AMSS

WORKSHOP DATES

AUG
12–15
2026

SCIENTIFIC PROGRAM
13–14 AUG

N202, SOUTH BUILDING
AMSS, CAS
BEIJING, CHINA

WORKSHOP HANDBOOK • 2026

WORKSHOP ON NONLINEAR PDEs IN FLUID MECHANICS

OVERVIEW

The scientific program will be held on August 13–14, 2026, at the Academy of Mathematics and Systems Science (AMSS), Chinese Academy of Sciences. August 12 and 15 are the designated arrival and departure dates.

The workshop brings together researchers working on the mathematical analysis of partial differential equations arising in fluid dynamics. It provides a forum for presenting recent developments, exchanging ideas, and discussing challenging open problems, while encouraging interaction between established researchers and young mathematicians.

PROGRAMME THEMES

Incompressible and compressible flows • Regularity and singularity formation • Stability and long-time behavior • Free-boundary problems • Nonlocal fluid equations • Related analytical methods

INVITED SPEAKERS

Jiajie Chen
The University of Chicago

Ke Chen
The Hong Kong Polytechnic University

Ruilin Hu
University of Bath

Guolin Qin
Academy of Mathematics and Systems Science, CAS

Fei Wang
Shanghai Jiao Tong University

Zhenfu Wang
Peking University

Hang Xiong
Xiangtan University

Xiaoqian Xu
Duke Kunshan University

Liutang Xue
Beijing Normal University

Weicheng Zhan
Xiamen University

Junyan Zhang
University of Science and Technology of China

ORGANIZERS Quoc-Hung Nguyen and Zhilong Xue
Academy of Mathematics and Systems Science, Chinese Academy of Sciences

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Schedule

All times are displayed in **Beijing Time**. Session chairs not listed by name will be announced after confirmation by the organizers.

THURSDAY

AUGUST 13, 2026
N202, SOUTH BUILDING, AMSS

8:50–9:00 am	**Organizers** Workshop organizers *Welcome and Opening Remarks*	CHAIR —
9:00–10:00 am	**Jiajie Chen** The University of Chicago *Asymptotically Self-Similar Blowup for 3D Incompressible Euler with $C^{1,1/3-}$ Velocity*	CHAIR Quoc-Hung Nguyen
10:00–10:30 am	**Coffee break**	
10:30–11:30 am	**Guolin Qin** Academy of Mathematics and Systems Science, CAS *Uniqueness and Stability of Traveling-Wave Solutions for the Incompressible Euler Equations*	CHAIR Zhilong Xue
11:30 am–2:00 pm	**Lunch break** (boxed lunch provided)	
2:00–3:00 pm	**Liutang Xue** Beijing Normal University *Global Regularity of 2D Boussinesq Temperature Patches in $W^{k,\infty}$ and $C^{k,\gamma}$*	CHAIR Zhilong Xue
3:00–3:30 pm	**Coffee break**	
3:30–4:30 pm	**Weicheng Zhan** Xiamen University *Existence, Stability, and Rigidity of Vortex Structures in Ideal Fluids*	CHAIR Guolin Qin
4:30–5:30 pm	**Junyan Zhang** University of Science and Technology of China *The Incompressible Limit of Free-Surface Inviscid Fluids*	CHAIR Quoc-Hung Nguyen
Evening	**Workshop dinner at Wuke Hotel**	

Daily note. Each research talk is allocated 60 minutes, including questions. Lunch is provided at the venue.

Schedule

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FRIDAY

AUGUST 14, 2026
N202, SOUTH BUILDING, AMSS

9:00–10:00 am	**Fei Wang** Shanghai Jiao Tong University *Nonlinear Stability Threshold for 3D Compressible Couette Flow*	CHAIR	Junyan Zhang
10:00–10:30 am	**Coffee break**		
10:30–11:30 am	**Zhenfu Wang** Peking University *Mean-Field Limits for Singular Interactions: Entropy, Modulated Energies, and Recent Results*	CHAIR	Quoc-Hung Nguyen
11:30 am–12:30 pm	**Ruilin Hu** University of Bath *Strong Solutions for Inhomogeneous Navier–Stokes Equations in the Borderline Critical Space*	CHAIR	Ke Chen
12:30–2:00 pm	**Lunch break** (boxed lunch provided)		
2:00–3:00 pm	**Xiaoqian Xu** Duke Kunshan University *AI Proofs in PDEs*	CHAIR	Zhilong Xue
3:00–3:30 pm	**Coffee break**		
3:30–4:30 pm	**Ke Chen** The Hong Kong Polytechnic University *Scaling-Critical Theory for the Boltzmann and Landau Equations*	CHAIR	Ruilin Hu
4:30–5:30 pm	**Hang Xiong** Xiangtan University *Hydrodynamic and Newtonian Limits from the Relativistic Vlasov–Maxwell–Boltzmann System to the Classical Euler–Poisson System*	CHAIR	Ke Chen
Afterward	**Boxed dinner provided after the final talk**		

MEALS
Boxed lunches are provided on both program days; a boxed dinner is provided after the final talk on August 14.

WORKSHOP DINNER
The workshop dinner will be held at Wuke Hotel on the evening of August 13.

Abstracts

01 Asymptotically Self-Similar Blowup for 3D Incompressible Euler with $C^{1,1/3-}$ Velocity

Jiajie Chen (The University of Chicago)

Whether the incompressible Euler equations in $\mathbb{R}^3$ can develop a finite-time singularity from smooth initial data is a long-standing open problem in mathematical fluid mechanics. In the axisymmetric setting without swirl, global regularity is known for C_c^α initial vorticity for all $\alpha \geq 1/3$. Below this regularity threshold, for any $\alpha \in (0, 1/3)$, we construct exact C^α self-similar blowup profiles for the vorticity of the 3D axisymmetric Euler without swirl, and build on them to prove asymptotically self-similar blowup from C_c^α initial vorticity and $C^{1,\alpha} \cap L^2$ initial velocity. Moreover, we provide a complete characterization of the limiting behavior of these C^α vorticity profiles and the associated blowup solutions as α tends to $1/3$. Our construction is based on lifting C^∞ blowup profiles for a 1D nonlocal model and exploits the anisotropy of the 3D self-similar flow. To the best of our knowledge, our results provide the first example in which a singularity from a genuinely 1D nonlocal fluid model is lifted to construct blowup for incompressible fluid equations in $\mathbb{R}^2$ or $\mathbb{R}^3$.

02 Scaling-Critical Theory for the Boltzmann and Landau Equations

Ke Chen (The Hong Kong Polytechnic University)

In this talk, I will present two results concerning the spatially inhomogeneous non-cutoff Boltzmann and Landau equations with very soft potentials. The first result is a scaling-critical global well-posedness theory near a Maxwellian. For sufficiently small initial perturbations measured in a weighted anisotropic Riesz-potential norm, we prove global existence and uniqueness in the whole space. The proof combines a critical fixed-point argument with weighted hypocoercive estimates controlling the macroscopic low-frequency dynamics. The second result is a short-time pointwise Green-function theory for variable-coefficient kinetic equations. By constructing a frozen small-jump kernel along kinetic characteristics and then applying a parametrix expansion, we obtain bounds that capture the anisotropic fractional Kolmogorov geometry and rapid decay away from the characteristic region.

03 Strong Solutions for Inhomogeneous Navier–Stokes Equations in the Borderline Critical Space

Ruilin Hu (University of Bath)

In this talk, we establish local existence of strong solutions for Lipschitz initial density and $L^2 \cap VMO^{-1}$ initial velocity, and global existence for sufficiently small BMO^{-1} data when the density is close to a positive constant. The proof relies on a refined freezing-coefficient method, Koch–Tataru type estimates, and new time-weighted energy estimates, yielding the first borderline BMO^{-1}/VMO^{-1} theory for the inhomogeneous Navier–Stokes equations.

04 Uniqueness and Stability of Traveling-Wave Solutions for the Incompressible Euler Equations

Guolin Qin (Academy of Mathematics and Systems Science, CAS)

In this talk, I will discuss uniqueness and orbital stability of several families of traveling vortex structures for the incompressible Euler equations, including concentrated vortex rings, near-Lamb dipoles, and large-impulse dipoles. This talk is based on joint works with K. Abe, D. Cao, I.-J. Jeong, S. Lai, W. Zhan, C. Zou.

05 Nonlinear Stability Threshold for 3D Compressible Couette Flow

Fei Wang (Shanghai Jiao Tong University)

We establish the nonlinear stability threshold $O(\nu^{3/2})$ for the three-dimensional Couette flow governed by the compressible Navier–Stokes equations. While stability thresholds are well understood in two dimensions for both compressible and incompressible flows, and in three dimensions for incompressible flows, the three-dimensional compressible case remains open due to additional structural features, strong mode interactions, and wave coupling. The proof is based on a refined frequency-space approach. For zero modes, we improve upon two-dimensional methods by clearly separating and precisely estimating the main contributions from diffusion waves, acoustic waves, and the lift-up mechanism, leading to a systematic way to handle their nonlinear coupling. For the non-zero modes, we introduce new multiplier estimates and a decomposition based on the structure of the compressible system, which allows us to track the interaction between dissipation and acoustic effects.

06 Mean-Field Limits for Singular Interactions: Entropy, Modulated Energies, and Recent Results

Zhenfu Wang (Peking University)

Mean-field limits and propagation of chaos for interacting particle systems with singular interaction forces have recently seen major advances, driven by new quantitative stability techniques beyond the classical Lipschitz regime. This talk surveys a work-centered line of developments based on relative entropy, modulated energy / modulated free energy, and duality methods, highlighting how they deliver explicit quantitative control for singular kernels. I will then present our recent progress on particle approximations of the Landau equation, non-exchangeable particle systems, and selected links to PDE numerical algorithms. The talk concludes with several open problems and future directions.

07 Hydrodynamic and Newtonian Limits from the Relativistic Vlasov–Maxwell–Boltzmann System to the Classical Euler–Poisson System

Hang Xiong (Xiangtan University)

In this talk, 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.

08 AI Proofs in PDEs

Xiaoqian Xu (Duke Kunshan University)

In this talk, I will discuss recent results on fluid equations obtained with the assistance of AI. I will first outline the relationship between the mixing properties of incompressible flows and the diffusion process, including dissipation enhancement. I will then focus on the so-called unmixing phenomenon and on the existence of Batchelor scales for certain flows, both of which are results recently proved using AI.

09 Global Regularity of 2D Boussinesq Temperature Patches in $W^{k,\infty}$ and $C^{k,\gamma}$

Liutang Xue (Beijing Normal University)

In this talk, we present recent progress on the global persistence of boundary regularity for temperature patches in the spaces $W^{k,\infty}$ and $C^{k,\gamma}$ for the two-dimensional whole-space nondiffusive Boussinesq system with subcritical dissipation. We also discuss the infinite-Prandtl-number limit for such temperature patch solutions.

10 Existence, Stability, and Rigidity of Vortex Structures in Ideal Fluids

Weicheng Zhan (Xiamen University)

Vortex structures are fundamental objects in the mathematical theory of incompressible fluids. Classical examples include vortex rings, vortex pairs, and rotating vortices, all of which exhibit rich dynamical and geometric behavior. In this talk, I will present several recent developments in the qualitative theory of vortex structures in ideal incompressible fluids, with particular emphasis on their existence, uniqueness, stability, and rigidity. The presentation is mainly based on a series of joint works with collaborators carried out over the past several years.

11 The Incompressible Limit of Free-Surface Inviscid Fluids

Junyan Zhang (University of Science and Technology of China)

This talk concerns the incompressible limit for free-surface inviscid fluids, with particular emphasis on the compressible Euler equations. In contrast to fixed-domain problems, the motion of the free interface introduces new and substantial difficulties. We will present methods for establishing this singular limit in various settings, depending on the scale of the initial singular perturbation, the boundary conditions, including whether surface tension and vortex sheets are taken into account.

Acknowledgments

SUPPORT
This workshop is supported by the Research Fund for International Excellent Young Scientists, grant number W2532011.