流体力学中的偏微分方程
研讨会

2023年7月15–16日

河南 · 郑州

郑州轻工业大学 数学与信息科学学院

流体力学中的偏微分方程研讨会简介

为了交流流体力学中非线性偏微分方程的最新研究进展与成果，加强郑州轻工业大学数学与信息科学学院偏微分方程研究团队与国内高校和科研院所的学术交流与合作，郑州轻工业大学数学与信息科学学院将于 2023 年 7 月 15、16 日，通过腾讯会议平台，举办"流体力学中的偏微分方程研讨会"。

本次会议拟邀请多位国内偏微分方程领域的杰出专家和知名学者，介绍该领域的最新研究成果和动态。

组织委员会人员列表

组织委员会主席	郭晓丽
组织委员	黄守佳 黄士国 何国亮 许振华 王艳青 刘静静 王淑娟 王洪霞

会议时间：**2023 年 7 月 15、16 日**

腾讯会议号：**524-7157-4253**

会议密码：　**202307**

主办单位：郑州轻工业大学数学与信息科学学院

资助单位：国家自然科学基金委、河南省科技厅、郑州轻工业大学

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会议议程

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2023 年 7 月15 日 上午			
时间	报告人	题目	主持人
8:20-8:30		开幕式致辞 郑州轻工业大学黄士国教授、首都师范大学酒全森教授	何国亮
8:30-9:20	谢春景	Removable singularity and asymptotic behavior for steady Navier-Stokes system in high dimensions	酒全森
9:20-10:10	李进开	Inhomogeneous regularities and uniform boundedness of entropy to compressible Navier-Stokes in multi-dimensions	酒全森
10:10-10:20		茶歇	
10:20-11:10	王文栋	Singularity analysis of a class of chemotaxis-Navier-Stokes equations	周道国
11:10-12:00	江 飞	Rayleigh-Taylor Instability in Stratified Compressible Fluids	周道国
12:00-14:30		午休	
2023 年 7 月15 日 下午			
时间	报告人	题目	主持人
14:30-15:10	薛留堂	Emergence of time periodic solutions for the generalized surface quasi-geostrophic equation in the disc	刘继涛
15:10-15:50	郑继强	Threshold dynamics for the 3d radial cubic-quintic NLS	刘继涛
15:50-16:30	张 谦	Remarks on the incompressible coupled chemotaxis-fluid equations	田苗青
16:30-16:40		茶歇	
16:40-17:20	郑孝信	Self-similar solutions for the incompressible Navier-Stokes equations with critical-dissipation	徐夫义
17:20-18:00	王跃循	Global Existence Versus Wave Breaking for the (Modified) Fractional Korteweg- de Vries Equations	徐夫义

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2023 年 7 月16日 上午			
时间	报告人	题目	主持人
8:30-9:10	姬瑞红	Some recent results on the stability of the incompressible fluid equations with partial dissipation	何国亮
9:10-9:50	李明杰	Global strong solutions to the Cauchy problem for planar magnetohydrodynamic equations with large initial data	何国亮
9:50-10:30	于 幻	Long time behaviour of weak solutions to 3D damped Navier-Stokes equations and the generalized SQG equations	王淑娟
10:30-10:40	茶歇		
10:40-11:20	裴 龙	The symmetry of periodic traveling waves for nonlocal dispersive equations	刘静静
11:20-12:00	张腾飞	From kinetic flocking model of Cucker-Smale type to self-organized hydrodynamic model	刘静静
12:00-14:30	午休		
2023 年 7 月16日 下午			
时间	报告人	题目	主持人
14:30-15:10	牛冬娟	Stability and large-time behavior of 2D tropical climate model with zero thermal dissipation	王艳青
15:10-15:50	杨佳琦	On Leray's problem with the Navier-slip boundary condition	王艳青
15:50-16:30	潘星宏	Finite speed axially symmetric Navier-Stokes flows passing a cone	王艳青
16:30-16:40	茶歇		
16:40-17:20	李自来	Global Classical Solutions to the Viscous Two-Phase Flow Model with Navier-type Slip Boundary Condition in 2D Bounded Domains	窦昌胜
17:20-18:00	赵杰风	Ill-posedness for 2D resistive MHD equations	窦昌胜

报告题目与摘要

Removable singularity and asymptotic behavior for steady Navier-Stokes system in high dimensions

谢春景（上海交通大学）

In this talk, we will discuss this rigidity result to a most general scaling-invariant class. We proved that any stationary solutions u satisfying $|u(x)| \leq C/|x|$ in $\mathbb{R}^n \setminus \{0\}, n \geq 4$, are trivial, eliminating a more general possibility of singularity. Here, we do not assume any type of self-similarity. With the aid of this powerful took, we proved the removable singularity and far field asymptotic behavior for steady Navier-Stokes system in high dimensions.

Inhomogeneous regularities and uniform boundedness of entropy to compressible Navier-Stokes in multi-dimensions

李进开（华南师范大学）

In this talk, we will consider the following two issues for the Cauchy problem to the heat conductive compressible Navier-Stokes equations in the presence of far field vacuum: (i) regularities of solutions in the inhomogeneous Sobolev spaces; (ii) uniform boundedness of the entropy. The previous works concerning these two issues focus on the case in one dimension. While in this talk, we will update the results for the case in multi-dimensions. This talk is based on a recent joint work with Prof . Zhouping Xin.

Singularity analysis of a class of chemotaxis-Navier-Stokes equations

王文栋（大连理工大学）

In this talk we will recall the background and research progress of some chemotactic fluids. Specifically, we will introduce suitable weak solutions for chemotactic fluids and investigate the Hausdorff dimension of these vortices (singular points) by considering partial regularity of weak solutions at the first blow-up time. The new ingredients are to establish certain type of local energy inequality and deal with the non-scaling invariant quantity of n ln n.

Rayleigh-Taylor Instability in Stratified Compressible Fluids

江飞（福州大学）

Guo--Tice obtained the conclusion that the internal surface tension can not inhit the Rayleigh--Taylor instability in the stratified (compressible viscous) fluids, the flow of which is not horizontally periodic, by applying a so-called ``normal mode" method to the linearized (partical differential) equations in 2011. However it is a long-standing problem whether Guo--Tice's conclusion can be verified by the nonlinear (original) equations, due to the failsure of the construction of RT instbality solutions of the linearized equations (in an infinite slab domain). In this paper, we do not try to fix the construction problem of linear RT instbality solutions, but evelop a new alternative method, i.e. using the linear RT nstability solutons in the stratified fluids with horinzontally periodic flow to approximately construct the RT instability solutions, which is not horizontally periodic. Thanks to the new approximate method, we can rigorously prove the Guo--Tice's conclusion based on the nonlinear (original) equations by expoiting the Guo--Hallstrom--Spirn's bootstrap instablity method.

Emergence of time periodic solutions for the generalized surface quasi-geostrophic equation in the disc

薛留堂（北京师范大学）

In this talk we address the existence of time periodic solutions for the generalized inviscid SQG equation in the unit disc with homogeneous Dirichlet boundary condition when $\alpha \in (0,1)$. We show the existence of a countable family of bifurcating curves from the radial patches. In contrast with the preceding studies in active scalar equations, the Green function is no longer explicit and we circumvent this issue by a suitable splitting into a singular explicit part (which coincides with the planar one) and a smooth implicit one induced by the boundary of the domain. Another problem is connected to the analysis of the linear frequencies which admit a complicated form through a discrete sum involving Bessel functions and their zeros. We overcome this difficulty by using Sneddon's formula leading to a suitable integral representation of the frequencies.

Threshold dynamics for the 3d radial cubic-quintic NLS

郑继强（北京应用物理与计算数学研究所）

In this talk, we consider the nonlinear Schrödinger equation(NLS) with focusing quintic and defocusing cubic nonlinearity in three space dimensions. In [Miao-Xu-Zhao, CMP, 13] and [Xu-Zhao, JDE, 20], the authors classified the dynamics of solutions under the energy constraint E(u)< E^c(W), where W is the quintic NLS ground state and E^c is the quintic NLS energy. In this work we classify the dynamics of H^1 solutions at the threshold E(u)=E^c(W). This work is jointed with Alex H. Ardila and Jason Murphy.

Self-similar solutions for the incompressible Navier-Stokes equations with critical-dissipation

郑孝信（北京航空航天大学）

In this talk, we show the global regularity and the optimal decay of weak solutions to the generalized Leray problem with critical dissipation. Our method is based on the maximal smoothing effect, $W^{2,p}(R^3)$ -type theory of linearization, and the action of the heat semigroup generated by the fractional powers of Laplace operator on distributions with Fourier transforms supported in an annulus. As a by-product, we shall construct a self-similar solution to the tree-dimensional Navier-Stokes equations, and more importantly, prove the global regularity and the optimal decay without additional requirement.

Long time behaviour of weak solutions to 3D damped Navier-Stokes equations and the generalized SQG equations

于幻（北京信息科技大学）

In this talk, we focus on the long time behaviour of the weak solutions to the three-dimensional (3D) Navier-Stokes equations with damping term and the generalized surface quasi-geostrophic equation(SQG). By introducing a time-dependent frequency cut-off estimate of or to gain the smallness via three steps in different directions, I will first derive the optimal decay rates of the -norm of the weak solutions to the 3D damped Navier-Stokes equations with ; I will also prove that the weak solutions of the generalized surface quasi-geostrophic equation decay to zero in as time tends to infinity. As a result, our results extend the corresponding results by Tianyi Yang and Zhaoyun Zhang(ZAMP,2020) and Zhuan Ye (JFA, 2022).

Remarks on the incompressible coupled chemotaxis-fluid equations

张谦（河北大学）

In this talk, we discuss the global well-posedness and global-in-time boundedness of solutions to the incompressible coupled chemotaxis-fluid equations in R^3. Using the geometry structure of axisymmetric flow without swirl and local-in-space estimates, we improve some previous results.

Stability and large-time behavior of 2D tropical climate model with zero thermal dissipation

牛冬娟（首都师范大学）

In this talk, we are concerned with stability problem and large-time behavior of 2D tropical climate model with zero thermal dissipation under small initial data. The first one studys that stability of Couette flow to the system with $-\Delta u$, $-\Delta v$ and a damping term v in the domain $T \times R$. The key is fully utilizing the enhanced dissipation created by the operator $y\partial x - v\Delta$ and construction of the Fourier operator M. It is emphasized that the absences of thermal dissipation and divv = 0 cause great difficulties to solve the stability problem.By exploiting the structure of the system, we establish the expected stability results. The second one studys the global well-posedness and large time behavior of solutions of the system with $-\Delta u$ and a damping term v in the whole space. The key ingredient here is the explicit large-time decay rate of solutions.

Global strong solutions to the Cauchy problem for planar magnetohydrodynamic equations with large initial data

李明杰（中央民族大学）

In this talk, we consider the Cauchy problem to the compressible planar magnetohydrodynamic equations without heat conduction, and establish the local and global existence and uniqueness of strong solutions with general large initial data. This is a joint work with Professor Jinkai Li.

Global Existence Versus Wave Breaking for the (Modified) Fractional Korteweg-de Vries Equations

王跃循（兰州大学）

We review some global existence and wavebreaking results for the (modified) fractional KdV equations.

The symmetry of periodic traveling waves for nonlocal dispersive equations

裴龙（中山大学）

We consider the a priori symmetry of traveling wave solutions of a general class of nonlocal dispersive equations. We formulate a reflection criterion which does not presuppose a monotone structure on the wave profile. The result applies not only to smooth traveling wave solutions, but also to those with singular crests around which some cancellation structure appears, including in particular waves with peaks or cusps.

From kinetic flocking model of Cucker-Smale type to self-organized hydrodynamic model

张腾飞（中国地址大学（武汉））

In this talk, I will discuss our recent results on the hydrodynamic limit problem for a kinetic flocking model of Cucker-Smale type. Using the Cucker-Smale model as an example, we develop systematically a GCI-based expansion method, and micro-macro decomposition on the dual space, to justify the limits to the macroscopic system, a non-Euler type hyperbolic system. We believe our method has widely application in the collective motions and active particle systems. This is a joint work with Prof. Ning JIANG and Prof. Yi-Long LUO.

Finite speed axially symmetric Navier-Stokes flows passing a cone

潘星宏（南京航空航天大学）

Let D be the exterior of a cone inside a ball, with its altitude angle at most $\pi/6$ in R^3, which touches the x_3 axis at the origin. For any initial value u_0 lying in a $C^2(\bar{D})$ class, which has the usual even-odd-odd symmetry in the x_3 variable and has the partial smallness only in the swirl direction: $ru_{0,\theta} \leq 1/100$, the axially symmetric Navier-Stokes equations with Navier-Hodge-Lions slip boundary condition has a finite-energy solution that stays bounded for all time. In particular, no finite-time blowup of the fluid velocity occurs. Compared with standard smallness assumptions on the initial velocity, no size restriction is made on the components $u_{0,r}$ and $u_{0,3}$. In a broad sense, this result appears to solve 2/3 of the regularity problem of ASNS in such domains in the class of solutions with the above symmetry. This talk is based on joint works with Zijin Li, Xin Yang, Chulan Zeng, Qi S. Zhang and Na Zhao

On Leray's problem with the Navier-slip boundary condition

杨佳琦（西北工业大学）

The original Leray's problem concerns the well-posedness of weak solutions to the steady incompressible Navier-Stokes equations in a distorted pipe, which approach to the Poiseuille flow subject to the no-slip boundary condition at spacial infinity. In this talk, we will discuss the same problem with the Navier-slip boundary condition instead of the no-slip boundary condition. Our recent developments on this aspect will be presented. This is a joint work with Zijin Li and Xinghong Pan.

Some recent results on the stability of the incompressible fluid equations with partial dissipation

姬瑞红（成都理工大学）

In this talk, we will present some recent results on the stability and large-time behavior of the incompressible anisotropic fluid equations with partial dissipation. We present a systematic approach to obtain the stability and the optimal decay rates of the solutions emanating from small data

Global Classical Solutions to the Viscous Two-Phase Flow Model with Navier-type Slip Boundary Condition in 2D Bounded Domains

李自来（河南理工大学）

We consider the viscous two-phase flow model with Navier-type slip boundary condition in a two-dimensional simply connected bounded domain with smooth boundary. Based on some new estimates of effective viscous flux on boundary integrals related to the Navier-type slip boundary condition, we establish the global existence and large time behavior of the classical solutions to two-phase flow model in time provided the initial energy is suitably small even if the density contains vacuum and has large oscillations. This is the first result concerning the global existence of classical solutions to the viscous two-phase flow model with density containing vacuum initially for general 2D bounded smooth domain.

Ill-posedness for 2D resistive MHD equations

赵杰风（河南理工大学）

It is well-known that the global well-posedness on the 2D resistive MHD equations without kinematic dissipation remains an outstanding open problem. And the vorticity plays a very important role in studying this problem. In this talk, we will construct a sequence of initial data near a special steady state for 2d resistive MHD equations to show that the L^{∞}-norm of vorticity is mildly ill-posed

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