

Fall 2009
University of Michigan-Department of Mathematics
<http://www.math.lsa.umich.edu/seminars/index.shtml>
Ann Arbor, MI 48109-1043
October 5th – October 11th

Monday, October 5

- 2:10-3:00pm **Topics in Algebraic Geometry** --- Eugene Eisenstein (UM) *Stability of M-bundles* --- 3866 EH
- 4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Tien-Cuong Dinh (Paris VI, visiting UM) *On the Hodge-Riemann theorem and the Beauville-Bogomolov theorem* --- 3096 EH
- 4:10-5:00pm **Student Combinatorics** --- Luis Serrano (UM) *Symmetric functions* --- 3866 EH
- 4:10-6:00pm **Geometry & Physics** --- Todor Milanov (UM) *Orbifold structures on the projective line and integrable hierarchies* --- 4088 EH
- 5:15-6:30pm **Teaching Mathematics** --- Karen Rhea (UM) *The Calculus Concept Inventory—What does it tell us?* --- 3096 EH

Tuesday, October 6

- 2:10-3:00pm **“What is ...” Seminar** --- Ron Solomon (Ohio State Univ) *What is ... a signalizer functor?* --- 3096 EH
- 3:10-4:00pm **Student Geometry/Topology** --- Dan Kneezel (UM) *Buildings* --- 4096 EH
- 3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
- 4:10-5:00pm **Colloquium** --- Ron Solomon (Ohio State Univ) *Simple 2-Fusion Systems* --- 1360 EH

Wednesday, October 7

- 3:10-4:00pm **Student Arithmetic Seminar** --- Hunter Brooks (UM) *Iwasawa Theory of Elliptic Curves and Complex Multiplication* --- 3866 EH
- 3:10-4:00pm **Geometric Function Theory Seminar** --- Th. Foertsch (U of Bonn) *Ptolemy Circles – A Moebius Characterization of n-Spheres* --- 4096 EH
- 4:10-5:00pm **Student AIM Seminar** --- Matthew Masarik (UM) *A Brief Introduction of the Mathematics of Finance* --- 3866 EH
- 4:10-6:00pm **Algebraic Geometry Seminar** --- Daniel Erman (Berkeley) *Deformations of \emptyset -dimensional schemes* --- 3088 EH
- 4:30-6:00pm **Logic Seminar** --- Andreas Blass (UM) *Matet’s proof of the Hales-Jewett Theorem* --- 3096 EH

Thursday, October 8

- 12:00-1:00pm **Mathematical Biology Seminar** --- Berton Earnshaw (MSU) *Global asymptotic stability of nonautonomous master equations: extensions of van Kampen’s theorem* --- 4096 EH
- 3:10-4:00pm **Commutative Algebra Seminar** --- Christine Berkesch (Purdue) *The rank of a hypergeometric* --- 3096 EH
- 3:10-4:00pm **Topology Seminar** --- Jason DeBlois UIC--- TBA --- 4096 EH
- 4:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar (Note: Non-standard day)** --- Tasho Kaletha (Chicago) TBA --- 4096 EH
- 4:10-5:00pm **Financial/Actuarial Mathematics Seminar** --- TBA --- 3088 EH
- 4:10-5:00pm **Differential Equations** --- Todd Kapitula (Calvin College) *Orbital stability of periodic waves for generalized KdV* --- 4088 EH

4:10-5:00pm **Math Club** --- Joe Marker (UM) *Property-Casualty Insurance: Predicting Misfortunes*
-- 2nd floor Nesbitt Common Room

Friday, October 9

10:30-11:30am **Theoretical Computer Science Seminar** --- Xiaodi Wu (UM) *QIP = PSPACE*--- 3941
CSE

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Sherif El-Tawil (UM)
*Multiscale Computational Simulation of Progressive Building Collapse and Other
Collapse-Related Stuff* --- 1084 EH

3:10-4:00pm **Intersection Theory Study Seminar** --- TBA --- 3866 EH

3:10-4:00pm **Geometry Seminar** --- Jeremy Kahn (Stony Brook) *Essential Immersed Surfaces in
Closed Hyperbolic 3-Manifolds*--- 3096 EH

4:10-5:00pm **Combinatorics** --- Benjamin Howard (UM) *The relations among invariants of points
on the projective line* --- 3866 EH

UPCOMING EVENTS

Michigan Conference on Topology and Physics

Feb 6-7, 2010

ABSTRACTS FOR THE WEEK OF OCT. 5 – OCT. 11, 2009

Several Complex Variables and Complex Dynamics Seminar

Monday, October 5, 4:10-5:00pm

3096 EH

Tien-Cuong Dinh (Paris VI, visiting UM)

On the Hodge-Riemann theorem and the Beauville-Bogomolov

We give an abstract version of the Hodge-Riemann theorem for compact Kaehler manifolds and discuss some applications. We will consider in particular the case of symplectic Kaehler manifolds. This is a joint work with Viet-Anh Nguyen (Orsay)..

Student Combinatorics
Monday, October 5, 4:10-5:00pm
3866 EH
Luis Serrano (UM)
Symmetric functions

This talk is an appetizer for Max's talk next week about the cohomology of the Grassmannian.

A symmetric function is a polynomial in many variables, which is invariant under permuting the variables. Among these lie the Schur functions, which arise in other areas of mathematics, such as geometry and representation theory. In this talk we will introduce them, explain some of their properties, and explain how they are obtained as generating functions for Young tableaux.

We will introduce their product coefficients, the Littlewood-Richardson numbers, and briefly overview their importance in other areas of mathematics. We will show a combinatorial interpretation of the Littlewood-Richardson numbers by the means of the plactic monoid, a nice monoid in which every element is a Young tableau, and multiplication between tableaux is defined in a way that might be reminiscent of a childhood game.

If time permits we might touch on Schubert polynomials, which are related to the cohomology of the flag variety, but that might be a pipe dream.

Geometry & Physics Seminar
Monday, October 5, 4:10-6:00pm
4088 EH
Todor Milanov (UM)
Orbifold structures on the projective line and integrable hierarchies

This talk will be based on my recent work with H.-H. Tseng. Using the symplectic loop space formalism of A. Givental, we constructed an integrable hierarchy that governs the Gromov-Witten theory of the orbifold $\mathbb{C}P^1_{k,m}$. The latter is the projective line equipped with two orbifold points of types respectively \mathbb{C}/\mathbb{Z}_k and \mathbb{C}/\mathbb{Z}_m . Our construction relies on the identification of the quantum cohomology of $\mathbb{C}P^1_{k,m}$ with the Frobenius structure on the space of Laurent polynomials in one variable. Such Frobenius structures arise naturally on the space of orbits of a certain extension of the affine Weyl group of type A_{k+m-1} . It would be interesting to find out if the Frobenius structures on the orbit spaces of the other extended affine Weyl groups of type B, D, E, F , and G are also related to Gromov-Witten theory of certain orbifolds. For example, a recent work of P. Rossi suggests that in the D and E cases a relevant model is provided by the projective line with 3 orbifold points.

“What is ...” Seminar
Tuesday, October 6, 2:10-3:00pm
3096 EH
Ron Solomon (Ohio State Univ)
What is ... a signalizer functor?

Signalizer functors were introduced by Danny Gorenstein as a tool in the study of finite simple groups, extrapolating from ideas of John Thompson. They played a central role in the classification of finite simple groups and have also been used in the study of infinite groups of finite Morley rank. The Signalizer Functor Theorem of Goldschmidt and Glauberman is one of the most beautiful theorems in finite group theory.

Colloquium
Tuesday, October 6, 4:10-5:00pm
1360 EH
Ron Solomon (Ohio State Univ)
Simple 2-Fusion Systems

The concept of a (saturated) fusion system was introduced by Lluís Puig, motivated by group representation theory. It was reinvented by Broto, Levi, and Oliver, motivated by homotopy theory. A fusion system is a category \mathcal{FP} , whose objects are the subgroups of the finite p -group P and whose morphisms are certain injective group homomorphisms, including all those induced by conjugations by elements of P . If P is a Sylow p -subgroup of the finite group G , then $\mathcal{FP}(G)$ has as morphisms precisely those maps induced by conjugations by elements of G , and this provides examples of fusion systems. Any fusion system not arising in this way is said to be exotic. There are natural notions of normal subsystems and simple systems. For $p = 2$, there is a unique one-parameter family of known exotic simple fusion systems. It seems increasingly plausible to conjecture that these are the only exotic simple 2-fusion systems. We shall describe these examples and discuss Aschbacher's strategy for the classification of all simple 2-fusion systems.

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Student Arithmetic Seminar
Wednesday, October 7, 3:00-4:00pm
3866 EH
Hunter Brooks (UM)
Iwasawa Theory of Elliptic Curves with Complex Multiplication

Iwasawa theory studies modules over an infinite extension of number fields with Galois group a “ p -adic Lie group.” Initiated by Iwasawa to study the class groups of cyclotomic fields, the theory was applied by Mazur to the study of rational points on abelian varieties. When applied to elliptic curves with complex multiplication, Iwasawa theory yields important geometric information about the curves and important arithmetic information about imaginary quadratic fields. We will discuss two important examples, one of each type of result.

Geometric Function Theory Seminar
Wednesday, October 7, 3:10-4:00pm
4096 EH
Th. Foertsch (U of Bonn)
Ptolemy Circles – A Moebius Characterization of n -Spheres

We will introduce Ptolemy metric spaces, i.e., metric spaces satisfying a certain four point property, and discuss certain of their characteristic properties. These spaces arise, for instance, naturally as Bourdon- or Hamenstaedt boundaries of CAT(-1)-spaces.

The main result stressed in the talk, is the characterization of compact extended Ptolemy metric spaces with many Ptolemy circles or intervals up to Moebius equivalence. This characterization yields a Moebius characterization of the n -dimensional spheres and hemispheres when endowed with their chordal metrics.

Student AIM Seminar
Wednesday, October 7, 4:10-5:00pm
3866 EH
Matthew Masarik (UM)
A Brief Introduction of the Mathematics of Finance

In this talk, we will introduce some of the basic ideas involved in mathematical finance. We will begin with a brief discussion of financial markets and derivative securities, and the rest of our talk will focus on methods to price these securities. In particular, we will mention the fundamental theorem of asset pricing, the binomial model, and then we will derive and solve the celebrated Black-Scholes PDE for a simple European call option on an asset paying no dividends.

Algebraic Geometry Seminar
Wednesday, October 7, 4:10-6:00pm
3088 EH
Daniel Erman (Berkeley)
Deformations of \emptyset -dimensional schemes

A natural question in the study of 0-dimensional schemes is to determine when such a scheme deforms to a disjoint union of points.

I will discuss a syzygetic invariant which yields sharp information about this question. I will also give applications to the study of Hilbert schemes of points. This is joint work with M. Velasco.

Logic Seminar
Wednesday, October 7, 4:30-6:00pm
3096 EH
Andreas Blass (UM)
Matet's proof of the Hales-Jewett Theorem

The Hales-Jewett theorem is a strong (finitary) partition theorem. It asserts that, given positive integers n and c , there is a positive integer N so large that, if you color all the N -tuples of elements of $\{1, 2, \dots, n\}$ with c colors, then there is an N -tuple t of elements of $\{*, 1, 2, \dots, n\}$, with at least one occurrence of the new element $*$, such that the results of replacing all occurrences of $*$ in t by 1, or replacing them all by 2, or ... or replacing them all by n all have the same color. (This easily implies van der Waerden's theorem that, if you color the natural numbers with finitely many colors, there are arbitrarily long finite arithmetic progressions in a single color.)

The original proofs of both the Hales-Jewett theorem and the van der Waerden theorem needed extremely large N --- not even bounded by a primitive recursive function of n and c . Later, Shelah gave a different proof, with a much smaller N --- primitive recursive but still unpleasantly large. Finally, Matet simplified Shelah's proof to the point where I can try to present it in a seminar. It remains an open

problem how big N really needs to be; the upper bounds given by Shelah's and Matet's proofs are nowhere near any known lower bounds.

Mathematical Biology Seminar
Thursday, October 8, 12:00-1:00pm
4096 EH

Berton Earnshaw (MSU)

Global asymptotic stability of nonautonomous master equations: extensions of van Kampen's Theorem

From chemical reactions to ion channel kinetics, many stochastic processes in biology are modeled as finite-state, continuous-time jump process. Under mild assumptions on the transition rates, one derives a master equation (ME) governing the evolution of the probability distribution for the process. When the ME is autonomous, van Kampen proved that, with additional constraints on the (constant) transition rates, all probability distribution solutions of the ME converge to a unique stationary distribution in the long-time limit.

However, most biological processes are subject to nonstationary, external forces that are either unknown or difficult to model. In these cases the ME is necessarily nonautonomous, yet one still wants to understand the long-time behavior of the probability distribution solutions. In this talk we demonstrate how a variety of different constraints on the nonconstant transition rates ensure that the probability distribution solutions of the ME are globally asymptotically stable, thus extending van Kampen's theorem. By constructing counterexamples, we show that certain natural assumptions on the transition rates do not in general ensure that the probability distribution solutions of the associated ME are globally asymptotically stable. This is joint work with Dr. James Keener (University of Utah).

Commutative Algebra Seminar
Thursday, October 8, 3:10-4:00pm
3096 EH

Christine Berkesch (Purdue)

The rank of a hypergeometric system

An A -hypergeometric system is a D -module determined by a toric ideal and certain homogeneity parameters. The dimension of its solution space, called its rank, is constant for generic parameters. I will discuss the combinatorial nature of this rank at non-generic parameters and its ties to the local cohomology of the toric algebra with support in the maximal ideal.

Differential Equations
Thursday, October 8, 4:10-5:00pm
4088 EH

Todd Kapitula (Calvin College)

Orbital stability of periodic waves for generalized KdV

We first investigate the (in)stability of spatially periodic waves to the generalized KdV equation for various power nonlinearities when the perturbation has the same period as that of the wave. Solutions of the integrable modified KdV equation are studied analytically in detail, as well as

small solutions for higher-order pure power nonlinearities. The stability question for KdV has been answered when the period of the perturbation is the same as that of the underlying cnoidal wave. However, up until now the question of the orbital stability of these waves with respect to periodic perturbations whose period is an integer multiple of the wave period was still open, as in this case the wave is not a local minimizer of a constrained energy. By using the integrable structure associated with KdV we are able to show that these energetically unstable waves are indeed orbitally stable. This is joint work with Bernard Deconinck.

Math Club
Thursday, October 8, 4:10-5:00pm
2nd floor Nesbitt Common Room
Joe Marker (UM)
Property-Casualty Insurance: Predicting Misfortunes

Misfortunes such as fires, windstorms, accidents and legal liability for damages to others cause untold amounts of pain. Property/Casualty insurance (“P/C”) pays policyholders for the economic damage these misfortunes inflict. We will discuss examples, and how the insurer attempts to measure the risk of these events occurring.

Applied and Interdisciplinary Mathematics Seminar
Friday, October 9, 3:10-4:00pm
1084 EH
Sherif El-Tawil (UM)
Multiscale Computational Simulation of Progressive Building Collapse and Other Collapse-Related Stuff

Simulating the response of a steel building to extreme loading, especially all the way up to collapse, is complicated by the need to account for a number of interlinked processes that take place along widely disparate length scales. At the micro-scale, micrometer sized voids in the steel matrix can nucleate and coalesce leading to the formation of a crack. At the macro-scale, the crack can grow forming a discontinuity (centimeters in length) that leads to a rapid change in member structural properties. At the structural-scale, i.e. in regions measured in meters, the damaged member can trigger instability in subassembly response potentially leading to a chain of other interlinked micro-, macro- and structural-scale processes that ultimately stop when the building system reaches equilibrium or collapses into a debris pile.

My talk will start off by describing my general research interest in multi-scale collapse modeling then focus on simulating progressive structural collapse and some of the engineering aspects that influence the collapse-resistance of steel buildings. Digressing from the main topic of the presentation, I will describe some tools that we have developed to visualize our simulation results in virtual and augmented reality environments with the purpose of assisting and training first response teams. The talk will conclude with a short discussion of emergency occupant egress from distressed buildings and our ongoing efforts to address this area.

Geometry Seminar
Friday, October 9, 4:10-5:00pm
3096 EH

Jeremy Kahn (Stony Brook)
Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds

Given any closed hyperbolic 3-manifold M and $\epsilon > 0$, we find a closed hyperbolic surface S and a map $f: S \rightarrow M$ such that f lifts to a $1 + \epsilon$ -quasi-isometry from the universal cover of S to the universal cover of M . This is joint work with Vladimir Markovic.

Combinatorics
Friday, October 9, 4:10-5:00pm
3866 EH

Benjamin Howard (UM)
The relations among invariants of points on the projective line

We consider the coordinate rings of GIT quotients of n points on the projective line modulo automorphisms of the line. In particular we wish to describe such rings by generators and relations. Kempe found generators in 1894. We describe the full ideal of relations in these generators.

This is [joint work](#) with John Millson, Andrew Snowden, and Ravi Vakil.