ABSTRACT

Speaker： Yu Deng (University of Chicago)
Xiao Ma (University of Michigan)
Title: Hilbert's Sixth Problem: Derivation of the Boltzmann and fluid equations
Abstract: We present recent works with Zaher Hani and Xiao Ma, in which we derive the Boltzmann equation from the hard sphere dynamics in the Boltzmann-Grad limit, for the full time range in which the (strong) solution to the Boltzmann equation exists. This is done in the Euclidean setting in any dimension $d\geq 2$, and in the periodic setting in dimensions $d\in\{2,3\}$. As a corollary, we also derive the corresponding fluid equations from the the hard sphere dynamics. This resolves Hilbert's Sixth Problem pertaining to the derivation of hydrodynamic equations from colliding particle systems, via the Boltzmann equation as the intermediate step.
In the first lecture we will provide an overview of the problem, its scope and historical accounts, and the main intuition and ideas in our proof. In the subsequent lectures we will present the important steps and details of the proof.

Speaker： Seung-Yeal Ha (Seoul National University)
Title: Recent progress in the mean-field limit for the collective dynamics models
Abstract: In this talk, we discuss the mean-field limit of the collective dynamics models such as the Cucker-Smale model and Kuramoto model. In particular, we present uniform stability estimates for the Cucker-Smale (here C-S) flocking model and the Kuramoto model with respect to the initial data. As a direct application of these uniform stability estimates, we discusss how the uniform-in-time mean-field limit can be made from the particle collective dynamics models in Wasserstein metric. This generalizes the earlier result in which the rigorous mean-field limit has been studied only in a finite-time interval.

Speaker： Ning Jiang (Wuhan University)
Title: Hydrodynamic limits from Boltzmann equation with boundary
Abstract: We present some recent progress on the justification of fluid equations (compressible Navier-Stokes, Euler and acoustic system, etc) from Boltzmann equations with two types of boundary conditions: Maxwell reflection and incoming boundaries. In the first part, we discuss the well-posed theory in L^\infty framework of the kinetic boundary layer equations, including all range of collision kernels and accommodation coefficients. In the second part, we apply this theory to the derivation of boundary conditions of the fluid equations.

Speaker： Mario Pulvirenti (University of Roma 1)
Title:"On the rigorous derivation of the Quantum Boltzmann equation from particle systems"
Abstract: In this talk I discuss the problem of deriving the Boltzmann equation from quantum particle systems in the weak-coupling limit. The problem is difficult and still unsolved in general. I discuss partial results and some ideas associated with the problem.

Speaker： Xuecheng Wang (Tsinghua University)
Title: 3D Anisotropic wave equations with multiple characteristic hypersurfaces
Abstract: In this talk, we discuss the 3D Maxwell's system in homogeneous anisotropic media. This system arises naturally from the study of crystal optics. In the first part of this talk, we focus on the decay estimate of the linear system and related fourth order wave equations. In the second part of this part, we focus on a model problem of the nonlinear uniaxial crystal optics. For this system, we prove global existence and scattering for small regular localized initial data.

Speaker： Haitian Yue (ShanghaiTech University)
Title: Invariant Gibbs measure for 3D cubic NLW
Abstract: In this talk, we'll present our results about invariant Gibbs measures for the periodic cubic nonlinear wave equation (NLW) in 3D. The interest in this result stems from connections to several areas of mathematical research. At its core, the result concerns a refined understanding of how randomness gets transported by the flow of a nonlinear equation which involves probability theory and partial differential equations. This is joint work with Bjoern Bringmann (Princeton), Yu Deng (UChicago) and Andrea Nahmod (UMass Amherst).

Speaker： Datong Zhou (Sorbonne University)
Title: Coupling and Tensorization of Kinetic Theory and Graph Theory
Abstract: We study a non-exchangeable multi-agent system and rigorously derive a strong form of the mean-field limit. The convergence of the connection weights and the initial data implies convergence of large-scale dynamics toward a deterministic limit given by the corresponding extended Vlasov PDE, at any later time and any realization of randomness. This is established on what we call a bi-coupling distance defined through a convex optimization problem, which is an interpolation of the optimal transport between measures and the fractional overlay between graphs. The proof relies on a quantitative stability estimate of the so-called observables, which are tensorizations of agent laws and graph homomorphism densities. This reveals a profound relationship between mean-field theory and graph limiting theory, intersecting in the study of non-exchangeable systems.