



# Workshop on Differential Equations and Applications

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2022年10月15日

上海交通大学数学科学学院

黄淮学院数学与统计学院

## Workshop on Differential Equations and Applications

为更好地了解微分方程研究进展，进一步增强国内微分方程及应用领域的学术交流，将于 2022 年 10 月 15 日举办“Workshop on Differential Equations and Applications”，围绕微分方程以及相关领域的前沿问题和最新研究进展进行讨论。本次活动由上海交通大学数学科学学院主办，黄淮学院数学与统计学院协办，以线上形式举行。

### 组织委员会（按字母顺序排列）

楼元(上海交通大学) 陶有山(上海交通大学) 卓然(黄淮学院)

### 会议联系人

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### 会议时间

2022 年 10 月 15 日 (周六) 腾讯会议 ID: [241-724-340](#)

上海交通大学数学科学学院

黄淮学院数学与统计学院

2022 年 10 月

# 会议日程

2022年10月15日(北京时间) 腾讯会议 ID: <a href="#">241-724-340</a>			
时间	报告人	题目	主持人
8:40-8:45	开幕式		楼元
8:45-9:30	简怀玉	蒙日-安培方程的 Schauder 正则性和 Liouville 定理	李从明
9:30-10:15	郭玉劲	Refined expansions of ground states for attractive Bose-Einstein condensates	朱长江
休息 10:15-10:30			
10:30-11:15	杨孝平	Quantitative property of solutions to some elliptic equations	彭双阶
11:15-12:00	李学志	Modeling syphilis and HIV coinfection: A case study in the US	宋新宇
休息 12:00-15:00			
时间	报告人	题目	主持人
15:00-15:45	王学锋	Principal spectral theory and variational characterizations for cooperative systems with nonlocal diffusion	陶有山
15:45-16:30	李海刚	Babuska problem in composite materials and its application to acoustic resonators	卓然
休息 16:30-16:45			
16:45-17:30	李东升	Calderon-Zygmund estimates for elliptic equations on non-smooth domains	陈化
17:30-17:40	闭幕式		楼元

## 报告题目与摘要

(按报告人姓名字母顺序排列)

### **Refined expansions of ground states for attractive Bose-Einstein condensates**

郭玉劲

华中师范大学

This talk is focussed on ground states of two-dimensional attractive Bose-Einstein condensates (BECs) in the rotational trap. We discuss mainly the refined expansions of ground states for attractive BECs and illustrate how the trapping Potential  $V(x)$  affects ground states.

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### **蒙日-安培方程的 Schauder 正则性和 Liouville 定理**

简怀玉

清华大学数学科学系

这个报告首先综述蒙日-安培方程的 Schauder 估计和 Liouville 型定理，然后介绍蒙日-安培方程斜导数边值问题的最近研究成果，包括广义解的 Schauder 正则性以及半空间中的 Liouville 定理。最后我们给出半空间中一类奇异蒙日-安培方程的无穷远处的渐进性质。

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### **Calderon-Zygmund estimates for elliptic equations on non-smooth domains**

李东升

西安交通大学

Calderon-Zygmund estimates play a key role in the regularity of elliptic and parabolic equations, which give the  $L^p$  integral estimates for the second order derivatives of the solutions. In this talk, we will establish Calderon-Zygmund estimates for elliptic equations on  $C^{1,\alpha}$  domains. The classical method, straightening the boundary, is not applicable since the domain is not  $C^{1,1}$  which is the standard assumption to derive the estimates. Both linear and fully nonlinear equations will be considered. Our main idea is to use Whitney cover lemma to transfer the boundary estimates to the interior estimates.

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**Babuska problem in composite materials and its application to acoustic resonators**

李海刚

北京师范大学

A long-standing area of material science has been the study of electrostatic and elastic fields in composite material. For a general elliptic system, when the coefficients are piecewise Hölder continuous and uniformly bounded, an  $\varepsilon$ -independent bound of the gradient was obtained by Li and Nirenberg, where  $\varepsilon$  represents the distance between the interfacial surfaces. However, in high-contrast composites, when  $\varepsilon$  tends to zero, the stress always concentrates in the narrow regions. As a contrast to the boundedness result of Li and Nirenberg, in order to investigate the role of  $\varepsilon$  played in such kind of concentration phenomenon, in this talk we will show the blow-up asymptotic expressions of the gradients of the variational solutions to the Lamé system with partially infinite coefficients in dimensions two and three. This completely solves the Babuska problem on blow-up analysis of stress concentration in high-contrast composite media. Recently, we extend our method to deal with the resonant behavior between two close-to-touching convex acoustic subwavelength resonators.

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**Modeling syphilis and HIV coinfection: A case study in the US**

李学志

河南财政金融学院

Syphilis and HIV infections form a dangerous combination. In this paper, we propose an epidemic model of HIV-syphilis coinfection. The model always has a unique disease-free equilibrium, which is stable when both reproduction numbers of syphilis and HIV are less than 1. If the reproduction number of syphilis (HIV) is greater than 1, there exists a unique boundary equilibrium of syphilis (HIV), which is locally stable if the invasion number of HIV (syphilis) is less than 1. Coexistence equilibrium exists and is stable when all reproduction numbers and invasion numbers are greater than 1. Using data of syphilis cases and HIV cases from the US for model calibration, we estimated that both reproduction numbers for syphilis and HIV are

slightly greater than 1, and the boundary equilibrium of syphilis is stable. In addition, we observed competition between two diseases. Treatment for primary syphilis is more important in mitigating the transmission of syphilis. However, it might lead to increase of HIV cases. The results derived here could be adapted to other multi-diseases in other regions.

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**Principal spectral theory and variational characterizations for cooperative systems with nonlocal diffusion**

王学锋

香港中文大学（深圳）

We study a general class of cooperative systems with nonlocal diffusion operators that may or may not be coupled. These systems are either “strong” in cooperation or “strong” in the coupling of the nonlocal diffusion operators, and in the former case, diffusion may not occur in some of the components of the system at all. We prove results concerning the existence, uniqueness, multiplicity, variational characterizations of the principal eigenvalue of the system, the spectral bound, the essential spectrum, and the relationship between the sign of principal eigenvalue and the validity of the maximum principle. We do so using an elementary method, without resorting to Krein-Rutmen theorem. This is a joint work with Yuanhang Su and Ting Zhang.

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**Quantitative property of solutions to some elliptic equations**

杨孝平

南京大学

In this talk, we will discuss some quantitative properties of solutions to some elliptic equations, that include quantitative unique continuation, quantitative propagation of smallness and measure upper bounds of nodal sets, by introducing the frequency functions and doubling index, establishing some elliptic estimates, monotonicity properties and three ball theorems.