数学与系统科学研究院

计算数学所网络学术报告

报告人：　　段成华

（ *上海数学中心* ）

报告题目：

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

邀请人：　于海军 研究员

报告时间：**2021** 年 **5** 月 **28** 日（周五）

上午 **10:00-11:00**

报告工具：腾讯会议 **ID**：（**148 679 413**）

会议链接：

https://meeting.tencent.com/s/A39UPOB7SBVI

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.

个人简介：

段成华于2018年在苏州大学获得博士学位，期间访问美国伊利诺伊理工大学。

2018年至今在上海数学中心进行博士后研究。主要研究方向为偏微分方程数值解，研究的主要内容是基于能量变分方法数值求解偏微分方程，尤其是退化抛物方程。最近在求解非局部Fokker-Planck方程和Poisson－Nernst－Planck 方程上取得进展。研究工作发表在SIAM J. Sci. Comput., J. Comput. Phys., ESAIM: Math. Model. Num.等核心期刊上。

欢迎大家参加！