Hanoi University of Science and Technology
Faculty of Mathematics and Informatics

WORKSHOP

PARTIAL DIFFERENTIAL EQUATIONS AND RELATED TOPICS (PDEs 2025)

Hanoi, November 8^{th}, 2025

Foreword

Partial Differential Equations and Related Topics, scheduled for Saturday, November 8^{th}, 2025, which is jointly organized through the collaboration of the PDEs Working Group at Hanoi University of Science and Technology and the Department of Mathematical Sciences at Ritsumeikan University.

The workshop is designed to serve as a dynamic forum for promoting cooperation and intellectual exchange among researchers across the globe in partial differential equations and mathematical physics. Its central objective is to spur recent breakthroughs in the highly focused areas of the Theory of Schrödinger operators and the qualitative properties of partial differential equations on both Euclidean spaces and weighted graphs

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Website: https://bit.ly/PDEsFAMI2025

Programme

Saturday November 8th 2025

8:00-8:15 Reception

8:15-8:25 Opening ceremony

Session 1

Chair: **DUONG Anh Tuan**

8:30-9:15 **HIROSHIMA Fumio**

Spectral zeta function of the critical 2p Rabi model

9:20-10:05 **NGUYEN Thi Kim Son**

Hybrid uncertain dynamical systems: Advances in fuzzy, interval fractional, and neutrosophic intelligent modeling

10:10-10:20 Photo session

10:20-10:45 Coffee break

Session 2

Chair: **NGUYEN Thi Kim Son**

10:45-11:15 **YOSHIDA Naoya**

Semi-classical Resonances for Landau Stark Hamiltonians

11:20-11:50 **VU Thi Bich Tuyen**

The spectral Faber-Krahn inequalities for the Dirac and Laplacian

12:00-14:00 Lunch

Session 3

Chair: **DAO Tuan Anh**

14:00-14:30 **HIGUCHI Kenta**

Asymptotic analysis on the resonant tunneling effect for quantum walks

14:35-15:05 **NGUYEN Thi Lien**

Stability analysis of irreversible chemical networks with boundary equilibria

15:10-15:40 Coffee break

Session 4

Chair: **NGUYEN Thi Lien**

15:40-16:10 **NGUYEN Thi Nga**

Some remarks on the asymptotic profile of solutions to structurally damped σ-evolution equation

16:15-16:45 **NGUYEN Thi Van Anh**

Allen-Cahn approximation of mean curvature flows: generic noncontinuous initial conditions

16:45-16:50 Closing ceremony

List of abstracts

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Spectral zeta function of the critical 2p Rabi model

Hiroshima Fumio[1]

Abstract: For the two-photon Rabi model, when the coupling constant satisfies $g < \frac{1}{2}$, the spectrum is purely discrete, so one can define the spectral zeta function by using its eigenvalues. We then consider the limit $g \to \frac{1}{2}$. By scaling the eigenvalues and defining an appropriately rescaled spectral zeta function, we show that the limit converges to the Riemann zeta function. The proof makes use of the Iwasawa decomposition of the squeezing operator.

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Hybrid uncertain dynamical systems: Advances in fuzzy, interval fractional, and neutrosophic intelligent modeling

Nguyen Thi Kim Son[1]

Abstract: This talk addresses the mathematical structure and analytical properties of hybrid uncertain dynamical systems formulated as generalized fractional evolution and partial differential equations in fuzzy, interval, and neutrosophic spaces. Within the framework of semilinear metric spaces equipped with generalized fuzzy and neutrosophic metrics, we investigate the existence, uniqueness, and qualitative behavior of mild solutions to fractional PDEs involving Caputo and Atangana-Baleanu derivatives. Emphasis is placed on Ulam-Hyers and finite-time stability, observability, and feedback control under hybrid uncertainty. The analysis employs fractional semigroup theory, fixed-point theorems, and measures of noncompactness to establish unified stability criteria for nonlocal, weighted, and time-delay systems. Recent developments on weighted α-fractional differential systems under granular computing are also discussed, bridging operator theory with uncertainty quantification. These advances contribute to a coherent analytical foundation for uncertain fractional dynamics - linking classical PDE analysis with modern representations of imprecision and indeterminacy - and open pathways toward mathematically grounded intelligent modeling.

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Semi-classical Resonances for Landau Stark Hamiltonians

Yoshida Naoya[1]

Abstract: In this talk, we study shape resonances of two-dimensional magnetic Stark Hamiltonians in the semiclassical limit. We derive the asymptotic distribution of resonances generated by the potential wells. These resonances are characterized as complex eigenvalues of complex-distorted Hamiltonians obtained by applying a complex translation outside a compact set.

This talk is based on joint work with K. Kameoka (Ritsumeikan Univ).

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The spectral Faber-Krahn inequalities for the Dirac and Laplacian

Vu Thi Bich Tuyen[1]

Abstract: The spectral isoperimetric inequalities for the Dirac and Laplace operators remain a hot and challenging topic in spectral geometry and mathematical physics. The talk presents a systematic approach to the isoperimetric Dirac and Laplace problems defined on both general bounded domains and specific geometric configurations. Some applications in materials science are discussed.

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Asymptotic analysis on the resonant tunneling effect for quantum walks

Higuchi Kenta[1]

Abstract: The resonant tunneling effect is one of the hallmark phenomena in quantum mechanics. It is a phenomenon in which the probability of a quantum particle with resonant energy (or frequency) tunneling through two potential barriers becomes greater than the probability of tunneling through a single potential barrier under some symmetry condition. Furthermore, the probability for double barrier attains almost one despite a vanishingly small probability for single barrier. In this presentation, the resonant tunneling effect for quantum walks that depend smoothly on a small parameter $\varepsilon \geq 0$ are considered. Our main result shows that the resonant tunneling effect is observed when there is an "isotropic" resonant state.

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Stability analysis of irreversible chemical networks with boundary equilibria

Nguyen Thi Lien[1]

Abstract: Large time dynamics of reaction-diffusion systems modeling some irreversible reaction networks are investigated. Depending on initial masses, these networks possibly possess boundary equilibria, where some of the chemical concentrations are completely used up. In the absence of these equilibria, we show an explicit convergence to equilibrium by a modified entropy method, where it is shown that reactions in a measurable set with positive measure is sufficient to combine with diffusion and to drive the system towards equilibrium. When the boundary equilibria are present, we show that they are unstable (in Lyapunov sense) using some bootstrap instability technique from fluid mechanics, while the nonlinear stability of the positive equilibrium is proved by exploiting a spectral gap of the linearized operator and the uniform-in-time boundedness of solutions.

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Some remarks on the asymptotic profile of solutions to structurally damped σ-evolution equations

Bui Thi Nga[1]

Abstract: In this talk, we are interested in analyzing the asymptotic profiles of solutions to the Cauchy problem for linear structurally damped sigma-evolution equations in L^2-sense. Depending on the parameters sigma and delta we would like to not only indicate the approximation formula of solutions but also recognize the optimality of their decay rates in the distinct cases of parabolic like damping and sigma-evolution like damping when the spatial dimension is sufficiently high. Moreover, some sharp blow-up solution results for the low dimensional cases are also discussed in this work.

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Allen-Cahn approximation of mean curvature flows: generic noncontinuous initial conditions

Nguyen Thi Van Anh[1]

Abstract: The Allen-Cahn equation (after John W. Cahn and Sam Allen's work) is a reaction-diffusion equation of mathematical physics which describes the process of phase separation in multi-component alloy systems, including order-disorder transitions. The relation between the Allen-Cahn equation and mean curvature flow has been an ongoing investigation for several decades. For well-prepared initial conditions, Evans, Soner, and Souganidis proved the convergence to the viscosity solution, Ilmanen showed convergence results to a Brakke flow, and many others. In this talk, I will consider the Allen-Cahn equation under the initial condition by a 'signed function' of a given set. The solvability of problems, the convergence to the mean curvature flows in both classical and weak sense are also discussed. This is a part of an ongoing research project with Giovanni Bellettini.

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