校庆一百一十六周年暨五十五届科学报告讨论会

时间：2021年5月26日下午 13:30-16:40

地点：上海数学中心102室

Chair: Weixiao Shen (沈维孝)

Lecture 1　13:30-14:15　Speaker: Ronggang Shi (石荣刚)

Title: **Rigidity of subgroup actions on homogeneous spaces**

Abstract: Y. Benoist and J.-F. Quint proved several rigidity theorems for random walks on homogeneous spaces in the early 2010s. Recently, A. Eskin and E. Lindenstrasuss extended Benoist-Quint's measure rigidity theorem. Based on this result, in a recent joint work with R. Prohaska and C. Sert, we proved more rigidity theorems for random walks given by expanding measures. In this talk we will discuss these developments.

Lecture 2　14:20-14:50　Speaker: Chenghua Duan (段成华)

Title: **Structure-Preserving Numerical Methods for Nonlinear Fokker–Planck Equations with Nonlocal Interactions by an Energetic Variational Approach**

Abstract: In this work, we develop novel structure-preserving numerical schemes for a class of nonlinear Fokker--Planck equations with nonlocal interactions. Such equations can cover many cases of importance, such as porous medium equations with external potentials, optimal transport problems, and aggregation-diffusion models. Based on the Energetic Variational Approach, a trajectory equation is first derived by using the balance between the maximal dissipation principle and least action principle. By a convex-splitting technique, we propose energy dissipating numerical schemes for the trajectory equation. Rigorous numerical analysis reveals that the nonlinear numerical schemes are uniquely solvable, naturally respect mass conservation and positivity at fully discrete level, and preserve steady states in an admissible convex set, where the

discrete Jacobian of flow maps is positive. Under certain assumptions on smoothness and a positive Jacobian, the numerical schemes are shown to be second order accurate in space and first order accurate in time. Extensive numerical simulations are performed to demonstrate several valuable features of the proposed schemes. In addition to the preservation of physical structures, such as positivity, mass conservation, discrete energy dissipation, and steady states, numerical simulations further reveal that our numerical schemes are capable of solving degenerate cases of the Fokker--Planck equations effectively and robustly. It is shown that the developed numerical schemes have convergence order even in degenerate cases with the presence of solutions having compact support and can accurately and robustly compute the waiting time of free boundaries without any oscillation. The limitation of numerical schemes due to a singular Jacobian of the flow map is also discussed.

Tea Break 14:50-15:20

Lecture 3 15:20-15:50 Speaker: Dongtai He (何东泰)

Title: Heegaard Floer homology and its applications

Abstract: Heegaard Floer homology is a family of invariants for 3- and 4-manifolds developed by Peter Oszváth and Zoltán Szabó. Thanks to its computability, Heegaard Floer homology and its variants have a significant impact on many areas such as low-dimensional topology, knot theory, symplectic and contact topology. In this talk I will walk through the history of Heegaard Floer homology, its basic idea and major applications.

Lecture 4 15:55-16:40 Speaker: Haining Wang (王海宁)

Title: Level raising and BSD conjecture

Abstract: In this talk, we will discuss how the technique of congruences of modular forms can be applied to construct Euler system and prove results in the direction of the BSD conjecture and its generalizations. We will first discuss the case of Heegner points and Heegner cycles on Shimura curves and then move on to the case of diagonal cycles on triple product of Shimura curves.