Titles and Abstracts

1. Hyeong-Ohk Bae Ajou University, Korea

Title: Mathematical Model for Investors' Herding Phenomena
Abstract: In this paper, we study the herding phenomena in financial markets arising from the combined effect of (1) non-coordinated collective interactions between the market players and (2) concurrent reactions of market players to dynamic market signals. By interpreting the expected rate of return of an asset and the favorability on that asset as position and velocity in phase space, we construct an agent-based particle model for herding behavior in finance. We then define two types of herding functionals using this model, and show that they satisfy a Gronwall type estimate and a LaSalle type invariance property respectively, leading to the herding behavior of the market players. Various numerical tests are presented to numerically verify these results.

2. Young-Pil Choi Inha University, Korea

Title: Consensus-based global optimization method
Abstract: In this talk, we discuss an analytical framework for investigating the efficiency of a consensus based model for tackling global optimization problems. We study the optimization algorithm in the mean-field sense showing the convergence to the global minimizer for a large class of functions.

3. Zhoujian Cao AMSS, Chinese Academy of Sciences

Title: Einstein Equation and Numerical Relativity
Abstract: General relativity is the theory of gravity introduced by Einstein. The Einstein equation is the dynamical equation involved in general relativity. This equation controls kinds of phenomena related to gravity in our Universe, such as black hole and gravitational wave. It is well known that the Einstein equations admit rigid property which results in the uniqueness of black hole. Einstein is proud of the diffeomorphism invariant property of his general relativity. But it is well known that it is impossible to solve the Einstein equation without a specific gauge which significantly affects the property of the Einstein equation as a differential equation. Numerical relativity is the topic solving the Einstein equation with supercomputer. The stability issue is the notorious problem of numerical relativity. Due to numerical error, the rigid property and gauge issue will introduce subtleties to the stability problem of numerical relativity. I will talk about these issues and related problems in numerical relativity.

4. Xiangmao Ding AMSS, Chinese Academy of Sciences

Title: Hopf Algebraic Structure for Tagged Graphs
Abstract: Using the shu e structure of the graphs, we introduce a new kind of the Hopf

algebraic structure for tagged graphs with, or without loops. Like a quantum group structure, its product is non-commutative. With the help of the Hopf algebraic structure, after taking account symmetry of the tagged graphs, we reconstruct the topological recursion on spectral curves proposed by B. Eynard and N. Orantin, which includes the one-loop equations of various matrix integrals as special cases.

5. Pigong Han AMSS, Chinese Academy of Sciences

Title: Long-time behavior for the nonstationary Navier-Stokes flows in L^1 space
Abstract: In this talk, we consider the large time decay for the Navier-Stokes flows in $L^1(\mathbb{R}^n_+)$. Using the Stokes solution formula, we find a crucial and new estimate for the Stokes flow in $L^1(\mathbb{R}^n_+)$, which plays a fundamental role in studying the time L^1-behavior for the Navier-Stokes equations. In addition, we decompose the operator into two parts, and reduce its unboundedness to establish an L^1 estimate for an elliptic problem with Neumann boundary condition, which is overcome by using the weighted estimates of the Gaussian kernel's convolution.

6. Jinwook Jung Seoul National University, Korea

Title: Remarks on the slow relaxation for the fractional Kuramoto model for synchronization
Abstract: The collective behavior of an oscillatory system is ubiquitous in our nature, and one interesting issue in the dynamics of many-body oscillatory systems is the relaxation dynamics toward relative equilibria such as phase-locked states. For the Kuramoto model, relaxation dynamics occurs exponentially fast for generic initial data. However, some synchronization phenomena observed in our nature exhibits a slow subexponential relaxation. Thus, as one of possible attempts for such slow relaxation, second-order inertia term was added to the Kuramoto model in the previous literature so that the resulting second-order model can exhibit a slow relaxation dynamics for some range of inertia and coupling strength. In this talk, we present another Kuramoto-type model exhibiting a slow algebraic relaxation. More precisely, our proposed model replaces the usual derivative by Caputo fractional derivative in the original Kuramoto model. For this new model, we present several sufficient frameworks for fractional complete synchronization and practical synchronization.

7. Jeongho Kim Seoul National University, Korea

Title: A probabilistic approach for the mean-field limit to the Cucker-Smale model with a singular communication
Abstract: I will present a probabilistic approach for derivation of the kinetic Cucker-Smale(C-S) equation from the particle C-S model with singular communication. More precisely, we provide a probabilistic estimate for the deviation of the particle trajectory from the kinetic trajectory in a suitable sense. We show that the set of “bad initial data” does in fact have small measure in the space of initial data, and that this small

probability goes to zero algebraically, as the particle number N tends to infinity. For this, we introduce a suitable cut-off in the communication weight. This work is a collaboration with Prof. Ha, Prof. Zhang and Prof. Pickl.

8. Namkwon Kim Chosun Unviersity, Korea

Title: On a decomposition of the Navier-Stokes flow and blow-up criterions
Abstract: For the three dimensional incompressible Naver-Stokes equations, it is not known whether smooth (local in time) solutions generate singularity in a finite time. There have a lot of criterions for such possible generation of singularity. We consider certain decomposition of the flow in the Fourier space and examine which one of the decomposed flows determines the possible generation of singularity. We also discuss some consequences of our result.

9. Minkyu Kwak Chonnam National University, Korea
Title: On the global existence of 3D Navier-Stokes equations and related equations

Abstract: We first consider the existence of a class of strecheded solutions of $2\frac{1}{2}$ Magnettohydrodynamics equations in $\mathbf{R^3}$. We introduce a regularity criteria in terms of 2D vorticity ω or 2D magnetic density j (but not both). We then present the global existence result for an axisymmetric flow without swirl for both velocity and magnetic field. We also present some exact global solutions as well as singular solutions with a special structure. We next consider a fractional Navier-Stokes equations in the critical Lei-Lin spaces. We extend the classical results by Lei-Lin to the general case with fractional diffusion. The Lei-Lin mild solution exists globally in the critival space settings provided that the initial data satisfies a smallness condition. Our method is simple and covers the range of dissipation parameter $\alpha \in [\frac{1}{2}, 1]$.

10. Moon-Jin Kang Sookmyung Women's University, Korea

Title: Contraction for large perturbation of shocks of the barotropic Navier-Stokes system
Abstract: In this talk, I present a proof on the contraction property for any weak perturbations of viscous shocks of the barotropic Navier-Stokes system, by constructing a weighted relative entropy and time-dependent shift. The contraction property of the shocks does not depend on the viscosity coefficient. Therefore, this provides a weak compactness for the inviscid limit problem, that is, entropy shocks for the isentropic Euler system are stable and unique in the class of weak inviscid limits of solutions to the Navier-Stokes system. This result becomes an important cornerstone in the study for the long standing conjecture on the uniqueness of entropy weak solutions as follows: The compressible Euler equations admit a unique entropy weak solution in a class of vanishing viscosity solutions as inviscid limits of solutions to the associated viscous system that is compressible Navier-Stokes system

11. Jaeseung Lee Seoul National University, Korea

Title: Remarks on the stability and instability properties of the mean-field equations with diffusion

Abstract: We present stability and instability properties of two types of mean-field equation with diffusion: sphere Lohe model and Kuramoto-Sakaguchi-Fokker-Planck equation with frustration. First, we introduce the derivation of sphere Lohe model from particle Lohe model based on Sznitmans theory and give sufficient framework leading to the asymptotic stability of the incoherent state. For KS-FP equation with frustration, we study both stability and instability properties of the incoherent state. For the instability, we improve the previous result, i.e., we construct a new unstable mode for the linear equation for the perturbation of the incoherent state, and we show that the nonlinear perturbation stays close to the unstable mode in some small time interval. Our instability results improve the previous results for the KS-FP with zero frustration by providing a new linear unstable mode.

12. Jing Li AMSS, Chinese Academy of Sciences

Title: On the global strong solutions of the compressible Navier-Stokes equations with large data

Abstract: In this talk, we will present some results on the global existence of strong and weak solutions of the compressible Navier-Stokes equations with large data. In particular, both the time-independent upper bound of the density and the large-time behavior of the strong and weak solutions are also obtained.

13. Zhuchun Li Harbin Institute of Technology, China

Title: Gradient System and L ojasiewicz inequality with applications in Kuramoto type systems

Abstract: The Lojasiewicz inequality reveals a fundamental relation between a potential and its gradient near its critical point, and provides a tool to analyze the convergence of a trajectory for a gradient system. In this talk, we will briefly introduce the Lojasiewicz inequality in finite-dimensions and its applications in Kuramoto type models.

14. Xiaodong Liu AMSS, Chinese Academy of Sciences

Title: Recovery of an embedded obstacle and the surrounding medium for Maxwell's system

Abstract: We are concerned with the inverse electromagnetic scattering problem of recovering a complex scatterer by the corresponding electric far-field data. The complex scatterer consists of an inhomogeneous medium and a possibly embedded perfectly electric conducting (PEC) obstacle. The far-field data are collected corresponding to incident plane waves with a fixed incident direction and a fixed

polarisation, but frequencies from an open interval. It is shown that the embedded obstacle can be uniquely recovered by the aforementioned far-field data, independent of the surrounding medium. Furthermore, if the surrounding medium is piecewise homogeneous, then the medium can be recovered as well. Those unique recovery results are new to the literature. Our argument is based on low-frequency expansions of the electromagnetic fields and certain harmonic analysis techniques.

15. Qinghua Xiao Wuhan Institute of Physics and Mathematics, CAS, China

Title: A global existence of classical solutions to the two-dimensional kinetic-fluid model for flocking with large initial data

Abstract: We present a two-dimensional coupled system for flocking particle-compressible fluid interactions, and study its global solvability for the proposed coupled system. For particle and fluid dynamics, we employ the kinetic Cucker-Smale-Fokker-Planck (CS-FP) model for flocking particle part, and the isentropic compressible Navier-Stokes (N-S) equations for the fluid part, respectively, and these separate systems are coupled through the drag force. For the global solvability of the coupled system, we present a sufficient framework for the global existence of classical solutions with large initial data which can contain vacuum using the weighted energy method. We extend an earlier global solvability result in the one-dimensional setting to the two-dimensional setting.

16. Shu Wang Beijing University of Technology

Title: Some Topics On Nonlinear Fluid-dynamical Equations and Their Recent Progresses

Abstract: Some topics on nonlinear Fluid-dynamical equations will be discussed and some recent progresses will be surveyed. These topics include an axi-symmetric model for the 3D incompressible Euler and Navier-Stokes equations, boundary layer problem in the viscosity-diffusion vanishing limit of the incompressible 2D/3D MHD system in the bounded domain, asymptotic limits of compressible Euler-Maxwell equations and quasi-neutral limit of drift-diffusion models for semiconductors and the related models. The new results obtained by us will be given in this talk.

17. Haitao Wang, Shanghai Jiaotong University, China

Title: Quantitative Pointwise Estimate of the Solution of the Linearized Boltzmann Equation

Abstract: We study the quantitative pointwise behavior of the solutions of the linearized Boltzmann equation for hard potentials, Maxwellian molecules and soft potentials, with Grad's angular cutoff assumption. More precisely, for solutions inside the finite Mach number region, we obtain the pointwise fluid structure for hard potentials and Maxwellian molecules, and optimal time decay in the fluid part and sub-exponential time decay in the non-fluid part for soft potentials. For solutions outside the finite Mach number region, we obtain sub-exponential decay in the space variable.

The singular wave estimate, regularization estimate and refined weighted energy estimate play important roles in this paper. This is a joint work with Yu-Chu Lin and Kung-Chien Wu.

18. Seok-Bae Yun Sungkyunkwan University, Korea

Title: BGK model of the Boltzmann equation with physical collision frequency
Abstract: The BGK model is a relaxation model of the Boltzmann equation. Yielding qualitatively satisfactory results at much lower computational cost, it is widely used in place of the Boltzmann equation in engineering and science. The mathematical study on the BGK model, however, is far from satisfactory, and most of the efforts so far has been concentrated on the case of trivial collision frequency. In this talk, we consider the Cauchy problem for the BGK model with physical collision frequency

19. Xiongtao Zhang Huazhong University of Science and Technology

Title: Cucker-Smale model in general graph: 1-D case
Abstract: In this paper we study the Cucker-Smale model with general network on the line. We will construct an exponential decay quantity which can control the velocity diameter. Therefore we can imply the unconditional flocking emergence if the communication function is nonintegrable. This method is independent of the graph if only the network contains a spanning tree. Thus we prove that unconditional flocking emerges in the Cucker-Smale model for general digraph with a spanning tree. Moreover, in the special case when the communication function is regular inverse power form, unconditional flocking emerges if and only if the exponent $\beta \geqslant \frac{1}{2}$

20. Yinglong Zhang Seoul National University, Korea

Title: Synchronization of Kuramoto oscillators
Abstract: The synchronization of large populations of weakly coupled oscillators is a ubiquitous phenomenon in complex biological and physical systems. Such synchronization has received considerable attention because of its diverse applications. In this talk, I will introduce the Kuramoto model with frustration and talk about its synchronization dynamics.

21. Zhe Zhou AMSS, Chinese Academy of Sciences

Title: Positive Homogeneity, Almost Periodicity, Rotation Number
Abstract: In this talk, we will establish the rotation number for the Schreodinger equation. The essential elements in the provement are positive homogeneity and almost periodicity. From this point of view, the concept of rotation numbers may be introduced in the case of discontinuous potentials. At last, we will post some questions on this topic.