Fall 2007
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
December 3rd – December 9th

Monday, December 3

3:10-4:00pm **Student Analysis Seminar** --- TBA --- 3866 EH
3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Organizational meeting for next semester --- 2866 EH
3:10-5:00pm **Number Theory and Representation Theory Seminar** --- Muthu Krishnamurthy (U of Iowa) *A refined converse theorem for GL(2)* --- 4096 EH
4:10-5:00pm **Several Complex Variables Seminar (Note non-standard room)** --- Joel Merker (ENS, Paris) *Demailly-Semple jets of orders 4 and 5 in dimension 2* --- 1060 EH
4:10-6:00pm **Geometry & Physics** --- David Nadler (Northwestern) *Springer theory via the Hitchin fibration* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- Abigail Stewart (UM) *Women in the STEM Disciplines: Why Do We Need Institutional Transformation?* --- 3088 EH

Tuesday, December 4

2:10-3:00pm "**What is … " Seminar** --- Anna Gilbert (UM) *What is compressed sensing?* --- 3096 EH
3:10-4:00pm **Geometry Seminar** --- Joerg Enders (MSU) *Reduced length based at singular time in the Ricci flow – monotonicity and applications* --- 4088 EH
3:10-4:00pm **Algebra Seminar** --- Alexei Oblomkov (Princeton) *Quantum cohomology of Hilbert scheme of points of ADE resolution and loop algebras* --- 3088 EH
3:10-4:00pm **Student Representation Theory/Lie Theory Seminar** --- TBA --- 4096 EH
4:10-5:00pm **Colloquium** --- Tom Mrowka (MIT) *Reflections on homological invariants for knots* --- 1360 EH

Wednesday, December 5

3:10-4:00pm **Geometric Function Theory Seminar** --- Not meeting this week --- 4096 EH
3:10-4:00pm **Student Arithmetic Seminar** --- TBA --- 3866 EH
3:10-4:00pm **Student AIM Seminar** --- Kris Reyes (UM) *Algebraic Statistics for Computational Biology* --- 3096 EH
3:10-4:00pm **Working Group in Integrable Systems and Asymptotics** --- Dong Wang (Brandeis) *Random matrices and spiked models of Wishart ensembles* --- 4088 EH
4:10-5:30pm **Working Seminar in Several Complex Variables and Complex Dynamics (Note: non-standard room)** --- Egmont Porten (Mid Sweden University) *Levi Flat Fillings of Spheres and the Continuity Principle* --- 1360 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Mike Roth (Queens Univ) *Cup products on complete flag varieties* --- 3088 EH

Thursday, December 6

2:10-3:00pm **Student Algebraic Geometry Seminar** --- Giancarlo Urzua (UM) *Geography of Surfaces* --- 3866 EH
2:10-3:00pm **Study Seminar (Pt. 1)** --- Not meeting this week --- 3096 EH
3:10-4:00pm **Study Seminar (Pt. 2)** --- Not meeting this week --- 4088 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar (non-standard room)** ---Mathieu Boudreault (HEC Montreal) *A structural credit risk model with a reduced-form default trigger* --- 3866 EH
3:10-4:00pm **Commutative Algebra Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Topology Seminar** --- TBA --- 4096 EH
3:10-4:00pm **Special AIM Seminar (talk co-sponsored by CSCS)** --- James Hyman (Los Alamos Nat'l Lab) *The Role of Mathematical Sciences in Science Based Simulations* --- 3088 EH

Thursday, December 6 … cont.

4:10-5:00pm **Differential Equations** --- Wilhelm Schlag (U. Chicago) *On the Schroedinger and wave evolutions on manifolds with conic ends* --- 4088 EH

4:10-5:00pm **Math Club** --- Ian Pulizzotto (UM) *Surreal numbers and games* --- 2nd floor Nesbitt Common Room

4:10-5:00pm **Student Combinatorics** --- Paul Johnson (UM) *Double Hurwitz Numbers* --- 3866 EH

Friday, December 7

10:50-12:00pm **EECS Theory Seminar** --- Wei Huang (UM) TBA --- CSE 3941

12:10-1:00pm **Special AIM Brown Bag Seminar (for students and young faculty) - talk co-sponsored by CSCS** --- James Hyman (Los Alamos Nat'l Lab) *Good Choices for Great Careers in the Mathematical Sciences* --- B844 EH

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar (talk co-sponsored by CSCS)** --- James Hyman (Los Alamos Nat'l Lab) *New Approaches to Mathematical Models for the Spread of Epidemics* --- 1084 EH

3:10-4:00pm **Student Geometry/Topology** --- Kyle Ormsby (UM) *Stable Homotopy of Spheres II* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Jan Vondrak (Princeton) *Approximation algorithms for combinatorial allocation problems* --- 3866 EH

UPCOMING EVENTS

Rainich Lecture
Jan. 15-17, 2008
Speaker: Gang Tian

Ziwet Lecture
Feb. 5, 2008
Speaker: Curtis McMullen

ABSTRACTS FOR THE WEEK OF DEC. 3 – DEC. 9, 2007

Topics in Algebraic Geometry Seminar
Monday, December 3, 3:10-4:00pm
2866 EH
Organizational meeting for next semester

Join us as we decide on a topic and a time. Some suggested topics include: Rational curves with a goal of understanding Graber-Harris-Starr; Log geometry; D-modules in positive characteristic; GIT

Number Theory and Representation Theory Seminar
Monday, December 3, 3:10-5:00pm
4096 EH
Muthu Krishnamurthy (U of Iowa)
A refined converse theorem for GL(2)

In this talk I will discuss my work in progress with Andrew Booker. I will present a version of the “converse theorem” for GL(2) where one can restrict the ramification of the twisting set at all finite places.

Several Complex Variables Seminar (Note non-standard room)
Monday, December 3, 4:10-5:00pm
1060 EH
Joel Merker (ENS, Paris)
Demailly-Semple jets of orders 4 and 5 in dimension 2

Siu and Demailly's strategy for Kobayashi's hyperbolicity conjecture involves the construction of global holomorphic jet differentials wich are (locally) invariant under reparametrization. For jets of orders 2, 3 and 4 in dimension 2; for jets of of order 2 and 3 in dimension 3, the so-called bracket procedure generates all the invariants (3, 5, 9; 6, 16 respectively). For jets of order 5 in dimension 2, the 36 bracket invariants share 210 syzygies ; for jets of order 6 in dimension 2, there would exist 210 bracket invariants sharing 14 950 syzygies. However, already for jets of order 5, we show that bracketing is not enough, and maybe, infinitely many invariants exist, as in Nagata's counterexample to Hilbert's 14th problem-conjecture. Strikingly, 5 is also the minimal expected degree for Kobayashi-hyperbolicity of surfaces of $\mathbb{P}_3$(&#x2102).

Geometry & Physics
Monday, December 3, 4:10-6:00pm
4088 EH
David Nadler (Northwestern)
Springer theory via the Hitchin fibration

The geometry of the adjoint quotient g/G plays a central role in representation theory. I will describe how it is easy to see certain aspects of its structure in the symplectic geometry of the cotangent bundle T^*(g/G). In particular, the Springer theory of Weyl group representations arises as a toy model of constructions arising in the geometric Langlands program.

Teaching Mathematics
Monday, December 3, 5:15-6:30pm
3088 EH
Abigail Stewart (UM)
Women in the STEM Disciplines: Why Do We Need Institutional Transformation?

Drawing on social science research on the recruitment and retention of women in STEM fields, I will discuss the reasons that an approach that emphasizes institutional transformation is essential to changing the representation and success of women in these disciplines. I will outline not only some of the efforts underway at Michigan under the aegis of the ADVANCE program, but those underway at many other institutions with support from the National Science Foundation. The direct implications of these transformative efforts for teaching math will be an important topic for discussion.

"What is … " Seminar
Tuesday, December 4, 2:10-3:00pm
3096 EH
Anna Gilbert (UM)
What is compressed sensing?

Compressed sensing is a new method for first acquiring and compressing data (e.g., functions, vectors, signals, or images) and then extracting relevant information about the data. From a mathematical perspective, we multiply the data (a column vector) by a matrix with considerably fewer rows than columns and call this vector of shorter dimension than the signal, the measurement vector or sketch of the signal. Although the sketch is much smaller than the original signal, if the matrix is chosen carefully, we can still extract plenty of useful information from the signal. I will discuss mathematical, algorithmic, and engineering constructions of carefully chosen measurement matrices, reconstruction algorithms, and physical devices to produce such sketches.

Geometry Seminar
Tuesday, December 4, 3:10-4:00pm
4088 EH
Joerg Enders (MSU)
Reduced length based at singular time in the Ricci flow – monotonicity and applications

Quantities monotone in time are an important tool in the analysis of singularities arising in geometric evolution equations. I will discuss a generalization of a monotone quantity by Perelman along certain complete n-dimensional Ricci flows that become singular in finite time. Then I will talk about how "gradient shrinking solitons" arise in the equality case of the monotonicity and help in the understanding of singularities.

Algebra Seminar
Tuesday, December 4, 3:10-4:00pm
3088 EH
Alexei Oblomkov (Princeton)
Quantum cohomology of Hilbert scheme of points of ADE resolution and loop algebras

Let X be a resolution of the ADE singularity $\mathbf{C}^2/\Gamma$. Together with D. Maulik we computed the operators of divisor multiplication in the ring of quantum equivariant cohomology of $Hilb_n(X)$. The answer is given in terms of the loop algebra of the corresponding type and the structure of the formulas is reminiscent of the Casimir operators. Conjecturally, these operators generate the whole ring of quantum cohomology. In my talk I will mostly discuss the case of A_1 singularity. All necessary geometric definitions unfamiliar to the audience will be reminded.

Colloquium
Tuesday, December 4, 4:10-5:00pm
1360 EH
Tom Mrowka (MIT)
Reflections on homological invariants for knots

A few years ago Peter Kronheimer noticed some curious coincidences between Khovanov homology for knots and a version of instanton floer homology partially developed in the late 90's by Collin and Steer and closely related to a version of the Donaldson invariants of a pair developed in the early 90's by Kronheimer and myself. Kronheimer and I have more fully developed this Floer homology theory recently. I will explain some of the background ideas in this area and make some speculations on future work.

Student AIM Seminar
Wednesday, December 5, 3:10-4:00pm
3096 EH
Kris Reyes (UM)
Algebraic Statistics for Computational Biology

In algebraic statistics, topics in probability and statistics are placed in an algebraic setting, allowing us to exploit that field's machinery to address many practical problems and questions. In this introductory talk about the subject, I focus on one such statistical topic, hidden Markov models (HMM) and its various applications to biology. I will develop the algebraic representation of HMM and show how we can interpret many classical problems of HMM in this new setting. The main idea is that a HMM can be seen as the image of several polynomials from some parameter space to an "observation-probability" space, and hence an algebraic variety. I then give examples of how this description of an HMM allows us to discuss common HMM issues in the language of algebra and combinatorics. This talk will be mostly self-contained and is based off a pair of papers by Lior Pachter and Bernd Sturmfels, "Tropical Geometry of Statistical Models," and "Parametric Inference for Biological Sequence Analysis."

Working Seminar in Several Complex Variables and Complex Dynamics (Non-standard room)
Wednesday, December 5, 4:10-5:30pm
1360 EH
Egmont Porten (Mid Sweden University)
Levi Flat Fillings of Spheres and the Continuity Principle

The classical continuity principle tells how to use families of holomorphic discs in the geometric study of envelopes of holomorphy. In order to gain flexibility in applications, it is desirable to have more general versions of the continuity principle applying to families of general holomorphic curves. In the talk, we will mainly concentrate on an example illustrating various hidden obstructions to possible generalizations. We will construct a 2-sphere $S \subset \mathbb{C}^2$ bounding an embedded Levi flat 3-ball along which holomorphic extension from neighborhoods of S fails. Interestingly, the same S also bounds an immersed Levi flat ball with good extension properties. This is joint work with Burglind Jöricke, Bonn.

Algebraic Geometry Seminar
Wednesday, December 5, 4:10-6:00pm
3088 EH
Mike Roth (Queens Univ)
Cup products on complete flag varieties

Let G be a semisimple algebraic group, B a Borel subgroup, and X = G/B. If L is a line bundle on X then by the Borel-Weil-Bott theorem there is at most one value of d for which the cohomology group H^d(X, L) is nonzero. Given two line bundles L_1 and L_2 with nonzero cohomologies in degrees d_1 and d_2, it is natural to look at the cup-product map

H^{d_1}(X, L_1) x H^{d_2}(X, L_2) ----> H^{d}(X, L) where d = d_1+d_2 and L is the tensor product L_1 x L_2.

By the Borel-Weil-Bott theorem, the cup product map is either surjective or zero, but it was not known how to tell which occurs.

The talk will give a complete answer in the A_n case, and partial answers for general semisimple G. A large part of the talk will be an exposition of the Borel-Weil-Bott theorem and some of the geometries of the varieties G/B. If there is time the talk will also adress the representation theoretic question of which components of a tensor product of irreducible representations can be realized via cup product.

Student Algebraic Geometry Seminar
Thursday, December 6, 2:10-3:00pm
3866 EH
Giancarlo Urzua (UM)
Geography of Surfaces

I will compare properties of curves and surfaces from moduli and geography perspectives, emphasizing how different they are. The term geography stands for the distribution of Chern numbers of algebraic manifolds of general type.

Financial/Actuarial Mathematics Seminar (Non-standard location)
Thursday, December 6, 3:10-4:00pm
3866 EH
Mathieu Boudreault (HEC Montreal)
A structural credit risk model with a reduced-form default trigger

We introduce in this paper a structural credit risk model where default results from an external source, highly correlated with leverage. We assume that the default intensity of the firm is a parametric transformation of the debt ratio, which can be interpreted as the sensitivity of the credit risk of the company to the debt of the firm. The result is that default can occur even if the company has good financial outlooks, or on the opposite, can survive even if the firm is highly indebted. The model provides for an endogenous recovery rate distribution that is tied to the solvency of the company.

We propose different capital structures for which we have quasi closed-form solutions for the default probability and the price of zero-coupon bonds. The model also easily accommodates stochastic interest rates. Because the model is defined in a framework where both physical and martingale measures are well defined, it is possible to use prices of credit sensitive assets to infer about real-world default probabilities. Moreover, we can value the equity of the firm along with the default put. Numerical illustrations are also shown and the results are in line with the empirical literature.

Special AIM Seminar
(talk is co-sponsored by Center for the Study of Complex Systems)
Thursday, December 6, 3:10-4:00pm
3088 EH
James Hyman (Los Alamos Nat'l Lab)
The Role of Mathematical Sciences in Science Based Simulations

The mathematical and computational sciences are increasingly important in scientific and policy decisions on energy, water, health, climate, and the economy. Mathematical models, based on the underlying physical models, can help the scientific and political communities understand and evaluate the potential effectiveness of different approaches in these complex problems.

Today's scientific world is experiencing a paradigm shift where the sophistication of mathematical models, the accuracy and efficiency of numerical algorithms, the robustness of computer software, and the power of computation have become so great that numerical simulations are now considered a third pillar, along with theory and experiment, in the triad of tools used for scientific discovery. The rate of advances in these fields, and our ability to simulate complex physical systems, will increasingly be the limiting factors in our ability to solve many of our most pressing scientific challenges. I will describe recent advances in mathematical models, numerical algorithms, software, and hardware that have allowed computer simulations of complex multidisciplinary problems to have unprecedented impact in guiding scientific discoveries.

Differential Equations
Thursday, December 6, 4:10-5:00pm
4088 EH
Wilhelm Schlag (U. Chicago)
On the Schroedinger and wave evolutions on manifolds with conic ends

We study the dispersive behavior of the linear Schroedinger or wave evolution on manifolds with conic ends. Our class of manifolds includes surfaces of revolutions such as the hyperboloid and always exhibits trapped regions under the Hamiltonian flow.

Math Club
Thursday, December 6, 4:10-5:00pm
2nd floor Nesbitt Common Room
Ian Pulizzotto (UM)
Surreal numbers and games

In this talk we will consider strategies for two-player games where the goal is to make the last move, leaving the opponent with no moves. We will intuitively discuss the notion of the value of a game, a measure of a player's amount of advantage or disadvantage.

We will focus on games whose positions can be assigned ``numerical'' values, including integers, fractions, real numbers, and surreal numbers. Surreal numbers include different kinds of infinity, such as infinity/2 and infinity - 1, and also positive ``numbers'' smaller than any positive real number. The surreal numbers are a much larger field containing the real numbers. Like the real numbers, surreal numbers can be ordered and enjoy most of the properties of the real numbers.

If there is time left, we will discuss games whose positions can be assigned ``positive'' values even smaller than any positive surreal number. The universe of small games is quite vast. This talk is the beginning of a fascinating branch of mathematics called combinatorial game theory.

Student Combinatorics
Thursday, December 6, 4:10-5:00pm
3866 EH
Paul Johnson (UM)
Double Hurwitz Numbers

Earlier this semester, Michael Shapiro spoke in the combinatorics seminar about double Hurwitz numbers: consider this talk a retroactive introduction and motivation to this field. Hurwitz numbers are combinatorial interesting objects in their own right and are related to the symmetric group, but are also important tools in studying the moduli space of curves. We hope to give a flavor of both the symmetric group and algebraic geometric approaches, and their interplay. If time permits, we will wave our hands at Goulden, Jackson and Vakil's proof that Double Hurwitz numbers are piecewise polynomial.

Special AIM Brown Bag Seminar (for students and young faculty)
(talk is co-sponsored by Center for the Study of Complex Systems)
Friday, December 7, 12:10-1:00pm
B844
James Hyman (Los Alamos Nat'l Lab)
Good Choices for Great Careers in the Mathematical Sciences

Students and young faculty members are at a critical point in their careers and are making choices that will impact them for a lifetime. I will use the experiences of scientists who have had great careers to identify universal distinguishing traits of good career choices that can guild decisions in education, choice of profession, and job opportunities to increase your chances of having a great career with long-term sustained accomplishments.

Applied and Interdisciplinary Mathematics Seminar
(talk is co-sponsored by Center for the Study of Complex Systems)
Friday, December 7, 3:10-4:00pm
1084 EH
James Hyman (Los Alamos Nat'l Lab)
New Approaches to Mathematical Models for the Spread of Epidemics

Mathematical models based on the underlying transmission mechanisms of the disease can help the medical/scientific community understand and anticipate the spread of an epidemic and evaluate the potential effectiveness of different approaches for bringing an epidemic under control. The primary goal of our modeling effort is to understand the spread of infectious diseases and to estimate and subsequently predict the impact of control measures on their spread.

Modeling can reduce the uncertainty of the estimates of disease prevalence and aid in the development of scientific understanding of the mechanisms of the disease and of the epidemic. It can also estimate the benefits and the costs of projected interventions and project the requirements that an epidemic will place on the health care system. Thus, the modeling techniques can join with biological, epidemiological, behavioral, and social science studies to produce better projections and better understanding of the epidemic I will describe a flexible, stochastic agent-based decision simulation model for understanding the spread of a disease within a major city and compare it with a class of deterministic differential equation models.

Student Geometry/Topology
Friday, December 7, 3:10-4:00pm
3096 EH
Kyle Ormsby(UM)
Stable Homotopy of Spheres II

This is the second talk in a two-part series. Building off of the definitions and results of last week's talk, we construct some of the well-known structure of the stable homotopy groups of spheres. While full descriptions of these groups are well beyond the state-of-the-art in algebraic topology, J.F. Adams specified some of their nicer properties in 1965. We construct the real J-homomorphism from the higher homotopy groups of the infinite orthogonal group to the higher homotopy groups of spheres. Using basic KO-theory (which we will develop in this seminar), we show that the image of J constitutes a direct summand of the n-th stable homotopy group of spheres in a manner that depends on the congruence class of n mod 8.

Combinatorics
Friday, December 7, 4:10-5:00pm
3866 EH
Jan Vondrak (Princeton)
Approximation algorithms for combinatorial allocation problems

Combinatorial allocation problems have been a subject of recent interest due to their role in on-line auctions and electronic commerce. An allocation problem entails a finite set of "items" that should be distributed among participating "players" in order to maximize a certain "social utility" function. Since such problems are typically NP-hard to solve optimally, we seek approximation algorithms that find a solution comparable to an optimum one. The approximation that one can achieve depends on what conditions we impose on the utility functions and how these functions are accessible. I will describe the history of these problems and how they relate to more classical work in combinatorial optimization.

A particular case of interest is the Submodular Welfare Problem, where the utility functions are assumed to be submodular, a property that is known in economics as "diminishing returns". Our recent result is that a (1-1/e)-approximation can be achieved for this problem. It has been known that a better approximation is impossible unless P=NP, but the best known algorithm achieved only a 1/2-approximation. The optimal (1-1/e)-approximation can be extended to a more general problem for which a 1/2-approximation was also known [Fisher, Nemhauser, Wolsey '78]. I will discuss this, related results, and the techniques that we use - randomization, replacing the discrete problem by a continuous one, and approximately solving a non-linear optimization problem using a variant of the gradient descent method.

Some of these results were obtained in collaborations with Uri Feige, with Vahab Mirrokni, and with Gruia Calinescu, Chandra Chekuri and Martin Pal.