Taiwan-Vietnam Workshop on PDEs and Applications

April 08-10, 2026

Vietnam Institute for Advanced Study in Mathematics (VIASM), Hanoi

April 08, 2026

Inverse source problems: from mathematical analysis to machine learning approaches

by **Jenn-Nan Wang** (National Taiwan University)

Abstract: In this talk I would like to discuss the inverse source problem. The aim is to study the reconstruction of an unknown compactly supported source by one boundary measurement on the surface of a large domain containing the support of the source. This is a linear inverse problem in which the forward operator mapping from the source to the measurement is usually compact. Due to the existence of non-radiating sources, the unique determination of the source at one fixed frequency is in general not true. It turns out the uniqueness holds if one uses multiple frequencies. Although the problem is severely ill-posed with a logarithmic stability estimate, we demonstrate, through careful analysis of the forward map's singular values, that increasing the frequency range enhances stability, a phenomenon known as increasing resolution/stability. Second, motivated by the singular value behavior, we establish a consistency theorem for the inverse problem using a non-parametric Bayesian approach. Despite ill-posedness, we can show that the posterior distribution contracts around the true source at a rate combining polynomial and logarithmic terms, both dependent on the frequency range, reflecting the increasing resolution/stability phenomena in a Bayesian framework. Finally, we explore the use of machine learning techniques to address the inverse source problem.

Decay characterization of solutions to generalized Navier-Stokes equations

by **Cung The Anh** (Hanoi National University of Education)

Abstract: We consider the Cauchy problem for the following n-dimensional generalized Navier-Stokes equations on the whole space $\mathbb{R}^n$

$$\begin{cases} u_t + (-\Delta)^\alpha u + u \cdot \nabla u + \nabla p = f(x,t), & x \in \mathbb{R}^n, t > 0, \\ \nabla \cdot u = 0, & x \in \mathbb{R}^n, t > 0, \\ u(x,0) = u_0(x), & x \in \mathbb{R}^n, \end{cases}$$

where $0 < \alpha < \dfrac{n+2}{4}$. First, we develop the notion of decay characters and evaluate these characters in important data spaces that often appear in problems related to fluid mechanics. Next, we apply our evaluation for the decay character of the initial datum to study the decay rates of the solution and all of its derivatives in the case of zero or fast decay external forces. Finally, we study the effect of slowly varying external forces and decay characters of initial data on the decay rates of L^2-norm of weak solutions to the problem.

The strategy introduced here can be also applied to many other dissipative parabolic equations in fluid mechanics and even for the so-called semilinear damped σ-evolution equations, which are natural generalizations of the classical damped wave equation and the strongly

damped wave equation. The obtained results unify and recover most of existing ones in L^2-framework and even contain some new ones.

See the Invisible

by **Jia-Yuan Dai** (National Tsing Hua University)

Abstract: Unstable orbits can be mathematically predicted, but they are mostly invisible in experiments or simulations due to their lack of robustness under environmental disturbances. To "see the invisible," in 1992, Kestutis Pyragas introduced a method of noninvasive feedback control, utilizing time delays to stabilize periodic orbits of ODEs. In 2016, Isabelle Schneider extended this approach to PDEs using spatio-temporal delays. As a concrete application, in this talk I will demonstrate pattern formation and stabilization of Ginzburg–Landau spiral waves in circular and spherical geometries. This talk aims to invite mathematicians and scientists to explore the potential of this technique for stabilizing other unstable orbits, such as traveling waves, across a variety of models.

Singularities in nonlinear PDEs

by **Van Tien Nguyen** (National Taiwan University)

Abstract: The presentation will provide an overview of my recent research on the formation of singularities in Nonlinear Partial Differential Equations. In this context, singularities are well characterized by solutions exhibiting self-similar structures, which include traveling waves, backward self-similar solutions, and stationary states, among others. I will discuss two mathematical issues: (I) The construction of blowup solutions satisfying prescribed asymptotic behaviors; and (II) The classification of blowup solutions with self-similarity arising from general initial conditions that may not be adequately prepared.

The Slicing Support Function and Its Recovery Formula

by **Yen Chang Huang** (National Yang Ming Chiao Tung University)

Abstract: The support function plays a central role in convex geometry by encoding the shape of a convex body through its supporting hyperplanes. In this talk, we introduce the slicing support function, which arises from extremal affine slices of a convex body and provides an alternative representation of convex geometry. We show that this function can be recovered from the classical support function through an infimal convolution structure. Moreover, the slicing support function reduces the dimensional complexity compared to using the original support function defined on the convex body.

Under suitable convexity assumptions, the associated minimizer is unique almost everywhere, yielding differentiability properties of the slicing function. We further derive a nonlinear partial differential equation of Monge–Ampère type satisfied by the slicing support function, revealing a new connection between slicing geometry and curvature reconstruction.

2D rotating Bose–Einstein condensation at the critical rotation speed

by **Nguyen Dinh Thi** (VNU University of Science, Ho Chi Minh City)

Abstract: We study the minimizers of a magnetic 2D non-linear Schrödinger energy functional in a harmonic trapping potential, describing a rotating Bose–Einstein condensate. In the case of a repulsive interaction potential, we derive an effective Thomas–Fermi-like model in the rapidly rotating limit where the centrifugal force compensates the confinement. The available states are restricted to the lowest Landau level. The coupling constant of the Thomas–Fermi functional is to link the emergence of vortex lattices (the Abrikosov problem). When turning from repulsive to attractive interactions, the system is unstable since there is a balance between kinetic and interaction energies. In the regime where the strength of the interaction approaches a critical value from below, the system collapses to a profile obtained from the (unique) optimizer of a Gagliardo–Nirenberg interpolation inequality. This was established before in the case of fixed rotation frequency. We extend the result to rotation frequencies approaching, or even equal to, the critical frequency at which the centrifugal force compensates the trap. We prove that the blow-up scenario is to leading order unaffected by such a strong deconfinement mechanism. In particular, the blow-up profile remains independent of the rotation frequency.

References

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- D.-T. Nguyen and N. Rougerie, Thomas–Fermi profile of a fast rotating Bose–Einstein condensate, Pure and Applied Analysis, 4 (2022), pp. 535-569.
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April 09, 2026

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by **Shih Hsien Yu** (Academia Sinica)

Abstract: - TBA -

-TBA-

by **Dinh Nho Hao** (Institute of Mathematics, Vietnam Academy of Science and Technology)

Abstract: - TBA -

The p-elastic flow of inextensible planar curves

by **Chun Chi Lin** (National Taiwan Normal University)

Abstract: In this talk, I will discuss my joint work with Ying-Hsian Tsai on the existence of solutions to the negative L^2-gradient flow of the p-elastic energy for the class of inextensible planar closed or open curves. For open curves, the boundary conditions correspond to either hinged ends (i.e., zero curvature at their boundaries) or clamped ends (i.e., fixed contact angles at their boundaries). We show the existence of weak solutions to the negative L^2-gradient flow for $p \in (1, \infty)$.

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by **Ngo Quoc Anh** (VNU University of Science, Hanoi)

Abstract: - TBA -

April 10, 2026

Harmonic oscillations around surface Ekman layer

by **Nguyen Thieu Huy** (Hanoi University of Science and Technology)

Abstract: We study the Navier-Stokes equations in a rotating framework near the surface Ekman layer and establish the existence and polynomial stability of a time-periodic (or almost periodic) solution under the action of a time-periodic (or almost periodic, respectively) external force. These results describe the nonlinear dynamics of (almost) harmonic oscillations around the surface Ekman spiral. In the absence of external forcing, the nonlinear stability of the Ekman spiral profile follows as a direct consequence.

Derivation of the classical Φ^4_3 theory from quantum mechanics

by **Phan Thanh Nam** (LMU Munich)

Abstract: We will discuss a rigorous derivation of the classical Φ^4_3 measure as an effective description of the quantum Gibbs state for an interacting Bose gas in the semiclassical limit. This corresponds to the formation of Bose–Einstein condensation just above the critical temperature. The proof combines techniques from stochastic quantization and many-body quantum mechanics. The talk is based on recent joint work with Rongchan Zhu and Xiangchan Zhu.

Diffusion Approximations for Fast–Slow Systems

by **Truong Son Van** (Ho Chi Minh City)

Abstract: Fast–slow stochastic systems model multiscale phenomena across many applications. In the averaging regime, one can often derive reduced effective dynamics for the slow variables (averaged drift and, at next order, diffusion approximations), but a recurring difficulty is whether these reduced models capture the correct long-time behavior and asymptotic statistics. This talk first surveys general approaches to stochastic averaging and diffusion approximation for fast–slow systems, emphasizing what can be proved and what typically fails over long times. We then specialize to Langevin dynamics with background flow and discuss recent results on an acceleration-corrected advection–diffusion approximation, including finite-time strong and weak error estimates and supporting numerical evidence.

Degree Counting Formulas of curvature equations

by **Hsin Yuan Huang** (National Yang Ming Chiao Tung University)

Abstract: In this talk, we study the monodromy matrices of second-order Fuchsian ordinary differential equations(ODEs) by employing the Leray-Schauder degree formulas for the corresponding curvature equations. More precisely, we obtain the form of the degree counting formulas. Let k be the number of non-integer difference of the local exponents at the singular points of the ODEs. As an application of this result, we show that under certain assumptions, the degree does not vanish when $k = 3, 4, 5$, which implies that the corresponding monodromy matrices are unitary. To the best of our knowledge, this is the first work that assigns the Leray-Schauder degree to Fuchsian ODEs from the perspective of the corresponding curvature equations.

Advancing Multimodal Medical Imaging and Health Data Analytics with AI and Beyond

by **Weichung Wang** (National Taiwan University)

Abstract: Modern healthcare generates vast amounts of multimodal data, including medical records, physiological signals, medical imaging, whole slide pathology images, and genomic data. These rich data sources offer unprecedented opportunities to understand human anatomy, physiology, and disease, yet their high dimensionality and heterogeneity make analysis and integration highly challenging. In this talk, we discuss how intelligent analytics can transform complex biomedical data into actionable knowledge. While artificial intelligence plays a central role, we highlight that impactful advances often arise from integrating AI with methods rooted in mathematics, statistics, computational science, and medical knowledge. Such interdisciplinary approaches enable key tasks across the medical workflow, including segmentation, detection, classification, prediction, and decision support. By bridging multimodal data, interdisciplinary analytics, and real clinical needs, this presentation highlights emerging opportunities to accelerate medical discovery and enable more intelligent and scalable healthcare systems.