 10-12: 00 | **Speaker**: Huihuang Zhou (周辉煌)<br>**Chair**: Shibing Chen (陈世炳)<br><br>**Title**: The Yamabe Constants and the First Eigenvalues of Fractional GJMS Operators |
| 12：00-14：30 | Lunch (学术活动中心) |
| | Afternoon |
| 14: 30-15: 20 | **Speaker**: Yuchen Bi (毕宇晨)<br>**Chair**: Fang Wang (王芳)<br><br>**Title**: concentration-compactness of mean field type equations in the critical case |
| 15:30-16: 20 | **Speaker**: Kai Zhang (张凯)<br>**Chair**: Yuan Lou (楼元)<br><br>**Title**: Boundary pointwise regularity and free boundary problems |
| 16: 30-17: 30 | Free discussion |
| 18: 00 | Fat Cat Restaurant (肥猫餐厅) |

## 3. Titles and Abstracts

**(1) Title**: concentration-compactness of mean field type equations in the critical case

**Speaker**: Yuchen Bi (University of Science and Technology of China)

**Abstract**: In this talk, I will introduce recent joint work with Prof. Jiayu Li. We consider mean field type equations in critical case with small perturbations, and describe the behavior of their solutions when volumes concentrate in small regions. In particular, we give an explicit expression of the limit of the corresponding energy functional. As an application, under some geometric conditions, we show the convergence of the corresponding flow equations for arbitrarily initial data.

**(2) Title**: The uniqueness and existence of steady solutions for the Euler system in an infinitely long nozzle

**Speaker**: Yingshu Lv (Fudan University)

**Abstract**: In this talk, we present a Liouville type theorem for Poiseuille flows in the class of incompressible steady inviscid flows in an infinitely long strip. The key point for this Liouville type theorem is that the flows can have stagnation points. With the aid of the delicate analysis on the energy minimizers, we show the global existence of steady incompressible Euler flows in infinitely long nozzles and Euler flows tend to the Poiseuille flows in the upstream. Furthermore, the uniqueness of the flows is established as long as horizontal velocity of the flow is positive and tends to the horizontal velocity of Poiseuille flows in the upstream. This is a joint work with Professor Congming Li and Professor Chunjing Xie.

**(3) Title**: Free-boundary constant p-mean curvature surfaces intersecting the Pansu sphere

**Speaker**: Shujing Pan (University of Science and Technology of China)

**Abstract**: In this talk, we will introduce the notion of free boundary constant p-mean curvature (CPMC) surface in a 3-dimensional pseudo-Hermitian manifold N with boundary M. It arises as the critical point of p-area among surfaces which divides N into two subsets of preassigned volumes and whose boundary is free to move in M. We introduce a stability criterion for free boundary CPMC surfaces. When M

is the Pansu sphere in the Heisenberg group $H_1$ and N is the interior of M, we introduce examples of free boundary CPMC surfaces which are rotationally symmetric about the t-axis of $H_1$.

**(4) Title**: Boundary pointwise regularity and free boundary problems

**Speaker**: Kai Zhang (Shanghai Jiao Tong University)

**Abstract**: In this talk, we prove a higher order boundary pointwise regularity for uniformly elliptic equations. Based this pointwise regularity, we give a simple and direct proof of the regularity of free boundaries in obstacle-type problems. Furthermore, tshe one-phase free boundary problems can be treated similarly.

**(5) Title**: The Yamabe Constants and the First Eigenvalues of Fractional GJMS Operators

**Speaker**: Huihuang Zhou (Shanghai Jiao Tong University)

**Abstract**: In this talk, we mainly consider fractional GJMS operators $P^{2\gamma}$ on the conformal infinity $(M^n,[\hat{g}])$ of a conformally compact Einstein manifold $(X^{n+1},g_+)$. We derive some inequalities between the Yamabe constants and the first eigenvalues associated to $P^1$ and $P^2$, and prove some rigidity theorems by characterizing the equalities. We also provide a new lower bound for the relative volume inequality for $(X^{n+1},g_+)$, as well as its applications in the rigidity theorem for CCE. This is a joint work with Fang Wang.

## 4. List of Participants

| Name | Affiliation |
| --- | --- |
| 毕宇晨 | 中国科学技术大学 |
| 陈世炳 | 中国科学技术大学 |
| 黄耿耿 | 复旦大学 |
| 来米加 | 上海交通大学 |
| 李从明 | 上海交通大学 |
| 李嘉禹 | 中国科学技术大学 |
| 李振杰 | 上海交通大学 |
| 廉媛媛 | 上海交通大学 |
| 梁警琦 | 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 |
| 牛亚婷 | 复旦大学 |
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| 王芳 | 上海交通大学 |
| 王丽丹 | 上海交通大学 |
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| 谢春景 | 上海交通大学 |
| 徐美清 | 上海交通大学 |
| 杨帆 | 上海交通大学 |
| 张凯 | 上海交通大学 |
| 周春琴 | 上海交通大学 |
| 周辉煌 | 上海交通大学 |