## Program

All meetings take place in the Chapelle meeting room, at the side of the Bastide.

**Monday**

9:00 -9:45 Mini-course Propagation of Chaos I (Mischler-Mouhot)

10:00-10:45 Arnaud

11:00-11:45 Roux

2:00-2:45 Mini-course Spectral Gap I (Carlen Carvalho)

**Tuesday**

9:00 -9:45 Mini-course Propagation of Chaos II (Mischler-Mouhot)

10:00-10:45 Miot

11:00-11:45 Einav

2:00-2:45 Mini-course Spectral Gap II (Carlen Carvalho)

**Wednesday**

9:00 -9:45 Haurray

10:00-10:45 Carrapatoso

11:00-11:45 Saffiro

**Thursday**

9:00 -9:45 Mini-course Propagation of Chaos III (Mischler-Mouhot)

10:00-10:45 Pulvirenti

11:00-11:45 Toubol

2:00-2:45 Problem Session (Carlen Carvalho)

**Friday**

9:00 -9:45 Mini-course Propagation of Chaos III (Mischler-Mouhot)

10:00-11: 00 Problem session

**Amit Einav**

**On Villani's conjecture concerning Entropy production for the Kac Master Equation**

**Abstract**:

Kleber Carrapatoso

**Title** : Propagation of chaos for the Landau equation

**Abstract** : This work deals with the propagation of chaos for the spatially homogeneous Landau equation, in the case of Maxwellian molecules. To this purpose, we use a duality method developed in Mischler-Mouhot (2010) and Mischler-Mouhot-Wennberg (2011).

**Arnaud Guillin**

**Title**: Long time behaviour of some kinetic Vlasov-Fokker-Planck equation

**Abstract** : We consider here a coupling (probabilistic) approach to study the exponential convergence in Wasserstein distance for the kinetic Vlasov-Fokker-Planck equation under some quite restricted hypothesis. We also study the associated (linear) particles approximation for which we show uniform in time propagation of chaos, and concentration inequality.

**Maxime Hauray**

**Title**: Statistical approach for deterministic N particles systems.

**Abstract** : Heuristic arguments may convince us that interacting particles system without noise or collisions should converge in the limit of large number $N$ of particles towards the associated mean-field equation. For instance , interacting particles system in the kinetic setting should converge towards the Vlasov equation, Vortices system towards the 2D

Euler equation. In fact, it is known to be true for smooth interaction forces since the end of the '70, with deterministic and also probabilistic results (law of large number an even CLT) . But, interesting physical force (Newtonian or Coulombian interaction,...) are often singular at the "origin". For such system, the only available results where given with a cut-off of the singularity (going to zero while $N$ increases, but slowly enough to be seen by many pairs of particles). We shall explain how to obtain deterministic and probabilistic results of convergence without cut-off for small singularity. We shall also explain how to obtain stability estimates around Gaussian equilibrium for larger singularities in periodic setting.

**Stephane Mischler**

**Title** : An inverse solution to Kac's program in mean-field theory

**Abstract** : This talk is devoted to the study of mean-field limit for systems of indistinguable particles undergoing collision processes. As formulated by M. Kac for a simplified model (and extended by H. McKean to the Boltzmann equation) this limit is based on the *propagation of chaos.*

We first prove new *quantitative and uniform in time estimates measuring the distance between the many-particle system and the limit system. These estimates imply in particular the propagation of chaos but are valid more generally for non-chaotic initial data.*

*We next prove a conjecture formulated by Kac, namely that the time for solutions to the $N$ particle Boltzmann-Kac system to converge to their equilibrium can be made uniform in the number of particles. The solution of that problem is reverse from Kac's program. Indeed, we prove the above result using the exponential convergence to the equilibrium of the solutions to the nonlinear Boltzmann equation when Kac formulated precisely his program in order to prove that last convergence (which has been proved by another way in the two last decades).*

*Our results cover the two main Boltzmann physical collision processes with unbounded* *collision rates: hard spheres and true Maxwell molecules interactions. This yields new results of propagation of chaos for (true) Maxwell molecules whose "Master equation" shares similarities with the one of a Lévy process; and it quantifies and improves previous non-constructive (finite time) results of A.-S. Sznitman for hard spheres.*

*Starting from an inspirative paper of A. Grünbaum we develop a new method which reduces the question of propagation of chaos to the one of proving a purely functional estimate on some generator operators (consistency estimate) together with fine stability estimates on the flow of the limit non-linear equation (stability estimates).*

*On the basis of this method we then make the propagation of chaos uniform in time by taking advantage of the dissipativity of the limit equation in order to make uniform in time stability estimates. We prove therefore a "trapping" property of the many-particle system around its mean-field limit (even in a non-chaotic setting).*

*Finally, we revisit the different notions of chaos, and we deduce from our analysis that the relative entropy associated to the $N$ particle system tends to* 0 *uniformly in $N$.*

**Evelyne Miot**

**Title***: On the attractive plasma-charge model in 2 dimensions*

**Abstract** *: We consider a two-dimensional system in which some negatively charged particles are immersed in a sea of positively charged light particles (plasma). In terms of a mean-field approximation, the evolution is conveniently described by a Vlasov-Poisson type equation for the plasma density with an extra singular field created by the charged particles. We prove global existence of a solution under suitable assumptions on the support of the plasma density. Uniqueness remains unsolved. This is joint work with Silvia Caprino, Carlo Marchioro and Mario Pulvirenti.*

**Mario Pulvirenti**

**Title***: Propagation of chaos for a soft ball model*

**Abstract** *: I consider a local mean-field intercting particle system (introduced by C. Cer-*

*cignani), in a bounded domain with diffusive boundary conditions at a constant temperature. I show that propagation of chaos holds uniformly in time, under suitable smallness assumptions.*

**Chiara Saffirio**

**Title***: On a Kac model for the Landau equation*

**Abstract** *: We introduce a N-particle system which approximates the solutions of the Landau equation with Coulomb singularity in the mean-field regime and state a weak convergence result (joint with E. Miot and M. Pulvirenti)*

**Jonathan Touboul**

**Title***: The propagation of chaos for cortical neurons.*

**Abstract** *: The brain is a very complex system in the strong sense. It features a huge amount of cells, among which neurons, which have a nonlinear intrinsic behavior and subject to noise. These neurons, it their behavior is not totally reliable, form very large scale spatially extended units which respond precisely, fast and reliably to stimuli. From the mathematical viewpoint, understanding the properties of the respective role of noise, nonlinearities, and collective treatment of the information raises profound mathematical questions. I will present some recent results and challenges that motivate the development of probabilistic methods from the kinetic theory towards the new type of problem motivated by neuroscience.*