

Fall 2007
University of Michigan-Department of Mathematics
<http://www.math.lsa.umich.edu/seminars/index.shtml>
Ann Arbor, MI 48109-1043

September 10th – September 16th

Monday, September 10

- 3:10-4:00pm **Student Analysis Seminar** --- Short Organizational Meeting --- 3866 EH
3:10-5:00pm **Number Theory and Representation Theory Seminar** --- Chris Hall (UM) *Tate's conjecture in fibers of a pencil* --- 4096 EH
4:10-5:00pm **Several Complex Variables Seminar** --- Lina Lee (UM) *Asymptotic behavior of invariant metrics* --- 3096 EH
4:10-6:00pm **Geometry & Physics** --- Eric Zaslow (Northwestern) *Constructible Sheaves and the Fukaya Category* --- 4088 EH

Tuesday, September 11

- 2:10-3:00pm **"What is ... " Seminar** --- Alejandro Uribe (UM) *"What is Spectral Geometry?"* --- 3096 EH
3:10-4:00pm **Geometry Seminar** --- Zhou Zhang (UM) *Kaehler-Ricci flow and complex Monge-Ampere equation* --- 4088 EH
4:10-5:00pm **Colloquium** --- Marina Ratner (UC Berkeley) *The theory of Unipotent Flows on homogeneous spaces of Lie groups with emphasis on applications* --- 1360 EH

Wednesday, September 12

- 3:10-4:00pm **Student Arithmetic Seminar** --- Organizational Meeting --- 3866 EH
3:10-4:00pm **Student AIM Seminar** --- Not meeting this week --- 3396 EH
3:10-5:00pm **Geometric Function Theory Seminar** --- Mario Bonk (UM) *Quasiconformal flows* --- 4096 EH
4:10-5:30pm **Working Seminar in Several Complex Variables and Complex Dynamics** --- Not meeting this week --- 4088 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Benjamin Howard (UM) *Nice projective embeddings for the GIT quotients $(P^1)^n // SL_2$* --- 3088 EH

Thursday, September 13

- 2:10-3:00pm **Student Algebraic Geometry Seminar** --- Kevin Tucker (UM) *Proximity Matrices and Easy Surface Resolution Computations* --- 3866 EH
3:10-4:00pm **Commutative Algebra Seminar** --- Mel Hochster (UM) *Tor, Ext, and local cohomology* --- 3096 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Erhan Bayraktar (UM) *On the finite horizon American option pricing problem: A proof of smoothness and an exponentially fast converging scheme* --- 3088 EH
3:10-4:00pm **Topology Seminar** --- Not meeting this week --- 4096 EH
4:10-5:00pm **Differential Equations** --- Jeffrey Rauch (UM) *Exponential Growth for Wave Equations with Positive Compactly Supported Potentials* --- 4096 EH
4:10-5:00pm **Math Club** --- Brian Conrad (UM) *The 17-gon* --- 2nd Floor Nesbitt Room
4:10-5:00pm **Student Combinatorics** --- Florian Block (UM) *Hidden Markov Models, Newton Polytopes, Tropical Math and Google* --- 4088 EH
4:10-5:30pm **Panel on Grant and Fellowship Applications (Special Seminar)** --- Present by UM Panel (A. Barvinok, S. Esedoglu, D. Forger, M. Mustata, et al) --- 3088 EH

Friday, September 14

- 11:00-12:00pm **EECS Theory Seminar** --- Erin Rhode (UM) TBA --- CSE 3941
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Santiago Schnell (Indiana U) *How do cells form rounded segments?* ---1084 EH

Friday, September 14 ... continued

- 3:10-4:00pm **Student Geometry/Topology** --- Nina White (UM) *Introduction to geometric group theory*
--- 3096 EH
- 4:10-5:00pm **Combinatorics** --- Lauren Williams (Harvard) *Toric geometry and the totally non-negative part of G/P* --- 3866 EH

UPCOMING EVENTS

Ziwet Lecture
Feb. 5, 2008
Speaker: Curtis McMullen

Rainich Lecture
Mar. 18, 2008
Speaker: Gang Tian

ABSTRACTS FOR THE WEEK OF SEPT. 10 – SEPT. 16, 2007

Student Analysis Seminar
Monday, Sept. 10, 3:10-4:00pm
3866 EH
Short Organizational Meeting

This week's seminar will be a half-hour organizational meeting. We will discuss which topics people are interested in hearing about during the coming semester so that we can plan some 2-4 week "themes" in addition to our usual individual talks. We will end in time for departmental tea at 3:45.

Number Theory and Representation Theory Seminar
Monday, Sept. 10, 3:10-5:00pm
4096 EH
Chris Hall (UM)
Tate's conjecture in fibers of a pencil

Let k be a finitely generated field, and E a non-isotrivial elliptic curve over $k(t)$. If k is finite then the function-field analogue of a conjecture of Goldfeld asserts that the average rank of all quadratic twists of E is well-defined and equal to $\frac{1}{2}$. If k is infinite then we prove that this average rank is well-defined and equals 0. At the heart of the proof is a theorem which asserts that for "most" one-parameter families of twists, almost all k -fibers of the family have rank 0. The methods used to prove the theorem apply to other one-parameter families of varieties, and in particular they allow one to show that the Tate conjectures are true for almost all k -fibers in the family.

Several Complex Variables Seminar
Monday, September 10, 4:10-5:00pm
3096 EH
Lina Lee (UM)
Asymptotic behavior of invariant metrics

As a point inside a domain moves toward the boundary, biholomorphically invariant metrics behave according to the characteristics of the domain. If a domain is holomorphically convex, one naturally expects it to be complete with respect to invariant metrics and the metric blowing up near the boundary. We explore the asymptotic behavior of invariant metrics near the boundary of pseudoconvex domains, which are known to be holomorphically convex, and show that the metrics blow up at a rate that is determined by the geometry of the boundary.

Geometry & Physics
Monday, September 10, 4:10-6:00pm
4088 EH
Eric Zaslow (Northwestern)
Constructible Sheaves and the Fukaya Category

I will describe an equivalence between these two categories, focusing on simple examples. The talk is based on work of Nadler and joint work with Nadler.

“What is ... ” Seminar
Tuesday, September 11, 2:10-3:00pm
3096 EH
Alejandro Uribe (UM)
“What is Spectral Geometry?”

In this talk I will survey problems and results about the relationship between the spectrum of the Laplace-Beltrami operator on a compact Riemannian manifold and the geometry of the manifold.

Geometry Seminar
Tuesday, September 11, 3:10-4:00pm
4088 EH
Zhou Zhang (UM)
Kaehler-Ricci flow and complex Monge-Ampere equation

The complex version of the Ricci flow, the Kaehler-Ricci flow, known to be equivalent to a scalar evolution equation, is relatively simple looking in comparison to the tensor evolution equation of the original Ricci flow. The equation is, indeed, the time-dependent version of the complex Monge-Ampere equation, which determinants and so is highly non-linear. Pluripotential theory of the Monge-Ampere operator naturally arises in the study of this problem. The relation to Algebraic Geometry can be seen as the motivation and goal.

Colloquium
Tuesday, September 11, 4:10-5:00pm
1360 EH
Marina Ratner (UC Berkeley)
The theory of Unipotent Flows on homogeneous spaces of Lie groups with emphasis on applications

In the last few years there has been a tremendous upsurge in applications of the theory of Unipotent flows on homogeneous spaces of Lie groups to various problems arising from different areas of mathematics. In this talk I will present the main results of the theory and then discuss a number of important applications. The talk will be accessible to a general audience familiar with the notion of a Lie group and its quotients with respect to discrete subgroups.

Geometric Function Theory Seminar
Wednesday, September 12, 3:10-5:00pm
4096 EH
Mario Bonk (UM)
Quasiconformal flows

A vector field generates a quasiconformal flow if its so-called strain tensor is essentially bounded. I will give a survey on this subject and discuss some related open problems.

Student Algebraic Geometry Seminar
Thursday, September 13, 2:10-3:00pm
3866 EH
Kevin Tucker (UM)
Proximity Matrices and Easy Surface Resolution Computations

This talk will give an overview of the Zariski-Lipman theory of complete ideals in the local ring of a point on a smooth surface. In particular, we will talk about proximity matrices and their use in computations of embedded resolutions in two dimensions. We will also talk about the relation to the germs of analytically irreducible curves. If there is time, we will mention Jarvilehto's use of the theory to compute the jumping numbers of these ideals.

Commutative Algebra Seminar
Thursday, September 13, 3:10-4:00pm
3096 EH
Mel Hochster (UM)
Tor, Ext, and local cohomology

For the first several weeks of the semester, I will be giving some talks on elementary homological algebra: the functors Tor and Ext, and then an introductory treatment of local cohomology. I will write up these lectures and make them available from my Web page. This is intended to supplement the background of students in Math 711, but others who are interested in this material are welcome.

**Financial/Actuarial Mathematics Seminar
Thursday, September 13, 3:10-4:00pm
3088 EH**

Erhan Bayraktar (UM)

On the finite horizon American option pricing problem: A proof of smoothness and an exponentially fast converging scheme

We give a new proof of the fact that the value function of the finite time horizon American put option for a jump diffusion, when the jumps are from a compound Poisson process, is the classical solution of a quasi-variational inequality and it is C^1 across the optimal stopping boundary. Our proof only uses the classical theory of parabolic partial differential equations of Friedman and does not use the theory of viscosity solutions, since our proof relies on constructing a sequence of functions, each of which is a value function of an optimal stopping time for a diffusion. The sequence is constructed by iterating a functional operator that maps a certain class of convex functions to smooth functions satisfying variational inequalities (or to value functions of optimal stopping problems involving only a diffusion). The approximating sequence converges to the value function exponentially fast, therefore it constitutes a good approximation scheme, since the optimal stopping problems for diffusions can be readily solved.

Math Club

**Thursday, September 13, 4:10-5:00pm
2nd Floor Nesbitt Room**

Brian Conrad (UM)

The 17-gon

At the end of the 18th century, the teenage Gauss stunned the mathematical world by constructing a new regular polygon with straightedge and compass. Whereas the ancient Greeks could construct regular triangles, squares, and pentagons in this way (and some others easily made from these by bisecting sides, etc.), no further progress had been made in 2000 years on whether or not it was possible to construct a regular 7-gon or beyond. Gauss' insight was that this apparently geometric problem is really a problem in arithmetic, and that to discover new constructions or prove impossibility results in this direction one had to carry out an arithmetic rather than geometric investigation.

In this talk we will explain some basic construction principles that translate the geometric problem into algebra, and then we show how to use some arithmetic to actually carry out the construction of a regular 17-gon.

Student Combinatorics

**Thursday, September 13, 4:10-5:00pm
4088 EH**

Florian Block (UM)

Hidden Markov Models, Newton Polytopes, Tropical Math and Google

We will explain the Hidden Markov Model as it is used in algebraic statistics and its connection to Google's "Did you mean"-feature. This turns out to be equivalent to the evaluation of a tropical polynomial which can be done efficiently by Minkowski decomposition of a newton polytope.

Panel on Grant and Fellowship Applications (Special Seminar)
Thursday, September 13, 4:10-5:30pm
Present by UM Panel (Alexander Barvinok, Selim Esedoglu, Danny Forger, Mircea Mustata, et al)
3088 EH

This panel discussion is aimed at helping new postdoctoral faculty in the process of applying for grants and fellowships. Others are welcome.

Applied and Interdisciplinary Mathematics Seminar
Friday, September 14, 3:10-4:00pm
1084 EH
Santiago Schnell (Indiana U)
How do cells form rounded segments?

The vertebral column develops during early embryogenesis. It is formed from a periodic pattern of somites along the anterior-posterior axis of an organism. These somites are rounded structures formed after compaction and segmentation of mesenchymal cells. There is an intricate pattern of gene activity and protein expression which appears to be involved in the rounding process. However, here we consider the physical aspects of the mechanism. Current theory is that increased cell-cell adhesion induces minimization of the tissue surface tension, yielding rounded tissue. We investigate this behaviour using a viscous liquid model of tissue dynamics. Given the relatively brief time in which somite formation occurs, and the high bulk viscosities of tissues, the basic model is unconvincing. We propose a simple chemotactic mechanism to extend the model. This new model successfully produces rounding within the timeframe found in vivo. (.....abstract continued on next page)

(Applied and Interdisciplinary Mathematics Seminar abstract continued)

..... This work was recently published in *Developmental Biology*. The reference is: R. Grima, S. Schnell (2007). Can tissue surface tension drive somite formation? *Developmental Biology* 307, 248-257.

This manuscript doesn't have any hard mathematics. We have published a number of papers on somitogenesis, a number of them are for a mathematical inclined audience. The most recent mathematical model we developed is the clock and wavefront model for somite formation. The references with the mathematical model and its analysis are:

- R. E. Baker, S. Schnell, P. K. Maini (2006). A clock and wavefront mechanism for somite formation. *Developmental Biology* 293, 116-126.
- R. E. Baker, S. Schnell, P. K. Maini (2006). A mathematical investigation of a new model for somitogenesis. *Journal of Mathematical Biology* 52, 458-482 .

These two papers are related to the topic of my talk (somitogenesis), though there are not directly dealing with the same problem. I'll explain what we have done and show some of the models. Then I'll go to our new theories, which at the moment we haven't developed yet into full mathematical models. We simply have done physio-chemical calculations to test different theories. This will give a flavour of the new biological problems and the opportunities open to applied mathematicians.

Combinatorics
Friday, September 14, 4:10-5:00pm
3866 EH
Lauren Williams (Harvard)
Toric geometry and the totally non-negative part of G/P

First I will discuss joint work with Alex Postnikov and David Speyer ([arXiv:0706.2501](https://arxiv.org/abs/0706.2501)) in which we use toric geometry to investigate the topology of the totally non-negative part of the Grassmannian $G(k,n)_+$. $G(k,n)_+$ is a cell complex whose cells C_G can be parameterized in terms of the combinatorics of certain planar graphs G . To each cell C_G we associate a certain polytope $P(G)$, whose combinatorial structure is reminiscent of the well-known Birkhoff polytopes: the face lattice of $P(G)$ can be described in terms of matchings and unions of matchings of G . We also demonstrate a connection between the polytopes $P(G)$ and matroid polytopes. We then associate a toric variety to each $P(G)$, and use our technology to prove that the cell decomposition of $G(k,n)_+$ is in fact a CW complex.

Next I will briefly describe very recent joint work with Konstanze Rietsch in which we extend the previous work to show that the Lusztig-Rietsch cell decomposition of the totally non-negative part of any G/P is a CW complex. In the proof, the combinatorics of planar graphs is replaced by the technology of Lusztig's canonical basis.