# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

| Thursday, January 10, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Benjamin Dodson (Berkeley) *Mass critical nonlinear Schrodinger equation* -- 4088 East Hall |

| Thursday, January 17, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Philip Isett (Princeton Univ.) *Holder Continuous Euler Flows with Compact Support in Time* -- 4088 East Hall |

| Thursday, January 24, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Joe Conlon (Umich) *On Global Stability for Lifschitz-Slyozov-Wagner like equations* -- 4088 East Hall |

| Thursday, January 31, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Moritz Reintjes (Univ. Regensburg) *Points of General Relativistic Shock Wave Interaction are "Regularity Singularities" where Spacetime is Not Locally Flat* -- 4088 East Hall |

| Thursday, February 21, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Kevin Zumbrun (Indiana U. ) *CONVEX ENTROPY, HOPF BIFURCATION, AND VISCOUS AND INVISCID SHOCK STABILITY* -- 4088 East Hall |

| Thursday, February 28, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Tai-Ping Liu (Academia Sinica, Taipei) *Solving Boltzmann Equation - The Green's function approach* -- 4088 East Hall |

| Thursday, March 14, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Jason Metcalfe (Univ. of North Carolina, Chapel Hill) *Local well-posedness for quasilinear Schrodinger equations with rough data* -- 4088 East Hall |

| Thursday, March 21, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Michael Kiessling (Rutgers University) *Nonlinear electromagnetism and the problem of point charge motion* -- 4088 East Hall |

| Thursday, March 28, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Cindy Keeler (UMICH Dept. Physics) *From Navier-Stokes to Einstein* -- 4088 East Hall |

| Thursday, April 04, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Chong-Qing Cheng (Nanjing Univ.) *Dynamical Instability of nearly integrable Hamiltonian systems* -- 4088 East Hall |

| Monday, April 08, 2013 | |
|---|---|
| 4:10pm-5:00pm | **Differential Equations** -- Antti Knowles (Courant Institute ) *Quantum diffusion and delocalization for random band matrices. COMBINED WITH ANALYSIS/PROBABILITY SEMINAR.* -- 1360 East Hall |

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

| Thursday, April 11, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Andreas Grotz (Harvard) *On the initial value problem for causal variational principles* -- 4088 East Hall |

| Thursday, April 18, 2013 | |
|---|---|
| 4:00pm-5:00pm | **Differential Equations** -- Michael Dabkowski (UMICH Dept. Mathematics ) *Eventual Regularity for Solutions of Supercritical Active Scalar Equations* -- 4088 East Hall |

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

## Abstracts

**Differential Equations**
**Thursday, January 10, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Benjamin Dodson (Berkeley)**
*Mass critical nonlinear Schrodinger equation*

The study of the nonlinear Schrodinger equation is motivated by many physical phenomena, in particular quantum mechanics. Hence it is natural to consider square integrable initial data, that is data with finite mass. I will describe my recent results about what is called the mass critical case.

**Differential Equations**
**Thursday, January 17, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Philip Isett (Princeton Univ.)**
*Holder Continuous Euler Flows with Compact Support in Time*

Motivated by the theory of hydrodynamic turbulence, Onsager conjectured in 1949 that solutions to the incompressible Euler equations with Holder regularity less than 1/3 may fail to conserve energy. DeLellis and Szkelyhidi have pioneered an approach to constructing such irregular flows based on an iteration scheme used by Nash to construct "wild" C^1 isometric embeddings. This approach involves correcting "approximate solutions" by adding rapid oscillations which are designed to reduce the error term in solving the equation. In this talk, I will discuss recent work on an improved iteration scheme using nonlinear phase functions for the corrections, which yields solutions in three dimensions with compact support in time and Holder regularity below 1/5.

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

**Differential Equations**
**Thursday, January 24, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Joe Conlon (Umich)**
*On Global Stability for Lifschitz-Slyozov-Wagner like equations*

This talk is concerned with the stability and asymptotic stability at large time of solutions to a system of equations, which includes the Lifschitz-Slyozov-Wagner (LSW) system in the case when the initial data has compact support. The main result of the paper is a proof of weak global asymptotic stability for LSW like systems. This is joint work with Barbara Niethammer.

**Differential Equations**
**Thursday, January 31, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Moritz Reintjes (Univ. Regensburg)**
*Points of General Relativistic Shock Wave Interaction are "Regularity Singularities" where Spacetime is Not Locally Flat*

In this talk I am going to present the results of a recent paper, in which we show that the regularity of the gravitational metric tensor cannot be lifted from C^{0,1} to C^{1,1} by any C^{1,1} coordinate transformation in a neighborhood of a point of shock wave interaction in General Relativity, without forcing the determinant of the metric tensor to vanish at the point of interaction. This is in contrast to Israel's celebrated 1966 Theorem, which states that such coordinate transformations always exist in a neighborhood of a point on a smooth single shock surface. The results imply that points of shock wave interaction represent a new kind of singularity in spacetime, singularities that make perfectly good sense physically, that can form from the evolution of smooth initial data, but at which spacetime is not locally Minkowskian under any coordinate transformation. In particular, at such singularities, delta function sources in the second derivatives of the gravitational metric tensor exist in all coordinate systems, but due to cancelation, the Riemann curvature tensor remains uniformly bounded.

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

**Differential Equations**
**Thursday, February 21, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Kevin Zumbrun (Indiana U. )**
*CONVEX ENTROPY, HOPF BIFURCATION, AND VISCOUS AND INVISCID SHOCK STABILITY*

We discuss relations between one-dimensional inviscid and viscous stability/bifurcation of shock waves in continuum-mechanical systems and existence of a convex entropy. In particular, we show that the equations of gas dynamics admit equations of state satisfying all of the usual assumptions of an ideal gas, along with thermodynamic stability- i.e., existence of a convex entropy- yet for which there occur unstable inviscid shock waves. For general 3x3 systems (but not up to now gas dynamics), we give numerical evidence showing that viscous shocks can exhibit Hopf bifurcation to pulsating shock solutions. Our analysis of inviscid stability in part builds on the analysis of R. Smith characterizing uniqueness of gas dynamical Riemann solutions in terms of the equation of state of the gas, giving an analogous criterion for stability of individual shocks.

**Differential Equations**
**Thursday, February 28, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Tai-Ping Liu (Academia Sinica, Taipei)**
*Solving Boltzmann Equation - The Green's function approach*

**Differential Equations**
**Thursday, March 14, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Jason Metcalfe (Univ. of North Carolina, Chapel Hill)**
*Local well-posedness for quasilinear Schrodinger equations with rough data*

We will discuss recent joint works with J. Marzuola and D. Tataru that focus on local existence for generic quasilinear Schrodinger equations with data in low regularity spaces. The Mizohata integrability conditions plays an essential role in choosing appropriate spaces, and in order to incorporate the necessary decay, we choose Sobolev spaces that are adapted to include a summability over a partition of space into cubes. The primary estimate is a local smoothing estimate, which is adapted to these spaces.

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

**Differential Equations**
**Thursday, March 21, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Michael Kiessling (Rutgers University)**
*Nonlinear electromagnetism and the problem of point charge motion*

In the 1930s Max Born suggested that the ultraviolet divergence problems of electrodynamics (both classical and quantum) associated with point charges would not show up if one uses suitable nonlinear field equations. He also suggested that the nonlinear nature of the field equations would determine the motion of the point charges. I review what is known rigorously about his ideas, and whereto they have led us so far.

**Differential Equations**
**Thursday, March 28, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Cindy Keeler (UMICH Dept. Physics)**
*From Navier-Stokes to Einstein*

I will discuss a mapping between solutions of the incompressible Navier-Stokes equations and the vacuum Einstein equations, mostly focussing on work with Bredberg, Lysov, and Strominger.

**Differential Equations**
**Thursday, April 04, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Chong-Qing Cheng (Nanjing Univ.)**
*Dynamical Instability of nearly integrable Hamiltonian systems*

Arnold diffusion is one of the most important problems in the field of dynamical systems and has puzzled us for half a century. It asks whether it is typical phenomenon that a higher-dimensional problems is topological instability: through an arbitrarily small neighborhood of any point there passes a phase trajectories along which the slow variables drift away from the initial value by a quantity of order 1.

In this talk, I shall survey recent progress on the topic and sketch our proof of Arnold diffusion in nearly integrable systems with three degrees of freedom.

# Seminar & Events Bulletin: Differential Equations

**01-01-2013 to 06-30-2013**

**Differential Equations**
**Monday, April 08, 2013, 4:10pm-5:00pm**
**1360 East Hall**
**Antti Knowles (Courant Institute )**

*Quantum diffusion and delocalization for random band matrices. COMBINED WITH ANALYSIS/PROBABILITY SEMINAR.*

I give a summary of recent progress in establishing the diffusion approximation for random band matrices. We obtain a rigorous derivation of the diffusion profile in the regime W > N^{4/5}, where W is the band width and N the dimension of the matrix. As a corollary, we prove complete delocalization of the eigenvectors. Our proof is based on a new self-consistent equation for the Green function.
Joint work with L. Erdos, H.T. Yau, and J. Yin.

**Differential Equations**
**Thursday, April 11, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Andreas Grotz (Harvard)**

*On the initial value problem for causal variational principles*

We formulate the initial value problem for causal variational principles in the continuous setting on a compact metric space. The existence and uniqueness of solutions is analyzed. The results are illustrated by simple examples.

**Differential Equations**
**Thursday, April 18, 2013, 4:00pm-5:00pm**
**4088 East Hall**
**Michael Dabkowski (UMICH Dept. Mathematics )**

*Eventual Regularity for Solutions of Supercritical Active Scalar Equations*

We will develop a method to dualize the class of Holder continuous functions in a way that is advantageous for estimating the estimating $C^{\beta}$ norms of solutions to supercritical active scalar equations. We will then use these estimates along with Gagliardo-Nirenberg type inequalities to prove eventual smoothness of solutions to the after-fore mentioned equations.