

课程名:偏微分方程选讲 (Topics in PDEs) 课程号:00113030  
授课教师:王振富 (镜春园 78 号院 77102, 电话:010-62744097).

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答疑时间:通过邮件预约

上课时间:1-16 周每周周五 3-4 节, 单周周三 7-8 节

上课地点:三教 408

第一节课上课时间: 2024 年 2 月 21 日

考核方式: 个人或者组团 (2 人) 完成一个课程项目, 原创的文章最好。

课程主要内容: 本专题课集中探讨多体系统 (经典或者量子) 的大粒子数极限, 特别是具有奇异交互作用力的粒子系统在平均场尺度下的极限, 即平均场极限。我们将介绍研究此类问题的基本概念和基本工具, 以及最近的一些进展。课程前半部分集中于经典粒子系统的平均场极限问题, 主要讲授 Dobrushin 估计, 相对熵方法和调整能量方法等。另外, 我们会介绍领域内的公开问题以及新的研究热点方向。课程后半部分集中于量子多体系统的尺度极限等问题。我们将邀请研究方向与课程主题相关的学者做学术报告, 也欢迎大家参加。

先修课程: 本科阶段的常微分方程、偏微分方程、概率论以及实变函数课程即可。

本课程没有教材, 以下是相关的参考文献。

## References

- [1] A.S. Sznitman. Topics in propagation of chaos. In Ecole d'été de probabilités de Saint-Flour XIX—1989 (pp. 165-251). Springer 1991.
- [2] F. Golse, On the dynamics of large particle systems in the mean field limit. In Macroscopic and large scale phenomena: coarse graining, mean field limits and ergodicity (pp. 1-144). Springer, Cham 2016.
- [3] P.-E. Jabin, A review of the mean field limits for Vlasov equations. Kinetic and Related models 7 (2014) 661–711.
- [4] P.-E. Jabin and Z. Wang, Quantitative estimates of propagation of chaos for stochastic systems with  $W-1, \infty$  kernels. Inventiones mathematicae 214(1) (2018) 523–591.

- [5] D. Bresch, P.-E. Jabin and Z. Wang. Mean-field limit and quantitative estimates with singular attractive kernels. *Duke Mathematical Journal* 172, no. 13 (2023): 2591-2641.
- [6] D. Lazarovici and P. Pickl, A mean field limit for the Vlasov-Poisson system. *Arch. Ration. Mech. Anal.* 225 (2017) 1201–1231.
- [7] S. Serfaty (appendix with M. Duerinckx), Mean Field Limit for Coulomb-Type Flows. *Duke Math. J.* 169(15): 2887-2935 (15 October 2020)
- [8] X. Feng and Z. Wang. "Quantitative propagation of chaos for 2d viscous vortex model on the whole space." *arXiv preprint arXiv:2310.05156* (2023).
- [9] Wang, Zhenfu, Xianliang Zhao, and Rongchan Zhu. "Gaussian fluctuations for interacting particle systems with singular kernels." *Archive for Rational Mechanics and Analysis* 247, no. 5 (2023): 101.
- [10] Bresch, Didier, Pierre-Emmanuel Jabin, and Juan Soler. "A new approach to the mean-field limit of Vlasov-Fokker-Planck equations." *arXiv preprint arXiv:2203.15747* (2022).
- [11] Bresch, Didier, M. Duerinckx, and P.-E. Jabin. "A duality method for mean-field limits with singular interactions." *arXiv preprint arXiv:2402.04695* (2024).
- [12] Lieb, Elliott H., and Robert Seiringer. *The stability of matter in quantum mechanics*. Cambridge university press, 2010.