Kyoto-CAU Joint Workshop on Nonlinear PDEs

February 10–13, 2026

Meeting Room "Manoa" — Pacific Hotel Okinawa (Naha, Japan)

– Program –

February 10	February 11	February 12	February 13
	9:00 – 9:30 **J. Han** (Kyung-Hee Univ) 9:40 – 10:10 **I. Shimizu** (Kyoto Univ)	9:00 – 9:30 **S. Yoshikawa** (Hiroshima Univ) 9:40 – 10:10 **M. Chae** (Hankyong National Univ)	9:00 – 9:30 **Y. Ueda** (Kobe Univ) 9:40 – 10:10 **J. Lee** (Chung-Ang Univ)
	Coffee Break	Coffee Break	
	10:30 – 11:00 **J. La** (KIAS) 11:10 – 11:40 **M. Hamano** (Kyoto Univ)	10:30 – 11:00 **D. Kawagoe** (Kyoto Univ) 11:10 – 11:40 **K. Kim** (Seoul National Univ)	
	Lunch	Lunch	
	13:40 – 14:10 **J. Kim** (Ajou Univ) 14:20 – 14:50 **S. Sakamoto** (Kyushu Univ)	13:40 – 17:50 Open Discussion	
	Coffee Break		
	15:10 – 15:40 **Y.-K. Cho** (Chung-Ang Univ) 15:50 – 16:20 **I.-J. Jeong** (Seoul National Univ) 16:40 – 17:10 **Y. Maekawa** (Kyoto Univ)		
17:20 – 17:50 **S. Kwon** (KAIST) 18:00 – 18:30 **M. Aoki** (Kyoto Univ)	17:20 – 17:50 **H. Ohyama** (Kyoto Univ)		
	18:30 – 20:30 Banquet		

February 10 (Tuesday)

17:15 Opening

17:20 – 17:50 **Soonsik Kwom (KAIST)**

Classification of single-bubble blow-up solutions for Calogero–Moser DNLS

18:00 – 18:30 **Motofumi Aoki (Kyoto University)**

On the non-uniqueness of the solution to incompressible Navier–Stokes equations in two-dimensional half-space

February 11 (Wednesday)

9:00 – 9:30 **Jongmin Han (Kyung Hee University)**

Solution structures for the self-dual Einstein-Maxwell-Higgs equations on compact surfaces

9:40 – 10:10 **Ikkei Shimizu (Kyoto University)**

Global perturbation of isolated equivariant skyrmions from the Bogomol'nyi case

— Coffee Break —

10:30 – 11:00 **Joonhyun La (KIAS)**

Wave turbulence and some applications

11:10 – 11:40 **Masaru Hamano (Kyoto University)**

Radial scattering solution beyond the threshold to NLS with inverse-power potential

— Lunch —

13:40 – 14:10 **Junha Kim (Ajou University)**
On wellposedness of α-SQG equations in the half-plane

14:20 – 14:50 **Shota Sakamoto (Kyushu University)**
Uniqueness of weak solutions to the non cut-off Boltzmann equation

— Coffee Break —

15:10 – 15:40 **Yong-Kum Cho (Chung-Ang University)**
Evaluations of Fourier Series: Clausen Functions

15:50 – 16:20 **In-Jee Jeong (Seoul National University)**
Stability of multiple Lamb dipoles

16:40 – 17:10 **Yasunori Maekawa (Kyoto University)**
Boundary layer around a rotating cylinder with uniform flow

17:20 – 17:50 **Hiroki Ohyama (Kyoto University)**
Long-time solvability and asymptotics for the 3D rotating MHD equations

18:30 – 20:30 Banquet

February 12 (Thursday)

9:00 – 9:30 **Shuji Yoshikawa (Hiroshima University)**
The discrete Brezis-Gallouet inequality and finite difference methods for the cubic nonlinear Schrodinger equation in two space dimensions

9:40 – 10:10 **Myeongju Chae (Hankyong National University)**
Uniform in time propagation of chaos for two-type particles

— Coffee Break —

10:30 – 11:00 **Daisuke Kawagoe (Kyoto University)**
On the existence and regularity of weakly nonlinear stationary Boltzmann equations with the incoming boundary condition

11:10 – 11:40 **Kihyun Kim (Seoul National University)**
Rigidity results in multi-bubble dynamics for non-radial energy-critical heat equation

— Lunch —

13:40 – 17:50 Open Discussion

February 13 (Friday)

9:00 – 9:30 **Yoshihiro Ueda (Kobe University)**
Stability of the composite wave for the generalized Burgers equation

9:40 – 10:10 **Jihoon Lee (Chung-Ang University)**
Existence of the solutions to the aerotaxis model

10:15 Closing

Organizers

Kenji Nakanishi, Nobu Kishimoto (Kyoto University)
Jihoon Lee (Chung-Ang University)

– Abstracts –

Classification of single-bubble blow-up solutions for Calogero–Moser DNLS

Soonsik Kwon (KAIST)

We study the Calogero–Moser derivative nonlinear Schrödinger equation (CM-DNLS), a mass-critical and completely integrable dispersive model. Recent works established finite-time blow-up constructions and soliton resolution, describing the asymptotic behaviors of blow-up solutions. We go beyond soliton resolution and provide a sharp classification of finite-time blow-up dynamics in the single-bubble regime. Assuming that a solution blows up at time T, with a single-soliton profile, we determine all possible blow-up rates depending on the regularity of initial data. The proof relies on a modulation analysis combined with the hierarchy of conservation laws provided by the complete integrability of (CM-DNLS). However, it does not use more refined integrability-based techniques. This is joint work with Uihyeon Jeong, Kihyun Kim, and Taegyu Kim.

On the non-uniqueness of the solution to incompressible Navier–Stokes equations in two-dimensional half-space

Motofumi Aoki (Kyoto University)

In this talk, we consider the non-uniqueness of mild solutions to the two-dimensional forced Navier–Stokes equations in the half-space under the no-slip boundary condition. Albritton–Brué–Colombo (2022) established non-uniqueness for the three-dimensional forced Navier–Stokes equations by utilising the instability of a self-similar vorticity profile. Moreover, Albritton–Brué–Colombo (2023) extended their result to a smooth bounded domain under the no-slip boundary condition. In this study, we construct non-unique solutions based on the instability of self-similar vorticity that concentrates near the boundary at the initial time. In particular, we take into account the boundary layer when constructing non-unique solutions, in contrast to the previous study by Albritton–Brué–Colombo (2023). This work is a joint work with Yasunori Maekawa (Kyoto Univ.)

Solution structures for the self-dual Einstein-Maxwell-Higgs equations on compact surfaces

Jongmin Han (Kyung Hee University)

In this talk, we consider the self-dual equations arising from the Einstein-Maxwell-Higgs model on compact surfaces. We review some known results about the existence of solutions on $\mathbb{R}^2$ and compact surfaces, and then we focus on the existence problem on compact surfaces. According to the behaviors of solutions as the coupling parameter ε decreases to zero, we classify solutions on compact surfaces into two categories: topological solutions and nontopological solutions. If a is small and $N \geq 3$, we present the existence of nontopological solutions for all small ε by using a degree argument.

Global perturbation of isolated equivariant skyrmions from the Bogomol'nyi case

Ikkei Shimizu (Kyoto University)

We consider the variational problem for the Landau-Lifshitz energy in the equivariant class. Under the regime of coefficients where the energy is positive perturbation from the Bogomol'nyi case, we construct solutions to the Euler-Lagrange equation, and investigate their profile and stability. This is joint work with Slim Ibrahim (Univ. of Victoria).

Wave turbulence and some applications

Joonhyun La (KIAS)

In this talk, we briefly introduce wave turbulence theory, a statistical theory of nonlinear dispersive systems in weakly turbulent regimes. Then we see applications of wave turbulence theory - on MMT equation, an one-dimensional toy model to understand wave turbulence, and on FPUT-experiment. The talk is based on a joint work with Pierre Germain (ICL) and Zhiyuan Zhang (Northeastern), and one with Pierre Germain and Angeliki Menegaki (ICL).

Radial scattering solution beyond the threshold to NLS with inverse-power potential

Masaru Hamano (Kyoto University)

In this talk, we consider nonlinear Schrödinger equation with an inverse-power potential. We show radial scattering result in a framework, which includes solutions with action beyond that of radial ground state.

On wellposedness of α-SQG equations in the half-plane

Junha Kim (Ajou University)

We investigate the wellposedness of α-surface quasi-geostrophic (α-SQG) equations in the half-plane, where $\alpha = 0$ and $\alpha = 1$ correspond to the 2D Euler and SQG equations respectively. For $0 < \alpha \leq 1/2$, we prove local wellposedness in certain weighted anisotropic Hölder spaces. We also show that such a wellposedness result is sharp: for any $0 < \alpha \leq 1$, we prove nonexistence of Hölder regular solutions (with the Hölder regularity depending on α) for initial data smooth up to the boundary. This is a joint work with Prof. In-Jee Jeong(SNU) and Prof. Yao Yao(NUS).

Uniqueness of weak solutions to the non cut-off Boltzmann equation

Shota Sakamoto (Kyushu University)

We consider the uniqueness of weak solutions to a Cauchy problem of the non cut-off Boltzmann equation near the global equilibrium. In general, uniqueness results require smallness or regularity of solutions, so it is largely open whether uniqueness holds for bounded solutions or non-classical solutions. We will show that, if two weak solutions with the same initial data are bounded in some L^p spaces, then they coincide a.e. The strategy of our proof is to develop a Littlewood-Paley type decomposition both for the spatial and velocity variables to appropriately utilize the smoothing effect of the Boltzmann collision kernel. This talk is based on a joint work with Dingqun Deng (Akita University).

Evaluations of Fourier Series: Clausen Functions

Yong-Kum Cho (Chung-Ang University)

In this talk we evaluate Clausen functions defined by

$$C_n(x) = \sum_{k=1}^{\infty} \frac{\cos kx}{k^n},$$
$$S_n(x) = \sum_{k=1}^{\infty} \frac{\sin kx}{k^n}, \quad n = 1, 2, \cdots,$$

and discuss various applications such as the recursive relation among odd zeta values $\zeta(3), \zeta(5), \cdots, \zeta(2n+1)$.

Stability of multiple Lamb dipoles

In-Jee Jeong (Seoul National University)

Classical variational approach of maximizing the kinetic energy under constraints provides nonlinear stability of the maximizing vortex configuration in various settings, but this approach fails to handle the situations where the vorticity is concentrated at multiple points in the fluid domain. This is simply because such configurations are not even local kinetic energy maximizers, even when we restrict the admissible class using all known coercive conserved quantities. We present results on nonlinear stability of superpositions of several Lamb dipoles, obtained by combining classical variational principle with dynamical bootstrapping schemes. This is based on joint works with Ken Abe, Kyudong Choi, and Yao Yao.

Boundary layer around a rotating cylinder with uniform flow

Yasunori Maekawa (Kyoto University)

We discuss the boundary layers generated by a rigid cylindrical obstacle undergoing constant, but fast, rotation in a viscous incompressible fluid in the presence of the background uniform flow. The outer flow is given by the superposition of two irrotational flows due to the rotation of the cylinder and to the uniform flow, while it contains unknown parameter which represents the circulation around the cylinder. We solve the boundary layer equations and rigorously verify the asymptotics both for the boundary layer velocity and the circulation of the outer flow when the rotation speed is fast enough compared with the speed of the uniform flow, which has been formally observed in fluid mechanics. This talk is based on the joint work with Slim Ibrahim (University of Victoria).

Long-time solvability and asymptotics for the 3D rotating MHD equations

Hiroki Ohyama (Kyoto University)

We consider the initial value problem for the 3D incompressible rotating MHD equations around a constant magnetic field. We prove the long-time existence and uniqueness of solutions for small viscosity coefficient and high rotating speed. Moreover, we investigate the asymptotic behavior of solutions in the limit of vanishing viscosity and fast rotation, and show that the velocity and magnetic field converge to the zero vector and the solution to the linear heat equation, respectively. We also derive the rates of these convergences in some space-time norm.

The discrete Brezis-Gallouet inequality and finite difference methods for the cubic nonlinear Schrodinger equation in two space dimensions

Shuji Yoshikawa (Hiroshima University)

We study a structure-preserving finite difference scheme for the cubic nonlinear Schrodinger equation in two space dimensions. The existence of a solution for the scheme is shown by the classical energy method, similar to the result by Brezis-Gallouet (1980). The key to the proof is to construct the discrete version of the Brezis-Gallouet inequality.

Uniform in time propagation of chaos for two-type particles

Myeongju Chae (Hankyong National University)

We study uniform-in-time propagation of chaos for a two-type interacting particle system in which particles change type at prescribed rates. The type dynamics admit two equivalent representations, either as a Poisson jump process or as a spin-flip dynamics, and we exploit both viewpoints to implement a coupling approach. The key ingredient for obtaining long-time control is a reflection coupling with respect to a modified Wasserstein distance, following the framework developed by A. Eberle et al. for McKean–Vlasov type equations.

On the existence and regularity of weakly nonlinear stationary Boltzmann equations with the incoming boundary condition

Daisuke Kawagoe (Kyoto University)

We consider a boundary value problem of the weakly nonlinear Boltzmann equation with the incoming boundary condition in a bounded convex domain. For the collision kernel, we consider the hard sphere model, hard potential model and the Maxwell model. With the diffuse reflection boundary condition, the $W_x^{1,p}$ regularity of the solution for $1 \leq p < 3$ is known under the positive Gaussian curvature condition. In this talk, we show the existence of the solution in a weighted $W^{1,\infty}$ space assuming the positive Gaussian curvature condition, which implies that the solution belongs to $W^{1,p}$ for $1 \leq p < 3$. A generalized Fredholm alternative theorem plays an important role in our analysis. This talk is based on joint work with I-Kun Chen and Chun-Hsiung Hsia (National Taiwan University).

Rigidity results in multi-bubble dynamics for non-radial energy-critical heat equation

Kihyun Kim (Seoul National University)

In this talk, I will present my recent joint work with Frank Merle (IHES and CY Cergy-Paris University) on the classification of asymptotic behaviors in multi-bubble dynamics for energy-critical heat equations in large dimensions $N \geq 7$ without symmetry. This multi-bubble dynamics appears naturally at least for a sequence of times in view of soliton resolution. We assume each bubble is given by the scalings and translations of $\pm W$ with (localized) non-colliding conditions for a sequence of times, where W is the ground state. The case of one soliton was previously established and in particular there is no blow-up. We consider the case of $J \geq 2$ solitons, where we expect only infinite-time blow-up.

We are able to identify three different scenarios, where we have a continuous-in-time resolution with an unexpected universal blow-up speed. The first one is when one scaling is much larger than the others. In this case, one bubble does not concentrate (hence stabilize) and the other bubbles concentrate with the universal blow-up speed $t^{-2/(N-6)}$ together with strong sign constraints. Next, assuming we are not in the first scenario, we establish a non-degenerate condition on the positions of bubbles to obtain that all bubbles concentrate with the universal blow-up speed $t^{-1/(N-4)}$. The last case we consider is a degenerate, but not too much degenerate, scenario. Here again, we obtain that all bubbles concentrate with the universal blow-up speed $t^{-1/(N-3)}$. This last rate has not been discovered before. Our theorem covers the case of four or less bubbles and we provide the construction of examples. To our knowledge, this is the first classification result in the non-radial multi-bubble dynamics, where both the scales, positions, and signs enter the dynamics nontrivially.

Stability of the composite wave for the generalized Burgers equation

Yoshihiro Ueda (Kobe University)

We consider the stability of the composite wave for the generalized Burgers equation. Especially, we focus on the case that the flux function is non-convex. Then the corresponding Riemann problem admits a Riemann solution which consists of an Oleinik shock and a rarefaction wave. In this situation, we will show the asymptotic stability of the composite wave of the viscous Oleinik shock and the rarefaction wave. This is a joint research with Masaya Kageura from Kobe University.

Existence of the solutions to the aerotaxis model

Jihoon Lee (Chung-Ang University)

In this talk, I will discuss the existence of solutions to the aerotaxis model, which describes the dynamics of the aerobic bacterium B. subtilis. First, I will consider the existence and properties of weak solutions to a model that also incorporates the motion of the surrounding fluid. Then, I will turn to the existence of solutions for an extended system that additionally accounts for the dynamics of algae.