SIAM Conference on Analysis of Partial Differential Equations

Scottsdale, Arizona, December 7-10, 2015

Mini-Symposium: ***"Dynamics of Partial Differential Equations"***

Organizers:

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Part I. MS28. Monday, December 7

• Monday, 12/7, 5:00-5:25, Animikh Biswas, *University of Maryland, Baltimore County*

Generalized Gevrey Norms with Applications to Dissipative Equations

ABSTRACT. The regular solutions of the Navier-Stokes equations are well-known to be analytic in both space and time variables, even when one starts with non-analytic initial data. The space analyticity radius has an important physical interpretation. It demarcates the length scale below which the viscous effect dominates the (nonlinear) inertial effect. Foias and Temam introduced an effective approach to estimate space analyticity radius via the use of Gevrey norms which, since then, has become a standard tool for studying analyticity. We extend this approach to a class of dissipative equations, including critical and super-critical quasigeostrophic equations, where the dissipation operator is a fractional Laplacian and discuss application of these methods to establish optimal decay rate of higher order derivatives. Time permitting we will discuss the extension of some of these methods, including recently introduced one involving higher order energy functional, to bounded domains.

• Monday, 12/7, 5:30-5:55, Bingsheng Zhang, *Texas A&M University*

Navier-Stokes-alpha Model for Channel Flows

ABSTRACT. The Navier-Stokes-alpha (NS-alpha) models are a good mathematical model for the dynamics of appropriately averaged turbulent fluid flows. It is considered as an averaged version of the Navier-Stokes equations (NSE). In particular, the NS-alpha analogue of the Poiseuille and Hagen solution in channels and pipes, respectively, display both the classical von Karman and the Barenblatt-Chorin laws. A remarkably successful extension of the classic Blasius theory for turbulent boundary layer to a larger range of Reynolds number was done using the NS-alpha. In this talk, I will present a simple Reynolds type averaging which might be used for explaining the transforming from the NSE into the NS-alpha. This is a joint work with C.Foias, A.Haqverdiyev and J.Tian.

• Monday, 12/7, 6:00-6:25, Michael S. Jolly, *Indiana University*

Turbulence in Vertically Averaged 3D Rayleigh-Benard Convection

ABSTRACT. We look for features of 2D turbulence in the momentum equations that result by taking the vertical average of the 3D Rayleigh-Benard system. The 2D system has a body force which involves various integrals of the 3D flow. We present rigorous upper bounds for the Grashof number associated with this time-dependent force as well as numerical computations to fill in for the missing lower bounds.

• Monday, 12/7, 6:30-6:55, Hal L. Smith, *Arizona State University*

Spread of Phage Infection of Bacteria in a Petri Dish

ABSTRACT. We extend our previous work on the spatial spread of phage infection of immobile bacteria on an agar coated plate by explicitly including loss of viruses by both adsorption to bacteria

and by decay of free viruses and by including a distributed virus latent period and distributed burst size rather than fixed values of these key parameters. We extend earlier results on the spread of virus and on the existence of traveling wave solutions when the basic reproductive number for virus exceeds one and we compare the results with those obtained in earlier work. Finally, we formulate and analyze a model of multiple virus strains competing to infect a common bacterial host in a petri dish.

• Monday, 12/7, 7:00-7:25, Luan Hoang, *Texas Tech University*
Continuity of Attractors for Dynamical Systems
ABSTRACT. Let Λ be a complete metric space, and let $\{S_\lambda(\cdot) : \lambda \in \Lambda\}$ be a parametrized family of semigroups with global attractors A_λ. We assume that there exists a fixed bounded set D such that $A_\lambda \subset D$ for every $\lambda \in \Lambda$. We show that the attractors A_λ are continuous with respect to the Hausdorff distance at a residual set of parameters λ in the sense of Baire Category. This result is then extended to the pullback and uniform attractors of a family of non-autonomous systems.

Part II. MS69. Wednesday, December 9

• Wednesday, 12/9, 8:30-8:55, Tuoc V. Phan, *University of Tennessee, Knoxville*
Asymptotic Stability of Solitary Waves in 1-D Nonlinear Dirac Equation
ABSTRACT. We explore the nonlinear Dirac equation in (1+1)D with scalar self-interaction (Gross-Neveu model), and with quintic or higher order nonlinearities. We prove that solitary wave solutions are asymptotically stable in the even subspace of perturbations. The approach is based on the spectral information about the linearization at solitary waves which we obtain numerically. For the proof, we develop the spectral theory for the linearized operators and obtain appropriate estimates in mixed Lebesgue spaces with and without weights.

• Wednesday, 12/9, 9:00-9:25, Cecilia F. Mondaini, *Texas A&M University*
On the Kolmogorov entropy of the weak global attractor of the 3D Navier-Stokes equations
ABSTRACT. Motivated by the long-standing question concerning the finite-dimensionality of three-dimensional turbulent flows, we study the long time behavior of solutions to the 3D Navier-Stokes equations with respect to the functional dimensional of the weak global attractor. By using the squeezing property of the trajectories, we are able to obtain an estimate of the Kolmogorov entropy of the weak global attractor in terms of physical parameters of the flow. Such estimate then provides an upper bound of the functional dimension given by 5/2.

• Wednesday, 12/9, 9:30-9:55, Yusuke Shimabukuro, *McMaster University*
Global Solutions to the Derivative NLS Equation with the Inverse Scattering Transform Method
ABSTRACT. We address existence of global solutions of the derivative nonlinear Schrödinger equation without the small-norm assumption. By using the inverse scattering transform method without eigenvalues and resonances, we construct a unique global solution in $H^2(\mathbb{R}) \cap H^{1,1}(\mathbb{R})$ which is also Lipschitz continuous with respect to the initial data. Compared to the existing literature on the

spectral problem for the derivative NLS equation, we transform the Riemann-Hilbert problem in the complex plane to the jump on the real line.

• Wednesday, 12/9, 10:00-10:25, Alexey Cheskidov, *University of Illinois, Chicago*
Determining Wavenumber for Fluid Equations
ABSTRACT. In this talk we review classical results on determining modes for fluid equations and present a slightly different approach where we start with a time-dependent determining wavenumber defined for each individual trajectory and then study its dependence on the force. While in some cases this wavenumber has a uniform upper bound, it may blow up when the equation is supercritical. Nevertheless, the average determining wavenumber is uniformly bounded even for the 3D Navier-Stokes and some supercritical SQG equations.

• Wednesday, 12/9, 10:30-10:55, Peter Constantin, *Princeton University*
On the Inviscid Limit
ABSTRACT. TBA