Winter 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
January 26th – February 1st

Monday, January 26

3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Not meeting this week --- 2866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Ben Brubaker (MIT) *Crystal Bases in Automorphic Forms* --- 4096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Al Taylor (UM) *Extremal plurisubharmonic functions for linear growth (Part I)* --- 3096 EH
4:10-5:00pm **Student Combinatorics** --- Florian Block (UM) *Packing Problems* --- 3866 EH
4:10-6:00pm **Geometry and Physics Seminar** --- Igor Kriz (UM) *String K-theory and the Verlinde algebra* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- Alejandro Uribe (UM) & Katherine Walker (UM) *Teaching proof in an IBL format to pre-service teachers* --- 3096 EH

Tuesday, January 27

2:10-3:00pm "**What is … " Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Geometry Seminar** --- Lars Louder (UM) *Graphs of Subgroups of Free Groups* --- 3866 EH
3:10-4:00pm **Student Algebraic Geometry Seminar** --- Eugene Eisenstein (UM) *Basics of multiplier ideals* --- 3088 EH
3:10-4:00pm **Student Seminar in Complex Dynamical Systems** --- TBA --- 4088 EH
4:10-5:00pm **Colloquium** --- Andreas Blass (UM) *Uncountable abelian groups that want to be free* --- 1360 EH
4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH

Wednesday, January 28

3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH
3:10-4:00pm **Student Representation Theory Seminar** --- Brian Jurgelewicz (UM) *Intro to weighted projective lines* --- 3096 EH
3:10-4:00pm **Student Arithmetic Seminar** --- Julian Rosen (UM) TBA --- 3088 EH
4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- Al Taylor (UM) *Extremal plurisubharmonic functions for linear growth (Part II)* --- 3096 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Not meeting this week **---** 3088 EH

Thursday, January 29

3:10-4:00pm **Commutative Algebra Seminar** --- Mel Hochster (UM) *Quasilength and content of local cohomology (continued)* --- 3096 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Sergey Nadtochiy (Princeton University) *Market Models for European Options* --- 3088 EH
3:10-4:00pm **Topology Seminar** --- Aaron Magid (UM) *The Topology of Deformation Spaces of Hyperbolic 3-Manifolds* --- 4088 EH
4:10-5:00pm **Differential Equations** --- David Shaeffer (Duke) *Chaotic behavior in a one-dimensional cardiac model* --- 4088 EH
4:10-5:00pm **Math Club** --- Marty Weissman (UC Santa Cruz) *A well-rounded discussion of spheres* --- 2nd floor Nesbitt Common Room
4:10-6:00pm **RTG Study Seminar** --- Mario Bonk (UM) *Isometric actions on trees and degenerations of hyperbolic structures* --- 3866 EH

Friday, January 30

11:10-12:00pm **Theoretical Computer Science Seminar** --- TBA --- CSE 3941

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Jorge Balbás (California State University) *Non-oscillatory Central Schemes for Hyperbolic Systems of Conservation Laws in 3D* --- 1084 EH

3:10-4:00pm **Student Geometry/Topology** --- Michelle Lee (UM) *Algebraic and Geometric Convergence* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Alex Fink (UC Berkeley) *Valuations for matroid subdivisions* --- 3866 EH

ABSTRACTS FOR THE WEEK OF JAN. 26 – FEB. 1, 2009

Group Theory/Lie Theory/Number Theory Seminar
Monday, January 26, 3:10-5:00pm
4096 EH
Ben Brubaker (MIT)
Crystal Bases in Automorphic Forms

It's no secret that automorphic forms and representation theory are closely related. But surprisingly, data from FINITE dimensional representations of Lie groups often play a role in automorphic forms as well. I'll explain how these representations can be used to describe Fourier coefficients of a large class of automorphic forms using the language of crystal graphs. No prior knowledge of crystal bases is required.

Several Complex Variables and Complex Dynamics Seminar
Monday, January 26, 4:10-5:00pm
3096 EH
Al Taylor (UM)
Extremal plurisubharmonic functions for linear growth (Part I)

We will discuss properties of the extremal function $\Lambda_E(z)$, associated to plurisubharmonic functions of linear growth, i.e. the upper envelope of all psh functions u that are bounded above by zero on the set E and satisfy $u(z) \le |z| + o(|z|)$. Questions about this function arise naturally in trying to classify the algebraic varieties with sufficiently many real points that they satisfy the strong radial Phragmen-Lindelof condition.
This extremal function is also an analogue of the Siciak-Zaharuta extremal psh function L_E of logarithmic growth. However, we will show that it fails to have most of the properties that make L_E such a useful function in pluripotential theory.
In Monday's seminar talk, we will give an overview of these results, but very few proofs. In the working seminar on Wednesday, we will present enough of the proofs to explain all the main techniques used in the work. All of the material is taken from the 1998 Ph.D. thesis of David Bainbridge. 

Student Combinatorics
Monday, January 26, 4:10-5:00pm
3866 EH
Florian Block (UM)
Packing Problems

This is an introduction to packing problems and how they relate to algebraic combinatorics. We'll see some answers and open questions in various dimension. For example, in dimension 8 the E_8 lattice is the densest, in dimension 24 the densest packing seems to be (conjecturally) the leech lattice whereas in dimension 23 and many others there is not even a conjecture.

Geometry and Physics Seminar
Monday, January 26, 4:10-6:00pm
4088 EH
Igor Kriz (UM)
String K-theory and the Verlinde algebra

The subject of this talk is a joint work with Westerland, which is a next step in ``string topology'': the investigation of operations in twisted K-theory of free loop spaces of manifolds. This is especially intriguing since the twisted K-theory of LBG for a compact Lie group G is, by the work of Freed, Hopkins and Teleman, the completion of the Verlinde algebra of G, which is a Poincare (=closed Frobenius) algebra. How much of this structure is present in free loop spaces of compact manifolds? We showed that the product is, in some sense, reproduced, while the coproduct is different, exhibiting an inherent ``flaw'' in ``string topology''. At the end of the talk, I might speculate that closed Frobenius K-modules might perhaps be attainable by Gromov-Witten theory.

Teaching Mathematics
Monday, January 26, 5:15-6:30pm
3096 EH
Alejandro Uribe (UM) & Katherine Walker (UM)
Teaching proof in an IBL format to pre-service teachers

We will describe our experiences teaching Math 489, Topics in Elementary Mathematics, using Inquiry Based Learning methods. In particular we will discuss our efforts to teach proof as a foundation for the course, and some of our successes and difficulties. We hope to generate a discussion about our approach to teaching this and other similar courses.

Colloquium
Tuesday, January 27, 4:10-5:00pm
1360 EH
Andreas Blass (UM)
Uncountable abelian groups that want to be free

The title refers to those abelian groups whose failure to be free is caused by set-theoretic rather than algebraic issues.
An easy example is the group of infinite sequences of integers (with the operation of componentwise addition). I plan to use the theory of such groups, in particular questions about how far they are from being free, as a motivation for giving quick glimpses of some of the main areas of contemporary set theory.

Student Representation Theory Seminar
Wednesday, January 28, 3:10-4:00pm
3096 EH
Brian Jurgelewicz (UM)
Intro to weighted projective lines

Last week we learned about (generalized) root systems. This week we will see how the Grothendieck group of a so-called weighted projective line, equipped with the symmetric Euler form, is such a root system. We will describe the roots corresponding to indecomposable torsion sheaves, by reducing the problem to a question about quivers, and applying Kac's theorem. In future talks, we will describe the roots corresponding to indecomposable vector bundles (Crawley-Boevey's theorem).

RTG Working Seminar in Several Complex Variables and Complex Dynamics
Wednesday, January 28, 4:10-5:00pm
3096 EH
Al Taylor (UM)
Extremal plurisubharmonic functions for linear growth (Part II)

We will discuss properties of the extremal function $\Lambda_E(z)$, associated to plurisubharmonic functions of linear growth, i.e. the upper envelope of all psh functions u that are bounded above by zero on the set E and satisfy $u(z) \le |z| + o(|z|)$. Questions about this function arise naturally in trying to classify the algebraic varieties with sufficiently many real points that they satisfy the strong radial Phragmen-Lindelof condition.
This extremal function is also an analogue of the Siciak-Zaharuta extremal psh function L_E of logarithmic growth. However, we will show that it fails to have most of the properties that make L_E such a useful function in pluripotential theory.
In Monday's seminar talk, we will give an overview of these results, but very few proofs. In the working seminar on Wednesday, we will present enough of the proofs to explain all the main techniques used in the work. All of the material is taken from the 1998 Ph.D. thesis of David Bainbridge.

Commutative Algebra Seminar
Thursday, January 29, 3:10-4:00pm
3096 EH
Mel Hochster (UM)
Quasilength and content of local cohomology (continued)

This is the second of two lectures. Let R be a ring and x = x_1, ..., x_d a sequence of elements of R generating an ideal I. Craig Huneke and the speaker have recently introduced a notion of c o n t e n t for the highest local cohomology module H^d_I(R). This content is a real number between 0 and 1, and is defined asymptotically in terms of the behavior of the q u a s i l e n g t h s of the modules R/I_t , where I_t is the ideal generated by the t th powers of the x_j. Here, the quasilength is the length of a shortest filtraton in which the factors are homomorphic images of R/I. This content depends, a priori, on the choice of the x_j.

It is difficult to calculate quasilengths even in simple examples. It is conjectured that this content is always 1 if the x_j form a system of parameters for a local ring. This is true for local rings containing a field, which can be proved by reduction to characteristic p. This conjecture implies the direct summand conjecture. Many open questions will be discussed.

Financial/Actuarial Mathematics Seminar
Thursday, January 29, 3:10-4:00pm
3088 EH
Sergey Nadtochiy (Princton University)
Market Models for European Options

Most financial models introduced for the purpose of pricing and hedging derivatives concentrate on the dynamics of the underlying stocks, or underlying instruments on which the derivatives are written. However, as certain types of derivatives became liquid, it appeared reasonable to model their prices directly and use these *market models* to price or hedge exotic derivatives. This framework was originally advocated by Heath, Jarrow and Morton for the Treasury bond markets.
We discuss the characterization of arbitrage free dynamic stochastic models for the markets with infinite number of European Call options as the liquid derivatives. Subject to our assumptions on the presence of jumps in the underlying, the option prices are represented either through *local volatility* or through *local Levy measure*. Each of the latter ones is then given dynamics through an Itô stochastic process in a Banach space. The main thrust of our work is to characterize absence of arbitrage in this framework and address the issue of construction of the arbitrage free models.

Topology Seminar
Thursday, January 29, 3:10-4:00pm
4088 EH
Aaron Magid (UM)
The Topology of Deformation Spaces of Hyperbolic 3-Manifolds

For any closed surface S, the deformation space AH(S) is the space of all marked hyperbolic 3-manifolds homotopy equivalent to S. After reviewing some of the classical results that describe topology of the interior of AH(S), we will show that there are certain points on the boundary where AH(S) is not locally connected. This is a generalization of Ken Bromberg's result that the space of Kleinian punctured torus groups is not locally connected.

Differential Equations
Thursday, January 29, 4:10-5:00pm
4088 EH
David Shaeffer (Duke)
Chaotic behavior in a one-dimensional cardiac model

In electrocardiology, the term action potential refers to the behavior that, in response to a brief stimulus, the electrical potential across cardiac cell walls is elevated for an extended period. The duration of action potentials under periodic pacing is an important quantity clinically, physiologically, and mathematically. At slow to moderate pacing rates, every stimulus produces an action potential of the same duration, but at high pacing rates cardiac tissue often undergoes a bifurcation to what is called alternans : i.e., uniform APD□s are replaced by an alternation between short and long action potentials. In a single cell or a small piece of cardiac tissue, this bifurcation is a familiar period-doubling bifurcation, but when propagation eects are important the nature of the bifurcation to alternans is far from clear. For example, the short/long alternation may suer phase reversals at various locations in the tissue. This behavior, known as discordant alternans, is considered to be a precursor to ventricular fibrillation. In collaboration with my student, Shu Dai, I have studied these phenomena through an approximate equation (derived by Echebarria-Karma) for the modulation of nonuniform wave trains in one spatial dimension. In this lecture, after describing the context of the problem, I will report on this work. In particular, we have shown that: The modulation equation undergoes both Hopf and steady-state bifurcations; which bifurcation occurs first depends on a parameter derived from the speed of traveling waves; the competition between the two modes gives rise to interesting secondary bifurcation. Moreover, in certain parameter ranges, solutions of this equation exhibit chaotic behavior, as indicated in my title. While chaos has been observed in simulations of spiral waves in several dimensions, it is surprising to find it in a one-dimensional model.

Math Club
Thursday, January 29, 4:10-5:00pm
2nd floor Nesbitt Common Room
Marty Weissman (UC Santa Cruz)
A well-rounded discussion of spheres

We will discuss some or all of the following questions, using little more than advanced calculus throughout: What is the volume of the n-dimensional sphere? What is the best way to compute this volume? Why do the powers of π jump up every two dimensions, instead of every dimension? Why are spheres in even dimensions so much different than spheres in odd dimensions? What do the rational coefficients in these volume formulae mean? Do spheres get bigger or smaller in higher dimensions? What does volume mean, anyways? What does this have to do with Riemann's zeta function?

RTG Study Seminar
Thursday, January 29, 4:10-6:00pm
3866 EH
Mario Bonk (UM)
Isometric actions on trees and degenerations of hyperbolic structures

Let H^n(G) be the space of conjugacy classes of discrete and faithful representations of a discrete group G in the isometry group of hyperbolic n-space. According to a theorem due to Culler, Morgan and Shalen H^n(G) admits a natural compactification arising from isometric actions of G on real trees. I will present a proof of this fact due to M. Bestvina.

Applied and Interdisciplinary Mathematics Seminar
Friday, January 30, 3:10-4:00pm
1084 EH
Jorge Balbás (California State University)
Non-oscillatory Central Schemes for Hyperbolic Systems of Conservation Laws in 3D

We present a family of high-resolution, semi-discrete central schemes for hyperbolic systems of conservation laws in three space dimensions. Along with a detailed derivation of the semi-discrete formulation of the underlying PDE, and the description of the black-box schemes that result from it, their implementation, and properties, we present the solutions of several prototype problems for a variety of hyperbolic conservation laws. These extend previous results obtained for the same hyperbolic models in one and two space dimensions, and they further demonstrate the versatility and robustness of the semi-discrete central formulation.

Student Geometry/Topology
Friday, January 30, 3:10-4:00pm
3096 EH
Michelle Lee (UM)
Algebraic and Geometric Convergence

We will discuss algebraic and geometric convergence of Kleinian groups.

Combinatorics
Friday, January 30, 4:10-5:00pm
3866 EH
Alex Fink (UC Berkeley)
Valuations for matroid subdivisions

Subdivisions of matroid polytopes have made appearances in several combinatorial and algebraic contexts. An interesting class of functions on matroids, first investigated by Billera, Jia & Reiner and Speyer, are those that are valuative: a function is valuative if it behaves well in subdivisions, i.e., factors through the map from matroids to the group of the polyhedral algebra. Several well-known matroid invariants are valuative. Derksen has conjectured, and since proved, that a certain set of matroid invariants generate all S_n-symmetric valuative functions, and the conjecture readily extends to the nonsymmetric case. I'll present a mostly independent proof of this conjecture, and discuss some other valuative functions.

Knowledge of matroids will not be assumed. Parts of this work are joint separately with Felipe Rincon and Federico Ardila, and with David Speyer.