

Fall 2008
University of Michigan-Department of Mathematics
<http://www.math.lsa.umich.edu/seminars/index.shtml>
Ann Arbor, MI 48109-1043

December 8th – December 14th

Monday, December 8

- 3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- TBA --- 2866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- George McNinch (Tufts)
Nilpotent orbits for a reductive group over a local field --- 4096 EH
4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics (Non-standard day)** --- Anna Siano (UM) *Fatou-Bieberbach domains* --- 3096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- TBA --- 3096 EH
4:10-5:00pm **Student Combinatorics** --- Alan Stapledon (UM) *Toric Pre-varieties and Matroids* --- 3866 EH
5:15-6:00pm **Teaching Mathematics** --- Not meeting this week --- 3096 EH

Tuesday, December 9

- 2:10-3:00pm **"What is ... " Seminar** --- Richard Canary (UM) *What is bumponomics?* --- 3096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Geometry Seminar** --- Amir Mohammadi (Yale) *Unipotent flows in positive characteristic* --- 4096 EH
3:10-4:00pm **Student Algebraic Geometry Seminar** --- TBA --- 3088 EH
4:10-5:00pm **Colloquium** --- Steffen Rohde (U Washington) *From DLA to SLE (and back?)* --- 1360EH
4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH

Wednesday, December 10

- 9:10-12:00pm **RTG Student Session in Algebraic Geometry and its Boundaries** --- Various speakers --- 3088 EH
3:10-4:00pm **Geometric Function Theory Seminar** --- TBA --- 4096 EH
3:10-4:00pm **Student Representation Theory Seminar** --- TBA --- 3096 EH
3:10-4:00pm **Student Arithmetic Seminar** --- Ben Weiss (UM) *Heuristics on Class Groups of Number Fields* --- 3866 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Sam Payne (Stanford) *Tropicalization and nonarchimedean analytification* --- 3088 EH

Thursday, December 11

- 3:10-4:00pm **Commutative Algebra Seminar** --- Not meeting this week --- 3096 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Not meeting this week --- 3088 EH
3:10-4:00pm **Topology Seminar** --- Jesse Johnson (Yale) *Bounding the stable genus of Heegaard splitting from below* --- 4096 EH
4:10-5:00pm **Differential Equations** --- TBA --- 4088 EH
4:10-5:00pm **Math Club** --- TBA --- 2nd floor Nesbitt Common Room
4:10-5:00pm **Reading Group in Probabilistic Methods in Geometric Functional Analysis and Combinatorics** --- 3096 EH
4:10-6:00pm **RTG Study Seminar** --- Moon Duchin (UM) *Currents II* --- 3866 EH
4:10-6:00pm **Geometry and Physics Seminar** --- Alexsey Zinger (Stony Brook) *Gromov-Witten invariants and integer curve counts* --- 4096 EH

Friday, December 12

- 11:10-12:00pm **Theoretical Computer Science Seminar** --- Alex Andoni (UM) *A New Approach to Nearest Neighbor Search via Iterated Product Spaces* --- Room TBA
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- TBA --- 1084 EH
3:10-4:00pm **Student Geometry/Topology** --- TBA --- 3096 EH
4:10-5:00pm **Combinatorics** --- TBA --- 3866 EH

EVENTS THIS WEEK

RTG Student Session in Algebraic Geometry and its Boundaries
Wednesday Dec 10, 2008
Room 3088 EH
9--12 am

9:10–9:35 Chelsea Walton: *Degenerate Sklyanin Algebras and Generalized Twisted Homogeneous Coordinate Rings.*

We examine noncommutative graded algebras with use of algebro-geometric techniques. In particular, we introduce a generalization of Artin-Tate-van den Bergh's machinery to execute such a task.

9:45–10:10 Marc Krawitz: *Landau-Ginzburg Mirror Symmetry*

In physics, an $N=2$ superconformal field (Landau-Ginzburg) theory is specified by a weighted homogeneous polynomial satisfying a mild non-degeneracy condition. The "chiral ring" associated to the theory is the orbifolded A-model constructed mathematically by Fan, Jarvis and Ruan. The unorbifolded B-model of the theory is given by the local algebra (Milnor ring) of the defining polynomial. I will describe a new construction orbifolding the B-model, and show how a natural transposition operation implements mirror symmetry (i.e. exchanges the A-model and B-model rings) for a large class of Landau-Ginzburg theories, including those specified by the simple and unimodal singularities of Arnol'd's classification.

10:20–10:45 Victor Lozovanu: *Regularity of smooth curves in biprojective spaces*

In 2004, Maclagan and Smith developed a multigraded version of Castelnuovo-Mumford regularity. In this talk we will discuss how can we obtain bounds on the regularity of the ideal sheaf of a smooth curve embedded in biprojective spaces. At the same time I will try to emphasize the differences between the multigraded regularity and the classical one.

10:55–11:20 Roi Docampo: *Arcs on Determinantal Varieties*

I will explain how to use actions of algebraic groups to study arc spaces and jet schemes of some quasi-homogeneous algebraic varieties. As an application, I will analyze the case of generic determinantal varieties. If time permits, I will explore possible extensions of my results to spherical varieties.

11:30–11:55 Jonathan Bober: *Integer ratios of factorials and related questions*

I'll describe some results about when ratios of products of factorials are integers. Equivalently, this is a description of when some step functions related to the Beurling-Nyman criterion for the Riemann Hypothesis are nonnegative. In addition, through work of Alexander Borisov, this is related to the classification of terminal and canonical cyclic quotient singularities. Some of these results come from Beukers and Heckman's classification of algebraic hypergeometric functions, while others use complex analysis.

ABSTRACTS FOR THE WEEK OF DEC. 8 – DEC. 14, 2008

**Group Theory/Lie Theory/Number Theory Seminar
Monday, December 8, 3:10-5:00pm
4096 EH
George McNinch (Tufts)
*Nilpotent orbits for a reductive group over a local field***

Let X be a nilpotent element of $\mathrm{Lie}(G) = \mathrm{Lie}(G)(K)$, where G is a reductive group over an arbitrary field K . Geometrically, the orbit of X is classified by its "Bala-Carter datum". In some recent work, the author showed -- under mild assumptions on the characteristic of K -- that in some sense the structure of the geometric centralizer of X depends only on this datum, and not on the characteristic of K . In particular, the centralizer has a Levi decomposition over K , and the root datum of the reductive quotient of the centralizer is independent of $\mathrm{char} K$.

To prove this result, the author chose a discrete valuation A , with residues K and fractions of $\mathrm{char}. 0$ -- and a reductive group scheme H over A whose special fiber identifies with G . A crucial step is the construction of a suitable nilpotent section X_0 in $\mathrm{Lie}(H)(A)$ whose image in $\mathrm{Lie}(H)(K)$ is X ; an essential feature is that the centralizer in H of X_0 should be *smooth* over A .

Now suppose instead that K is a local field, and that A is the ring of integers in K . Let P be a parahoric A -group scheme associated with G ; then G is the generic fiber of P while in general the special fiber is not reductive. The talk will consider the extent to which the author's previous study -- which corresponds to the case in which P is reductive over A -- can be generalized. It will discuss the application of these ideas to DeBacker's parametrization of nilpotent orbits.

**RTG Working Seminar in Several Complex Variables and Complex Dynamics (Non-standard day)
Monday, December 8, 4:10-5:00pm
3096 EH
Anna Siano (UM)
*Fatou-Bieberbach domains***

A Fatou-Bieberbach domain is an open proper subset of \mathbb{C}^n that is biholomorphic to \mathbb{C}^n . We will discuss examples of such domains that arise as basins of attraction of automorphisms of \mathbb{C}^n , following Rosay-Rudin's paper.

Student Combinatorics
Monday, December 8, 4:10-5:00pm
3866 EH
Alan Stapledon (UM)
Toric Pre-varieties and Matroids

A toric pre-variety satisfies all the definitions of a toric variety except that it is not necessarily separated. We explain how the geometry of certain pre-toric varieties is related to the combinatorics of matroids.

“What is ...” Seminar
Tuesday, December 9, 2:10-3:00pm
3096 EH
Richard Canary (UM)
What is bumponomics?

The Teichmüller space of all (marked) hyperbolic surfaces homeomorphic to a fixed closed surface naturally arises in various areas of mathematics. For example, it is the universal cover, from the orbifold viewpoint, of the much-studied Moduli space.

We will discuss a 3-dimensional analogue of Teichmüller space, the space $AH(M)$ of all marked hyperbolic 3-manifolds homotopy equivalent to a fixed compact 3-manifold M (usually with non-empty boundary). While Teichmüller space is homeomorphic to an open ball, the topology of $AH(M)$ tends to be quite complicated. Bumponomics is the study of the topology of $AH(M)$.

Geometry Seminar
Tuesday, December 9, 3:10-4:00pm
4096 EH
Amir Mohammadi (Yale)
Unipotent flows in positive characteristic

Over the past 40 years or so unipotent flow on homogeneous spaces and its applications to number theory especially to Diophantine approximation has attracted considerable attention. G. Margulis's celebrated proof of Oppenheim's conjecture and M. Ratner's proof of Raghunathan's conjecture are two examples of this. The S-arithmetic case of Raghunathan's conjecture was also settled by Margulis-Tomanov and Ratner independently. The problem in positive characteristic however is far from being solved. In this talk we will address the recent developments on this. In particular we discuss the joint work with M. Eisiedler on joining classification for certain flows which has an application to quasi-isometry rigidity of lattices, this appears as an appendix by K. Wortman to our work.

Colloquium
Tuesday, December 9, 4:10-5:00pm
1360 EH
Steffen Rohde (U of Washington)
From DLA to SLE (and back?)

Diffusion Limited Aggregation (DLA) is a random process of growing sets, proposed by physicists Witten and Sander in 1981, as a model describing the aggregation of randomly moving (diffusing) particles. It is easy to describe and to simulate on a computer, yet very difficult to analyze: Despite intense research by physicists and mathematicians, very little is rigorously known.

The Schramm-Loewner Evolution (SLE), discovered by Schramm around 2000, has been instrumental in the resolution of several outstanding conjectures in probability theory, and in providing rigorous proof of numerous predictions from physics. It has generated immense excitement both in the probability and statistical physics community and led to active exchange of ideas.

Both have in common that they can be defined by means of compositions of (random) conformal maps. In my talk, aimed at the non-specialist, I will explain and compare the definitions of DLA and SLE, describe some fundamental properties and applications, and will conclude with a discussion of some open questions and speculations.

Algebraic Geometry Seminar
Wednesday, December 10, 4:10-6:00pm
3088 EH
Sam Payne (Stanford)
Tropicalization and nonarchimedean analytification

Abstract Tropicalization is a functor that maps subvarieties of toric varieties over nonarchimedean fields to combinatorial spaces stratified by polyhedral complexes, and may be thought of roughly as taking the image of the variety under the valuation. Analytification is a functor that maps a variety over a nonarchimedean field to a topological space whose points are equivalence classes of multiplicative seminorms on coordinate rings of affine open subsets.

I will give a gentle and elementary introduction to these two functors, together with a proof that the analytification of a quasiprojective variety is the inverse limit of the tropicalizations of its closed embeddings in toric varieties.

Topology Seminar
Thursday, December 11, 3:10-4:00pm
4096 EH
Jesse Johnson (Yale)
Bounding the stable genus of Heegaard splitting from below

It is a classical result that given two Heegaard splittings of a 3-manifold, there is a third Heegaard splitting, called a common stabilization, that results from adding handles to each of the original two Heegaard surfaces. It is an open problem to determine how many handles are needed, in general, to form this common stabilization. I will describe a way to construct, for each integer k , a 3-manifold with Heegaard splittings of genus $2k$ and $2k-1$ such that the smallest common stabilization has genus at $3k-1$.

RTG Study Seminar
Thursday, December 11, 4:10-6:00pm
3866 EH
Moon Duchin (UM)
Currents II

Details on Bonahon's geodesic currents and the properties of intersection number.

Geometry and Physics Seminar
Thursday, December 11, 4:10-6:00pm
4096 EH
Alexsey Zinger (Stony Brook)
Gromov-Witten invariants and integer curve counts

Gromov-Witten invariants of a non-singular projective variety X are virtual counts of curves in X . These rational numbers are rarely integer, but are generally believed to be related to some integer counts. In string theory, these counts are known as instanton numbers and BPS states. The predictions of Aspinwall-Morrison and Gopakumar-Vafa for the existence of BPS states of Calabi-Yau 3-folds are extended by Pandharipande to all 3-folds, by Klemm-Pandharipande to all Calabi-Yau varieties in genus 0 and Calabi-Yau 4-folds in genus 1, and by Pandharipande and the speaker to Calabi-Yau 5-folds in genus 1. The last extension came as a bit of a surprise to some string theorists, who also feel that extensions to higher dimensions are impossible. The aim of the first hour is to survey the known predictions, indicating how they arise. In the second hour, I will describe how a simple reformulation of the immersion property leads to a fundamental topological difference between the 6+ dimensional and 5- dimensional cases, as well as why the integrality predictions hold for Fano classes in 3-folds.

The seminar in winter semester will be moved back to Monday

Theoretical Computer Science Seminar
Friday, December 12, 11:10-12:00pm
Room TBA
Alex Andoni (UM)
A New Approach to Nearest Neighbor Search via Iterated Product Spaces

A New Approach to Nearest Neighbor Search via Iterated Product Spaces A common approach for solving computational problems over a "difficult" metric space is to embed the hard metric into L_1 , which admits efficient algorithms and is thus considered an "easy" metric. Over years, this approach has proved successful or partially successful for important spaces such as the edit distance, but it also has inherent limitations: it is provably impossible to go below certain approximation for some metrics. We propose a new approach, of embedding the difficult space into richer host spaces, namely iterated products of standard spaces like L_1 and L_∞ . We show that this class is rich since it contains useful metric spaces with only a constant distortion, and, at the same time, it is tractable and admits efficient algorithms. Using this approach, we obtain for example the first nearest neighbor data structure with $O(\log \log d)$ approximation for edit distance in non-repetitive strings (the Ulam metric). This approximation is exponentially better than the lower bound for embedding into L_1 . Furthermore, we give constant factor approximation algorithms for two other computational problems. Along the way, we answer positively some questions left open in [Ajtai-Jayram-Kumar-Sivakumar, STOC'02]. One of our algorithms has already found applications for smoothed edit distance over 0-1 strings [Andoni-Krauthgamer, ICALP'08]. Joint work with Piotr Indyk (MIT) and Robert Krauthgamer (Weizmann Inst).