首都师范大学数学科学学院

School of Mathematical Sciences Capital Normal University

Workshop on Nonlinear PDE Theory and Applications

2021 年 12 月 4-5 日

首都师范大学

一、会议信息

首都师范大学数学科学学院拟于 2021 年 12 月 4 日至 5 日举办“2021年非线性偏微分方程理论及相关应用”线上学术会议。本次会议将邀请偏微分方程领域的优秀青年学者，围绕流体力学中的偏微分方程理论及其应用展开研讨，通过报告相关领域的最新研究成果及发展动态，进一步加强学术交流与合作研究， 并为青年教师和研究生提供学习和交流的平台。

会议组织者（按照拼音排序）**：**

段祥龙 酒全森 李海梁 牛冬娟 王越 吴雅萍

线上腾讯会议：

会议 ID: 928 1307 8115

会议密码: 8278

会议链接：https://meeting.tencent.com/dm/B5lrJKrwczix

二、日程表

日期	时间	报告人	事项	主持人
12 月 4 日	8:30-8:40	开幕式		
	8:40-9:20	赵立丰（中国科学技术大学）	Shock Formation of 3D Euler-Poisson System for Electron Fluid	李海梁
	9:20-10:00	黄丙康（合肥工业大学）	Existence and stability of dissipative measure-valued solutions to the compressible MHD system	
	10:00-10:20	茶歇		
	10:20-11:00	王天怡（武汉理工大学）	On continuous solution of compressible Euler equations	张挺
	11:00-11:40	陈世炳（中国科学技术大学）	On the uniqueness of solitons to the anisotropic gauss curvature flow	
	11:40-14:00	午休		
	14:00-14:40	段祥龙（首都师范大学）	From conservative to dissipative systems through quadratic change of time	吴雅萍
	14:40-15:20	许文兵（首都师范大学）	Acceleration among species in cooperative systems	
	15:20-15:40	茶歇		
	15:40-16:20	郑孝信（北京航空航天大学）	Regular solutions to the generalized Leray equations	牛冬娟
	16:20-17:00	曹文涛（首都师范大学）	Global bounded weak solutions to the Euler-Vlasov equations in fluid-particle system	

日期	时间	报告人	事项	主持人
12 月 5 日	**8:30-9:10**	**费明稳** （安徽师范大学）	Sharp interface limit of a matrix-valued Allen-Cahn equation	**王伟**
	9:10-9:50	**童嘉骏** （北京大学）	On the Free Boundary Evolution in a Tumor Growth Model with Nutrient	
	9:50-10:10	**茶歇**		
	10:10-10:50	**王艳青** （郑州轻工业大学）	Leray’s backward self-similar solutions to the 3D Navier-Stokes equations in Morrey spaces	**酒全森**
	10:50-11:30	**王越** （首都师范大学）	Asymptotic behavior of the steady Prandtl equation	
	11:30-14:00	**午休**		
	14:00-17:00	**分组讨论**		

三、报告题目与摘要

Shock Formation of 3D Euler-Poisson System for Electron Fluid

赵立丰（中国科学技术大学）

We consider shock formation for 3D Euler-Poisson system for electron fluid in plasma. The shock solution we construct is of large initial data, also compactly supported during the lifespan. In addition, the blowup time and location can be computed explicitly. This talk is based on joint work with Yiya Qiu.

Existence and stability of dissipative measure-valued solutions to the compressible MHD system

黄丙康（合肥工业大学）

In this paper, we are concerned with dissipative measure-valued (DMV) solutions to the compressible Magnetohydrodynamics (MHD). The existence of the DMV solutions is established. Moreover, the strong solutions remain stable in this class of generalized solution. Precisely, we show that a DMV solution is the same as the strong solution if they have same initial data.

On continuous solution of compressible Euler equations

王天怡（武汉理工大学）

In this talk, we will consider two progresses on the continuous solutions of compressible Euler equations. For the multiple space dimensional case, we prove the break-down of classical solutions with a large class of initial data by tracking the propagation of radially symmetric expanding wave including compression. The singularity formation is corresponding to the finite time shock formation. We also constructed two types of continuous solution with uniform bounds on velocity and density. For the vanishing pressure limit, which formulated as small parameter \epsilon goes to 0. Due to the characteristics are degenerated in the limiting process, the resonance may cause the

mass concentration. It is shown that in the pressure vanishing process, for the isentropic Euler equations, the continuous solutions with compressive initial data converge to the mass concentration solution of pressureless Euler equations, and with rarefaction initial data converge to the continuous solutions globally. It is worth to point out: u converges in C^1, while \rho converges in C^0, due the structure of pressureless Euler equations. To handle the blowup of density \rho and spatial derivatives of velocity u, a new level set argument is introduced. Furthermore, we consider the convergence rate respect to \epsilon, both u and the area of characteristic triangle are \epsilon order, while the rates of \rho and u_x depend on the further regularity of the initial data of u. These are the joint work with Hong Cai, Geng Chen, and Wen-Jian Peng.

On the uniqueness of solitons to the anisotropic gauss curvature flow

陈世炳(中国科学技术大学)

We will discuss the uniqueness of self-similar solutions to the anisotropic gauss curvature flow in \mathbb{R}^3. It is believed that the uniqueness fails in general. In this talk, we will discuss the case when the speed function is a small perturbation of a constant.

From conservative to dissipative systems through quadratic change of time

段祥龙（首都师范大学）

There are many examples of dissipative systems that can be derived from conservative ones. A classical example is the heat equation (or more generally the porous medium equation) that can be derived from the Euler equations of isentropic gases. The derivation can be done in many ways. In this talk, we will focus on a very straightforward idea: just perform the quadratic change to the time variable \theta=t^2/2.

Acceleration among species in cooperative systems

许文兵（首都师范大学）

It is well-known that in a monostable nonlocal dispersal scalar equation, the spreading speed for thin-tailed dispersal kernel is finite, and the spreading speed for heavy-tailed dispersal kernel is infinite (namely, acceleration propagation happens). However, in cooperative systems, we find that some species can propagate by accelerating although its dispersal kernel is thin-tailed. More precisely, we show that the spatial propagation of every species at large time is mainly determined by the tail of the maximum of their dispersal kernels, which further implies that their spatial propagation is accelerated by each other because of the cooperation relation between them. This gives us a new understanding of the cooperation relation in the spatial propagation of nonlocal dispersal cooperative systems.

Regular solutions to the generalized Leray equations

郑孝信（北京航空航天大学）

In this talk, we address regularity for weak solutions to the generalized Leray equations which arises from the study of self-similar solutions to the generalized Naiver-Stokes equations in R^3.

Global bounded weak solutions to the Euler-Vlasov equations in fluid-particle system

曹文涛（首都师范大学）

In this talk, we consider a fluid-particle system which describes the evolution of a two-phase flow. The system consists of the compressible Euler equations for the fluid (fluid phase) coupled with the Vlasov equation for the particles (disperse phase) through the drag force. We obtain a global bounded weak solution for such one-dimensional Euler-Vlasov equations with arbitrarily large initial data for the whole range of physical adiabatic exponents \gamma>1. To achieve this, we apply vanishing viscosity method and compensated compactness theory. We construct globally

defined approximate solutions by adding our novel viscosity terms to the Euler equations, which together with our key observation on relative velocity plays a fundamental role in the hardest part of our proof: the uniform L^\infty estimate. After deriving entropy dissipation estimate, we prove the convergence of approximate solutions by the compensated compactness argument. This talk is based on a joint work with Prof. Peng Jiang from Hohai University.

Sharp interface limit of a matrix-valued Allen-Cahn equation

费明稳（安徽师范大学）

In this talk we consider the sharp interface limit of a matrix-valued Allen-Cahn equation. We show that the sharp interface limit system is a two-phases flow system: the interface evolves according to the motion by mean curvature; in the two bulk phase regions, the solution obeys the heat flow of harmonic maps with values in the sets of nˆn orthogonal matrices with determinant 1 and -1 respectively; on the interface, the phase matrices in two sides satisfy a novel mixed boundary condition. The above result provides a solution to the Keller-Rubinstein-Sternberg's (conjecture) problem in the orthogonal matrix setting. This is a joint work with Prof. Fanghua Lin, Prof. Wei Wang and Prof. Zhifei Zhang.

On the Free Boundary Evolution in a Tumor Growth Model with Nutrient

童嘉骏（北京大学）

We study a free boundary problem that naturally arises in a 2-D tumor growth model with nutrient. In this model, the tumor cells proliferate by consuming the nutrient locally, and meanwhile they migrate into ambient empty space because of an incompressibility constraint on the cell density. We shall focus on evolution of the tumor boundary, which couples strongly with the dynamics of nutrient in the bulk. We will show, under suitable assumptions, global well-posedness of evolution of the tumor boundary, provided that it is initially close to a circle. We will also establish its long-time convergence to a circular shape as well as a (sharp) decay estimate. Discussions will be made on several related problems.

Leray's backward self-similar solutions to the 3D Navier-Stokes equations in Morrey spaces

王艳青（郑州轻工业大学）

In 1934, Leary suggested the one seek the non-zero backward self-similar solutions to construct singular solutions to the 3D Navier-Stokes equations. The first breakthrough of backward self-similar solutions was due to Necas-Ruzicka-Sveraks in 1996. They ruled out the existence of Leray's backward self-similar solutions to the 3D Navier-Stokes system if a weak solution $u(x,t)=\frac{1}{\sqrt{2a(T-t)}}U(\frac{x}{\sqrt{2a(T-t)}})$ is in $L^3(R^3)$. Later, Tsai extended their results to usual Lebesgue spaces $L^p(R^3)$ with $p \geq 3$. Tsai's second result is that there does not exist a non-trivial backward self-similar solution if u satisfy the local energy inequality. Very recently, Chae-Wolf and Guevara-Phuc independently studied this issue in Lorentz spaces and Morrey spaces. I will report some new results in Morrey spaces in this direction. This talk is based on the joint work with Prof. Quansen Jiu and Dr. Wei Wei.

Asymptotic behavior of the steady Prandtl equation

王越（首都师范大学）

For the 2-D steady Prandtl Equations, Oleinik proved the global-in-x existence of solutions in the case of favorable pressure gradient. For the asymptotic behavior of the Oleinik's solution to the steady Prandtl equation when the outer flow U(x) = 1, Serrin proved that the Oleinik's solution converges to the famous Blasius solution u_B in L ∞ sense and Iyer proved the explicit decay estimates of u − u_B and its derivatives when the initial data is a small localized perturbation of the Blasius profile. In this talk, I will first review some related results and then report our recent works for the decay estimate of u − u_B for general initial data with exponential decay and the decay estimates of its derivatives when the initial data has an additional concave assumption. The proof is based on the maximum principle.