

Winter 2009  
University of Michigan-Department of Mathematics  
<http://www.math.lsa.umich.edu/seminars/index.shtml>  
Ann Arbor, MI 48109-1043  
**March 16<sup>th</sup> – March 22<sup>nd</sup>**

**Monday, March 16**

- 3:10-4:00pm **Algebra Seminar (Non-standard time/place)** --- Sue Sierra (University of Washington) *Primitivity of twisted homogeneous coordinate rings and complex dynamics* --- 3866 EH
- 3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Eugene Eisenstein (UM) *Geometric invariant theory and flips* --- 2866 EH
- 3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Linus Kraemer (U of Muenster) *Coarse rigidity of Euclidean buildings* --- 4096 EH
- 4:10-5:00pm **Differential Equations (Special Seminar)** --- Eitan Tadmor (U of Maryland) *Spectral Dynamics and Critical Thresholds in Nonlinear Convective Equations* --- 3088 EH
- 4:10-5:00pm **Student Combinatorics** --- Kevin Dilks (UM) *Promotion and Evacuation* --- 3866 EH
- 4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- TBA --- 3096 EH
- 4:10-6:00pm **Geometry and Physics Seminar** --- Melissa Liu (Columbia) *T-duality and equivariant homological mirror symmetry for toric varieties* --- 4088 EH

**Tuesday, March 17**

- 2:10-3:00pm **"What is ... " Seminar** --- Martin Weissman (UC Santa Cruz) *What is ... G-2?* --- 3096 EH
- 3:10-4:00pm **Student Algebraic Geometry Seminar** --- Kyle Hofmann (UM) *Examples of flips and flops* --- 3088 EH
- 3:10-4:00pm **Geometry Seminar** --- Ko Honda (USC) TBA --- 3866 EH
- 3:10-4:00pm **Student Seminar in Complex Dynamical Systems** --- TBA --- 4088 EH
- 4:10-5:00pm **Colloquium** --- Susan Sierra (University of Washington) – *Sumner Myers Prize lecture: The geometry of (some) noncommutative surfaces* --- 1360 EH
- 4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH
- 5:15-6:30pm **Teaching Mathematics (Non-standard Day)** --- Sybilla Beckman (U of Georgia) *What is worth focusing on in math courses for elementary teachers, and why?* --- 3096 EH

**Wednesday, March 18**

- 3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH
- 3:10-4:00pm **Student Representation Theory Seminar** --- Harlan Kadish (UM) --- *Just Work Mod  $p$ : Finishing Kac's Theorem for Weighted Projective Lines* --- 3096 EH
- 3:10-4:00pm **Student Arithmetic Seminar** --- Alex Mueller (UM) *Analysis as it was intended: A brief tour of non-standard analysis* --- 3088 EH
- 4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- Elizabeth Wulcan (UM) *Sparse effective Nullstellensätze via residue currents* --- 3096 EH
- 4:10-5:30pm **Logic Seminar** – Jessica Metcalf-Burton (UM) *Information Rates for Secret Sharing over Various Access Structures* --- 4088 EH
- 4:10-6:00pm **Algebraic Geometry Seminar** --- No seminar this week --- 3088 EH

**Thursday, March 19**

- 2:10-3:00pm **Commutative Algebra Seminar (Note: Time/location)** --- Takehiko Yasuda (Kagoshima University) *F-blowup* --- 3088 EH
- 3:10-4:00pm **Topology Seminar** --- Matthew Ando (UIUC) *A quasicategorical approach to Thom spectra and twisted Umkehr maps* --- 4088 EH

**Thursday, March 19 ... continued**

- 3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- TBA --- 3088 EH  
4:10-5:00pm **Differential Equations** --- Selim Esedoglu (UM) *A variational model for denoising surfaces in computer graphics applications* --- 4088 EH  
4:10-5:00pm **Math Club - Undergraduate Colloquium (Non-standard room)** --- Brian Conrad (Stanford) *Can a random Rubik's cube be solved?* --- 1360 EH  
4:10-6:00pm **RTG Study Seminar** --- TBA --- 3866 EH  
5:00-6:00pm **Social Hour** – Upper Atrium

**Friday, March 20**

- 11:10-12:00pm **Theoretical Computer Science Seminar** --- Patrick Poon (UM) --- *Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space  $O(n \log^2 n)$ -Time Algorithm* --- CSE 3941  
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Michael Herrmann (Oxford Centre for Nonlinear PDE) *Lattices Versus PDEs* --- 1084 EH  
3:10-4:00pm **Student Geometry/Topology** --- Becky Haoi (UM) --- *Geometrization Conjecture* --- 3096 EH  
4:10-5:00pm **Combinatorics** --- Stephen Griffeth (U. Minnesota) *Unitary representations of rational Cherednik algebras* --- 3866 EH

**EVENTS THIS WEEK**

**Graduate Recruitment Weekend  
March 20 - March 22, 2009**

**MSU-UM Grad Student Geo/Top Conference  
Sunday, March 22 at 8am-6pm  
3088 EH and 3096 EH**

**UPCOMING EVENTS**

**Departmental External Review  
March 22-24, 2009**

**RTG Workshop on SCV and Geometry  
April 10 - April 12, 2009**

**Ziwet Lectures  
John Tyson (Virginia Polytechnic Institute & State University)  
April 13-16, 2009**

**Ziwet Lectures  
Cedric Villani (Ecole Normale Supérieure de Lyon)  
October 2009**

**ABSTRACTS FOR THE WEEK OF MARCH 16 – MARCH 22, 2009**

**Algebra Seminar (Non-standard time/place)**

**Monday, March 16, 3:10-4:00pm**

**3866 EH**

**Sue Sierra (University of Washington)**

***Primitivity of twisted homogeneous coordinate rings and complex dynamics***

Let  $B = B(X, L, f)$  be the twisted homogeneous coordinate ring associated to a complex projective variety  $X$ , an automorphism  $f$  of  $X$ , and an appropriately ample invertible sheaf  $L$ . We study the primitive spectrum (the noncommutative analogue of the maximal spectrum) of  $B$ , and show that there is an intriguing relationship between primitivity of  $B$  and the dynamics of the automorphism  $f$ . In many cases Dixmier and Moeglin's characterization of primitive ideals in enveloping algebras generalizes to  $B$ ; in particular, this holds if  $X$  is a surface. This is joint work with J. Bell and D. Rogalski.

**Group Theory/Lie Theory/Number Theory Seminar**

**Monday, March 16, 3:10-5:00pm**

**4096 EH**

**Linus Kraemer (U of Muenster)**

***Coarse rigidity of Euclidean buildings***

Euclidean buildings are certain metric spaces of nonpositive curvature. In several ways, they are similar to Riemannian symmetric spaces of noncompact type. The coarse structure of a metric space is what one sees from "far away". In my talk I will explain why the Tits boundary of a Euclidean building is a coarse metric invariant. As a result one obtains rigidity results that generalize earlier work by Prasad and by Kleiner-Leeb. This is joint work with Richard Weiss.

**Differential Equations (Special Seminar)**

**Monday, March 16, 4:10-5:00pm**

**3088 EH**

**Eitan Tadmor (U of Maryland)**

***Spectral Dynamics and Critical Thresholds in Nonlinear Convective Equations***

We discuss the global regularity vs. finite time breakdown in Eulerian dynamics, driven by different models of nonlinear forcing. Finite time breakdown depends on whether the initial configuration crosses intrinsic,  $O(1)$  critical thresholds (CT). Our approach is based on spectral dynamics, tracing the eigenvalues of the velocity gradient which determine the boundaries of CT surfaces in configuration space. We demonstrate how spectral dynamics is used to study several  $n$ -dimensional prototype models. We present a stability theory for vanishing viscosity solutions of the 2D nonlinear "pressureless" convection. We revisit the critical thresholds of 3D restricted Euler and Euler-Poisson equations, and we obtain a surprising global existence result for a large set of sub-critical initial data in the 4D case.

**Student Combinatorics**

**Monday, March 16, 4:10-5:00pm**

**3866 EH**

**Kevin Dilks (UM)**

***Promotion and Evacuation***

Promotion and evacuation are two operations based off of jeu de taquin which give automorphisms on the set of linear extensions of a partially ordered set, and they happen to show up in some interesting places. To start, I'll derive some of the classical relations between the two operations. Then I'll move on to a couple different applications where promotion and evacuation come into play, including some recent results and conjectures related to the cyclic sieving phenomenon.

**Geometry and Physics Seminar  
Monday, March 16, 4:10-6:00pm  
4088 EH**

**Melissa Liu (Columbia)**

***T-duality and equivariant homological mirror symmetry for toric varieties***

This is a sequel of David Treumann's talk on February 16.

I will discuss (i) SYZ transformation relating equivariant coherent sheaves on the toric variety to Lagrangians in the cotangent of  $R^n$ , (ii) microlocalization functor relating the Fukaya category of the cotangent to constructible sheaves on the base (due to Nadler-Zaslow, Nadler), and (iii) a categorification of Morelli's theorem relating equivariant coherent sheaves on the toric variety to constructible sheaves on  $R^n$ . This is a joint work with Bohan Fang, David Treumann, and Eric Zaslow, generalizing Bohan Fang's work on projective spaces.

**"What is ..." Seminar  
Tuesday, March 17, 2:10-3:00pm  
3096 EH  
Martin Weissman (UC Santa Cruz)  
*What is ... G-2?***

I will answer the question "What is  $G_2$ ?" in many different and correct ways, providing a user's manual to this exceptional group. I will approach the question from numerous points of view, including Hurwitz algebras and octonions, root data, and Chevalley groups. The only prerequisites for this lecture will be basic group theory and linear algebra. Participants will receive commemorative handouts.

**Colloquium  
Tuesday, March 17, 4:10-5:00pm  
1360 EH**

**Susan Sierra (University of Washington)**

***Sumner Myers Prize lecture: The geometry of (some) noncommutative surfaces***

The correspondence between commutative graded rings and projective algebraic varieties is well-known. Perhaps surprisingly, geometric techniques have also been highly successful in understanding noncommutative graded rings, particularly those of low dimension: the analogues of projective curves and projective surfaces. Noncommutative curves are understood, and noncommutative surfaces are an active research area. We present our recent classification of birationally commutative projective surfaces, and discuss open problems.

**Teaching Mathematics (Note: Non-standard day)  
Tuesday, March 17, 5:15-6:30pm  
3096 EH**

**Sybilla Beckman (U of Georgia)**

***What is worth focusing on in math courses for elementary teachers, and why?***

We want elementary school teachers to develop a deep and coherent understanding of the mathematics they will teach. But what does this deep and coherent understanding consist of and how do we help teachers acquire it? In order to encourage depth and coherence in the elementary and middle grades, the National Council of Teachers of Mathematics has published Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics and the National Math Panel has described critical foundations for algebra. In this talk I will present my view of the key topics on which mathematics courses for prospective elementary teachers should focus and the rationale for this view. I will also raise questions for empirical study.

**Student Representation Theory Seminar  
Wednesday, March 18, 3:10-4:00pm  
3096 EH**

**Harlan Kadish (UM)**

***Just Work Mod  $p$ : Finishing Kac's Theorem for Weighted Projective Lines***

Continuing our series, we complete the examination of indecomposable sheaves on a weighted projective line: we reduce to the case of working over a finite field.

**RTG Working Seminar in Several Complex Variables and Complex Dynamics  
Wednesday, March 18, 4:10-5:00pm  
3096 EH**

**Elizabeth Wulcan (UM)**

***Sparse effective Nullstellensatz via residue currents***

Residue currents are generalizations of one complex variable residues and can be thought of as currents representing ideals of holomorphic functions or polynomials.

I will discuss how residue currents on toric varieties can be used to obtain certain effective versions of Hilbert's Nullstellensatz.

**Logic Seminar  
Wednesday, March 18, 4:10-5:30pm  
4088 EH**

**Jessica Metcalf-Burton (UM)**

***Information Rates for Secret Sharing over Various Access Structures***

Suppose you're the manager of a bank, and the combination to the vault is a number  $S$  between 0 and 999. You have two underlings who need to be able to open the vault, but you want them to keep an eye on each other so neither one runs off with the money. This means you need to share the secret of the vault combination between your two underlings.

You could give underling #1 a random number mod 1000, and give underling #2 the sum of the random number and  $S$  mod 1000. Then they can open the vault if and only if they work together. This scheme for sharing a secret is efficient: you share one number mod 1000, each underling gets one number mod 1000. But what happens when you have more underlings and the rules determining who is allowed to open the vault become more complicated? It turns out you can't always get away with giving each person just one number mod 1000.

In this talk I will formalize, in terms of Shannon entropy, what it means to share a secret.

I will also talk about how efficiently one can share a secret in a few specific situations, including some arising from matroids.

**Commutative Algebra Seminar (Note: Time/Location)  
Thursday, March 19, 2:10-3:00pm  
3088 EH**

**Takehiko Yasuda (Kagoshima University)**

***F-blowup***

We survey the notion of an  $F$ -blowup, which the speaker recently introduced. The  $F$ -blowup is a canonical blowup of a singular variety in positive characteristic, which is by definition the universal flattening of the Frobenius morphism. This simply defined blowup has turned out very interesting. For instance, when the given variety is the quotient of a smooth variety by a tame finite group action, then the  $F$ -blowup is isomorphic to the  $G$ -Hilbert scheme. The  $F$ -blowup is also related with  $F$ -pure singularities and non-commutative geometry.

**Differential Equations**  
**Thursday, March 19, 4:10-5:00pm**  
**4088 EH**

**Selim Esedoglu (UM)**

***A variational model for denoising surfaces in computer graphics applications***

Geometry denoising, also known as surface fairing, is an important problem in computer graphics. It is needed whenever 3D objects are digitized and represented e.g. as triangulated surfaces, typically by sampling points from the surface of an object using a 3D scanner. Measurement errors (noise) in coordinates of the sampled points inevitably lead to oscillations in the digitized surface, giving it a rough and unnatural appearance. The goal of surface fairing is to smooth out the oscillations that are due to noise without also rounding out "legitimate" singularities such as creases and corners that are commonly found on manmade objects (such as machine parts). We will describe a new variational model for surface fairing that is the natural geometric analogue of an image processing model due to Rudin, Osher, and Fatemi. Gradient descent for the energy that we propose, which is defined on surfaces, leads to an interesting new geometric motion that removes the noise but keeps creases and corners intact as it evolves a surface. Its numerical implementation (discretization) using triangulated surfaces turns out to be quite tricky; to accomplish this task, we rely on important previous work of geometers who were interested in extending certain classical theorems from smooth to polyhedral manifolds. Joint work with Matt Elsey.

**Math Club - Undergraduate Colloquium (Non-standard room)**

**Thursday, March 19, 4:10-5:00pm**

**1360 EH**

**Brian Conrad (Stanford)**

***Can a random Rubik's cube be solved?***

If the pieces of a Rubik's cube are pried apart with a screwdriver and reassembled in random positions, can the puzzle be solved? It turns out that the answer is no: the proportion of random arrangements of the puzzle pieces that can reach the "solved" position via legal moves is  $1/12$ . In the course of explaining this curious fact, we will see how to use elementary ideas from group theory to analyze this famous puzzle as well as its 19th-century analogue, the 15-puzzle. Previous knowledge of group theory will not be assumed.

**Theoretical Computer Science Seminar**

**Friday, March 20, 11:10-12:00p**

**CSE 3941**

**Patrick Poon (UM)**

***Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space  $O(n \log^2 n)$ -Time Algorithm***

Shortest Paths in Directed Planar Graphs with Negative Lengths: a Linear-Space  $O(n \log^2 n)$ -Time Algorithm Philip Klein, Shay Mozes, Oren Weiman Presented by Patrick Poon We give an  $O(n \log^2 n)$ -time, linear-space algorithm that, given a directed planar graph with positive and negative arc-lengths, and given a node  $s$ , finds the distances from  $s$  to all nodes. The best previously known algorithm requires  $O(n \log^3 n)$  time and  $O(n \log n)$  space.

**Applied and Interdisciplinary Mathematics Seminar**  
**Friday, March 20, 3:10-4:00pm**  
**1084 EH**  
**Michael Herrmann (Oxford Centre for Nonlinear PDE)**  
***Lattices Versus PDEs***

Lattice ODEs have a continuous time but a discrete space variable, and can hence be regarded as discrete PDEs. Despite their seeming simplicity they possess a very complex dynamics and behave sometimes completely different than their continuous counterparts. In this talk we discuss simple 1D Hamiltonian lattices and present an overview on typical questions and problems that arise when passing to a continuum scale. In particular, we emphasize the role of strong oscillations and outline the connections to modulation theory, nonlinear conservation laws, and thermodynamics.

**Student Geometry/Topology**  
**Friday, March 20, 3:10-4:00pm**  
**3096 EH**  
**Becky Haoi (UM)**  
***Geometrization Conjecture***

The purpose of this talk is to provide a brief survey of Thurston's geometrization conjecture, which establishes a complete characterization of geometric structures on 3-manifolds. We will begin by discussing its 2-dimensional analogue, the uniformization theorem for surfaces. A vague notion of what curvature is and some knowledge of covering space theory will be assumed.

**Combinatorics**  
**Friday, March 20, 4:10-5:00pm**  
**3866 EH**  
**Stephen Griffeth (U. Minnesota)**  
***Unitary representations of rational Cherednik algebras***

I. Cherednik posed the problem of classifying the set of unitary irreducible modules for the rational Cherednik algebra, in particular hoping for new examples of interesting infinite dimensional unitary representations.

Etingof and Stoica began the analysis, conjecturing (and partially proving) a classification in type A. This talk aims to explain how Cherednik and Suzuki's combinatorial description of rational Cherednik algebra modules leads to a proof of the Etingof-Stoica conjecture, and how to solve the analogous problem for the family  $G(r,p,n)$  of complex reflection groups, and perhaps for the Cherednik algebras attached to Weyl groups of arbitrary type.

This talk is based on work (in progress) with Charles Dunkl, on the paper "[Unitary representations of rational Cherednik algebras](#)" by Etingof and Stoica, and on the appendix I wrote to that paper.