TURBULENT·E·S

Report of Contributions

Contribution ID: **1** Type: **not specified**

Weak turbulence beyond the Euclidean case

Thursday, May 23, 2024 10:00 AM (1 hour)

The theory of weak turbulence has seen much progress recently, in particular regarding the derivation of kinetic models. However, most of the literature, be it physical or mathematical, relies on Euclidean Fourier analysis. Since many interesting physical experiments or observations are set on more general domains, it is of interest to extend the theory in this direction - but the mathematical difficulties become rapidly overwhelming! I will present two attempts to make progress on this question. First, through the use of random matrices as a model of linear evolution (joint with G. Dubach and B. Harrop-Griffiths), and second by relying on the Random Wave model of Berry (joint with Hui Zhu).

Presenter: GERMAIN, Pierre

Contribution ID: **2** Type: **not specified**

Turbulence at the Kolmogorov scale

Thursday, May 23, 2024 11:15 AM (1 hour)

If you stir strongly enough a viscous flow, it becomes turbulent and displays vortices and coherent structures of various sizes. The typical scale for energy dissipation is called the Kolmogorov scale η and marks the transition between the power law behavior and a steep exponential decay in the wavenumber range. Therefore, scales smaller than η contains a negligible fraction of the kinetic energy. Because of that, it is often thought that scales below η are irrelevant and that "nothing interesting is happening below η". For a long time, it was for example thought that a direct numerical simulation of a viscous fluid is "well resolved"if its minimal grid spacing is η. Recent theoretical and experimental progresses however suggest that many interesting phenomena do happen below η and this may impact the validity of Navier-Stokes equations (NSE) as model for the dynamics of industrial, geophysical or astrophysical fluids. This talk discusses some of these phenomena using both numerical simulations and a dedicated large turbulent experiment.

Presenter: DUBRULLE, Bérengère

Contribution ID: **3** Type: **not specified**

Flow of incompressible turbulent-like rough vector fields

Thursday, May 23, 2024 2:45 PM (1 hour)

I will begin with recalling some key ingredients of the phenomenology of three- dimensional fluid turbulence, both in the Eulerian framework and in its Lagrangian coun- terpart. It will be the occasion for us to define so-called fractional Gaussian fields: they are random representation of statistically homogeneous Hölder-continuous functions, and can be considered as a simplistic probabilistic formulation of the expected behavior of fluids at infinite Reynolds numbers (choosing the particular Hölder exponent 1/3). We will propose then a numerical exploration of the induced flow once these fields are regularized at small scales over the Kolmogorov length scale. In such a setting, Cauchy-Lipschitz theorem warrants the uniqueness of the trajectories and a clear meaning to the flow. This allows us to observe how the flow behaves as the Kolmogorov length scale goes to zero, and gives a numerical picture of the selection process by viscosity of the flow of Hölder-continuous fields. Joint work with Jason Reneuve, and more recent developments with Charles-Edouard Bréhier and Matthieu Châtelin.

Presenter: CHEVILLARD, Laurent

Contribution ID: **4** Type: **not specified**

Scattering, random phase and wave turbulence

Friday, May 24, 2024 11:15 AM (1 hour)

The theory of wave turbulence aims at a description of the nonlinear interaction of a large number of waves. In this talk, I will present a family of initial data for the cubic two-dimensional nonlinear Schrödinger equation on the real plane, motivated by the link between regularity of the resonant manifold and dispersive properties of the equation and scattering phenomena. These initial data are periodic functions embedded in the whole space by Gaussian truncation and we are able to describe the time evolution in various time scales for deterministic and random initial data, in the limit of a large number of periods and small initial data. This allows explicit computations and we identify two different regimes where the time evolution converges towards the kinetic operator but with different forms of convergence, coming from resonances or quasiresonances. This is a joint work with Erwan Faou.

Presenter: MOUZARD, Antoine

Contribution ID: **5** Type: **not specified**

Fractional diffusion approximation for kinetic equations

Friday, May 24, 2024 1:30 PM (1 hour)

After a short introduction to kinetic equations, I will explain the principle of diffusion approximation which justifies the fact that the solution of a kinetic equation is approximated by an equilibrium profile with a density satisfying a macroscopic equation. I will then focus on the Fokker Planck equation with heavy tail equilibrium handled by a spectral method.

Presenter: PUEL, Marjolaine

Contribution ID: **6** Type: **not specified**

Landau's currents in kinetic theory, applications to wave turbulence

Friday, May 24, 2024 2:45 PM (1 hour)

In his 1936 paper on collisions between charged particles subject to the Coulomb potential, Landau introduced a current whose divergence is the collision integral. This talk discusses applications of Landau's idea to some classical notions in wave turbulence, such as Kolmogorov-Zakharov profiles (Work with M. Escobedo and L. Saint-Raymond).

Presenter: GOLSE, François

Contribution ID: **7** Type: **not specified**

Wave kinetic theory for the forced/dissipated NLS equation

Thursday, May 23, 2024 1:30 PM (1 hour)

We will present some recent developments in the justification of kinetic equa- tions in the presence of forcing and dissipation. Such settings are of particular physical relevance as they allow the study of cascades: the transfer of energy from large scales to small scales. In this talk, we provide the first rigorous justification of such a kinetic equation in the case of a wave system governed by the cubic Schrödinger equation with a stochastic forcing and viscous dissipation. We will describe various regimes depending on the relative strength of the dissipation, the forcing and the nonlinear interactions, which give rise to different kinetic equations. Based on joint work with Zaher Hani.

Presenter: GRANDE, Ricardo

Contribution ID: **8** Type: **not specified**

Large Population Limit for Interacting Particle Systems on Weighted Graphs

When studying interacting particle systems, two distinct categories emerge: indistinguishable systems, where particle identity does not influence system dynamics, and non-exchangeable systems, where particle identity plays a significant role. One way to conceptualize these second systems is to see them as particle systems on weighted graphs. In this talk, we focus on the latter category. Recent developments in graph theory have raised renewed interest in understanding large population limits in these systems. Two main approaches have emerged: graph limits and mean-field limits. While mean-field limits were traditionally introduced for indistinguishable particles, they have been extended to the case of non-exchangeable particles recently. In this presentation, we introduce several models, mainly from the field of opinion dynamics, for which rigorous convergence results as N tends to infinity have been obtained. We also clarify the connection between the graph limit approach and the mean-field limit one. The works discussed draw from several papers, some co-authored with Nastassia Pouradier Duteil and David Poyato.

Presenter: AYI, Nathalie

Contribution ID: **9** Type: **not specified**

On linearisation around singular Rayleigh-Jeans for the 4-waves kinetic equation

Friday, May 24, 2024 10:00 AM (1 hour)

We consider the 4-waves spatial homogeneous kinetic equation arising in weak wave turbulence theory. In this talk I will present some new results on the existence and behaviour of solutions around different Rayleigh-Jeans (RJ) thermodynamic equilibrium solutions. In particular, I will discuss existence of global solutions in L2 around RJ with positive chemical potential, for confined frequencies. Moreover, I will discuss a more recent work on linearisation around singular RJ, i.e. zero chemical potential, where instabilities are present. If time permits, I will briefly discuss the nonlinear problem for singular initial data, where an instantaneous condensation can be proven, explaining the behaviour of the linearised problem. The latter is a joint work with Miguel Escobedo (UPV/EHU).

Presenter: MENEGAKI, Angeliki

Contribution ID: **10** Type: **not specified**

Large population limit for interacting particle systems on weighted graphs

Thursday, May 23, 2024 4:00 PM (1 hour)

When studying interacting particle systems, two distinct categories emerge: indistinguishable systems, where particle identity does not influence system dynamics, and non-exchangeable systems, where particle identity plays a significant role. One way to conceptualize these second systems is to see them as particle systems on weighted graphs. In this talk, we focus on the latter category. Recent developments in graph theory have raised renewed interest in understanding large population limits in these systems. Two main approaches have emerged: graph limits and mean-field limits. While mean-field limits were traditionally introduced for indistinguishable particles, they have been extended to the case of non-exchangeable particles recently. In this presentation, we introduce several models, mainly from the field of opinion dynamics, for which rigorous convergence results as N tends to infinity have been obtained. We also clarify the connection between the graph limit approach and the mean-field limit one. The works discussed draw from several papers, some co-authored with Nastassia Pouradier Duteil and David Poyato.

Presenter: AYI, Nathalie