TITLES/ABSTRACTS FOR SCAPDE 2018

On the derivation of the kinetic wave equation

Tristan Buckmaster (Princeton)

In this talk, I will talk about recent work with Pierre Germain, Zaher Hani and Jalal Shatah on a rigorous derivation of the kinetic wave equation.

Remarks on the inviscid limit

Peter Constantin (Princeton)

I will describe conditional results concerning limiting behavior of high Reynolds number flows.

2D Euler equation in infinite cylinder: some stability and confinement results

Sergey Denisov (UW-Madison)

We will focus on two problems in 2D Euler dynamics: stability of the steady states and confinement of the positive vorticity. These results are based on joint papers with J. Beichman and K. Choi.

Kolmogorov, Onsager and a stochastic model for turbulence

Susan Friedlander (University of Southern California)

We will briefly review Kolmogorov's (41) theory of homogeneous turbulence and Onsagers (49) conjecture that in 3-dimensional turbulent flows energy dissipation might exist even in the limit of vanishing viscosity. Although over the past 60 years there is a vast body of literature related to this subject, at present there is no rigorous mathematical proof that the solutions to the Navier-Stokes equations yield Kolmogorovs laws. For this reason various models have been introduced that are more tractable but capture some of the essential features of the Navier-Stokes equations themselves. We will discuss one such stochastically driven dyadic model for turbulent energy cascades. We will describe how results for stochastic PDEs can be used to prove that this dyadic model is consistent with Kolmogorovs theory and Onsagers conjecture. This is joint work with Vlad Vicol and Nathan Glatt-Holtz.

Date: May 30, 2018.

SQG in bounded domains

Mihaela Ignatova (Princeton)

I will describe results regarding the surface quasi-geostrophic equation (SQG) in bounded domains. The results concern global interior Lipschitz bounds for large data for the critical SQG in bounded domains. In order to obtain these, we establish nonlinear lower bounds and commutator estimates for the Dirichlet fractional Laplacian in bounded domains. As an application global existence of weak solutions of SQG were obtained.

L^∞ instability of Prandtl's layers *Toan Nguyen (Penn State)*

Abstract: In 1904, Prandtl introduced his famous boundary layer theory to describe the behavior of solutions of incompressible Navier Stokes equations near a boundary in the inviscid limit. His Ansatz was that the solution of Navier Stokes can be described as a solution of Euler, plus a boundary layer corrector, plus a vanishing error term in L^∞.

In this talk, I will present a recent joint work with E. Grenier (ENS Lyon), proving that, for a class of regular solutions of Navier Stokes equations, namely for shear profiles that are unstable to Rayleigh equations, this Prandtl's Ansatz is false. In addition, for shear profiles that are monotone and stable to Rayleigh equations, the Prandtl's asymptotic expansions are invalid.

Global existence of large solutions to the compressible Euler equations with physical vacuum in three space dimensions

Steve Shkoller (UC-Davis)

We establish global existence of large solutions to the free-boundary compressible Euler equations, in the case that a finite volume of ideal gas expands into vacuum. Vacuum states can occur with either smooth or singular sound speed, the latter corresponding to the so-called physical vacuum singularity when the enthalpy vanishes on the vacuum wave front like the distance function. In this instance, the Euler equations lose hyperbolicity and form a degenerate system of conservation laws, for which a local existence theory has only recently been developed. This system admits expanding global-in-time ODE solutions with good time-decay properties which permit perturbations to the fully nonlinear PDE to be analyzed. For the ideal gas law in which $p = \rho^\gamma$, and $\gamma > 1$, we prove global existence and uniqueness. This is joint work with T. Sideris.

Wellposedness of the 2D full water wave equation in a regime that allows for non-C^1 interfaces
Sijue Wu (Michigan)

We consider the 2d gravity water wave equation in a regime where the free interface is allowed to be non-C^1. In this regime, only a degenerate Taylor inequality $-\frac{\partial P}{\partial \mathbf{n}} \geq 0$ holds, with degeneracy at the singularities. In an earlier work joint with R. Kinsey, an energy functional $\mathcal{E}(t)$ was constructed and an a-prori estimate was proved. The energy functional $\mathcal{E}(t)$ is not only finite for interfaces and velocities in Sobolev spaces, but also finite for a class of non-C^1 interfaces with angled crests. In this talk I will present the existence, uniqueness and stability of the solution of the 2d gravity water wave equation in the class where $\mathcal{E}(t) < \infty$, locally in time, for any given data satisfying $\mathcal{E}(0) < \infty$.

A two-dimensional vortex condensate at high Reynolds number
Bill Young (UC-San Diego)

I'll discuss solutions of the two-dimensional Navier-Stokes equation in a square box with stress-free boundary conditions. The flow is steadily forced by a single Helmholtz eigenmode of even order, so that the forcing has zero net integral. Numerical solutions show that at large Reynolds number the solution is a domain scale "vortex condensate" with a large projection onto the gravest eigenmode of the box. The sign of this vortex is selected by a symmetry breaking instability. Analytic perturbation theory, based on a quasilinear approximation, is used to understand in analytic detail how energy is transferred from the high-mode forcing to the condensate and to determined the condensate amplitude, which is shown to have a finite limit as the viscosity tends to zero. Thus, and in contrast to the well-studied case of white-noise forcing, there is no dissipative anomaly. Analysis also indicates that that the amplitude depends sensitively on the form of the dissipation, even in the undamped limit. All analytic results are verified by numerical solution of the two-dimensional Navier-Stokes equation.