Workshop on PDE Week-Kinetic and Related Topics

February 1-2, 2024

RCNA AMA PolyU

Program

February 1 (Venue: Z211)

Morning Session (Chair: Tong Yang)
9:50-10am: Opening Remark
10-10:50am: Yoshihiro Ueda
11-11:50am: Wei Xiang

12noon-2pm Lunch

Afternoon Session (Chair: Xianpeng Hu)
2-2:50pm: Zhu Zhang
3-3:50pm: Jan Brezina
4-4:30pm Coffee Break
4:30-5:30pm Free Discussion

6pm Banquet

February 2 (Venue: HJ305)

Morning Session (Chair: Renjun Duan)
10-10:50am: Kai Koike
11-11:50am: Shota Sakamoto

12noon-2pm Lunch

Afternoon Session (Chair: Xinlin Cao)
2-2:50pm: Miho Murata
3-3:50pm: Hongxu Chen
4-4:30pm Coffee Break
4:30-5:30pm Free Discussion

6pm Dinner

On-campus Internet Access

Wi-Fi access is provided during the workshop period. Please use the login name and password listed below.

User: gstrcna
Password: February2024

Remarks: Only SSID:PolyUWLAN can be used.

Title and Abstract

Long-time behavior of compressible MHD with non-conservative boundary conditions

Jan Brezina
Kyushu University

We consider the complete system of equations governing the motion of a general compressible, viscous, electrically and heat conductive fluid driven by non–conservative boundary conditions. Since we are interested in a long-time behavior of a system which may end up out of equilibrium, we study the existence of a bounded absorbing set in the energy space and asymptotic compactness of trajectories. As a consequence of our efforts, the set of all entire globally bounded solutions will be identified as a natural attractor. We also plan to discuss examples of boundary conditions that give rise to unbounded solutions.

Gradient decay of the Boltzmann equation with non-isothermal boundary

Hongxu Chen
Chinese University of Hong Kong

In this talk, I will discuss the regularity of the dynamical Boltzmann equation in a convex domain with non-isothermal boundary. The Boltzmann equation exhibits singularity near the boundary, to address this, we introduce the kinetic weight and establish a weighted C^1 regularity. We prove that dynamical solution converges to the stationary solution in the weighted C^1 regularity exponentially fast. Based on the weighted C^1 convergence, next we prove that the dynamical solution belongs to $W^{1,p}_x$ for $p<3$ and converges to the stationary solution in the same Sobolev space. This is a joint work with Chanwoo Kim.

Long-time behavior of a harmonic oscillator in a 1D viscous compressible fluid

Kai Koike
Tokyo Institute of Technology

We study the long-time behavior of a harmonic oscillator in a 1D viscous compressible fluid. It is shown that the displacement of the oscillator $X(t)$ satisfies a decay estimate $X(t)=O(t^{-3/2+\epsilon})$ for any $\epsilon>0$. This result is obtained as an application of a pointwise asymptotic expansion of the flow through the use of Green's function.

Unique solvability for a Q-tensor model of nematic liquid crystals

Miho Murata
Shizuoka University

We consider the model for a viscous incompressible liquid crystal flow proposed by Beris and Edwards in 1994.The model is coupled system by the Navier-Stokes equations with a parabolic-type equation describing the evolution of the director fields Q, which is called Q-tensor.

In this talk, we discuss the existence and uniqueness of the global strong solution for small initial data in the whole space. Furthermore, we consider the local solvability of the Q-tensor model in the half space with the help of the maximal regularity estimates for the linearized problem.This is a joint work with Professor Yoshihiro Shibata (Waseda University) and Daniele Barbera (Pisa University).

Faster decay of the microscopic part of a solution to the Boltzmann equation without angular cut-off

Shota Sakamoto
Kyushu University

We consider a Cauchy problem of the Boltzmann equation without angular cut-off near the global Maxwellian. It is widely observed that, under various settings of kinetic equations, the kinetic (microscopic) part of a solution decays faster in time than its fluid (macroscopic) counterpart. We will prove that a solution to the Boltzmann equation in the so-called low-regularity spaces also satisfies this property. The proof is based on the derivation of higher-order energy estimates and differential inequality for the microscopic part, which obtains (1+t)^{-1/2} faster decay for any order of differentiation.

Stability of non-zero equilibrium states for the viscous Burgers equation with time delay

Yoshihiro Ueda
Kobe University

In this talk, we consider the linear and nonlinear stability of the non-zero equilibrium state for the viscous Burgers equation with a delay effect. The linear stability is analyzed by using the characteristic equation of the corresponding eigenvalue problem. If our equation does not have a delay effect, the characteristic equation is given by a polynomial equation. On the other hand, if our equation has a delay effect, the characteristic equation becomes a transcendental equation, and it is difficult to analyze. In this situation, we apply the useful known result concerned with the characteristic equation for the ordinary delay differential equations and try to get the sharp stability condition for the viscous Burgers equation with delay.

Furthermore, we also attempt to derive the nonlinear stability based on the results obtained by the linear stability argument.

Contact discontinuity in finitely long nozzle

Wei Xiang
City University of Hong Kong

There can be contact discontinuities in a nozzle. In this talk, we will talk about the cases of the subsonic-supersonic and supersonic-supersonic contact discontinuity in a finitely long nozzle and establish the well-posedness results. Moreover, recent results on the supersonic combustion contact discontinuity will be discussed too.

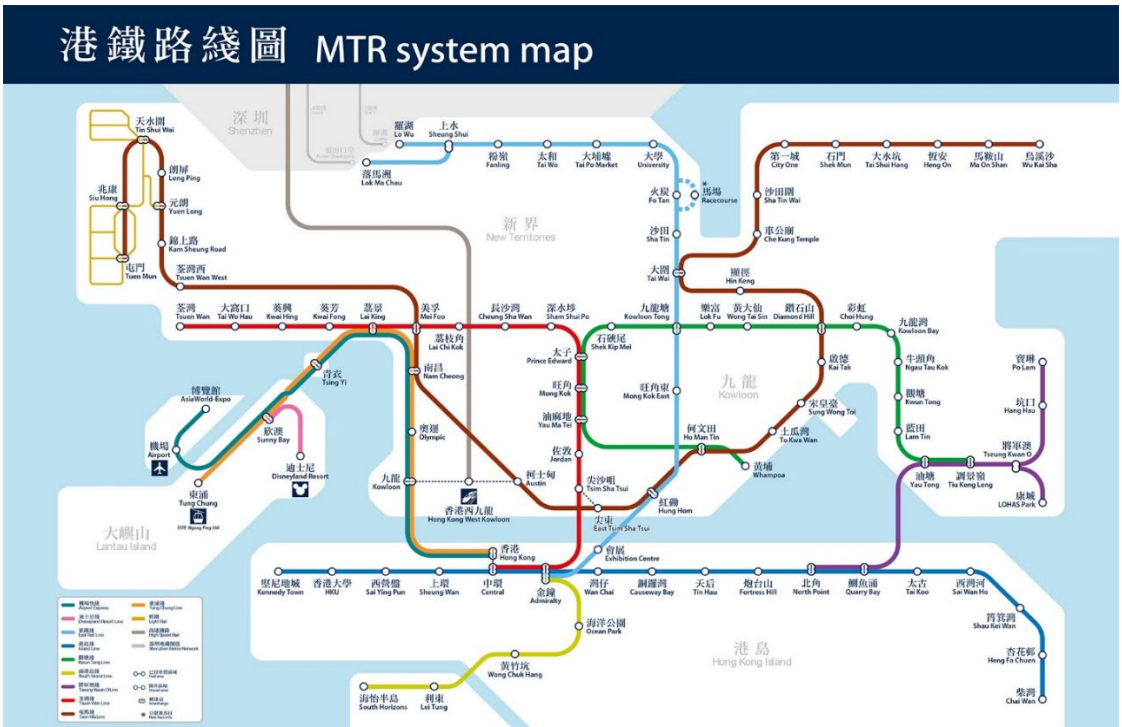
Cattaneo law and stability of boundary layers at the high Reynolds number

Zhu Zhang
The Hong Kong Polytechnic University

We consider the stability properties of shear flows of Prandtl type for Navier-Stokes equations with Cattaneo law. Compared with the Gevrey index 3/2 for the Navier-Stokes equations, the critical Gevrey index for stability of this model is 2. This reveals the stabilizing effect of Cattaneo law on the boundary layers.

Campus Map

[Hong Kong Polytechnic University Campus Map (polyu.edu.hk)]



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The Hong Kong Polytechnic University

Department of Applied Mathematics

Research Centre for Nonlinear Analysis

We would also like to thank the staff members in the Department of Applied Mathematics for their time and effort in making this workshop possible during the tight schedule. Their assistance has been indispensable.