## Schedule

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| **Friday** | |
| | Chair: Jose Carrillo |
| 9:00-9:10 | Welcome remark, group photo |
| 9:10-9:55 | Fengyu Wang (Tianjin University) |
| 9:55-10:40 | Sylvia Serfaty (Sorbonne Université and New York University) |
| 10:40-11:10 | Tea break |
| 11:10-11:55 | Xing Huang (Tianjin University) |
| 11:55-1:30 | Lunch |
| | Chair: Fengyu Wang |
| 1:30-2:15 | Panpan Ren (Chinese University of Hong Kong) |
| 2:15-3:00 | Difan Yuan (Beijing Normal University) |
| 3:00-3:30 | Tea break |
| 3:30-4:00 | Yun Gong (Peking University) |
| 4:00-4:30 | Shuchen Guo (Oxford University) |
| 4:30-5:00 | Pengzhi Xie (Fudan University) |
| **Saturday** | |
| | Chair: Xing Huang |
| 9:00-9:45 | Jose Carrillo (Oxford University) |
| 9:45-10:30 | Jianhai Bao (Tianjin University) |
| 10:30-11:00 | Tea break |
| 11:00-11:30 | Xuanrui Feng (Peking University) |

## Abstract

Speaker: Fengyu Wang (Tianjin University)

Title: Renormalization Limit for Empirical Measures in Critical Case

Abstract: We identify the leading term in the asymptotics of the quadratic Wasserstein distance between the invariant measure and empirical measures for diffusion processes on closed weighted 4-dimensional Riemannian manifolds, where 4D is critical. Unlike results in lower dimensions, our analysis shows that this term depends solely on the Riemannian volume of the manifold, remaining unaffected by the potential and vector field in the diffusion generator.

Speaker: Sylvia Serfaty (Sorbonne Université and New York University)

Title: Mean-Field limits for singular flows by the modulated energy method

Abstract: We consider a system of N points in singular interaction of Coulomb or Riesz type, evolving by gradient flow or conservative flow (such as the point vortex system in 2D) with or without noise. We discuss convergence to the mean-field limit by a modulated energy method, that relies on a commutator estimate. The method also allows to obtain global-in-time convergence in some settings.

Speaker: Xing Huang (Tianjin University)

Title: Some progress on quantitative propagation of chaos for mean field interacting particle system by coupling methods

Abstract: In this talk, we will present some results on quantitative propagation of chaos(PoC) for mean field interacting particle system, which mainly include the entropy-cost and TV-W_1 type PoC. These two types PoC can also be viewed as “generation of chaos”, i.e. the Kac’s chaotic property in relative entropy or total variation distance holds provided the time variable is strictly positive even though the corresponding property fails at initial time. This phenomenon can be attributed to the regularization effect of the stochastic noise. Both of the short time and long time PoC will be illustrated and the models can even involve in some highly degenerate ones-path dependent particle system. The main tricks rely on coupling by change of measure, reflection coupling method and gradient estimate for the decoupled SDEs.

Speaker: Panpan Ren (Chinese University of Hong Kong)

Title: Bi-coupling approach and It's applications

Abstract: By developing a new technique called the bi-coupling argument, we estimate the relative entropy between different diffusion processes in terms of the distances of initialdistributions and drift-diffusion coefficients. As an application, the entropy-cost inequality and exponential ergodicity in entropy are established for distribution dependent stochastic Hamiltonian system associated with nonlinear Fokker-Planck equations.

Reference:

1. P. Ren, F.-Y. Wang, Probability Distance Estimates Between Diffusion Pro- cesses and Applications to Singular McKean-Vlasov SDEs, arXiv:2302.13500.

2. X. Huang, P. Ren, F.-Y. Wang, Entropy Estimate Between Diffusion Processes and Application to McKean-Vlasov SDEs, JDE,2025.

3. Z. Qian, P. Ren, F.-Y. Wang, Entropy Estimate for Degenerate SDEs with Applications to Nonlinear Kinetic Fokker-Planck Equations, SIAM.J.M.A.,2024.

4. X. Huang, P. Ren, F.-Y. Wang, Distribution Dependent SDEs with Singular Interactions: Well-Posedness and Regularity, In preprint,2025.

Speaker: Difan Yuan (Beijing Normal University)

Title: Global Existence and Nonlinear Stability of Finite-Energy Solutions of the Compressible Euler-Riesz Equations with Large Initial Data of Spherical Symmetry

Abstract: The compressible Euler-Riesz equations are fundamental with wide applications in astrophysics, plasma physics, and mathematical biology. In this talk, I will present the global existence and nonlinear stability of finite-energy solutions of the multidimensional Euler-Riesz equations with large initial data of spherical symmetry. Both attractive and repulsive interactions for a wide range of Riesz and logarithmic potentials for dimensions larger than or equal to two are considered. This is achieved by the inviscid limit of the solutions of the corresponding Cauchy problem for the Navier-Stokes-Riesz equations. The strong convergence of the vanishing viscosity solutions is achieved through delicate uniform estimates in Lp. It is observed that, even if the attractive potential is super-Coulomb, no concentration is formed near the origin in the inviscid limit. Moreover, we prove that the nonlinear stability of global finite-energy solutions for the Euler-Riesz equations is unconditional under a spherically symmetric perturbation around the steady solutions. Unlike the Coulomb case where the potential can be represented locally, the singularity and regularity of the nonlocal radial Riesz

potential near the origin require careful analysis, which is a crucial step. We also establish uniform energy estimates of global solutions for not only the Riesz potential but also the limiting end-point case: the logarithmic potential. Finally, unlike the Coulomb case, a Grönwall type estimate is required to overcome the difficulty of the appearance of boundary terms in the sub-Coulomb case and the singularity of the super-Coulomb potential. Furthermore, we prove the nonlinear stability of global finite-energy solutions for the compressible Euler-Riesz equations around steady states by employing concentration compactness arguments. Steady states properties are obtained by variational arguments connecting to recent advances in aggregation-diffusion equations. This is a joint work with Jose A. Carrillo, Samuel R. Charles, Gui-Qiang Chen.

Speaker: Yun Gong (Peking University)

Title: Uniform-in-time propagation of chaos for second order interacting particle systems

Abstract: We consider the long-time behavior of second order particle systems interacting through global Lipschitz kernels. Combining hypocoercivity method and relative entropy method, we are able to overcome the degeneracy of diffusion in position direction by controlling the relative entropy and relative Fisher information together. This implies the uniform-in-time propagation of chaos through the strong convergence of all marginals. This method works at the level of Liouville equation and relies on the log Sobolev inequality of equilibrium of Vlasov-Fokker-Planck equation.

Speaker: Shuchen Guo (Oxford University)

Title: Mean-field derivation of the Landau-Coulomb hierarchy

Abstract: We consider the Kac model for the space-homogeneous Landau equation with the Coulomb potential. We show that the Fisher information of the Liouville equation for the unmodified N-particle system is monotonically decreasing in time. The monotonicity ensures the compactness to derive a weak solution of the Landau hierarchy.

Speaker: Pengzhi Xie (Fudan University)

Title: Uniform-in-Time Estimates on the Size of Chaos for Interacting Particle Systems

Abstract: For any weakly interacting particle system with bounded kernel, we give uniform-in-time estimates of the $L^2$ norm of correlation functions, provided that the diffusion coefficient is large enough. When the condition on the kernels is more restrictive, we can remove the dependence of the lower bound for diffusion coefficient on the initial data and estimate the size of chaos in a weaker sense. Based on these estimates, we also study fluctuation around the mean-field limit.

Speaker: Jose Carrillo (Oxford University)

Title: Propagation of chaos for multi-species moderately interacting particle systems with attractive Coulomb potentials

Abstract: We derive a class of multi-species aggregation-diffusion systems from stochastic interacting particle systems via relative entropy method with quantitative bounds. We show an algebraic L1-convergence result using moderately interacting particle systems approximating attractive/repulsive singular potentials up to Newtonian/Coulomb singularities without additional cut-off on the particle level. The first step is to make use of the relative entropy between the joint distribution of the particle system and an approximated limiting aggregation-diffusion system. A crucial argument in the proof is to show convergence in probability by a stopping time argument. The second step is to obtain a quantitative convergence rate to the limiting aggregation-diffusion system from the approximated PDE system. This is shown by evaluating a combination of relative entropy and L2-distances.

Speaker: Jianhai Bao (Tianjin University)

Title: $L^2$-Wasserstein contraction of modified Euler schemes for SDEs with high diffusivity and applications

Abstract: In this talk, we are concerned with a modified Euler scheme for the SDE under consideration, where the drift is of super-linear growth and dissipative merely outside a closed ball. By adopting the synchronous coupling, along with the construction of an equivalent quasi-metric, the $L^2$-Wasserstein contraction of the modified Euler scheme is addressed provided that the diffusivity is large enough. In particular, as a by-product, the $L^2$-Wasserstein contraction of the projected (truncated) Euler scheme and the tamed Euler algorithm is treated under much more explicit conditions imposed on drifts. The theory derived on the $L^2$-Wasserstein contraction has numerous applications on various aspects. In addition to applications on Poincar\'{e} inequalities (with respect to the numerical transition kernel and the numerical invariant probability measure), concentration inequalities for empirical averages, and bounds concerning the KL-divergence, in this paper we present another two potential applications. One concerns the non-asymptotic $L^2$-Wasserstein bound corresponding to the projected Euler scheme and the tamed Euler recursion, respectively, which further implies the

$L^2$-Wasserstein error bound between the exact invariant probability measure and the numerical counterpart.

It is worthy to emphasize that the associated convergence rate is improved greatly in contrast to the existing literature. Another application is devoted to the strong law of large numbers of additive functionals related to the modified Euler algorithm, where the observable functions involved are allowed to be of polynomial growth, and the associated convergence rate is also enhanced remarkably.

Speaker: Xuanrui Feng (Peking University)

Title: Quantitative Propagation of Chaos for Singular First-order System on the Whole Space.

Abstract: We derive the quantitative propagation of chaos in the sense of relative entropy for singular first-order systems on the whole Euclidean space, including the 2D viscous vortex model with general circulations approximating the Navier-Stokes equation, and the 2D log gas model approximating the Poisson-Nernst-Planck equation of single component. We estimate the relative entropy or the modulated free energy between the joint law of the particle system and the factorized law of the limit McKean-Vlasov system, where the logarithmic gradient and Hessian estimates are derived for the limit density to overcome the difficulties when working on the whole space. For the vortex model, we also obtain the optimal convergence rate for local relative entropy in Lacker's sense. These approaches are also migrated to the particle approximation of the Landau equation with Maxwellian molecules.

List of Speakers:

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