Conférence en l'honneur de Pierre Gilles Lemarié-Rieusset

6,7,8 novembre 2024

Mercredi 6 novembre

(Grand Amphi, bâtiment IBGBI, Université d'Evry)

Heure	Orateur
10h00 - 10h50	Boris Haspot
11h00 - 11h50	Frédéric Charve
12h00 - 14h00	*Déjeuner*
14h00 - 14h50	Elide Terraneo
15h00 - 15h50	Lorenzo Brandolese

Jeudi 7 novembre

(Salle W, ENS-Paris)

Heure	Orateur
10h00 - 10h50	Anne-Laure Dalibard
11h00 - 11h50	Raphaël Danchin
12h00 - 14h00	*Déjeuner*
14h00 - 14h50	Grzegorz Karch
15h00 - 15h50	Giulia Furioli

Vendredi 8 novembre

(Amphi Choquet-Bruhat, IHP)

Heure	Orateur
10h00 - 10h50	Franco Flandoli
11h00 - 11h50	Omar Lazar
12h00 - 14h00	*Déjeuner*
14h00 - 14h50	Yves Meyer
15h00 - 15h50	Claude Bardos

Comité Scientifique: Valeria Banica (LJLL, Sorbonne Université), Marco Cannone (LAMA, Université Gustave Eiffel), Diego Chamorro (LaMME, Université d'Evry), Isabelle Gallagher (DMA, ENS-PSL), Stéphane Menozzi (LaMME, Université d'Evry).

Claude Bardos. *About two critical indices* $0 < \frac{1}{3} \leq \frac{1}{2}$ *in the propagation of regularity and the* 0 *viscosity limit for Euler and Navier-Stokes equations.*

This is a report on a program initiated with Edriss Titi in 2007, with a remark of P.G. Lemarié-Rieusset (based on one of his contribution (2002)) and continued over the years with several collaborators. It concern several issues

- The propagation of regularity and the conservation of energy for solutions of Euler equation and the effect of the no slip boundary for the zero viscosity limit of solution of Navier-Stokes equations.
- In the absence of boundary a sufficient condition for the energy conservation is the Onsager $\frac{1}{3} < \alpha$ in Holder or Besov space.
- The effect of the boundary is measured by the so called Kato criteria (1984)
- In conjonction with the Kato criteria a regularity criteria for the pressure near the boundary is compulsory and such criteria is obtained for $\alpha < \frac{1}{2}$ (sufficient to obtain the result but not completely evident).

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Lorenzo Brandolese. *Large Self-similar solutions to Oberbeck-Boussinesq system with Newtonian gravitational field.*

After reviewing some results on self-similar solutions of the Navier-Stokes equations, we will construct forward self-similar solutions for a Boussinesq system, using the Leray-Shauder theorem and compactness arguments, without any smallness assumptions imposed on homogeneous initial conditions. This is a joint work with Grzegorz Karch.

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Frédéric Charve. *Nouvelles asymptotiques pour les solutions fortes du système de Boussinesq fortement stratifié avec données très mal préparées.*

Il est connu que lorsque le nombre de Froude ε tend vers zéro, les solutions du système de Boussinesq fortement stratifié tendent vers celles d'un système de type Navier-Stokes à deux composantes (mais dépendant des trois variables d'espace). De manière surprenante ce système limite ne dépend pas de la diffusivité thermique $\nu > 0$. Dans un précédent travail nous avons obtenu, pour des données initiales non-conventionnelles, et dans le cadre des solutions faibles, un système limite général dépendant de tous les paramètres: il s'agit du système de Navier-Stokes 3D à deux composantes précédent couplé avec une équation de la chaleur en la variable verticale. Dans cet exposé, on s'intéresse à cette même limite dans le cadre des solutions fortes pour des données initiales non conventionnelles et très mal préparées. Nous parvenons à obtenir des solutions globales en temps lorsque le nombre de Froude est suffisamment petit ainsi que des estimations (explicites en le petit paramètre ε) des vitesses de convergence. Ces résultats peuvent être ré-écrits sous forme de développement asymptotique autour de solutions particulières explicites pour le système de Boussinesq classique.

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Anne-Laure Dalibard. *Comportement en temps long du système de Stokes-transport dans un canal périodique.*

Cet exposé sera consacré à l'analyse du système de Stokes-transport dans le domaine T(0,1), avec des conditions de non-glissement (Dirichlet) pour la vitesse sur les frontières du domaine. On montrera tout d'abord que les profils de densité linéairement stratifiés sont stables sens de Lyapunov, et on identifiera l'état limite en temps grand comme un réarrangement de la donnée initiale. Nous montrons également que des couches limites se forment au voisinage de z=0 et z=1 en temps grand, et qu'elles freinent la relaxation de la solution vers son état d'équilibre.

Il s'agit d'un travail en collaboration avec Julien Guillod et Antoine Leblond.

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Raphaël Danchin. *On the large time asymptotics of global solutions to the Vlasov-Navier-Stokes equations in the whole space.*

The incompressible Vlasov-Navier-Stokes equations are a toy model for describing the dynamics of a cloud of particles that are immersed in an incompressible viscous fluid. Here we are concerned with the behavior of global strong solutions when the time goes to infinity, in the case where the equations are posed in the whole space. For small enough initial data with sufficient integrability at infinity, it is shown that the velocity decays to zero, with the same rate as the classical Navier-Stokes equations, and that the kinetic distribution of the particles is well approximated by a monokinetic distribution with velocity which is the same as that of the viscous fluid. We first establish this result in the 'smooth' case of H^1 velocity fields, then show that it remains true for critical regularity $H^{1/2}$. Our results rely on the use of a higher order energy functional that controls the regularity H^1 of the velocity and seems to have been first introduced by Li, Shou and Zhang in [12] in the context of the nonhomogeneous Vlasov-Navier-Stokes system, and on the propagation of suitable negative Besov regularity.

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Franco Flandoli. *The problem of regularization by noise of the 3D Navier-Stokes equation.*

The talk will review 25 years of efforts to show that suitable noise (additive or transport type) could have some regularizing property for the 3D Navier-Stokes equations. In spite of a lack of complete success, the topic is still alive and from time to time some new progress appears. In particular, the results around the stochastic extension of Caffarelli-Kohn-Nirenberg partial regularity theory and the recent results related to diffusion limit of transport noise, will be discussed.

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Giulia Furioli. *Fokker–Planck equations and functional inequalities for heavy tailed probability densities.*

We present and discuss connections between one-dimensional Fokker-Planck equations with variable diffusion coefficients and one-dimensional Poincaré and logarithmic Sobolev

inequalities satisfied by the probability densities with polynomial decay which are stationary states of these equations. As a main example, we consider inequalities satisfied by inverse Gamma densities, taking values on $\mathbb{R}^+$. We will also discuss some generalizations to the n–dimensional case. The talk is based on joint works with Ada Pulvirenti, Elide Terraneo and Giuseppe Toscani.

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Boris Haspot. *Vanishing Viscosity Solutions of Nonlinear Hyperbolic Systems with nonlinear viscosity coefficients.*

We consider the Cauchy problem for a strictly hyperbolic $n * n$ system in one space dimension assuming that the initial data have ssmall total variation. We will show that the solutions of the viscous approximations $u_t + A(u)u_x = \epsilon(B(u)u_x)_x$ are defined globally in time and satisfy uniform BV estimates, independent of ϵ when the flux matrix $A(u)$ and the viscosity matrix $B(u)$ satisfy suitable conditions that we will describe. In the conservative case where $A = Df$ is the Jacobian of some flux function, the vanishing viscosity limits are precisely the unique entropy weak solutions to the system of the associated conservation laws.

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Grzegorz Karch. *Barenblatt profiles and rarefaction waves in Euler alignment system.*

I shall present very recent results, obtained jointly with Szymon Cygan, on an existence and large time behavior of solutions to the following Euler alignment system

$$\begin{aligned} &\rho_t + (\rho u)_x = 0, \\ &u_t + uu_x = \int_{\mathbf{R}} \frac{u(y,t) - u(x,t)}{|x-y|^{1+\alpha}} \rho(y,t)\, dy, \qquad x \in \mathbf{R}, \quad t > 0, \end{aligned} \tag{1}$$

with $\alpha \in (0,1)$. This model arises as the macroscopic realization of the Cucker and Smale agent model dynamics which describes the collective motion of N individuals in particular alignment and flocking.

We proved that, for a large class of initial conditions including bounded and compactly supported $\rho(x,0)$ and suitably chosen $u(x,0)$, the corresponding solutions of the initial value problem are global-in-time and behave for large values of time either as the Barenblatt profiles (*i.e* explicit self-similar solution) of the nonlocal porous medium equation or as a rarefaction wave (*i.e* the explicit self-similar solution of the inviscid Burgers equation.)

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Omar Lazar. *On the Cauchy problem for the 2d Muskat equation with surface tension.*

Consider two incompressible fluids with the same viscosity but different densities in a porous media, we study the dynamic of the interface when surface tension and gravity are taken into account. By introducing a new formulation of the problem in terms of oscillatory integrals, we prove a global well-posedness result for any regular enough data which are possibly large in Lipschitz.

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Yves Meyer. *Andrey Kolmogorov.*

New examples of independent random variables on the n-dimensional torus are discussed in connection with a problem raised by Andrey N. Kolmogorov and a classical theorem by Lars Hörmander on the product between two distributions.

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Elide Terraneo. *Some nonlinear heat equations with exponential non-linearity and with singular data in two dimensions.*

In this talk we deal with a class of nonlinear heat equations in two dimensions. Recently, for some specific nonlinearities with exponential growth of Trudinger-Moser type, Ioku et al and Ibrahim et al establish the existence of a singular stationary solution. Then, they prove that the Cauchy problem, with this singular solution as initial data, admits, at least, two different solutions. Here we consider similar problems for a wider class of nonlinearities in two dimensions. Joint work with Yohei Fujishima (Shizuoka University, Japan), Norisuke Ioku (Tohoku University, Japan) and Bernhard Ruf (Istituto Lombardo, Italy).

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