Topics in analysis of many-particle systems (E12)

Clément Mouhot

This non-examinable course will present some mathematical tools and concepts for the rigorous derivation and study of nonlinear partial differential equations arising from many-particle limits: Vlasov transport equations, Boltzmann collision equations, nonlinear diffusion, quantum Hartree equations... Depending on time and interest it will include part or all of the following items: Liouville and master equations of a many-particle system, the notion of empirical measures, the BBGKY hierarchy, the Hewitt-Savage theorem, the Braun-Hepp-Dobrushin theorem, the coupling method, the concepts of chaos and entropic chaos, the recent works making progress on the mean-field limit, the hydrodynamic limit of lattice systems.

Pre-requisites

Basics in measure theory, functional analysis, partial differential equations and probability.

Literature

1. H. Spohn, *Large Scale Dynamics of Interacting Particles.* Springer 1991.
2. C. Kipnis and C. Landim, *Scaling Limits of Interacting Particle Systems.* Springer 1999.
3. F. Golse, *The Mean-Field Limit for the Dynamics of Large Particle Systems*, Journaux derivees partielles Forges-les-Eaux, 2-6 juin 2003.
4. F. Bolley, *Optimal coupling for mean field limits*, available online
5. P.-E. Jabin, *A review of the mean field limits for Vlasov equations*, Kinetic and Related models 2014, vol 7, pp 661-711.
6. P.-E. Jabin & Z. Wang, Mean Field Limit and Propagation of Chaos for Vlasov Systems with Bounded Forces. J. Funct. Anal. 271 (2016), no. 12, 3588-3627.
7. P.-E. Jabin & Z. Wang, *Quantitative estimates of propagation of chaos for stochastic systems with* $W^{-1,infty}$ *kernels, preprint.*
8. D. Lazarovici, Dustin & P. Pickl, *A mean field limit for the Vlasov-Poisson system.* Arch. Ration. Mech. Anal. 225 (2017), no. 3, 1201-1231.

Additional support

Three examples sheets will be provided and three associated examples classes will be given. There will be a one-hour revision class in the Easter Term.