WORKSHOP ON
NONLINEAR PDE
AND ELLIPTIC REGULARITY
2026

WORKSHOP DATES

NOV
17–19
2026

CLASSICAL PROBLEMS
NEW PERSPECTIVES
IN THE AGE OF AI

Room N202, South
Building, AMSS

WORKSHOP ON NONLINEAR PDE AND ELLIPTIC REGULARITY

Classical Problems and New Perspectives in the Age of AI

OVERVIEW

This workshop brings together researchers in nonlinear partial differential equations and geometric analysis to discuss regularity, singularities, sharp estimates, and long-standing open problems. With a particular emphasis on elliptic regularity, the program connects quaternionic Monge–Ampère equations, critical semilinear equations and elliptic systems, geometric variational problems, and hypoelliptic kinetic equations.

Research talks will explore boundary singularities, Liouville theorems, maximal hypersurfaces, functional inequalities, and Aleksandrov–Bakelman–Pucci estimates. These themes provide opportunities to exchange methods and identify connections across different classes of equations.

Recent AI-assisted approaches to major problems in analysis add a timely perspective. Discussions will examine proposed arguments, their relationship to established results, and the importance of clear proofs and appropriate attribution. Through focused exchanges, the workshop aims to sharpen unresolved questions, develop new approaches, and encourage collaborations across PDE and geometry.

INVITED SPEAKERS

Doanh Pham
Peking University

Huyuan Chen
SIMIS, Shanghai

Marie-Françoise Bidaut-Véron
Institut Denis Poisson, Université de Tours

Bin Deng
Wuhan University

Yimei Li
Beijing Jiaotong University

Laurent Véron
Institut Denis Poisson, Université de Tours

Jingang Xiong
Beijing Normal University

Yuzhe Zhu
The Chinese University of Hong Kong, Shenzhen

Xinan Ma
University of Science and Technology of China

ORGANIZERS

Quoc-Hung Nguyen, Guohuan Qiu, and Zhilong Xue

Registration: November 17, 14:00. Room N202, South Building, AMSS.

Meals: Wuke Hotel Restaurant.

Schedule

ALL TIMES ARE IN BEIJING TIME (UTC+8)

TUESDAY, NOVEMBER 17 — AFTERNOON

14:00	**Registration**
15:00–15:50	**Doanh Pham** Peking University A Logarithmic Sobolev Inequality for Closed Submanifolds
15:50–16:40	**Huyuan Chen** SIMIS, Shanghai Maximal Hypersurfaces with Singularities in Lorentz–Minkowski Space

WEDNESDAY, NOVEMBER 18 — MORNING

09:00–09:50	**Marie-Françoise Bidaut-Véron** Institut Denis Poisson, Université de Tours An Elliptic Equation Involving Exponential and Gradient Source Terms
09:50–10:10	**Tea break**
10:10–11:00	**Bin Deng** Wuhan University Global Minimality and Rigidity of the Constraint Map Vortex: A Problem of Fanghua Lin
11:00–11:50	**Yimei Li** Beijing Jiaotong University A Liouville Theorem for Monotone Solutions of the Lane–Emden System in a Half-Space
11:50–14:00	**Lunch at Wuke Hotel Restaurant**

The November 18 afternoon program continues on the next page.

Schedule

ALL TIMES ARE IN BEIJING TIME (UTC+8)

WEDNESDAY, NOVEMBER 18 — AFTERNOON

14:00–14:50	**Laurent Véron** Institut Denis Poisson, Université de Tours Nonlinear Conservative Elliptic Equations in an Infinite Cylinder
14:50–15:10	**Tea break**
15:10–16:00	**Jingang Xiong** Beijing Normal University The Critical Semilinear Elliptic Equation with Isolated Boundary Singularities
16:00–16:50	**Yuzhe Zhu** The Chinese University of Hong Kong, Shenzhen Aleksandrov Estimates for Hypoelliptic Kinetic Equations
17:30–20:00	**Conference dinner at Wuke Hotel Restaurant**

THURSDAY, NOVEMBER 19 — MORNING

09:50–10:30	**Tea before the talk**
10:30–11:20	**Xinan Ma** University of Science and Technology of China The Dirichlet problem for quaternionic Monge–Ampère equations on flat quaternionic quotients
From 11:20	**Lunch at Wuke Hotel Restaurant**

Venue: Room N202, South Building, AMSS. Meals: Wuke Hotel Restaurant.

Abstracts

TUESDAY, NOVEMBER 17 • AFTERNOON

01 A Logarithmic Sobolev Inequality for Closed Submanifolds

Doanh Pham Peking University

15:00–15:50

We present a logarithmic Sobolev inequality for closed submanifolds of Riemannian manifolds with nonnegative curvature. The proof draws on ideas from the Alexandrov–Bakelman–Pucci maximum principle and the classical Heintze–Karcher estimates for the volumes of tubular neighborhoods.

02 Maximal Hypersurfaces with Singularities in Lorentz–Minkowski Space

Huyuan Chen SIMIS, Shanghai

15:50–16:40

We study maximal hypersurfaces with multiple light cones in Lorentz–Minkowski space by considering weak solutions of the mean curvature equation with multiple Dirac masses. Our approach is based on an approximation argument.

Abstracts

WEDNESDAY, NOVEMBER 18 • MORNING

03 An Elliptic Equation Involving Exponential and Gradient Source Terms

Marie-Françoise Bidaut-Véron Institut Denis Poisson–CNRS UMR 7013, Université de Tours, France

09:00–09:50

We study some local and global properties of solutions of equation

$$-\Delta u = e^u + m|\nabla u|^q,$$

in a punctured domain $\Omega \setminus \{0\}$, or in an exterior domain of $\mathbb{R}^N$ ($N \geq 2$), where m is a positive parameter and $q > 1$. We give a priori estimates and a precise description of the local behaviour of solutions near the singularity or near ∞, and prove the existence of solutions with the behaviours previously described. There is a strong competition between the gradient and the exponential source terms. The behaviour changes drastically according q is smaller or larger than 2. Many results are obtained by introducing various dynamical systems associated to the equation.

04 Global Minimality and Rigidity of the Constraint Map Vortex: A Problem of Fanghua Lin

Bin Deng Wuhan University

10:10–11:00

For $0 < a < 1$, we study the exterior-ball obstacle problem posed by Fanghua Lin in his lectures (Example 1.5, *Lectures on Elliptic Free Boundary Problems*):

$$\min\left\{\int_{B_1} |Du|^2\,\mathrm{d}x : \begin{array}{l} u \in W^{1,2}(B_1;\mathbb{R}^n), \\ u = x \text{ on } \partial B_1, \quad |u| \geq a \text{ a.e. in } B_1 \end{array}\right\}.$$

We prove that the canonical radial map is the unique global minimizer in dimensions $3 \leq n \leq 6$. Together with the result of Figalli, Guerra, Kim, and Shahgholian for $n \geq 7$, this gives a complete solution in every dimension $n \geq 3$. In particular, the coincidence set is a concentric ball, confirming Lin's proposed geometric picture and resolving the remaining cases of the vortex minimality problem. The proof combines singularity analysis and a sharp whole-space energy estimate with a monotonicity principle in the obstacle radius a and an analysis of the equality cases. This is joint work with Jiahuan Li, Yilu Liu, and Xi-nan Ma.

Abstracts

WEDNESDAY, NOVEMBER 18 • MORNING & AFTERNOON

05 A Liouville Theorem for Monotone Solutions of the Lane–Emden System in a Half-Space

Yimei Li Beijing Jiaotong University

11:00–11:50

The Lane–Emden system is an important model for Hamiltonian elliptic systems. We consider the zero Dirichlet problem in a half-space for arbitrary exponents $p, q \geq 1$. We prove that every nonnegative classical solution that is nondecreasing in the normal direction is necessarily trivial. No bound of any kind is imposed at infinity. This result extends the known scalar monotonicity theorem.

06 Nonlinear Conservative Elliptic Equations in an Infinite Cylinder

Laurent Véron Institut Denis Poisson, Université de Tours

14:00–14:50

We study some properties of solutions of

$$u_{tt} + \Delta_\sigma u + \lambda u + \epsilon |u|^{q-1} u = 0$$

in the cylinder $\mathbb{R} \times S^{N-1}$ in the range $q > 1$, $\lambda \in \mathbb{R}$ and $\epsilon = \pm 1$. We recall the origin of the problem and study too particularly the equation in $\mathbb{R} \times S^1$ pointing out the role of the set of *stationary solutions* i.e. the solutions of

$$\omega'' + \lambda \omega + \epsilon |\omega|^{q-1} \omega = 0 \quad \text{on } S^1,$$

and the *elliptic waves solutions*, i.e. solutions $u(t, \theta) = \omega_\alpha(\alpha t + \theta)$ where

$$(1 + \alpha^2)\omega_\alpha'' + \lambda \omega_\alpha + \epsilon |\omega_\alpha|^{q-1} \omega_\alpha = 0 \quad \text{on } S^1.$$

Abstracts

WEDNESDAY, NOVEMBER 18 • AFTERNOON

07 The Critical Semilinear Elliptic Equation with Isolated Boundary Singularities

Jingang Xiong Beijing Normal University

15:10–16:00

We study the Sobolev critical semilinear elliptic equation in the half-space with an isolated boundary singularity and zero Dirichlet boundary condition. We address two open questions: the existence of Delaunay-type log-periodic solutions and the asymptotic classification of singular solutions. We establish a global branch of positive log-periodic solutions, construct the corresponding concentrating family, and prove its local uniqueness. Consequently, the expected stationary asymptotic classification fails, and no universal critical scale-invariant upper bound holds throughout the half-space, in sharp contrast with the classical theory of interior singularities. This is joint work with Huayang Wang.

08 Aleksandrov Estimates for Hypoelliptic Kinetic Equations

Yuzhe Zhu The Chinese University of Hong Kong, Shenzhen

16:00–16:50

We discuss Aleksandrov–Bakelman–Pucci (ABP) type estimates for hypoelliptic kinetic equations with rough coefficients. The proof is based on an adjoint argument and avoids the convex geometric gradient map used in classical ABP theory.

Abstracts

THURSDAY, NOVEMBER 19 • MORNING

09 The Dirichlet problem for quaternionic Monge–Ampère equations on flat quaternionic quotients

Xinan Ma University of Science and Technology of China

10:30–11:20

We prove smooth solvability of the Dirichlet problem for quaternionic Monge–Ampère equations on smooth relatively compact domains in $\mathbb{H}^m/\Gamma$, where $m \geq 2$ and Γ is a discrete additive subgroup: for a smooth positive density, the existence of a smooth strictly plurisubharmonic subsolution guarantees the existence and uniqueness of the smooth admissible solution. The technique of the proof is a simple adaptation from the Ph.D. Thesis of Jingyong Zhu [25] in 2017, supervised by Xinan Ma, which is a joint work of Ma and Zhu. The claim [OpenAI, Theorem A.1] by OpenAI on Sogge's local smoothing conjecture is a special case of our theorem. This is joint work with Jingyong Zhu.

Related reference: X.-N. Ma and J. Zhu, *The Dirichlet problem for quaternionic Monge–Ampère equations on flat quaternionic quotients* (2026). arxiv.org/abs/2611.03214 Reference [25] follows the numbering in this preprint.