天元數學國際交流中心
Tianyuan Mathematics Research Center

Workshop on Fluid and Kinetic Partial Differential Equations

Organizer

José A. Carrillo

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Conference Program

Yunnan · Kunming

July 19–25, 2026

Introduction to the Tianyuan Mathematics Research Center

The Tianyuan Mathematics Research Center (hereinafter referred to as "the Center") was established in July 2023. Jointly developed under the Tianyuan Fund of the National Natural Science Foundation of China and a funding program of the National Development and Reform Commission, it serves as a platform for academic exchange in mathematics and interdisciplinary sciences. The Center is affiliated with the Academy of Mathematics and Systems Science, Chinese Academy of Sciences.

The Center is situated in a national-level public-welfare forest within the Chaishitan Reservoir area in Yiliang County, Kunming, Yunnan Province. Surrounded by mountains on three sides and facing the water on the fourth, it enjoys beautiful scenery and a pleasant climate. Located at an elevation of 1,700 meters, the Center is approximately 90 kilometers from Kunming Changshui International Airport, or about a 1.5-hour drive. It is 30 kilometers from the Stone Forest Scenic Area and 20 kilometers from the Jiuxiang Scenic Area. The site covers approximately 27,000 m², including about 19,000 m²of landscaped grounds, with a total floor area of approximately 6,000 m^2. The Center comprises three main two-story buildings: the Research Building, the Guest House, and the Logistics and Support Building. The Guest House contains 50 rooms, including 41 rooms with one 1.5-meter-wide bed and nine standard twin rooms, each furnished with two 1.2-meter-wide beds. Every room has a private bathroom and shower facilities. The building is equipped with four staircases and two elevators, and a meditation pavilion is located in the inner courtyard. Additional facilities include public restrooms, linen rooms, and laundry rooms. A self-service coffee machine is available in the second-floor common lounge, while a self-service laundry room with a combined washer-dryer is located in the southwest corner of the second floor.

The Research Building includes a relatively self-contained main lecture hall equipped with a high-definition LED screen and vertically sliding blackboards, with seating for up to 100 people. It also contains one medium-sized conference room (80 m²) equipped with a high-definition LED screen; four small conference rooms (35 m^2 each), each furnished with a high-definition short-throw projector and a blackboard; 21 seminar rooms/workrooms (20 m²each); one library and reading room; and one café. On the ground floor of the Logistics and Support Building, there is a multipurpose activity room serving as a staff fitness room, with an area of approximately 50 m², as well as seven rooms for the Center's management and service staff, each measuring approximately 20 m². The second-floor dining hall, covering approximately 200 m^2, provides meals for visitors and can accommodate up to 60 diners at one time.

The Center is enclosed by a perimeter wall and is also equipped with a duty room, a fire-water reservoir and pump room, a reclaimed-water treatment facility, and a security surveillance system.

Tianyuan Mathematics Research Center

CONFERENCE INFORMATION

The Workshop on Fluid and Kinetic Partial Differential Equations will be held at the Tianyuan Mathematics Research Centere. The workshop will focus on the well-posedness and long-time behavior of solutions to fluid and kinetic partial differential equations, together with related hydrodynamic limits.

1、Date：

July 19–25, 2026
Registration: July 19
Departure: July 25

2、Venue：

Main Lecture Hall, Ground Floor, Research Building
the Tianyuan Mathematics Research Center, Kunming

3、Accommodation：

Guest House of the Center

4、Meals：

Dining Hall, Second Floor, Logistics and Support Building
Breakfast: 7:30–9:00
Lunch: 11:30–13:30
Dinner: 17:30–19:00

5、Organizing Committee：

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6、Service Contacts

Conference Reception (Research Building): 0871-64993941 (Extension 3941)
Guest House Reception: 0871-64993942 (Extension 3942)
Security Desk: 0871-64993910 (Extension 3910)

IMPORTANT INFORMATION：

1. The Center provides complimentary accommodation and meals for participants, as well as round-trip transportation between the Center and either Kunming Airport or a railway station in Kunming. Participants are responsible for all other travel expenses. Detailed attendance information must be submitted through the Center's website no later than three days before the workshop begins.
2. Wi-Fi is available throughout the Center. The Wi-Fi password is 88888888.
3. A limited number of buckwheat-husk and cassia-seed pillows are available. Please contact the reception desk should you require a replacement pillow.
4. A self-service laundry room equipped with a combined washer-dryer is located in the south-west corner of the second floor of the Guest House.
5. Multifunction printers are available in both the Guest House and the Research Building for printing, copying and scanning documents.
6. As the Center is situated in a relatively remote area, participants are advised to exercise due care and pay close attention to personal safety. A limited supply of basic emergency medication is available at the reception desk.

CONFERENCE PROGRAM

Sunday, July 19, 2026	**Registration and Check-in**
Saturday, July 25, 2026	**Departure**

Monday, July 20, 2026

8:30 am - 9:00 am	**OPENING and GROUP PHOTO**	
Morning Session I **9:00 am - 9:50 am**	**Speaker**	**Chair**
9:00 am - 9:50 am	**Emmanuel Grenier**	**Gui-Qiang G. Chen**
9:50 am - 10:20 am	**TEA BREAK**	
Morning Session II **10:20 am - 12:00 am**	**Speaker**	**Chair**
10:20 am - 11:10 am	**Aneta Wróblewska-Kamińska**	**Renjun Duan**
11:10 am - 12:00 am	**Ruiwen Shu**	
12:00 am - 14:00 pm	**LUNCH BREAK**	
Afternoon Session I **14:00 pm - 15:40 pm**	**Speaker**	**Chair**
14:00 pm - 14:50 pm	**Tianyi Wang**	**Emmanuel Grenier**
14:50 pm - 15：40 pm	**Jiawen Zhang**	
15:40 pm - 16:00 pm	**TEA BREAK**	
Afternoon Session II **16:00 pm - 17:40 pm**	**Speaker**	**Chair**
16:00 pm - 16:50 pm	**Siran Li**	**Tao Wang**
16:50 pm - 17:40 pm	**Weiqiang Wang**	
17:40 pm	**DINNER BREAK**	

Tuesday, July 21, 2026

Morning Session I 9:00 am - 9:50 am	**Speaker**	**Chair**
9:00 am - 9:50 am	**Seung Yeal Ha**	**Jose A. Carrillo**
9:50 am - 10:20 am	**TEA BREAK**	
Morning Session II 10:20 am - 12:00 pm	**Speaker**	**Chair**
10:20 am - 11:10 am	**Tao Wang**	**Xianpeng Hu**
11:10 am - 12:00 am	**Xinyu Wang**	
12:00 am - 14:00 pm	**LUNCH BREAK**	
Afternoon Session I 14:00 pm - 15:40 pm	**Speaker**	**Chair**
14:00 pm - 14:50 pm	**Matthew Schrecker**	**Bobo Hua**
14:50 pm - 15:40 pm	**Jie Ji**	
15:40 pm - 16:00 pm	**TEA BREAK**	
Afternoon Session II 16:00 pm - 17:40 pm	**Speaker**	**Chair**
16:00 pm - 16:50 pm	**Dowan Koo**	**Siran Li**
16:50 pm - 17:40 pm	**Ruijia Yu**	
17:40 pm	**DINNER BREAK**	

Wednesday, July 22, 2026

Morning Session I 9:00 am - 9:50 am	Speaker	Chair
9:00 am - 9:50 am	Renjun Duan	Seung Yeal Ha
9:50 am - 10:20 am	TEA BREAK	
Morning Session II 10:20 am - 12:00 pm	Speaker	Chair
10:20 am - 11:10 am	Dongfen Bian	Yong Wang
11:10 am - 12:00 am	Peter Pang	
12:00 am - 14:00 pm	LUNCH BREAK	
14:00 pm - 17:30 pm	Open Discussion	
17:30 pm	DINNER BREAK	

Thursday, July 23, 2026

Morning Session I 9:00 am - 9:50 am	Speaker	Chair
9:00 am - 9:50 am	Xianpeng Hu	Ming Mei
9:50 am - 10:20 am	TEA BREAK	
Morning Session II 10:20 am - 12:00 pm	Speaker	Chair
10:20 am - 11:10 am	Weiyuan Zou	Tianyi Wang
11:10 am - 12:00 am	Hyangdong Park	
12:00 am - 14:00 pm	LUNCH BREAK	
Afternoon Session I 14:00 pm - 15:40 pm	Speaker	Chair
14:00 pm - 14:50 pm	Fanqin Zeng	Min Ding
14:50 pm - 15:40 pm	Hang Xiong	
15:40 pm - 16:00 pm	TEA BREAK	
Afternoon Session II 16:00 pm - 17:40 pm	Speaker	Chair
16:00 pm - 16:50 pm	Song Liu	Xiao Feng
16:50 pm - 17:40 pm	Gyeonghun Go	
17:40 pm	DINNER BREAK	

Friday, July 24, 2026

Morning Session I 9:00 am - 9:50 am	Speaker	Chair
9:00 am - 9:50 am	Ming Mei	Feimin Huang
9:50 am - 10:20 am	TEA BREAK	
Morning Session II 10:20 am - 12:00 pm	Speaker	Chair
10:20 am - 11:10 am	Yun Pu	Weiyuan Zou
11:10 am - 12:00 am	Samuel Richard Charles	
12:00 am - 14:00 pm	LUNCH BREAK	
14:00 pm - 17:30 pm	Open Discussion	
17:30 pm	DINNER BREAK	

Presentation Information

Dongfen Bian, Beijing Institute of Technology, China
Title: Boundary layers of Navier-Stokes equations
Abstract: The question of the stability of the boundary layers which appear as the viscosity of the fluid goes to zero is a classical question in Fluid Mechanics. In this talk I will discuss recent mathematical results on this question and in particular show that any shear layer is linearly and nonlinearly unstable provided the viscosity is small enough, and that the classical Prandtl boundary layers are always unstable.

Samuel Richard Charles, University of Oxford, UK
Title: Nonlinear stability/instability of steady states of the compressible Euler-Riesz equations
Abstract: The compressible Euler-Riesz equations are fundamental with wide applications in astrophysics, plasma physics, and mathematical biology. We show the nonlinear stability of global finite-energy solutions for the compressible Euler-Riesz equations around steady states by employing concentration compactness arguments. Steady states properties are obtained by variational arguments connecting to recent advances in aggregation-diffusion equations. Moreover, we will investigate how instability can be shown for an isentropic pressure, such an approach heavily relies upon the homogeneity of the pressure/potential terms and the concavity of the free energy with respect to the mass preserving dilation scaling parameter.

Renjun Duan, The Chinese University of Hong Kong, China
Title: A free boundary problem on the Boltzmann equation
Abstract: We concern a free boundary value problem for the Boltzmann equation that models the interaction of a rarefied gas with a moving wall — a classical piston problem in kinetic theory. While free boundary problems for fluid dynamic equations have been extensively investigated, their counterparts for kinetic models remain largely open due to the intrinsic difficulties caused by limited regularity and the strong coupling between particle transport and boundary motion. In the talk, we report a recent result on the topic with focus on the one-dimensional stability issue. Joint with Shengchuang Chang and Shuangqian Liu.

Gyeonghun Go, Academy of Mathematics and Systems Science, China
Title: Global Well-posedness for the Multi-species Boltzmann Equation with Large Amplitude Initial Data
Abstract: This paper establishes the global well-posedness of the multi-species Boltzmann equation with large-amplitude initial data in the periodic domain. In contrast to the single-species case, the multi-species mixture model lacks structural symmetry in its collision operators due to the distinct masses of different species. This asymmetry makes it difficult to obtain pointwise estimates for the nonlinear collision terms. Although the Carleman representation for the mixture

model provides a useful reduction of the collision integral, it does not directly yield the desired estimate. To overcome this difficulty, we identify an additional algebraic cancellation structure which leads to the pointwise estimates for the nonlinear terms. By applying this refined approach, we derive the necessary velocity-weighted L^\infty estimates for the nonlinear terms. Furthermore, under the smallness assumption on the initial relative entropy, we establish a uniform lower bound for the nonlinear collision frequency and prove that the large-amplitude solutions exist globally in time and decay exponentially to the global equilibrium.

Emmanuel Maurice Raymond Grenier, Academy of Mathematics and Systems Science, China

Title: linear stability and instability of BGK waves

Abstract: The BGK waves are particular solutions of the Vlasov – Poisson system, and their stability has been an open problem since their discovery in 1957 by Bernstein, Greene and Kruskal. The aim of this talk is to prove that the stability or instability of small- amplitude BGK waves depends on the derivative of the distribution of energies at the separatrix (work with D. Bian, B. Pausader and W. Huang).

Seung Yeal Ha, Seoul National University, Korea

Title: Exponential flocking of the inertial spin model and its extensions

Abstract: In this talk, we discuss recent progress on the flocking estimates for the inertial spin(IS) model on the three-dimensional Euclidean space, and high-dimensional generalization of the three-dimensional one. For two-dimensional case, it reduces to the inertial Kuramoto model for synchronization. For quantitative flocking estimates, we derive a system of differential inequalities for relative kinetic and spin energies, and explicitly obtain exponential flocking under the proposed frameworks. We also introduce a high-dimensional inertial spin model which generalizes the inertial spin model on three-dimensional Euclidean space and study its emergent behaviors. For the generalization of the IS model to the high-dimensional Euclidean space, we replace the cross product by the multiplication via skew-symmetric matrix, and identify a new set of constants of motions which are conserved along the proposed model. We provide two frameworks leading to the collective behaviors of the high-dimensional IS model leading to qualitative and quantitative emergent dynamics in terms of system parameters and initial data. This is a joint work with Guanghui Jin, Myeonghyeon Kim, Tommaso Ruggeri and Qinghua Xiao.

Xianpeng Hu, The Hong Kong Polytechnic University, China

Title: Quantitative Properties of Co-rotational Beris-Edward system in critical spaces $L^3(R^3)$

Abstract: We will discuss the co-rotational Beris-Edwards system, which models in compressible liquid crystal flows with Laudau-De Gennes bulk potential. We establish the quantitative blow-up rates for critically bounded solutions of the co-rotational Beris Edwards system. We applied the cancellation property to deal with the loss of regularity for Q tensors. Moreover, with the help of linearization of Q tensors and the partial regularity for perturbed co-rotational Beris-Edwards

system, we establish a refined quan titative Carleman estimate based on the vorticity-Hessian formulation to overcome the bulk potential.

Jie Ji, Nanjing University of Aeronautics and Astronautics , China

Title: Runaway avalanches in plasmas with external electric fields: spatially inhomogeneous case in a perturbation framework

Abstract: We consider the Landau-Coulomb equation for a (hydrogen) plasma heated by an external electric field. In this setting, theoretical and experimental results in plasma physics show the emergence of so-called \emph{runaway electrons} which are linearly accelerating but only lead to a minimal increase of the plasma temperature. Runaway electrons are a major obstacle in nuclear fusion since they can overcome the confinement and damage the structure of the reactor. We rigorously prove the well-posedness of the underlying nonlinear \emph{open} Landau-Coulomb system in a perturbative setting and the conjectured growth bounds for the mean velocity and plasma temperature. We show that the mean velocity is linearly increasing in time, and capture the sharp logarithmic growth of the temperature. Furthermore, we prove that the electron distribution can be asymptotically described by a scattering-type Maxwellian.
Due to the different nature of the electron-electron and electron-ion interactions, we recast the equation as a novel coupled system that allows us to isolate the dissipation structures of the two operators. For the coupled system, we perform a micro-macro decomposition to show convergence to the scattering-type Maxwellian.

Dowan Koo, University of Oxford, UK

Title: Exponential and algebraic decay in Euler-alignment models with nonlocal interactions

Abstract: In this talk, I will discuss the long-time behaviour of the pressureless Euler–alignment model with nonlocal interactions, focusing on quantitative convergence to equilibrium. I will present sharp decay results towards the asymptotic profile, showing that the convergence rate is determined by the local behaviour of the communication weight: bounded kernels yield exponential convergence, while weakly singular kernels lead to algebraic decay.Joint work with José Carrillo, Young-Pil Choi, and Oliver Tse.

Siran Li, Shanghai Jiao Tong University, China

Title: Some geometric observations and the regularity theory for incompressible Navier--Stokes equations

Abstract: We show that finite-energy weak solutions to the incompressible Navier--Stokes equations on a three-dimensional bounded smooth domain are regular up to the boundary, provided that the spacetime L^4-norm of the solution is smaller than a constant depending only on the geometry of the domain. This answers a problem raised in [D. Albritton, T. Barker, and C. Prange, J. Math. Fluid Mech. 25 (2023), Paper No. 49]. The key ingredient of our proof is a "clam-like" slicing construction near the boundary of the domain. In addition, we also the discuss the existence theory for very weak solutions to the Navier--Stokes equations on domains with critical low regularity. The latter part is based on joint work with Xiangxiang Su and Xiaojin Bai at SJTU.

Song Liu, Innovation Academy for Precision Measurement Science and Technology, CAS, China

Title: Conjecture on structures of Riemann solutions and interactions of fundamental waves for two-dimensional Euler equations

Abstract: In this talk, I will present our recent works on the conjecture on structures of Riemann solutions and interaction of fundamental waves. The Riemann problem with 4-shock interactions for the Euler equations of potential flow is reformulated to a shock reflection-diffraction problem with respect to a symmetric line, and three critical angles are introduced to clarify all shock configurations for the interactions of two-forward and two-backward shocks. Then the problem is further reformulated to the free boundary problem of a quasilinear equation of mixed elliptic-hyperbolic type in a pseudo-subsonic domain. We shall address some of the main difficulties in attacking the conjecture on structures of Riemann solutions. This talk is based on a joint work with Prof. Feimin Huang, Prof. Gui-Qiang G. Chen, Prof. Qin Wang and Dr. Alexander Cliffe.

Ming Mei, Jiangxi Normal University, China

Title: Stability of viscous shock waves for Burgers equation with double singularities in viscosity and flux

Abstract: This talk is concerned with Burgers equation with singular viscosity and singular flux. We realize that, when the singularity for flux is less than the singularity of viscosity, there exists smooth viscous shock wave, otherwise the shock wave does not exist. The main issue is to show the stability of these shock waves. To overcome the singularities caused by viscosity and flux, we use the weighted energy method, where the selection of weights are technical and play a crucial role in the proof. This talk is based on a series of studies joint with Dr. Xiaowen Li, Prof. Jingyu Li, Prof. Jean-Christophe Nave, Prof. Wancheng Sheng, and Dr. Shufang Xu.

Peter Pang, University of Nottingham, UK

Title: Variational wave equations with gradient noise

Abstract: Gradient noise perturbed fluid equations has been a topic of much interest. I shall discuss the well-posedness of a class of stochastic variational wave equations where the noise has gradient structure. In particular, I shall discuss how to adapt DiPerna--Lions renormalisation to the stochastic setting in handling a class of supercritical nonlocal variational wave equations with gradient noise. If time permits shall also discuss structure-preserving semi-discrete numerical schemes for gradient noise.

Hyangdong Park, Korea Advanced Institute of Science and Technology (KAIST), Korea

Title: A Two-Phase Free Boundary Problem for Axisymmetric Subsonic Euler Flows with Contact Discontinuities

Abstract: We study a two-phase free boundary problem for the three-dimensional steady compressible Euler equations with a contact discontinuity in an infinitely long circular cylinder.

The contact discontinuity separates an axisymmetric rotational subsonic flow from an axisymmetric potential subsonic flow, where both phases are unknown. Using a Helmholtz decomposition, we reformulate the problem and develop a coupled iteration scheme that simultaneously determines the free boundary and the two flow fields. We establish the global existence of solutions and their downstream asymptotic behavior.

Yun Pu, Academy of Mathematics and Systems Science, CAS, China
Title: An Inverse Problem of Reconstructing Piston Path from a Lipschitz Leading Shock
Abstract: In this paper, we study an inverse problem for determining the path of a piston. The gas flow is governed by the p-system and the speed of the Lipschitz leading shock in a shock-tube is given. When the leading shock satisfies an Oleinik type entropy condition, we apply a modified wave front tracking method to construct the flow behind the leading shock and then determine the speed of the piston.

Matthew Schrecker, University of Bath, UK
Title: On quantitative gravitational relaxation
Abstract: We study the dynamics of galaxies around steady states of the Vlasov-Poisson system in the presence of a point mass potential. We prove quantitative decay rates for the gravitational potential for the linearised dynamics, a phenomenon called gravitational (linear) Landau damping by analogy to Landau damping in plasma physics. Gravitational steady states feature stably trapped particles which present a severe obstacle to any kind of dispersion. The problem is further complicated by the presence of an infinite-dimensional kernel. To handle these issues, we combine tools from dynamical systems, Hamiltonian geometry, and scattering theory. Our theorem can be viewed as a first quantitative proof of (linear) gravitational Landau damping. This is joint work with Mahir Hadzic.

Ruiwen Shu, University of Georgia, USA
Title: Recent progress on interaction energy minimizers
Abstract: Interaction energy minimizers appear natually in the study of collective dynamics in biological and social sciences. Despite the simple formulation, these minimizers may exhibit rich and unexpected pattern formation. The study of existence, uniqueness and qualitative behavior of minimizers is often challenging and requires the development of new theoretical tools. In this talk, I will discuss my recent results on the uniqueness of minimizers based on convexity theory, as well as the theoretical justification of annulus-shaped minimizers.

Tao Wang, Wuhan University, China
Title: Local well-posedness for plasma interface problems
Abstract: In this talk, I will present our recent progress on the local well-posedness for plasma interface problems in non-relativistic and relativistic ideal compressible MHD.

Tian-Yi Wang, Huazhong University of Science and Technology, China
Title: On the Asymptotic Behavior of Irrotational Steady Euler Equations
Abstract: This talk concerns the asymptotic behavior of steady irrotational Euler flows. We begin by establishing the far-field convergence rate of order $|x|^{-(n-1)}$ through a refined maximum principle argument, which is optimal for the largely open nozzle problem. For the airfoil problem, the slip boundary condition induces a first-order cancellation, yielding an improved velocity convergence rate of $|x|^{-n}$ for $n \geqslant 3$. The asymptotic expansion formula for subsonic flows at infinity is derived via the Kelvin transformation and Schauder estimates near the origin, with special attention to the two-dimensional case. An explicit example is constructed to confirm the optimality of these rates. Finally, we present recent progress on the two-dimensional general largely open nozzle problem.

Weiqiang Wang, University of Pittsburgh, USA
Title: The Boltzmann Equation for 2D Taylor-Couette Flow
Abstract: We investigate the existence of 2-D Taylor-Couette flow for a rarefied gas between two coaxial rotating cylinders, characterized by differing angular velocities at the outer boundary $\{r=1\}$ and the inner boundary $\{r=r_{1}>0\}$, with a small relative strength denoted by α. We formulate the problem using the steady Boltzmann equation in polar coordinates and seek a solution invariant under rotation. We assume that the steady state has the specific form $F(r,v_{r},v_{\phi}-\alpha\frac{r-r_{1}}{1-r_{1}},v_{z})$, where the translation angular velocity $\alpha\frac{r-r_{1}}{1-r_{1}}$ is linearly sheared along the radial direction. With this ansatz, the problem is reduced to solve the nonlinear steady Boltzmann equation with geometric correction, subject to an external shear force of strength α and the homogeneous non-moving diffuse reflection boundary condition. We establish the existence of a non-equilibrium steady solution for any small enough shear rate α through Caflisch's decomposition, complemented by careful uniform estimates based on Guo's $L^{\infty} \cap L^2$ framework. The steady profile displays a polynomial tail behavior at large velocities.

Xinyu Wang, Harbin Institute of Technology, China
Title: Relaxation dynamics of the continuum Kuramoto model with non-integrable kernels
Abstract: We study the asymptotic behavior of the continuum Kuramoto model with a fractional Laplacian-type kernel. For this, we construct global weak solutions via a two-parameter regularization procedure using a kernel truncation with fractional dissipation. Using a priori uniform estimates derived in fractional Sobolev spaces, we employ compactness arguments to construct global weak solutions to the singular continuum Kuramoto model. Furthermore, we also establish an exponential relaxation toward the initial phase average in L^2-norm under suitable assumptions on initial data and system parameters. These findings provide a rigorous characterization of the existence of solutions and the emergent dynamics of Kuramoto ensembles under physically important strongly singular interactions, including power-law singular kernels and Coulomb-type kernels.

Yong Wang, Academy of Mathematics and Systems Science, CAS, China

Title: Validity of Prandtl Expansion for Steady Compressible Navier-Stokes-Fourier Flows

Abstract: Studying steady flows is crucial in fluid dynamics for designing efficient systems (e.g., pipes, turbines, aircraft). Boundary layer study is fundamental in flying vessels surrounded by a compressible fluid, for which the classical boundary layer theory for incompressible fluid becomes inadequate. Despite its importance both from mathematical and physical standpoints, to our knowledge, there are very limited mathematical results to solve the steady compressible flows with both momentum and energy equations even for a finite Reynolds' number in the presence of mixed non-slip and in-flow boundary condition. Assume no-slip boundary conditions for the velocity field and either insulated or Dirichlet boundary conditions for the temperature field in a steady compressible fluid. In the inviscid limit $\v \rightarrow 0$, we develop a mathematical framework for the uniform-in-$\v$ remainder estimate for the linear steady compressible Navier-Stokes-Fourier equations around a Prandtl layer profile with both velocity and thermal layers, which leads to the validity of the Prandtl layer expansion. The talk is based on joint works with Yan Guo.

Aneta Wróblewska-Kamińska, Institute of Mathematics of the Polish Academy of Sciences, Poland

Title: Coupled Vlasov and non-Newtonian dynamics

Abstract: We study a coupled kinetic-non-Newtonian fluid system on the periodic domain, where particles evolve by a Vlasov equation and interact with an incompressible power-law fluid through a drag force. We prove the global existence of weak solutions for a large enough power-law exponent of the fluid’ s stress-strain relation (p>8/5). Under an additional uniform boundedness assumption on the particle density, we also establish large-time decay of a modulated energy functional measuring deviation from velocity alignment which depends on the range of power-law exponent, reflecting the role of fluid dissipation in the large-time dynamics. This is recent joint work with Young-Pil Choi and Jinwook Jung.

Hang Xiong, Xiangtan University, China

Title: Hydrodynamic limit and newtonian limit from the relativistic Vlasov-Maxwell-Boltzmann system to the classical Euler-Poisson system

Abstract: In this paper, around a global smooth irrotational solution to the classical isentropic compressible Euler-Poisson system, we construct classical solutions to the one-species relativistic Vlasov-Maxwell-Boltzmann system on any finite time interval $[0,T]$, and rigorously justify the combined hydrodynamic and Newtonian limits to the Euler-Poisson system. In particular, this yields a rigorous derivation of the compressible Euler-Poisson system, whose Poisson coupling induces an instantaneous electrostatic response and thus no longer preserves a strict finite-speed propagation structure, from a relativistic kinetic model with finite propagation speed. The analysis is based on a Hilbert expansion in ε for the relativistic Vlasov--Maxwell--Boltzmann system, an asymptotic expansion in c^{-1} for the relativistic Euler--Maxwell system, and estimates that are uniform in c and ε for both the

expansion coefficients and the remainder terms, without imposing any a priori relation between ε and c.

Ruijia Yu, Academy of Mathematics and Systems Science, CAS, China

Title: The incompressible limit of the compressible Navier-Stokes equations with large bulk viscosity

Abstract: We present recent results on the large bulk viscosity limit for the compressible Navier – Stokes equations. We focus on singular initial layers generated by ill-prepared data and on time-decaying convergence estimates. These results offer a new perspective on the transition from compressible to incompressible flow.

Fanqin Zeng, Seoul National University, Korea

Title: Flocking in Delayed Cucker–Smale Systems under Switching Interactions and Stochastic Perturbations

Abstract: We present two results on flocking in delayed Cucker–Smale particle systems.

The first model allows the interaction to switch between attractive and repulsive regimes. Since repulsive phases may enlarge the velocity diameter and the delay destroys the standard contraction structure, the usual flocking argument is no longer directly applicable. We prove mono-cluster flocking under suitable conditions on the switching pattern and a sufficiently long-ranged communication kernel. Our result covers both finite and infinite total duration of the repulsive phases.

The second model is a delayed stochastic Cucker–Smale system with agent-wise multiplicative Brownian noise and distance-dependent communication. Under suitable assumptions on the delay, noise intensity, and empirical moments of the initial histories, we establish polynomial mean-square velocity alignment uniformly in the number of particles. A stronger moment condition further yields uniform-in-time spatial confinement and almost-sure flocking for each fixed particle number.

For the switching system, the proof combines delay-dependent velocity-diameter estimates on the attractive and repulsive intervals. For the stochastic system, it uses a memory-corrected Lyapunov functional and empirical moment estimates to recover effective coercivity.

Jiawen Zhang, Shanghai Jiao Tong University, China

Title: Global well-posedness for the Degenerate Compressible Navier-Stokes Equations with Large Data of Spherical Symmetry

Abstract: A longstanding open problem in the theory of compressible Navier-Stokes equations is whether regular spherically symmetric flows can develop singularities, such as cavitation or implosion, in finite time. In this talk, I will present our recent works [1, 2] that provide a definitive answer to this question for the barotropic compressible Navier-Stokes equations with degenerate, density-dependent viscosity, as in the viscous shallow water system (i.e., Saint-Venant system).

We consider two of its most challenging settings—the Cauchy problem (with far-field vacuum or

strictly positive initial density) and the vacuum free boundary problem (in which vacuum appears in an open set)—in two and three space dimensions. In both cases, we prove that solutions remain globally regular and cannot undergo cavitation (inside the fluid) or implosion, thereby establishing the global well-posedness of classical solutions with large spherically symmetric initial data. The methodology developed here should also be useful for solving other related nonlinear partial differential equations involving similar difficulties.

Weiyuan Zou, Beijing University of Chemical Technology, China

Title: Global Dynamics of Three-Dimensional Damped Euler Flows

Abstract: In this talk, we study the global dynamics of three-dimensional compressible Euler equations with linear damping. For the isothermal system with an exterior potential, we establish global classical solutions for a class of large initial data under sufficiently strong damping and derive sharp decay rates for small perturbations of a nonconstant equilibrium. We also present global well-posedness and optimal decay near a constant equilibrium, including partially large initial data, and justify the isothermal limit through estimates uniform in the adiabatic exponent. Finally, we discuss finite-time blow-up in the pressureless case, highlighting both the stabilizing effect and the limitations of damping.