Winter 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
April 6th – April 12th

Monday, April 6

3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Paul Johnson (UM) *Variation of GIT and moduli spaces* --- 2866 EH

3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Mitya Boyarchenko (Chicago) *Geometric Methods in representation theory of finite p-groups* --- 4096 EH

4:10-5:00pm **Student Combinatorics** --- Luis Serrano (UM) TBA --- 3866 EH

4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Tatyana Foth (University of Western Ontario) *Complex submanifolds, connections and asymptotics* --- 3096 EH

4:10-6:00pm **Geometry and Physics Seminar** --- TBA --- 4088 EH

5:15-6:30pm **Teaching Mathematics** --- Jack Smith (MSU) *The Mathematical Transitions Project: Lessons and Issues for Collegiate Mathematics Educators* --- 3096 EH

Tuesday, April 7

2:10-3:00pm "**What is … " Seminar** --- Jeff Lagarias (UM) *What is … Euler's constant?* --- 3096 EH

3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH

3:10-4:00pm **Student Algebraic Geometry Seminar** --- Victor Lozovanu (UM) *Singularities aren't always bad: the theorem of Anghern and Siu* --- 3088 EH

3:10-4:00pm **Geometry Seminar** --- Richard Canary (UM) *Moduli spaces of hyperbolic 3-manifolds* --- 3866 EH

3:10-4:00pm **Student Seminar in Complex Dynamical Systems** --- TBA --- 4088 EH

4:10-5:00pm **Colloquium ---** Claude LeBrun (SUNY Stony Brook) **–** *Complex Surfaces, and Symplectic 4-Manifolds* **---** 1360 EH

4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH

Wednesday, April 8

11:10-12:00pm **Financial/Actuarial Mathematics Seminar (Special Seminar)** --- Sara Biagini (U of Perugia) *A natural framework for optimization problems and applications to Mathematical Finance, Part I* --- 3088 EH

3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH

3:10-4:00pm **Student Representation Theory Seminar** --- Brian Jurgelewicz (UM) *Wrapping up our series: looking back and looking forward* --- 3096 EH

3:10-4:00pm **Student Arithmetic Seminar** --- Jonathan Bober (UM) TBA --- 3088 EH

4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- Richard Lärkäng (Chalmers University of Technology) *Residue currents associated with weakly holomorphic functions* --- 3096 EH

4:10-6:00pm **Algebraic Geometry Seminar** --- Burt Totaro (Cambridge and MSRI) *Algebraic surfaces and hyperbolic geometry* --- 3088 EH

Thursday, April 9

3:10-4:00pm **Commutative Algebra Seminar** --- Mel Hochster (UM) *A Tight Closure Theory that Commutes with Localization in Equal Characteristic, Part 2* --- 3096 EH

3:10-4:00pm **Topology Seminar** --- Dan Kneezel (UM) *On completions of Verlinde rings* --- 4088 EH

Thursday, April 9 … continued

3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Sara Biagini (U of Perugia) *A natural framework for optimization problems and applications to Mathematical Finance, Part II* --- 3088 EH

4:10-5:00pm **Differential Equations ---** Chris Jones (U of North Carolina) *"Oscillations" and Stability in Multi-Dimensions* **---** 4088 EH

4:10-5:00pm **Math Club** --- Zachary Scherr (UM) *Pick's Theorem, Farey Sequences, and the Geometry of Numbers* --- 2nd floor Nesbitt Room

4:10-6:00pm **RTG Study Seminar** --- TBA --- 3088 EH

5:00-6:00pm **Social Hour** --- Upper Atrium

Friday, April 10

11:10-12:00pm **Theoretical Computer Science Seminar** --- Ran Canetti (MIT/TAU) *Security and Composition of Cryptographic Protocols* --- CSE 3941

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Bob Pego (Carnegie Mellon) *Self-similarity and the Scaling Attractor for Models of Coagulation and Clustering* --- 1084 EH

3:10-4:00pm **Student Geometry/Topology** --- TBA --- 3096 EH

4:10-5:00pm **Combinatorics** --- Gregg Musiker (MIT) *Positivity results for cluster algebras from surfaces* --- 3866 EH

EVENTS THIS WEEK

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

UPCOMING EVENTS

Ziwet Lectures
April 13-16, 2009
John Tyson (Virginia Polytechnic Institute & State University)
1. How do Cells Compute?
2. Temporal Organization of the Eukaryotic Cell Cycle
3. Mathematical Challenges in Systems Biology

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

ABSTRACTS FOR THE WEEK OF APRIL 6 – APRIL 12, 2009

Group Theory/Lie Theory/Number Theory Seminar
Monday, April 6, 3:10-5:00pm
4096 EH
Mitya Boyarchenko (Chicago)
Geometric Methods in representation theory of finite p-groups

Let G be an algebraic group over a finite field F_q of characteristic p. Then G(F_q) is a finite group, and one of the common themes in geometric representation theory (going back several decades) is trying to connect irreducible characters of G(F_q) to the geometry of G.

One of the most basic questions one can ask is the following. Given an irreducible character \chi of G(F_q) over an algebraic closure of the field of \ell-adic numbers (where \ell is a prime different from p), does there exist an \ell-adic sheaf on G such that the associated function on G(F_q) equals \chi, and the associated function on G(F_{q^n}) is SOME irreducible character of the finite group G(F_{q^n}) for every natural number n? (Here, F_{q^n} is the unique field extension of F_q of degree n. The sheaves-to-functions correspondence to which I alluded above will be recalled in my talk.)

Sometimes the answer is yes (for instance, when G=GL_n). In general, the answer is no.

One can view the theory of character sheaves on algebraic groups over finite fields as the closest approximation to a positive answer to the question posed above.

For reductive groups G over F_q, the first major advance in the geometric representation theory of G(F_q) was made by Deligne and Lusztig in the 1970s. A few years later Lusztig developed the theory of character sheaves for reductive groups in a series of works.

In my talk I will focus on the "opposite" case, where G is a unipotent group (in particular, G(F_q) is a finite p-group in this case). I will define character sheaves in the unipotent setting and explain the main results on the relationship between character sheaves on G and irreducible characters of G(F_q).

The talk is based on joint work with Vladimir Drinfeld.

Several Complex Variables and Complex Dynamics Seminar
Monday, April 6, 4:10-5:00pm
3096 EH
Tatyana Foth (University of Western Ontario)
Complex submanifolds, connections and asymptotics

Let L be a positive line bundle on a compact complex manifold X. Suppose Y,S are compact submanifolds of X and Y -> S is a holomorphic submersion. I shall talk about two natural connections in certain line bundles on S.

Teaching Mathematics
Monday, April 6, 5:15-6:30pm
3096 EH
Jack Smith (MSU)
The Mathematical Transitions Project: Lessons and Issues for Collegiate Mathematics Educators

The Mathematical Transitions Project was a multi-year examination of how beginning high school and college students navigated the shift into programs of school/collegiate mathematics that were quite different from their immediately previous experience. The background to this study was the perception that both pre-college and college curricula (Standards-based and "reform calculus" materials) and associated aspects of teaching make quite different demands on students than more traditionally constructed materials. The project followed about 50 students either out of or into programs using Standards-based or "reform calculus" materials, half starting in the 9th grade and half starting as college freshmen. The analysis tracked their achievement, disposition, how they saw differences between their "old" and "new" programs, and their approach to learning. Results generally showed effects for both curriculum type and educational level (high school vs. college). The results will describe the concepts and measures used in the study; some results, particularly at the collegiate level; and some issues that remain with me years after the completion of the work.

"What is … " Seminar
Tuesday, April 7, 2:10-3:00pm
3096 EH
Jeff Lagarias (UM)
What is … Euler's constant?

In 1734 Euler introduced the constant now bearing his name, and computed it to be approximately .577218. But what is the "meaning" of this constant? This talk will review Euler's work related to zeta values and "renormalization," which is topical since these numbers show up in various quantum field theory calculations. It will then describe various places Euler's constant and harmonic numbers H_n show up in number theory, especially in relation to the Riemann hypothesis.

Geometry Seminar
Tuesday, April 7, 3:10-4:00pm
3866 EH
Richard Canary (UM)
Moduli spaces of hyperbolic 3-manifolds

In two-dimensional hyperbolic geometry, one focus of study is the Teichmueller space of all marked hyperbolic surfaces of a given genus. The outer automorphism group of the fundamental group of the surface acts properly discontinuously on its Teichmueller space and the quotient is the Moduli space of all hyperbolic surfaces of a fixed genus. This moduli space inherits the structure of an orbifold and is a much-studied object in various fields of mathematics.

In three-dimensional hyperbolic geometry, one often studies the space AH(M) of all hyperbolic 3-manifolds homotopy equivalent to a fixed compact 3-manifold M with boundary. The outer automorphism group of the fundamental group of M often fails to act properly discontinuously on AH(M), so the quotient moduli space is not nearly as well behaved as it is in 2 dimensions. Nevertheless, we will discuss the topology of the quotient moduli space and the action of the relative outer automorphism group on AH(M) (and perhaps if time permits on the character variety where AH(M) lives).

Colloquium
Tuesday, April 7, 4:10-5:00pm
1360 EH
Claude LeBrun (SUNY Stony Brook)
Complex Surfaces, and Symplectic 4-Manifolds

An Einstein metric is by definition a Riemannian metric of constant Ricci curvature. One would like to completely determine which smooth compact n-manifolds admit such metrics. In this talk, I will describe recent progress regarding a the 4-dimensional case. These results specifically concern 4-manifolds that also happen to carry either a complex structure or a symplectic structure

Financial/Actuarial Mathematics Seminar (Special Seminar)
Wednesday, April 8, 11:10-12:00pm
3088 EH
Sara Biagini (U of Perugia)
A natural framework for optimization problems and applications to Mathematical Finance, Part I

It is often the case that optimization problems are formulated on a somewhat artificial domain such as bounded functions/random variables or those satisfying artificial integrability constraints. Although intended to simplify the treatment, this in fact results in major difficulties when trying to catch the optimal solution or when looking for a good dual system. A more reasonable approach is to let the problem itself induce the correct, most natural domain of optimization. These domains turn out to be Orlicz spaces, which are generalizations of L^p spaces. And we will see that if one is willing to go beyond the L^p world - at a mild cost - things may be surprisingly smooth.
Part I. Introduction on Orlicz spaces.
Part II. Applications to Math. Finance: portfolio optimization, non-linear pricing and risk measures.

Student Representation Theory Seminar
Wednesday, April 8, 3:10-4:00pm
3096 EH
Brian Jurgelewicz (UM)
Wrapping up our series: looking back and looking forward

Our starting point was a star-shaped Dynkin diagram, gamma. We associated to it an abelian category A, the category of coherent sheaves on an orbifold P^1, whose (cyclic) orbifold points have orders the same as the lengths of the arms of gamma. We then passed to the (two-periodic) derived category R = D(A)/T^2, and its so- called lattice algebra, L(R). The composition subalgebra C in L(R), generated by the simples of A, is (almost) the Kac-Moody lie algebra one usually gets from gamma. We saw that the choice of A inside R corresponds to a polarization of L(R), and C. In down to earth terms, the simples in A determine a choice of the simple roots (hence the positive roots). This week, to suggest the general nature of these phenomena, we will associate to gamma a different geometric category, from a surface S containing a chain of -2 curves whose intersection diagram is gamma. The derived categories and lattice algebras are (almost) the same, but the hearts, and simples, are different.

RTG Working Seminar in Several Complex Variables and Complex Dynamics
Wednesday, April 8, 4:10-5:00
3096 EH
Richard Lärkäng (Chalmers University of Technology)
Residue currents associated with weakly holomorphic functions

Residue currents like the Coleff-Herrera product and Bochner-Martinelli type residue currents are certain currents associated with a set of holomorphic functions, or more generally an ideal of holomorphic functions on a complex manifold or an analytic space. I will discuss how to define analogous currents related to weakly holomorphic functions, and how the theory generalizes from holomorphic functions to the case of weakly holomorphic functions.

Algebraic Geometry Seminar
Wednesday, April 8, 4:10-6:00pm
3088 EH
Burt Totaro (Cambridge and MSRI)
Algebraic surfaces and hyperbolic geometry

The intersection form on the group of line bundles on a complex algebraic surface always has signature (1,n) for some n. So the automorphism group of an algebraic surface always acts on hyperbolic n-space. For a class of surfaces including K3 surfaces and many rational surfaces, there is a close connection between the properties of the variety and the corresponding group acting on hyperbolic space.
(In fancier terms: the Morrison-Kawamata cone conjecture holds for klt Calabi-Yau pairs in dimension 2.)

Commutative Algebra Seminar
Thursday, April 9, 3:10-4:00pm
3096 EH
Mel Hochster (UM)
A Tight Closure Theory that Commutes with Localization in Equal Characteristic, Part 2

The talk will discuss joint work with Neil Epstein concerning a variant definition of tight closure both in positive characteristic and in equal characteristic 0, under the mild assumption that the ring is locally excellent. This new notion commutes with arbitrary localization! The new definition arises from the study of closures instances of which occur because a homogeneous system of equations is satisfied. The characteristic p definition agrees with the original notion for systems of parameters and does not change the parameter test ideal. In all characteristics the new notion is smaller than the original: it is certainly strictly smaller in some cases in positive characteristic. The characteristic p notion contains the plus closure, and in all characteristics the new notion agrees with the original in graded cases in finitely generated graded algebras over a prime field. The new notion still captures colons and gives a theory of phantom homology similar to ordinary tight closure. All ideals are tightly closed over regular rings, and one has a Briancon-Skoda theorem. As is the case for ordinary tight closure, the new notion is persistent under arbitrary base change, and one can test the new notion modulo every minimal prime or by localizing and completing at all maximal ideals. The new notion gives rise to a new class of rings with the property that every ideal is tightly closed: this class agrees with the weakly F-regular rings in the Gorenstein case in characteristic p, contains all weakly F-regular rings, but is closed under localization. This work raises a host of new open questions.

Topology Seminar
Thursday, April 9, 3:10-4:00pm
4088 EH
Dan Kneezel (UM)
On completions of Verlinde rings

Let G be a simple, simply-connected, compact Lie group, and let m be a non-negative integer. The "level m Verlinde ring of G" (an object similar in spirit to an ordinary representation ring, related to certain representations of the loop group LG = Map(S^1, G)) may be realized as a quotient of the representation ring of G. In other words, V(G,m) = R(G)/I_m, where I_m is the "Verlinde ideal." By a result of Freed-Hopkins-Teleman and a twisted generalization of the Atiyah-Segal completion theorem, the (m+h(G))-twisted K-theory of LBG is isomorphic to the completion of V(G,m) at the augmentation ideal of R(G) (as an R(G)-module), where h(G) is the dual Coxeter number of G. Let V(G,m)^ denote this completion. After a brief review of relevant definitions, I will describe the additive structure of V(G,m)^. In particular, we will see that after further completing V(G,m)^ at a prime p, it splits as a finite sum of copies of the p-adic numbers.

Financial/Actuarial Mathematics Seminar
Thursday, April 9, 3:10-4:00pm
3088 EH
Sara Biagini (U of Perugia)
A natural framework for optimization problems and applications to Mathematical Finance, Part II

It is often the case that optimization problems are formulated on a somewhat artificial domain such as bounded functions/random variables or those satisfying artificial integrability constraints. Although intended to simplify the treatment, this in fact results in major difficulties when trying to catch the optimal solution or when looking for a good dual system. A more reasonable approach is to let the problem itself induce the correct, most natural domain of optimization. These domains turn out to be Orlicz spaces, which are generalizations of L^p spaces. And we will see that if one is willing to go beyond the L^p world - at a mild cost - things may be surprisingly smooth.
Part I. Introduction on Orlicz spaces.
Part II. Applications to Math. Finance: portfolio optimization, non-linear pricing and risk measures.

Differential Equations
Thursday, April 9, 4:10-5:00pm
4088 EH
Chris Jones (U of North Carolina)
"Oscillations" and Stability in Multi-Dimensions

The problem of relating the (oscillatory) structure of a solution of an elliptic boundary value problem to its Morse Index is an old one. In one space dimension, it is resolved by Sturm-Liouville theory. The importance of this question derives from the Morse index being a measure of its (in)stability relative to an appropriate evolution equation, Based on joint work with Jian Deng (Beijing), I will describe an approach that gives results in many space dimensions.

Math Club
Thursday, April 9, 4:10-5:00pm
2nd Floor Nesbitt Room
Zachary Scherr (UM)
Pick's Theorem, Farey Sequences, and the Geometry of Numbers

The Farey Sequence of order n is the sequence of completely reduced fractions between 0 and 1 which, when in lowest terms, have denominators less than or equal to n (the terms are arranged in order of increasing size).

In this talk we will investigate some very cool properties of Farey Sequences and use geometry to prove them. In particular, we will prove and use Pick's theorem, which says that, given a simple polygon P having its vertices at lattice points in the plane, there is a simple formula for calculating its area; namely,

$$\text{Area}(P) = I + B/2 - 1$$

where I is the number of lattice points contained in the interior of P, and B is the number of lattice points on P's boundary.

Theoretical Computer Science Seminar
Friday, April 10, 11:10-12:00p
CSE 3941
Ran Canetti (MIT/TAU)
Security and Composition of Cryptographic Protocols

What does it mean for a cryptographic protocol to be "secure"? Capturing the security requirements of cryptographic tasks in a meaningful way is a subtle and tricky business. One major stumbling point is protocol composition, namely the often unexpected vulnerabilities that result from the interference between protocols in a multi-protocol system. Indeed, security properties of protocols have traditionally been very fragile with respect to protocol composition. The framework of Universally Composable security, proposed in 2001, allows one to design and analyze protocols in a way that guarantees security even when the protocol runs in an arbitrary multi-protocol system. For the first time, it allows one to assert the security of cryptographic protocols in unpredictable, multi-protocol environments such as the Internet. It also enables the security analysis of complex systems to be modular. This talk motivates and presents the paradigm of Universally Composable security. It then briefly reviews some of the recent research done within this paradigm and on it. Part of this research touches foundational aspects; other parts have immediate practical implications.

Applied and Interdisciplinary Mathematics Seminar
Friday, April 10, 3:10-4:00pm
1084 EH
Bob Pego (Carnegie Mellon)
Self-similarity and the Scaling Attractor for Models of Coagulation and Clustering

We study limiting behavior of rescaled size distributions in several models of clustering or coagulation dynamics, `solvable' in the sense that the Laplace transform converts them into nonlinear PDE. The scaling analysis that emerges has many connections with the classical limit theorems of probability theory, and an application to the study of shock clustering in the inviscid Burgers equation with random-walk initial data. I'll focus on recent progress regarding a `min-driven' clustering model related to domain coarsening dynamics in the Allen-Cahn equation.

Combinatorics
Friday, April 10, 4:10-5:00pm
3866 EH
Gregg Musiker (MIT)
Positivity results for cluster algebras from surfaces

We give combinatorial formulas for cluster algebras with principal coefficients coming from triangulated surfaces (with or without punctures), as well as some cluster algebras obtained by ``folding''. In particular, this proves the positivity conjecture of Fomin and Zelevinsky for such cluster algebras, including those of classical type.

This is joint work with Ralf Schiffler and Lauren Williams.