

The 1st Meeting of Young Researchers in PDEs

August 18 – 19, 2016

Program and Abstract

Workshop Venue

Yonsei University

Industry-University Research Center (Building # 114), Room 310

Speakers

Jaewook Ahn (Yonsei University)
Myoungjean Bae (Postech)
Sunho Choi (Kyung Hee University)
Sukjung Hwang (Yonsei University)
Yunsoo Jang (Yonsei University)
Moon-Jin Kang (University of Texas, Austin)
Jaemyoung Kim (Seoul National University)
Bongsuk Kwon (UNIST)
Youngae Lee (NIMS)
Sung-Jin Oh (KIAS)
Jihoon Ok (KIAS)
Ihyeok Seo (Sungkyunkwan University)
Seok-Bae Yun (Sungkyunkwan University)

Organizers

Hantaek Bae (UNIST)
Minsuk Yang (KIAS)

Sponsor

Hi Jun Choe (Centre for Mathematical Analysis & Computation, Yonsei University)

Program

August 18

13:30–14:00 **Registration and opening**

14:00–14:30 **Jaewook Ahn**

Remarks on localized damping effects in channel flows with a periodic rough boundary

14:40–15:10 **Myoungjean Bae**

Nonlinear system of mixed type and its application to steady Euler-Poisson system

15:20–15:50 **Sunho Choi**

Individual based models for prey-predator and Boltzmann type equations

15:50–16:30 **Break**

16:30–17:00 **Jihoon Ok**

On $W^{1,q}$ estimates for elliptic Schrödinger equations of p -Laplace type in non-smooth domains

17:10–17:40 **Jaemyoung Kim**

Local regularity of the 3D MHD equations

August 19

10:00–10:30 **Yunsoo Jang**

Calderón-Zygmund estimate for homogenization of steady state Stokes systems

10:40–11:10 **Moon-Jin Kang**

Criteria on contraction for admissible discontinuities of hyperbolic system of conservation laws

11:20–11:50 **Bongsuk Kwon**

Quasi-neutral limit for Euler-Poisson system in the presence of plasma sheaths

12:00–14:00 **Lunch**

14:00–14:30 **Youngae Lee**

Degree counting for Toda system of rank two: one bubbling

14:40–15:10 **Sung-Jin Oh**

Global well-posedness of high dimensional Maxwell-Dirac for small critical data

15:20–15:50 **Sukjung Hwang**

The Dirichlet boundary problem for 2nd order parabolic operators satisfying Carleson condition

15:50–16:30 **Break**

16:30–17:00 **Ihyeok Seo**

Strichartz and smoothing estimates in weighted L^2 spaces and their applications

17:10–17:40 **Seok-Bae Yun**

Ellipsoidal BGK model for polyatomic particles

Title and Abstract

Jaewook Ahn (Yonsei University)

Title: Remarks on localized damping effects in channel flows with a periodic rough boundary

Abstract: In this talk, I'd like to talk about a modified stationary Navier-Stokes system involving damping effect for a channel flow with periodic roughness. The proposed Navier-Stokes system yields an $O(\epsilon^{3/2})$ quadratic approximation of real flow for a small pressure difference.

Myoungjean Bae (Postech)

Title: Nonlinear system of mixed type and its application to steady Euler-Poisson system

Abstract: With the ultimate goal of constructing multi-dimensional smooth transonic-transonic shock solution to steady Euler-Poisson system in a nozzle of finite length, multidimensional solutions in various states have been investigated: *subsonic, supersonic, and transonic*.

I will first present recent results on the well-posedness of a class of quasilinear second order elliptic system, and a class of quasilinear hyperbolic-elliptic coupled system. Also, as applications of these well-posedness results, the unique existence and structural stability of multidimensional subsonic/supersonic solutions to steady Euler-Poisson system will be discussed.

This talk is based on collaboration with Ben Duan (Dalian University of Science and Technology, China), Shangkun Weng(POSTECH, Republic of Korea), Jingjing Xiao(Chinese University of Hong Kong, Hong Kong) and Chungjing Xie (Shanghai Jiao Tong University, China).

- [1] M. Bae , B. Duan , J.-J. Xiao and C.-J. Xie, *Two dimensional supersonic solutions for the steady Euler-Poisson system in a bounded domain*, preprint.
- [2] M. Bae , B. Duan and C.-J. Xie, *Existence and stability of multidimensional steady potential flows for Euler-Poisson equations*, Arch. Ration. Mech. Anal. **220** (2016), 155–191.
- [3] ———, *Two dimensional subsonic flows with self-gravitation in bounded domain*, Math. Models Methods Appl. **25** (2015), no. 5, 2721–2747.
- [4] ———, *Subsonic solutions for steady Euler-Poisson system in two-dimensional nozzles*, SIAM J. Math. Anal. **46** (2014), no. 5, 3455–3480.
- [5] M. Bae and S. Weng, *Axissymmetric subsonic flows with nonzero swirl for the steady Euler-Poisson system*, arXiv:1604.05147v2.

Sunho Choi (Kyung Hee University)

Title: Individual based models for prey-predator and Boltzmann type equations

Abstract: I present well-known agent (individual) based models for prey-predator relation. These models consists of stochastic process and classical relations between prey and predator. The main issue of this talk is a counterpart of kinetic model corresponding to the individual based models. In order to express classical prey-predator relation, I employ indirect collision operator which is a Boltzmann type binary operator. This operator measure the amount of probability how much prey and predator contact each other. In this talk, I present the some simulation result for individual based model and modeling process for the kinetic model. This is joint work with Yong-Jung Kim.

Jihoon Ok (KIAS)

Title: On $W^{1,q}$ estimates for elliptic Schrödinger equations of p -Laplace type in non-smooth domains

Abstract: In this talk, we consider elliptic equations of the following type

$$-\operatorname{div} (a(x)|Du|^{p-2}Du) + V|u|^{p-2}u = -\operatorname{div} (|F|^{p-2}F) \text{ in } \Omega, \quad u = 0 \text{ on } \partial\Omega.$$

Here V is a nonnegative function. For $\gamma > \frac{n}{p}$, we prove that if $V \in L^q(\Omega)$ satisfies the reverse Hölder inequality that

$$\left(\frac{1}{|B|} \int_B V^\gamma dx \right)^{\frac{1}{\gamma}} \leq c \frac{1}{|B|} \int_B V dx$$

for all balls B and for some constant $c > 0$, then the following implication holds

$$F \in L^q(\Omega) \implies F \in L^q(\Omega)$$

for every $q \leq \gamma^*(p-1)$ with $\gamma^* := \frac{n\gamma}{n-\gamma}$, under possibly minimal assumptions on coefficients and domains.

Jaemyoung Kim (Seoul National University)

Title: Local regularity of the 3D MHD equations

Abstract: We study a local boundary regularity condition for a suitable weak solutions of the magnetohydrodynamics equations in three-dimensional space.

Yunsoo Jang (Yonsei University)

Title: Calderón-Zygmund estimate for homogenization of steady state Stokes systems

Abstract: We consider a steady state Stokes system in a homogenization problem. Recently, a $W^{1,p}$ estimate for homogenization of a steady state Stokes system with VMO coefficients over C^1 domain was proved by Gu and Shen. In this talk, for a steady state Stokes system with BMO coefficients over a Reifenberg domain, which is a natural generalization of the system with VMO coefficients over C^1 domain, we discuss how to obtain $W^{1,p}$ estimates for $1 < p < \infty$.

Moon-Jin Kang (University of Texas, Austin)

Title: Criteria on contraction for admissible discontinuities of hyperbolic system of conservation laws

Abstract: In this talk, we present criteria on contraction in a weighted relative entropy for admissible discontinuities for the hyperbolic system of conservation laws including the Euler systems. Based on this criteria, we have the contraction for large perturbation of extremal shocks. On the other hand, to investigate a possibility of non-contraction, we consider a necessary condition for the contraction, and various criteria for non-contraction. It follows from these criteria that some intermediate discontinuities of 3-D isentropic MHD and full Euler do not satisfy any of our contraction properties.

Bongsuk Kwon (UNIST)

Title: Quasi-neutral limit for Euler-Poisson system in the presence of plasma sheaths

Abstract: The purpose of this work is to mathematically justify the phenomena of the plasma sheath formation near the surface of a ball-shaped material immersed in a bulk plasma, and to get some qualitative information of such a boundary sheath layer. To this end, we employ the Euler-Poisson equations in the three dimensional annulus domain to study the existence and the quasi-neutral limit behavior of boundary layer solutions. If time permits, I will briefly talk about outlines of the proofs.

Youngae Lee (NIMS)

Title: Degree counting for Toda system of rank two: one bubbling

Abstract: In this talk, we study the degree counting formula of the rank two Toda system with simple singular sources. The key step is to derive the degree formula of the shadow system, which arises from the bubbling solutions as one of parameters crosses 4π . In order to compute the topological degree of the shadow system, we need to find some suitable deformation. During this deformation, we shall deal with new difficulty arising from the new phenomena: blow up does not necessarily imply concentration of mass. This phenomena occurs due to the collapsing of singularities. This talk is based on the joint works with Prof. Chang-Shou Lin, Prof. Juncheng Wei, Prof. Lei Zhang, and Dr. Wen Yang.

Sung-Jin Oh (KIAS)

Title: Global well-posedness of high dimensional Maxwell-Dirac for small critical data

Abstract: We prove global well-posedness of the $(d + 1)$ -dimensional ($d \geq 4$) massless Maxwell-Dirac equation in Coulomb gauge for data with small scale-critical Sobolev norm. A key step is to exploit (and justify) a deep analogy between Maxwell-Dirac and Maxwell-Klein-Gordon (for which an analogous result was proved earlier by Krieger-Sterbenz-Tataru), which says that the most difficult part of Maxwell-Dirac takes essentially the same form as Maxwell-Klein-Gordon. This is a joint work with C. Gavrus.

Sookjung Hwang (Yonsei University)

Title: The Dirichlet boundary problem for second order parabolic operators satisfying Carleson condition

Abstract: In a Lipschitz domain, there is a history of studies to prove the solvability of elliptic partial differential equations with rough coefficients as long as they obey certain natural and minimal smoothness conditions, say Carleson conditions. We here establish L^p , $2 \leq p \leq \infty$ solvability of the Dirichlet boundary value problem for a parabolic equation

$$u_t - \operatorname{div}(A\nabla u) - B \cdot \nabla u = 0$$

on time-varying Lipschitz domains with coefficient matrices $A = [a_{ij}]$ and $B = [b_i]$ that satisfy a small Carleson condition. We use quantitative methods without relying on any layer potential theories. Moreover, we introduce quantitative results of the solvability for elliptic systems satisfying certain Carleson conditions.

Ihyeok Seo (Sungkyunkwan University)

Title: Strichartz and smoothing estimates in weighted L^2 spaces and their applications

Abstract: Over the last three decades, Strichartz and smoothing estimates proved to be very efficient tools for dealing with dispersive equations of great importance in mathematical physics. For this reason, they have been intensively investigated starting from the pioneering works of Strichartz and Kato. We will obtain those estimates for a class of dispersive equations like wave, Schrödinger, KdV equations. Especially, we will give an answer to an open question concerning weighted L^2 Strichartz estimates for the Schrödinger equation. This is a joint work with Youngwoo Koh.

Seok-Bae Yun (Sungkyunkwan University)

Title: Ellipsoidal BGK model for polyatomic particles

Abstract: In this talk, we present our recent results on the polyatomic ellipsoidal BGK model, which is a relaxation type kinetic model describing the time evolution of phase space distribution of polyatomic particles.