Fall 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
September 21st – September 27th

Monday, September 21

2:10-3:00pm **Topics in Algebraic Geometry** --- Yusuf Mustopa (UM) *Introductory Talk* --- 3866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Marty Weissman(UC Santa Cruz) *Dichotomy for generic supercuspidal representations of G 2* --- 4096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- TBA --- 3096 EH
4:10-5:00pm **Student Combinatorics** --- Austin Shapiro (UM) *Introduction to Convex Polytopes* --- 3866 EH
4:10-6:00pm **Geometry & Physics** --- Yongbin Ruan (UM) *Landau-Ginzburg/Calabi-Yau correspondence* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3096 EH

Tuesday, September 22

2:10-3:00pm "**What is … " Seminar** --- Andreas Blass (UM) *What is … forcing?* --- 3096 EH
3:10-4:00pm **Student Geometry/Topology** --- Geoff Scott (UM) *Spines and Turaev-Viro Invariants* --- 4096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
4:10-5:00pm **Colloquium** --- Leslie Smith (U of Wisconsin) *New PDE Reduced Models for Geophysical Flows* --- 1360 EH

Wednesday, September 23

3:10-4:00pm **Student Arithmetic Seminar** --- Ben Weiss (UM) *Adelic Fourier Analysis* --- 3866 EH
3:10-4:00pm **Geometric Function Theory Seminar** --- Mario Bonk (UM) *Expanding Thurston maps* --- 4096 EH
4:10-5:00pm **Student AIM Seminar** --- Kris Reyes (UM) *The MAGMA Computer Algebra System and Planar Graph Coloring* --- 3866 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Tommaso De Fernex (U of Utah) *Rigidity properties of Fano varieties* --- 3088 EH
4:30-6:00pm **Logic Seminar** --- Andreas Blass (UM) *Strong measure zero* --- 3096 EH

Thursday, September 24

12:00-1:00pm **Mathematical Biology Seminar** --- Cecilia Diniz Behn (UM) *Mathematical models of narcolepsy* --- 4096 EH
3:10-4:00pm **Commutative Algebra Seminar** --- Karl Schwede (UM) *Rationality of Hilbert-Kunz multiplicity for 2 dimensional graded rings, part 1* --- 3096 EH
3:10-4:00pm **Topology Seminar** --- Juan Souto (UM) *Periodic maximal flats are not peripheral* --- 4096 EH
4:10-5:00pm **Financial/Actuarial Mathematics Seminar** --- Qingshuo Song (UM) *Impulse control and portfolio optimization with general transaction cost* --- 4096 EH
4:10-5:00pm **Differential Equations** --- Chunjing Xie (UM) *Classical Solutions of Two Dimensional Inviscid Rotating Shallow Water System* --- 4088 EH
4:10-5:00pm **Math Club** --- Michael Khoury (UM) *Integral Apollonian Packings* --- 2nd floor Nesbitt Common Room

Friday, September 25

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Oleg Zikanov (UM-Dearborn) *Effect of magnetic fields on dynamics of electrically conducting fluids* --- 1084 EH
3:10-4:00pm **Intersection Theory Study Seminar** --- Hunter Brooks (UM) & Mihai Fulger (UM) TBA --- 3866 EH

Friday, September 25 … continued

3:10-4:00pm **Geometry Seminar** --- Lizhen Ji (UM) *Coarse Schottky problem and Equivariant cell decomposition of Teichmuller spaces* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Frank Sottile (Texas A&M) *Orbitopes* --- 3866 EH

UPCOMING EVENTS

Michigan Conference on Topology and Physics

Feb 6-7, 2010

ABSTRACTS FOR THE WEEK OF SEPT. 21 – SEPT. 27, 2009

Topics in Algebraic Geometry
Monday, September 21, 2:10-3:00pm
3866 EH
Yusuf Mustopa (UM)
Introductory Talk

I will discuss the classification of vector bundles on P^1 as well as some basic concepts necessary for the study of the positive genus case.

Group Theory/Lie Theory/Number Theory Seminar
Monday, September 21, 3:10-5:00pm
4096 EH
Marty Weissman (UC Santa Cruz)
Dichotomy for generic supercuspidal representations of G_2

During the pre-tea part of the talk, I will give an introduction to exceptional groups and some parabolic subgroups, using some exotic algebras (octonions, tensor products of Hurwitz algebras, and structurable algebras). Using some of these constructions, I will explain how every Galois representation with values in the exceptional complex Lie group G_2 leads to such a representation with values in SL_3 or in Spin_7. This is called the "dichotomy of cuspidal parameters for G_2".

During the post-tea part of the talk, I will describe how the local Langlands conjectures predict a corresponding dichotomy for irreducible generic supercuspidal representations of G_2. Then, I will present recent work (joint with G. Savin), which proves this predicted dichotomy over all p-adic fields (excluding p=2 in some results). The dichotomy arises from theta correspondences in the exceptional groups E_6 and E_7. This reduces the local Langlands parameterization for generic supercuspidal representations of G_2 to a single conjecture about the Langlands parameterization for PGSp_6.

Student Combinatorics
Monday, September 21, 4:10-5:00pm
3866 EH
Austin Shapiro (UM)
Introduction to Convex Polytopes

A convex polytope is...
- the n-dimensional analogue of a polygon or polyhedron
- a bounded intersection of finitely many half-spaces in R^n
- a bounded solution set for finitely many simultaneous linear inequalities
- the convex hull of finitely many points

I will give you a crash course on these objects and their basic properties, including symmetry, Euler characteristic, face structure (f-vectors and h-vectors), and other topics to be determined. The emphasis will be on breadth rather than depth; many results will be stated and not proved, on the grounds that one should have a look at the landscape before setting off on a hunt. (This talk is the beginning of something approximating a series.)

Geometry & Physics Seminar
Monday, September 21, 4:10-6:00pm
4088 EH
Yonbin Ruan (UM)
Landau-Ginzburg/Calabi-Yau correspondence

For last twenty years, physics has generated many amazing predictions in mathematics. Many of them comes from powerful physical correspondence or duality which connects completely different mathematics. In this talk, we will discuss one of these powerful correspondences called Landau-Ginzburg/Calabi-Yau correspondence connecting singularity theory to Calabi-Yau geometry.

"What is … " Seminar
Tuesday, September 22, 2:10-3:00pm
3096 EH
Andreas Blass (UM)
What is … forcing?

Forcing is the most powerful known method for proving consistency and independence results in set theory, i.e., for proving that certain statements cannot be proved on the basis of the usual foundation of mathematics. The forcing method works by very carefully enlarging the universe of sets. Part of the talk will be about the conceptual issue of how one could introduce new sets into a universe that already contains all sets. Another part will describe some of the technical issues that arise. Finally, if time permits, I'll indicate a few of the applications of forcing.

Student Geometry/Topology
Tuesday, September 22, 3:10-4:00pm
4096 EH
Geoff Scott (UM)
Spines and Turaev-Viro Invariants

Intuitively, a spine of a 3-manifold M is a 2-polyhedron onto which M deformation retracts. If we impose certain restrictions on spines, they give an elegant combinatorial representation of 3-manifolds. In the first half of the talk, I will summarize the basic theory of spines. In the second half, I will present one application of this theory: the Turaev-Viro 3-manifold invariants. Along the way, I will mention some current research being done on these topics. This talk will be accessible to everyone and includes several colorful pictures.

Colloquium
Tuesday, September 22, 4:10-5:00pm
1360 EH
Leslie Smith (U of Wisconsin)
New PDE Reduced Models for Geophysical Flows

We review the mathematical structure of the PDEs governing atmosphere-ocean flows. Since these PDEs are fundamentally multi-scale, mathematical and physical understanding has been based largely on reduced models valid for limiting parameter regimes. One of the simplest such reduced models is the celebrated quasi-geostrophic (QG) equation. After explaining the QG model from several points of view, we will show how to derive a hierarchy of new PDE reduced models intermediate between QG and the full governing equations. We illustrate how the new reduced PDEs can be used to identify the nonlinear interactions primarily responsible for observed non-QG phenomena, such as cyclone/anticyclone asymmetry in geophysical flows.

Student Arithmetic Seminar
Wednesday, September 23, 3:00-4:00pm
3866 EH
Ben Weiss (UM)
Adelic Fourier Analysis

This talk will start from first principles, and should be accesible to anyone. We will define the p-Adics and discuss some basic analysis and measure theory. We will then extend to the Adeles (which we will define and introduce to all), and discuss how to compute Fourier transforms on this space, and some applications to number theory.

Geometric Function Theory Seminar
Wednesday, September 23, 3:10-4:00pm
4096 EH
Mario Bonk (UM)
Expanding Thurston maps

A branched cover f of a 2-sphere is called post-critically finite, if the forward orbit of each critical point is a finite set.
These maps where first studied by Thurston and are now called Thurston maps. In my talk I will consider Thurston maps whose dynamical behavior under iteration is expanding in a suitable sense.
In joint work with Daniel Meyer we showed that every expanding Thurston maps admits an essentially combinatorial description given by a so-called subdivision rule.

Student AIM Seminar
Wednesday, September 23, 4:10-5:00pm
3866 EH
Kris Reyes (UM)
The MAGMA Computer Algebra System and Planar Graph Coloring

I will talk about the MAGMA Computer Algebra System, including how to access and run it, and some basic MAGMA syntax. I will then investigate how the problem of finding nowhere-zero *k*-flows in graphs, which is related to planar graph coloring. I shall follow paper 15 in "Discovering Mathematics with MAGMA." This talk should be relevant to anyone interested computational discrete mathematics.

Algebraic Geometry Seminar
Wednesday, September 23, 4:10-6:00pm
3088 EH
Tommaso De Fernex (U of Utah)
Rigidity properties of Fano varieties

I will discuss some deformation properties of Fano varieties. The general methods rely on the investigation of the variation of the cone of effective curves and, more generally, of the Mori chamber decomposition, which, according to Mori theory, encode information on the geometry of the variety. The talk is based on joint work with C. Hacon.

Logic Seminar
Wednesday, September 23, 4:10-6:00pm
3096 EH
Andreas Blass
Strong measure zero

A set X of real numbers has strong measure zero if, for any sequence of positive numbers e_1, e_2, ..., X can be covered by a sequence of intervals I_1, I_2, ... such that each I_n has measure e_n. Borel conjectured that all strong measure zero sets are countable; this turned out to be independent of the axioms of set theory. I'll prove the easier half of the independence and make some comments about the harder half (a 1976 theorem of Laver). I'll also describe a surprising connection between strong measure zero and Baire category.
Finally, I'll discuss some even stronger smallness properties of sets of real numbers.

Mathematical Biology Seminar
Thursday, September 24, 12:00-1:00pm
4096 EH
Cecilia Diniz Behn (UM)
Mathematical models of narcolepsy

I'll provide a brief overview of the sleep disorder narcolepsy and review the phenomenological and physiologically-based modeling approaches that have been used to describe and/or investigate various aspects of the narcolepsy phenotype.

Commutative Algebra Seminar
Thursday, September 24, 3:10-4:00pm
3096 EH
Karl Schwede (UM)
Rationality of Hilbert-Kunz multiplicity for 2 dimensional graded rings, part 1

I'll talk about work of Brenner on this topic.

Topology Seminar
Thursday, September 24, 3:10-4:00pm
4096 EH
Juan Souto (UM)
Periodic maximal flats are not peripheral

We prove that every finite volume locally symmetric space M contains a compact set K with the property that no periodic maximal flat can be homotoped so that it is disjoint of K. This is joint work with Alexandra Pettet.

Financial/Actuarial Mathematics Seminar
Thursday, September 24, 4:10-5:00pm
4096 EH
Qingshuo Song (UM)
Impulse control and portfolio optimization with general transaction cost

In this paper we study an optimal portfolio selection problem under general transaction cost. The problem is reduced to an impulse control problem with sub-additive transaction costs. We show that the optimal strategy exists and the number of trading times has finite expectation. The result covers the transaction costs possibly without fixed cost components.
This is a joint work with Jin Ma, Jing Xu, and Jianfeng Zhang.

Differential Equations
Thursday, September 24, 4:10-5:00pm
4088 EH
Chunjing Xie (UM)
Classical Solutions of Two Dimensional Inviscid Rotating Shallow Water System

In this talk, we will discuss the global existence and asymptotic behavior of classical solutions for two dimensional inviscid Rotating Shallow Water system with small initial data subject to the zero-relative-vorticity constraint. One of the key steps is a reformulation of the problem into a symmetric quasilinear Klein-Gordon system, for which the global existence of classical solutions is then proved with combination of the vector field approach and the normal forms. We also probe the case of general initial data and reveal a lower bound for the lifespan that is almost inversely proportional to the size of the initial relative vorticity. This is a joint work with Bin Cheng.

Math Club
Thursday, September 24, 4:10-5:00pm
2nd floor Nesbitt Common Room
Michael Khoury (UM)
Integral Apollonian Packings

Begin with three circles inside a larger circle such that each pair of gaps, you can draw a circle which is tangent to three existing circles. This creates smaller gaps, which can be filled with smaller circles, and so on. If you continue this process, you will obtain a compelling fractal picture. The geometric and topological properties have of these Apollonian circle packings have been studied for some time. More unexpectedly, these pictures raise many deep and difficult questions in number theory.
What kind of numbers can appear in such a packing? What kinds of sequences of numbers can appear along chains of circles? We will talk about some of the surprising things that are known about integral Apollonian packings as well as some questions that still lie well out of reach. This talk does not require any prior knowledge more advanced than high-school geometry and some modular arithmetic.

Applied and Interdisciplinary Mathematics Seminar
Friday, September 25, 3:10-4:00pm
1084 EH
Oleg Zikanov (UM-Dearborn)
Effect of magnetic fields on dynamics of electrically conducting fluids

Motion of an electrically conducting fluid in a magnetic field generates electric currents and produces Lorentz force, which affects the flow. We consider this interaction for the technologically interesting case of low magnetic Reynolds number, in which the additional magnetic field induced by the fluid motion is weak. The results illustrate the spectacular and, often, unexpected way, in which the applied magnetic field transforms familiar hydrodynamic phenomena, such as the mixing layer instability, transient growth in a channel, and ideal flow in an ellipsoid.

Geometry Seminar
Friday, September 25, 3:10-4:00pm
3096 EH
Lizhen Ji (UM)
Coarse Schottky problem and Equivariant cell decomposition of Teichmuller spaces

In this talk, I will explain some similar results and interaction between locally symmetric spaces and moduli spaces of curves.

First, let A_g be the moduli space of principally polarized abelian varieties of dimension g, the quotient of the Siegel upper space by $Sp(2g;Z)$, and Mg be the moduli space of projective curves of genus g. Then there is a Jacobian map $J : M_g \to A_g$, by associating to each curve its Jacobian.

The celebrated Schottky problem is to characterize the image J(Mg). Buser and Sarnak viewed A_g as a complete metric space and showed that J(Mg) lies in a very small neighborhood of the boundary of A_g as g goes to infinity. Motivated by this, Farb formulated the coarse Schottky problem: determine the image of $J(M_g)$ in the asymptotic cone (or tangent space at infinity) $C_\infty(A_g)$ of A_g, as defined by Gromov in large scale geometry. In a joint work with Enrico Leuzinger, we showed that $J(M_g)$ is d-dense in A_g for some constant d and hence its image in the asymptotic cone $C_\infty(A_g)$ is equal to the whole cone.

Another example is that the symmetric space $SL(n,R)/SO(n)$ admits several important equivariant cell decompositions with respect to the arithmetic group $SL(n,Z)$ and hence a cell decomposition of the locally symmetric space $SL(n,Z) \backslash SL(n,R)/SO(n)$. One such decomposition comes from the Minkowski reduction of quadratic forms (or marked lattices). We generalize the Minkowski reduction to marked hyperbolic Riemann surfaces and obtain an equivariant weak cell decomposition of the Teichmuller space T_g with respect to the mapping class groups Mod_g.

Combinatorics
Friday, September 25, 4:10-5:00pm
3866 EH
Frank Sottile (Texas A&M)
Orbitopes

An orbitope is the convex hull of an orbit of a compact group G acting linearly on a vector space. Orbitopes are the simplest convex bodies which possess many symmetries. Some, particularly those in low-dimensional representations of G, have very beautiful structure. Our interest is in whether or not these appealing convex bodies are spectahedra, that is, if they are described by a system of linear matrix inequalities, preferably with coefficients in the field of definition of the orbitope.

In this talk, I will introduce orbitopes and discuss spectahedra and the new field of convex algebraic geometry in which these questions lie. I will illustrate this with orbitopes for SO(2) and for the special orthogonal group acting on trace-free symmetric matrices.
This is joint work with Raman Sanyal and Bernd Sturmfels.