Fall 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
September 14th – September 20th

Monday, September 14

2:10-3:00pm **Topics in Algebraic Geometry** --- Organizational meeting --- 3866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Not meeting this week --- 4096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Per Manne (NSEBA, Bergen) *Holomorphic Convexity and Carleman Approximation by Entire Functions on Stein Manifolds* --- 3096 EH
4:10-5:00pm **Student Combinatorics** --- Planning/Organizational Meeting --- 3866 EH
4:10-6:00pm **Geometry & Physics** --- Nathan Priddis (UM) & Yefeng Shen (UM) *FJRW-rings for the singularities x^p+xy^q and exceptional singularities of Arnol'd* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3096 EH

Tuesday, September 15

2:10-3:00pm "**What is … " Seminar** --- Amanda Knecht (UM) *What is the algebraic fundamental group?* --- 3096 EH
3:10-4:00pm **Student Geometry/Topology** --- William Gignac (UM) *Expanding Maps* --- 4096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
4:10-5:00pm **Colloquium** --- Jeffrey Lagarias (UM) *Smooth solutions to the ABC Equation* --- 1360 EH

Wednesday, September 16

3:10-4:00pm **Student Arithmetic Seminar** --- Ben Weiss (UM) *A Classical Introduction to the Gamma Function* --- 3866 EH
3:10-4:00pm **Geometric Function Theory Seminar** --- Not meeting this week --- 4096 EH
4:10-5:00pm **Special Scientific Computing Seminar** --- Jean-Luc Vay (Lawrence Berkeley National Laboratory) *Novel Particle-in-Cell Simulation Methods in Heavy-Ion Fusion Science and Related* Fields --- 1005 EECS
4:10-6:00pm **Algebraic Geometry Seminar** --- Mark DeCataldo (Stony Brook) *Topology of the Hitchin fibration and Hodge theory of character varieties* --- 3088 EH
4:30-6:00pm **Logic Seminar** --- TBA --- 3096 EH

Thursday, September 17

12:00-1:00pm **Mathematical Biology Seminar** --- Anmar Khadra (National Inst. of Health) *Investigating the role of IGRP-specific low avidity T cells in the protection against T1D* --- 4096 EH
3:10-4:00pm **Commutative Algebra Seminar** --- Not meeting this week --- 3096 EH
3:10-4:00pm **Topology Seminar** --- Elmas Irmak (BGSU) *Superinjective Simplicial Maps of the Complexes of Curves on Nonorientable Surfaces* --- 4096 EH
4:10-5:00pm **Differential Equations** --- Divakar Viswanath (UM) *Complex singularities and the Lorenz attractor* --- 4088 EH
4:10-5:00pm **Math Club** --- Jeffrey Lagarias (UM) *The Pancake Flipping Problem* --- 2nd floor Nesbitt Common Room

Friday, September 18

10:10-11:00am **Financial/Actuarial Mathematics Seminar (Non-Standard Day/Time)** --- Hao Xing (Boston University) TBA --- 4096 EH
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- David Dowling (UM) *Techniques for predicting the effects of environmental uncertainties on underwater acoustic fields* --- 1084 EH

Friday, September 18 … continued

3:10-4:00pm **Intersection Theory Study Seminar** --- TBA --- 3866 EH
3:10-4:00pm **Student Algebraic Geometry Seminar** --- TBA --- 4096 EH
3:10-4:00pm **Geometry Seminar** --- Zhou Zhang (UM) *Kahler-Ricci flows over quasi-projective manifolds* --- 3096 EH
4:10-5:00pm **Combinatorics** --- Jeffrey Lagarias (UM) *Ternary expansions of powers of 2* --- 3866 EH

ABSTRACTS FOR THE WEEK OF SEPT. 14 – SEPT. 20, 2009

Several Complex Variables and Complex Dynamics Seminar
Monday, September 14, 4:10-5:00pm
3096 EH
Per Manne (NSEBA, Bergen)
Holomorphic Convexity and Carleman Approximation by Entire Functions on Stein Manifolds

We give necessary and sufficient conditions for totally real subsets of Stein manifolds to admit Carleman approximation of class C^k, k >= 1, by entire functions. T. Carleman (1927) showed that for any continuous function f on the real line and any strictly positive and continuous error function e, there exists an entire function h such that |h(x)-f(x)| < e(x) for all real x. We show that if M is a totally real subset of class C^k in a Stein manifold X such that M is holomorphically convex and has bounded exhaustion hulls in X, then M admits C^k Carleman approximation with interpolation. Moreover, if M is a totally real subset which admits C^1 Carleman approximation, then M is holomorphically convex and has bounded exhaustion hulls in X. This is a joint work with Erlend Fornaess Wold and Nils Ovrelid.

Geometry & Physics Seminar
Monday, September 14, 4:10-6:00pm
4088 EH
Nathan Priddis (UM) & Yefeng Shen (UM)
FJRW-rings for the singularities x^p+xy^q and exceptional singularities of Arnol'd

We will discuss the construction of an FJRW-ring (quantum ring) and some of its short history, and discuss some matters of Mirror-Symmetry. We will also discuss the computations for singularities x^p+xy^q and exceptional singularities of Arnol'd.

"What is … " Seminar
Tuesday, September 15, 2:10-3:00pm
3096 EH
Amanda Knecht (UM)
What is the algebraic fundamental group?

I will answer the question: What is the algebraic fundamental group? This group is like the topological fundamental group, but we replace unramified covering spaces with finite etale covers. It should be noted that we cannot simply replace bases loops with algebraic curves. I will give examples of these groups and some uses for them.

Student Geometry/Topology
Tuesday, September 15, 3:10-4:00pm
4096 EH
William Gignac (UM)
Expanding Maps

My hope for this talk is discuss one instance where ideas from dynamical systems can be used to derive topological information.
Expanding maps on manifolds are a class of maps that generate "chaotic" dynamics. I will derive some elementary topological constraints on spaces which admit expanding maps, leading up to a statement of a theorem of Shub and Gromov which classifies these maps up to topological conjugacy.

Colloquium
Tuesday, September 15, 4:10-5:00pm
1360 EH
Jeffrey Lagarias (UM)
Smooth solutions to the ABC Equation

The ABC equation is the linear Diophantine equation A+B+C=0, where one considers solutions (A, B, C) that are relatively prime integers. The height of a solution is H= max (|A|, |B|, |C|). The famous ABC conjecture studies the size of the conductor R, which is the product of all primes dividing ABC (taken without multiplicity), and says that to get infinitely many solutions, R must be as large as H^c for some positive c. Here we study instead solutions (A, B, C) having only small prime divisors. We define the smoothness of a solution as S = max{p: p a prime dividing ABC}. How small can S be as a function of H so that there are still infinitely many solutions? We determine--assuming unproved hypotheses-- what the right order of magnitude of S should be: it is S= (log H)^{c} for some positive constant c. This is joint work with K. Soundararajan.

Student Arithmetic Seminar
Wednesday, September 16, 3:00-4:00pm
3866 EH
Ben Weiss (UM)
A Classical Introduction to the Gamma Function

We will discuss Barnes' approach to the Gamma function from the solutions to difference equations. We will relate the construction to the Bernoulli Numbers, and various other classical constructions. This talk should be accessible to all.

Special Scientific Computing Seminar
Wednesday, September 16, 4:10-5:00pm
1005 EECS
Jean-Luc Vay (Lawrence Berkeley National Laboratory)
***Novel Particle-in-Cell Simulation Methods in Heavy-Ion Fusion Science and Related* Fields**

The Heavy Ion Fusion Science Virtual National Laboratory (HIFSVNL) is developing particle accelerators to deliver beams suitable for high energy density experiments and implosion of inertial fusion capsules. For such studies, the HIFSVNL has developed novel numerical methods for Particle-In-Cell (PIC) simulations: PIC with adaptive mesh refinement (AMR) [1], and a large-timestep mover for particles of arbitrary magnetized species [2]. These methods were implemented into the HIFSVNL flagship PIC code Warp. Recently, Warp has been applied by HIFSVNL researchers to the high energy physics domain, for the study of electron clouds, free electron lasers and laser wakefield accelerators, following the introduction of new methods for relativistic beams and plasmas: simulation in boosted frames [3], and a new relativistic leapfrog particle pusher [4]. We will review these developments. This is joint work with R.H. Cohen [2], A. Friedman [2], D.P. Grote [2], W.M. Fawley [1], M.A. Furman [1], and C.R. Geddes [1].

[1] J.-L. Vay et al., Phys. Plasma 11, 5 (2004)

[2] R.H. Cohen et al., Nucl. Inst. Meth. A 577, 52 (2007)

[3] J.-L. Vay, Phys. Rev. Lett. 98, 130405 (2007)

[4] J.-L. Vay, Phys. Plasmas 15, 056701 (2008)

Algebraic Geometry Seminar
Wednesday, September 16, 4:10-6:00pm
3088 EH
Mark DeCataldo (Stony Brook)
Topology of the Hitchin fibration and Hodge theory of character varieties

Given a compact Riemann surface X of genus at least two, there are two algebraic varieties attached to it: the character variety Ch, and the Hitchin moduli space M.
The non Abelian Hodge theorem asserts that they are diffeomorphic (but have different complex structures). While the rational cohomology rings H*(Ch) and H*(M) are isomorphic, the mixed Hodge structures are different and so are the weight filtrations, which therefore cannot possibly correspond via the non Abelian Hodge theorem..

In recent joint work with T. Hausel (Oxford) and L. Migliorini (Bologna) it is shown that the non Abelian Hodge theorem exchanges the weight filtration on H*(Ch) with the (perverse) Leray filtration on H*(M) for the Hitchin map h: M->C^n. Moreover, curious symmetries observed on H^*(Ch) by number-theoretic means, turn out to be the more familiar Lefschetz and Poincar\'e symmetries for the map h.

(The perverse Leray filtration is formally analogous to the Leray filtration associated with the Leray spectral sequence. However, as my on-line thesaurus states: ``perverse = resistant to guidance or discipline.")

Mathematical Biology Seminar
Thursday, September 17, 12:00-1:00pm
4096 EH
Anmar Khadra (National Inst. of Health)
Investigating the role of IGRP-specific low avidity T cells in the protection against T1D

Recent experimental observations have revealed that during the onset of autoimmune Type 1 Diabetes (T1D), different clones of T cells with various T cell avidities and protein specificities are naturally generated in diabetic animal models. One particular protein, IGRP, is considered to be one of the most dominant autoantigen, responsible for activating low and high avidity IGRP-specific T cells via APCs. Although high avidity T cells destroy ~90% of beta cell repertoire, leading to the abolishment of insulin secretion crucial for glucose metabolism, low avidity T cells appear to play a protective role. Several hypotheses concerning the kinetics of these low avidity T cells and the effects of certain drug treatments on this populations have been suggested. In this talk, we shall present series of mathematical models that investigate these hypotheses and the outcome of certain drug treatments. We shall examine the experimental data available so far and explain certain features exhibited by the various clones of T cells.

Topology Seminar
Thursday, September 17, 3:10-4:00pm
4096 EH
Elmas Irmak (BGSU)
Superinjective Simplicial Maps of the Complexes of Curves on Nonorientable Surfaces

We prove that each superinjective simplicial map of the complex of curves of a compact, connected, nonorientable surface is induced by a homeomorphism of the surface, if g + n is at most 3 or g + n is at least 5, where g is the genus of the surface and n is the number of the boundary components.

Applied and Interdisciplinary Mathematics Seminar
Friday, September 18, 3:10-4:00pm
1084 EH
David Dowling (UM)
Techniques for predicting the effects of environmental uncertainties on underwater acoustic fields

There are many fine numerical methods for predicting underwater sound fields when the geometrical and mechanical properties of the environment are known. However, environmental knowledge at the requisite level of detail to fully exploit code capabilities is seldom available, and the resulting uncertainty in the predicted sound fields is problematic for a variety of sonar applications and environmental assessment techniques. In addition, the usual means of uncertainty assessment, direct-simulation and/or Monte-Carlo methods, involve repeated sound-field calculations and may be too computationally expensive for real-time applications. Thus, an efficient way to predict acoustic uncertainty and environmental sensitivity is needed. This presentation covers four techniques for quantifying acoustic uncertainty in shallow ocean environments: field-distribution transport, direct simulation, polynomial chaos, and field shifting. Here the various techniques are used to estimate the probability density function (PDF) for the acoustic field produced by a harmonic point source at (0,zs) at a distant range-depth location (r,z). Comparisons between the various techniques are made in two-dimensional range-depth environments with one or more uncertain environmental parameters. The results presented are drawn from range-independent modal-sum field calculations at frequencies from 100 to 1,000 Hz and source-receiver ranges from 1 to 10 km in sound channels with depths of 50 and 100 m. The comparisons show that the first technique is analytically incomplete (at least at the present time), the next two are effective but computationally burdensome, while the final one is approximate but computationally efficient.

Geometry Seminar
Friday, September 18, 3:10-4:00pm
3096 EH
Zhou Zhang (UM)
Kahler-Ricci flows over quasi-projective manifolds

In the joint work with John Lott, we study the Kahler-Ricci flow over non-compact manifold.
In the classic setting of quasi-projective manifold, we include the asymptotic behavior of the flow metric in the space direction. A key motivation is to use cohomology information to characterize the flow, just as for the closed manifold case.

Combinatorics
Friday, September 18, 4:10-5:00pm
3866 EH
Jeffrey Lagarias (UM)
Ternary expansions of powers of 2

P. Erdös raised the question whether there are infinitely many integers n such that the ternary expansion of $2n$ omits the digit 2. We discuss this question, and generalize it to viewing $\{2^n : n>0\}$ as a special case of an orbit of a dynamical system acting on the real numbers, and of a second dynamical system acting on the 3-adic integers. The set of orbits having infinitely many elements with the property above should be "small." This leads to new questions about the sizes of intersections of multiplicative translates of 3-adic Cantor sets. Their Hausdorff dimensions have a combinatorial description and are investigated experimentally. The latter reports on joint work with an REU student, Will Abram (U. Chicago).