Monday, 26

Claude Bardos (LJLL)

Title: Viscosity Solutions and Wild Solutions
Abstract: I intend to show on several simple examples (with the use of Kato criteria and of dissipative solutions) how the introduction of the wild solutions of De Lelleis and Szekelyhidi may contribute (if not to solutions) at least to the understanding of challenging problems posed by zero viscosity limit in presence of boundary or non regular initial data.

Eventually this talk which covers contributions done with Edriss Titi, Laszlo Szekelyhidi and Emil Wiedemann may serve as an introduction to the workshop.

Wladimir Neves (UFRJ)

Title: Stochastic Hyperbolic Partial Differential Equations

Abstract: We present some results concerning stochastic linear transport equations and quasilinear scalar conservation laws, where the additive noise is a perturbation of the drift. Due to the introduction of the stochastic term, we may prove for instance well-posedness for continuity equation (divergence-free), Cauchy problem, meanwhile uniqueness may fail for the deterministic case, see [1], [2] and [6]. Also for the transport equation, Dirichlet data, we established a better trace result by the introduction of the noise, see [7]. We introduce the study of stochastic hyperbolic conservation laws, in a different direction of [5], applying the kinetic-semigroup theory. Joint work with: Christian Olivera (Universidade Estadual de Campinas. [1] L. Ambrosio, Transport equation and Cauchy problem for BV vector fields, Invent. Math., 158, 227--260, 2004. [2] R. DiPerna, P. L. Lions, Ordinary differential equations, transport theory and Sobolev spaces, Invent. Math., 98, 511--547, 1989. [3] F Fedrizzi , F. Flandoli. Noise prevents singularities in linear transport equations, Journal of Functional Analysis, 264, 1329--1354, 2013. [4] F. Flandoli, M. Gubinelli, E. Priola, Well-posedness of the transport equation by stochastic perturbation, Invent. Math., 180, 1-53, 2010. [5] P. L. Lions, P. Benoit, P. E. Souganidis, Scalar conservation laws with rough (stochastic) fluxes, Stochastic Partial Differential Equations: Analysis and Computations , 1, 4, 664-686, 2013. [6] W. Neves, C. Olivera, Wellposedness for stochastic continuity equations with Ladyzhenskaya-Prodi-Serrin condition, arXiv:1307.6484v1, 2013. [7] W. Neves, C. Olivera, Stochastic transport equation in bounded domains, in preparation.

Edriss S. Titi (Weizmann Institute of Science and University of California - Irvine)

Title: An Algorithm for Advancing Slow Features in Fast-Slow Systems without Scale Separation - A Young Measure Approach

In the first part of the talk, and in order to set the stage, we will offer a multi-scale and averaging strategy to compute the solution of a singularly perturbed system when the fast dynamics oscillates rapidly; namely, the fast dynamics forms cycle-like limits which advance along with the slow dynamics. We describe the limit as a Young measure with values being supported on the limit cycles, averaging with respect to which induces the equation for the slow dynamics. In particular, computing the tube of the limit cycles establishes a good approximation for arbitrarily small singular parameters. We will demonstrate this by exhibiting concrete numerical examples.

In the second part of the talk we will examine singularly perturbed systems which may not possess a natural split into fast and slow state variables. Once again, our approach depicts the limit behavior as a Young measure with values being invariant measure of the fast contribution to the flow. These invariant measures are drifted by the slow contribution to the value. We keep track of this drift via slowly evolving observables. Averaging equations for the latter lead to computation of characteristic features of the motion and the location the invariant measures. To demonstrate our ideas computationally, we will present some numerical experiments involving a system derived from a spatial discretization of a Korteweg-de Vries-Burgers type equation, with fast dispersion and slow diffusion.

This is a joint work with Z. Artstein, W. Gear, I. Kevrekidis, J. Linshiz and M. Slemrod

Alexey Cheskidov (Univ. Illinois, Chicago)

Title: Long time behavior of the Navier-Stokes and related equations

Abstract: I will review some resent results on the long time behavior of equations arising in fluid dynamics,such as the 3D Navier-Stokes and critical surface quasi-geostrophic equations.

Paul Krause (UFSC)

Title: A prediction scheme for systems of partial differential equations with fast-determining variables

Abstract: A novel sampling scheme for the state of a system of partial differential equations, the Influence Sampling - Monte Carlo scheme, is presented for systems with fast-determining variables. The concept of fast-determining variables is an extension of the concept of determining variables on the attractor. The scheme uses a formula for the compatibility between fast-determining and trailing values to settle the most appropriate model for taking over the control run of an ongoing prediction among those models in use the sampling scheme. Predictability tests are conducted on unstable solutions of a moist convective rotating shallow water system of equations with time-varying coefficients using the constant coefficient version of this model in the sampling scheme.

Yanqiu Guo (Weizmann Inst.)

Title: Global Well-posedness of a coupled KdV system of Majda and Biello

Abstract: We study a coupled KdV system, introduced by Majda and Biello, describing nonlinear resonant interaction of Rossby waves. We show the global well-posedness of

this system with periodic boundary condition in L^2. Our approach is based on a successive time-averaging method developed by Babin, Ilyin and Titi (2011) on classic KdV equation. This is a joint work with K. Simon and E. S. Titi.

Cecília Mondaini (UFRJ)

Title: Statistical Solutions from an Abstract Viewpoint

Abstract: Statistical solutions have been mainly used for understanding some properties of turbulent flows in a deep and rigorous way. This type of solution is used as an alternative for the lack of a well-posedness result concerned with individual solutions of the Navier-Stokes equations, a widely accepted model for turbulent flows. The aim of this work is to extend the current theory of statistical solutions to an abstract level that allows it to be applied to a wide range of evolution problems which are also not known to be well-posed. For that purpose, an abstract framework is constructed with a general Hausdorff topological space as the phase space of the system, and with the corresponding set of trajectories belonging to the space of continuous paths in that phase space. Then, after presenting the definitions of statistical solutions in this general sense, two main points are addressed. First, the existence of such statistical solutions in regard to some initial-value problems, and secondly, the convergence of statistical solutions associated to approximated problems depending on a parameter. Some model examples are also provided in each case, illustrating the applicability of this abstract theory

James P Kelliher (University of California Riverside)

Title: Vortex patches redux

Abstract: Two proofs of the persistence of regularity of the boundary of a two-dimensional vortex patch were published in 1993, one by Chemin the other by Bertozzi and Constantin. A third, by Ph. Serfati, was published in 1994. His proof, while sharing elements of Chemin's proof, differs quite substantially, and is more elementary. We describe the main features of his proof and discuss directions in which it might be extended. This is a report on work in progress, joint with Hantaek Bae of UC Davis.

Charlie Doering (Univ. Michigan)

Title: Wall to wall optimal transport

Abstract: How much stuff can be transported by an incompressible flow containing a specified amount of kinetic energy or enstrophy? We study this problem for steady 2D flows focusing on passive tracer transport between two parallel impermeablewalls, employing the calculus of variations to find divergence-free velocity field with a given intensity budget that maximize transport between the walls. The maximizing velocity fields, i.e. the optimal flows, consist of arrays of (convection- like) cells. Results are reported in terms of the Nusselt number Nu, the convective enhancement of transport normalized by the flow-free diffusive transport, and the Péclect number Pe, the dimensionless gauge of the strength of the flow. For both energy and enstrophy constraints we find that as Pe increases, the maximum transport is achieved by cells of decreasing aspect ratio. For each of the two flow intensity constraints, we also consider buoyancy-driven flows the same constraint to see how the scalings for transport reported in the literature compare with the absolute upper bounds. This work provides new insight into both steady 2D optimal transport and turbulent transport, an increasingly lively area of research in geophysical, astrophysical, and engineering fluid dynamics. This is joint work with Pedram Hassanzadeh (UC Berkeley/Harvard) and Gregory P. Chini (University of New Hampshire).

Tuesday, 27

Sijue Wu (Univ. Michigan)

Title: On some large time behaviors of the full water wave problem

Abstract: We consider the full water wave problem in two and three dimensions. We will survey results on the well-posedness of this problem, and present a recent work on some type of singular behaviors in the solutions for this problem.

Alexei A. Mailybaev (IMPA)

Title: Blowup as a driving mechanism of turbulence in shell models

Abstract: Since Kolmogorov proposed his phenomenological theory of hydrodynamic turbulence in 1941, the description of mechanism leading to the energy cascade and anomalous scaling remains an open problem in fluid mechanics. Soon after, in 1949 Onsager noticed that the scaling properties in inertial range imply non-differentiability of the velocity field in the limit of vanishing viscosity. This observation suggests that the turbulence mechanism may be related to a finite-time singularity (blowup) of incompressible Euler equations. However, the existence of such blowup is still an open problem too. In this talk, we show that the blowup indeed represents the driving mechanism of inertial range for a simplified (shell) model of turbulence. Here, blowups generate coherent structures (instantons), which travel through the inertial range in finite time and are described by universal self-similar statistics. The anomaly (deviation of scaling exponents of velocity moments from the Kolmogorov theory) is related analytically to the process of instanton creation using the large deviation principle. The results are confirmed by numerical simulations.

Emil Wiedemann (UBC)

Title: Renormalization Defects for Continuity Equations

Abstract: In a seminal work from 1989, DiPerna and Lions defined the notion of renormalized solution for linear continuity equations. They showed that there exists, for every initial data, a unique renormalized solution. On the other hand, if the regularity of the transporting vector field is sufficiently low, examples are known of non-renormalized distributional solutions. I will present recent results that allow to construct non-renormalized solutions to continuity equations with an essentially arbitrary renormalization defect, using a convex integration-type argument. Joint work with G. Crippa, N. Gusev, and S. Spirito.

Flávio Dickstein (UFRJ)

Title: Finite-time blowup for a complex Ginzburg-Landau equation

Abstract: We consider the complex Ginzburg-Landau equation $e^{-i\theta} u_t = \Delta u + |u|^\alpha u$ in R^N, where $\theta \in \left[0, \frac{\pi}{2}\right], \alpha > 0$. We prove that negative energy solutions blow up in finite time if $\theta < \frac{\pi}{2}$. For a fixed initial value $u(0)$, we obtain estimates of the blow-up time T_{max}^{θ} as $\theta \to \frac{\pi}{2}$. It turns out that T_{max}^{θ} stays bounded (respectively, goes to infinity) as $\theta \to \frac{\pi}{2}$ in the case where the solution of the limiting nonlinear Schrodinger equation blows up in finite time (respectively, is global). This is a joint work with Thierry Cazenave, from U. Paris VI, and Fred Weissler, from U. Paris XIII.

Jinkai Li (Weizmann Inst.)

Title: Global strong solutions to the 3D primitive equations with only horizontal viscosities and diffusivity

Abstract: The primitive equations derived from the Boussinisq system of incompressible flow are fundamental models for weather prediction. Due to the strong horizontal turbulent mixing, the horizontal viscosities and horizontal diffusion are much stronger than the vertical ones. Therefore, it is important to analysis the primitive equations with only horizontal viscosities and diffusivity. In this talk, we will present the global existence of strong solutions to such a system.

Vincent Martinez (Indiana University)

Title: Smallest scale estimates for the Navier-Stokes equations

Abstract: The radius of analyticity of the Navier-Stokes equations indicates a length scale below which viscous effects dominate the inertial ones, and in the context of 3D turbulence, it can be couched in terms of the so-called Kolmogorov length-scale, the unique length scale determined by the viscosity and energy dissipation rate alone. This talk will address a refinement of a semigroup approach initiated by [Biswas-Swanson '07] for obtaining a lower bound on this radius in terms of Gevrey norms of the initial data and forcing. This approach recovers the best-known estimate in 2D obtained by [Kukavica '98] on a significant portion of the attractor and in 3D by [Doering-Titi '95] on a significant portion of the weak attractor. Moreover, the method is elementary and robust, being easily applicable to a wide class of dissipative equations.

Débora A. F. Albanez (UTFPR)

Title: Continuous Data Assimilation for the three-dimensional Navier-Stokes – α model

Abstract: Motivated by the presence of the finite number of determining parameters (degrees of freedom) such as modes, nodes and local spatial averages for dissipative dynamical systems, specially Navier-Stokes equations, we present in this thesis a new continuous data assimilation algorithm for the three-dimensional Navier-Stokes – α model, which consists of introducing a general type of approximation interpolation operator, (that is constructed from observational measurements), into the Navier-Stokes – α equations. The main result provides conditions on the finite-dimensional spatial resolution of the collected data, sufficient to guarantee that the approximating solution,

that is obtained from these collected data, converges to the unknown solution (physical reality) over time. These conditions are given in terms of some physical parameters, such as kinematic viscosity, the size of the domain and the forcing term.

Nathan Glatt-Holtz (Virginia Tech)

Title: Invariant Measures and Inviscid Limits for the Stochastic Navier-Stokes Equations and Related Systems

Abstract: One of the original motivations for the development of stochastic partial differential equations traces it's origins to the study of turbulence. In particular, invariant measures provide a canonical mathematical object connecting the basic equations of fluid dynamics to the statistical properties of turbulent flows. In this talk we discuss some recent results concerning inviscid limits in this class of measures for the stochastic Navier-Stokes equations and other related systems arising in geophysical and numerical settings.

Marco Sammartino (Univ. Palermo)

Title: Navier-Stokes equations with incompatible data in the zero viscosity limit

In this talk we shall consider an incompressible flow interacting with a boundary without assuming that the initial datum satisfies the no-slip condition at the boundary. A typical case when this situation occurs is the impulsively started disk. Other instances widely studied in the literature are when a vortical configuration, which is a steady solution of the Euler equations (like the thick core vortex or the vortex array), is assumed to interact instantaneously with a solid boundary.

Focusing our analysis on the Navier-Stokes equations on a half-space, we shall construct the initial-boundary layer corrector in the form of a Prandtl solution with incompatible data. This corrector is the first term of an asymptotic series that we shall prove to approximate, in the zero viscosity limit and for a short time, the Navier-Stokes solutions. Assuming analytic regularity in the tangential direction, we shall prove that this time does not depend on the viscosity.

This is joint work with M.C. Lombardo.

Wednesday, 28

Raphaël Danchin (Univ Paris XII, Creteil)

Title: A Lagrangian approach for solving models of fluid dynamics in critical spaces.

Abstract: A number of recent works have been devoted to solving system of PDEs governing the evolution of viscous fluids, in so-called critical spaces (a terminology borrowed from the pioneering work by Fujita and Kato on the incompressible Navier-Stokes equations). All those works are mostly based on estimates for the heat flow, for the transport equation and on nonlinear estimates in functional spaces that are scaling invariant (or almost scaling invariant) for the system under consideration. Owing to the hyperbolic nature of the mass equation however, a loss of one derivative occurs in the stability estimates related to the system. Consequently, as critical regularity solutions are not so regular, some restrictions appear on admissible spaces for initial data regarding the well-posedness issue. In the present talk, we will show that using Lagrangian coordinates transforms the mixed type system of PDEs into a parabolic type one, which allows to solve it directly by means of Banach fixed point theorem, and to avoid the loss of derivative.

That method turns out to be quite robust. In the talk, we will show how it may be implemented on the density dependent incompressible Navier-Stokes equations, on the isentropic compressible Navier-Stokes equations, and on the full Navier-Stokes equations in the heat-conductive case.

Helena Nussenzveig Lopes (UFRJ)

Title: Boundary correctors and energy estimates for the boundary layer problem

Abstract: In a short note in 1984 T. Kato established a criterion for the vanishing viscosity limit to hold in the presence of boundaries, namely that the energy dissipation must vanish in a small region near the boundary, as viscosity tends to zero. The proof is based on the use of a boundary corrector and energy estimates. In this talk, we will discuss Kato's result and its relation to the physical phenomenon of the boundary layer. We then describe the application of these boundary correctors to several different scenarios involving boundary layers, including small obstacles, large domains and Euler$-\alpha$.

Tristan Buckmaster (University of Leipzig, Max Planck Institute for Mathematics in the Sciences) (short talk)

Title: Recent progress towards resolving Onsager's Conjecture

Abstract: In 1949, Lars Onsager in his famous note on statistical hydrodynamics conjectured that weak solutions to the 3-D incompressible Euler equation belonging to the Hölder space with Hölder exponent greater than 1/3 conserve energy; conversely, he conjectured the existence of solutions belonging to any Hölder space with exponent less than 1/3 which dissipate energy. The first part of this conjecture has since been confirmed (cf. Eyink 1994, Constantin, E and Titi 1994). During this talk we will give an overview of recent work by Camillo De Lellis, László Székelyhidi Jr., Phil Isett and myself related to resolving the second component of Onsager's conjecture. In particular, we will discuss the construction of weak non-conservative solutions to the Euler equations whose Hölder $1/3 - \varepsilon$ norm is Lebesgue integrable in time.

Mihaela Ignatova (Stanford)

Title: The Harnack inequality for elliptic and parabolic equations with divergence-free drifts of low regularity

Abstract: We establish Harnack-type inequalities by adapting the classical Moser iteration technique to second order elliptic and parabolic equations with divergence-free drifts of lower regularity than the scale invariant spaces. As an application, we obtain the uniform continuity of solutions to advection-diffusion equations with slightly super-critical divergence-free drifts. This is a joint work with I. Kukavica and L. Ryzhik.

Vlad Vicol (Princeton)

Title: On the inviscid limit of the Navier-Stokes equations

Abstract: We consider the L^2 convergence in the   norm, uniformly in time, of the Navier-Stokes equations with Dirichlet boundary conditions to the Euler equations with slip boundary conditions. We prove that if the Oleinik conditions of no back-flow in the trace of the Euler flow, and of a lower bound for the Navier-Stokes vorticity is assumed in a Kato-like boundary layer, then the inviscid limit holds. This is joint work with P. Constantin and I. Kukavica.

Thursday, 29

Diego Cordoba (ICMAT)

Title: On the regularity of solutions for the Muskat problem.

Abstract: The Muskat equation governs the motion of an interface separation of two incompressible fluids in a porous media. I will describe recent projects on the global well-posedness and we present several scenarios where the interface is initially smooth and at a later time it develops a singularity.

Gabriela Planas (Unicamp)

Title: Non-homogeneous Navier-Stokes system with Navier friction boundary conditions

Abstract: In this talk we address the issue of existence of weak solutions for the non-homogeneous Navier-Stokes system with Navier friction boundary conditions allowing the presence of vacuum zones and assuming rough conditions on the data. We also study the convergence, as the viscosity goes to zero, of weak solutions for the non-homogeneous Navier-Stokes system with Navier friction boundary conditions to the strong solution of the Euler equations with variable density, provided that the initial data converge in $L^2$to a smooth enough limit. This work is in collaboration with E.J. Villamizar-Roa (Universidad Industrial de Santander, Colombia) and L.C.F. Ferreira (Unicamp, Brazil)

Xiaoming Wang (Florida State University)

Title: Phase Field models for two phase flows in karstic geometry

Abstract: Multiphase flow phenomena are ubiquitous. Common examples include coupled atmosphere and ocean system (air and water), oil reservoir (water, oil and gas), cloud and fog (water vapor, water and air). Multiphase flows also play an important role in many engineering and environmental science applications. In some applications such as flows in unconfined karst aquifers, karst oil reservoir, proton membrane exchange fuel cell, multiphase flows in conduits and in porous media must be considered together. Geometric configurations that contain both conduit (or vug) and porous media are termed karstic geometry. Despite the importance of the subject, little work has been done on multi-phase flows in karstic geometry. In this talk we present a family of phase field models for two phase flow in karstic geometry. These models together with the associated interface boundary conditions are derived utilizing Onsager's extremum principle. The models derived enjoy physically important energy laws. The global in time existence of weak solutions is established via appropriate time discretization that preserves the energy laws.

Michael Jolly (Indiana University)

Title: Determining forms for the NSE and NLS

Abstract: We present two types of ordinary differential equations in spaces of trajectories which encode the global attractors of the 2D Navier-Stokes equations (NSE), and the 1D damped driven nonlinear Schrodinger equation (NLS). The idea is derived from the concept of determining modes, determining nodal values, etc., and hence the resulting ODE is called a determining form. In one approach, based on Fourier modes, the trajectories on the global attractor are identified with traveling wave solutions of the determining form. In the other, which can be used with general interpolating operators such as nodal projections, the attractor is identified with steady states of the determining form. While determining forms were originally developed for the NSE, the analysis for the NLS requires a different approach, as it is dispersive and not strongly dissipative. This talk regards joint work with C. Foias, R. Kravchenko, T. Sadigov, and E. Titi.

Leonardo Kosloff (University of California Riverside)

Title: Existence and decay of solutions of the 2D QG equations in the presence of an obstacle

Abstract: We study certain aspects of dissipative partial differential equations governing fluid motion in the presence of an obstacle, in which the dissipative term is given by the Laplacian, or a fractional power of the Laplacian.
Our main tools are a generalized version of the Fourier transform due to Ikebe and Ramm, and the localized version of the fractional Laplacian due to Caffarelli and Silvestre, as improved by Stinga and Torrea. We give applications to the problem of existence of weak solutions of the two dimensional dissipative quasi-geostrophic equation and the decay of these solutions in the L^2-norm.

Mimi Dai (Univ. Illinois, Chicago)

Title: The existence of a global attractor for the forced critical surface quasi-geostrophic Equation in

We prove that the critical surface quasi-geostrophic equation driven by a force f possesses a compact global attractor in $L^2(T^2)$ provided $f \in L^p(T^2)$ for some $p > 2$.

Aibin Zang (Yichun Univ and UFRJ)

Title: Convergence of the 2D Euler$-\alpha$ to Euler equations in the Dirichlet case: indifference to boundary layers

Abstract: In this talk, I will present our new results of the Euler$-\alpha$ system as a regularization of the incompressible Euler equations in a smooth, two-dimensional, bounded domain. For the limiting Euler system we consider the usual non-penetration boundary condition, while, for the Euler$-\alpha$ regularization, we use velocity vanishing at the boundary. We also assume that the initial velocities for the Euler$-\alpha$ system approximate, in a suitable sense, as the regularization parameter $\alpha \rightarrow 0$, the initial velocity for the limiting Euler system. For small values of α, this situation leads to a boundary layer, which is the main concern of this work. Our main result is that, under appropriate regularity assumptions, and despite the presence of this boundary layer, the solutions of the Euler$-\alpha$ system converge, as $\alpha \rightarrow 0$, to the corresponding solution of the Euler equations, in L^2 in space, uniformly in time.

Christophe Lacave (Univ. Paris VII)

2D ideal flow through a porous medium

We will study the behavior of the solutions to the 2D Euler equations in a porous medium.

In a first part, the porous medium will be composed of inclusions of size ε separated by ε^{α} and the fluid fills the exterior. We will compare the asymptotic solution with the solution to the 2D Euler equations in the full plane or outside an impermeable obstacle.

In a second part, we will present another way to approximate an impermeable boundary: the vortex method, used in physics and engineering. The goal will be to justify rigorously this numerical method.

These works are partially in collaboration with D. Arsenio, V. Bonnaillie-Noel, E. Dormy, M. Lopes Filho, N. Masmoudi and H. Nussenzveig Lopes.

Roman Shvydkoy (Univ. Illinois, Chicago)

Title: Shortwave instability of Rayleigh-Taylor dynamics.

Abstract: In this talk we will describe a geometric optics treatment of the classical Rayleigh-Taylor instability. It will be shown that in the absence of a background shear the density unstable configuration of a stratified fluid results in the shortwave character (frequency of an unstable eigenmode is independent of the spectral parameter). On the other hand, when a shear is present, the instability shows a longwave character. As a consequence, we can find many examples of stationary solutions around which the linearized equation has no unstable continuous spectrum, which in turn allows as to construct local unstable manifolds for the full nonlinear problem. This is a preliminary report on a joint work with Zhiwu Lin and Chongchun Zeng.

Friday, 30

Igor Kukavica (Univ. Southern California)

Title: On the size of the nodal sets of solutions of elliptic and parabolic PDEs

Abstract: We present various results on the size of the nodal (zero) set for solutions of partial differential equations of elliptic and parabolic type. In particular, we establish a sharp upper bound for the $(n-1)-$dimensional Hausdorff measure of the nodal sets of the eigenfunctions of regular analytic elliptic problems. We also show certain more recent results concerning semilinear equations (e.g.~Navier-Stokes equations) and equations with non-analytic coefficients.

Ricardo Rosa (UFRJ)

Title: Recurrence and convergence of time averages for the three-dimensional incompressible Navier-Stokes equations

Abstract: Using the concept of stationary statistical solution, we prove that, in a suitable sense, time averages of almost every Leray-Hopf weak solution of the three-dimensional incompressible Navier-Stokes equations converge as the averaging time goes to infinity. In particular, this implies that, from a measure-theoretic point of view, the stationary statistical solution obtained from a generalized limit of time averages of a Leray-Hopf weak solution is, in general, independent of the choice of the generalized limit. We also show that for any Borel subset of the phase space with positive measure with respect to a stationary statistical solution is such that for almost all initial conditions and for at least one Leray-Hopf weak solution starting with that initial condition, the orbit is recurrent to that Borel subset and is such that the corresponding mean sojourn time of that solution within that Borel subset is strictly positive. This is a joint work with Ciprian Foias and Roger Temam.

Aseel Farhat (Indiana University)

Title: A new continuous data assimilation algorithm for the Bénard problem

Abstract: Data assimilation is the process by which observations are incorporated into a computer model of a real system. Applications of data assimilation arise in many fields of geosciences, perhaps most importantly in weather forecasting. In this work, we present a new continuous data assimilation algorithm for the two-dimensional Bénard problem based on an idea from control theory. Rather than inserting the observational measurements directly into the equations, a feedback control term is introduced that forces the model towards the reference solution. We will show that the approximate solutions constructed using only observations in the velocity field and without any measurements on the temperature converge intime to the reference solution of the two-dimensional Bénard problem. This is a joint work with Michael Jolly and Edriss S. Titi.

Jitao Liu (UFRJ)

Title: On the Boundary Regularity for the 6D Stationary Navier-Stokes Equations

Abstract: In this paper, we will discuss recent work which is joint with Wendong Wang and Zhouping Xin. It is shown in this paper that suitable weak solutions to the 6D steady incompressible Navier-Stokes equations are Holder continuous near boundary provided that either

$$r^{-3} \int_{B_{r_+}} |u(x)|^3 dx$$

or

$$r^{-2} \int_{B_{r_+}} |\nabla u(x)|^2 dx$$

is sufficiently small, which implies that the 2D Hausdorff measure of the set of singular points near the boundary is zero. This generalizes interior regularity results by Dong-Strain.

Anne Bronzi (UnB and UNICAMP)

Title: On the self-similar blow-up scenario for the Euler equations

Abstract: In this talk we will survey some results regarding the possibility of a self-similar blow-up for the Euler equations. We will also prove that under a mild L^p-growth assumption on the self-similar profile we obtain that the solution carries a positive amount of energy up to the time of blow-up. As a consequence, we will recovery and extend several previously known exclusion criteria. Also, we will present some preliminary studies on the fractal dimension of the energy measure, which roughly speaking is the limit of the measures on the space induced by the velocity squared as time approaches the time of blow-up. We will explore the relation between the fractal dimension of the energy measure and the growth of the velocity as time approaches the time of singularity formation. This is joint work with Roman Shvydkoy.

Maria Schonbek (Univ. California, Santa Cruz)

Title: Decay characterization for dissipative systems

Abstract: By examining the Fourier transform of the data near the origin, we give a method to study lower and upper algebraic rates of decay to solutions of diffusive systems of equations. The work is joint with C. Niche.

Peter Constantin (Princeton)

Title: Analyticity of particle paths in hydrodynamics.

Abstract: We prove that particle paths are real analytic in well-posed hydrodynamic systems, once the velocity spatial gradient is Holder continuous. The proof addresses directly the combinatorial issues and then follows from a uniform arc chord condition by singular integral calculus. This is joint work with Vlad Vicol and Jiahong Wu.