

Nonlinear Waves Conference
Sidney Frank Hall for Life Sciences
Marcovitz Auditorium, Room 220
185 Meeting Street
May 8 – 11, 2008

Thursday – May 8, 2008

- 9:00** **Peter Lax**
 Courant Institute of Mathematical Sciences
Title: *The Hyperbolic Wave Equation*
Abstract: Following Faddeev and Pavlov we study the translation representation of solutions of this linear equation. However we are lead to a highly nonlinear problem in connection with the Phillips-Sarnak-Wolpert theorem.
- 10:00** **Break**
- 10:30** **Marshall Slemrod**
 University of Wisconsin
Title: *Transonic Flow and Supersonic Geometry*
Abstract: In this talk I will present some recent results from work done with G Q Chen and Dehua Wang. The issue is to prove existence of weak solutions to (i) the equations of transonic steady gas dynamics and (ii) the Gauss-Codazzi equations for isometric immersions of a two dimensional Riemannian manifold with negative Gauss curvature in three dimensional Euclidean space. Surprisingly (perhaps) the analysis and technique used (the Murat-Tartar method of compensated compactness) is the same for both problems since the underlying PDEs are very similar.
- 11:30** **Hornng-Tzer Yau**
 Harvard University
Title: *Dynamics of Bose-Einstein Condensates.*
- 3:00** **Sijue Wu**
 University of Michigan
Title: *Almost Global Well-Posedness of the 2D Full Water Wave Equation*
Abstract: We consider the problem of global in time existence and uniqueness of classical solutions of the 2-D infinite depth full water wave equation. It is known that this equation has a solution for a time period $[0, T / \varepsilon]$ for initial data of type $\varepsilon\Phi$, where T depends only on Φ . We show that for such data there exists a unique classical solution for a time period $[0, e^{T/\varepsilon}]$. This is achieved by some better understandings of the nature of the nonlinearity of the water wave equation.
- 4:00** **Break**

4:30 **Robert Pego**
Carnegie Mellon University
Title: *How to Compute the Pressure in Incompressible Viscous Flow with No-slip Boundary*
Abstract: For the Navier-Stokes equations for incompressible flow with no-slip boundary conditions, I'll describe a formula for the pressure that involves the commutator of the Laplacian and Leray-Helmholtz projection operators. An estimate for this commutator shows that it is strictly dominated by the viscous term at leading order. This leads to a number of developments, including a well-posedness theorem for an extended Navier-Stokes dynamics unconstrained by the divergence-free condition, and improvements of methods of numerical computation and numerical analysis for such flows. This is joint work with Jian-Guo Liu (Maryland) and Jie Liu (Irvine).

Friday – May 9, 2008

9:00 **Adrian Constantin**
Trinity College
Title: *Pressure and Particle Trajectories Beneath a Stokes Wave*
Abstract: Consider periodic two-dimensional gravity water waves propagating in irrotational flow at constant speed at the surface of water with a flat bed. Then the pressure in the fluid strictly decreases horizontally away from the crest line and strictly increases with depth. Moreover, along each streamline the horizontal velocity strictly decreases away from the crest line. Some particle trajectories are closed orbits but most are looping orbits that drift either to the right or the left, depending on the presence of an underlying favorable or adverse current. These results have been obtained as joint work with Walter Strauss.

10:00 **Break**

10:30 **Catherine Sulem**
University of Toronto
Title: *The Water Wave Problem with Random Topography*

11:30 **Manoussos Grillakis**
University of Maryland
Title: *Walter A. Strauss and His Influence in Mathematical Analysis*
Abstract: The purpose of my presentation is to review some of the mathematical research of W.A. Strauss. Walter's mathematical career spans more than forty years and during this period he investigated a wide array of problems. I would like to highlight certain problems that Walter considered, as well as, some techniques that he developed that had a tremendous influence in the new generation of Mathematicians.

2:00 **Gerhard Rein**
University of Bayreuth
Title: *On Gravitational Collapse for the Einstein-Vlasov System*
Abstract: The Einstein-Vlasov system describes in the context of general relativity the time evolution of a large ensemble of mass points which interact only through gravity, such as a galaxy. After a brief introduction to this system we show that certain explicit conditions on the initial data lead to gravitational collapse and the formation of a black hole. The data are spherically symmetric and the analysis is carried out in Schwarzschild coordinates. Among the data there are such that lead to solutions which are global in Schwarzschild time.

3:00 **Igor Rodnianski**
Princeton University
Title: *Evolution Problem in General Relativity*

4:00 **Break**

4:30 **Panel Discussion**
What is the Future of Nonlinear Waves

Saturday – May 10, 2008

9:00 **Patrick Gerard**
University Paris-Sud 11
Title: *High frequency Analysis of the Nonlinear Schroedinger Equation on the Sphere*

10:00 **Break**

10:30 **Giorgio Velo**
University of Bologna
Title: *Bilinear Morawetz Inequalities and Asymptotic Completeness in the Energy Space for the NLS and Hartree Equations*
Abstract: Recently several authors have developed multilinear and in particular bilinear extensions of the classical Morawetz inequality. Those extensions provide (among other results) an easy proof of asymptotic completeness in the energy space for nonlinear Schroedinger equations in arbitrary space dimension and for Hartree equations in space dimension greater than one. We give a pedagogical review of those recent results.

11:30 **Yoshio Tsutsumi**
Kyoto University
Title: *Time Decay of Solution for the KdV Equation with Multiplicative Space-Time Noise*
Abstract: We consider the time decay property of solution for the KdV equation on a circle with multiplicative space-time noise. The stochastic KdV equation appears in

various fields of mathematical physics, e.g., fluid mechanics, plasma physics and it has been attracting many researchers. It is known that in the case of stochastic parabolic equation, a multiplicative noise can make solutions decay to zero as the time goes to infinity. This phenomenon is called the stabilization by noise. In this talk, I present a sufficient condition related to a covariance operator of noise for the almost sure decay of solution.

2:00 **Gigliola Staffilani**
Massachusetts Institute of Technology
Title: *Weak Turbulence for a 2D Periodic Schrodinger Equation*

3:00 **Wilhelm Schlag**
University of Chicago
Title: *On Conditional Stability Results for Unstable Nonlinear Wave Equations*
Abstract: We will review work on center stable manifolds for unstable equations and discuss related blow-up results for critical equations. Part of this work is joint with Joachim Krieger and Daniel Tataru.

Banquet – Brown Faculty Club – 1 Magee Street

6:00pm **Cocktails**

7:00pm **Buffet**

Sunday – May 11, 2008

9:00 **Claude Bardos**
Paris, France
Title: *MCTDHF Method*
Abstract: This is a report on a joint work with Isabelle Catto, Norbert Mauser and Saber Trabelsi. The Multiconfiguration time dependent Hartree Fock Method is a non linear approximation of a linear system of N quantum particles with binary interaction. It combines the principle of the Hartree Fock and the Galerkin approximation. The main difficulty is the introduction of a global (in space) density matrix $\Gamma(t)$ which may degenerate. By construction this approximation formally preserves the mass and the energy of the system. The conservation of energy can be used to balance the singularities Coulomb potential and to provide sufficient conditions for the global in time invertibility of $\Gamma(t)$. In numerical computations this matrix is very often regularized (changed into $\Gamma + \varepsilon(t)$). In this situation the energy is no more conserved and the mathematical analysis done in L^2 relies on Strichartz type estimates.

10:00 **Break**

10:30 **Cedric Villani**
Ecole Normale Supérieure de Lyon
Title: *Hypo-coercivity and Hypo-ellipticity: Variations on a Theme*

11:30

George Papanicolaou
Stanford University

Title: *Problems in Scattering Theory Arising in the Imaging of Edges*

Abstract: I will introduce and discuss some mathematical problems in scattering theory that arise in the imaging of edges, both with full and partial aperture (array) data. I will illustrate the theory with the results of numerical simulations.