### Monday, November 06, 2017

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<tr>
<th>Time</th>
<th>Event</th>
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| 4:00pm-6:00pm| **Geometry & Physics** -- Ronan Conlon (Florida International University)  
*Asymptotically conical Calabi-Yau manifolds* -- 4096 East Hall |                                            |
| 4:00pm-5:00pm| **Integrable Systems and Random Matrix Theory** -- Asad Lodhia (University of Michigan)  
*A tutorial on Spiked PCA using Linear Spectral Statistics* -- 1866 East Hall |                                            |
| 4:00pm-5:00pm| **Student Combinatorics Seminar** -- Jonathan Gerhard (University of Michigan)  
*Pattern Avoidance and Combinatorial Statistics for Set Partitions and RGFs* -- 3866 East Hall |                                            |
| 4:10pm-5:30pm| **Group, Lie and Number Theory** -- Alvaro Lozano-Robledo (University of Connecticut)  
*A probabilistic model for the distribution of ranks of elliptic curves over Q* -- 4088 East Hall |                                            |

### Tuesday, November 07, 2017

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| 11:30am-1:00pm| **Special Events** -- IBL Lunch  
*IBL Lunch* -- 4866 East Hall |                                            |
| 3:00pm-4:00pm| **Student Geometry/Topology** -- John Kilgore (University of Michigan)  
*Weyl's law for singular projective algebraic varieties* -- 1866 East Hall |                                            |
| 3:00pm-4:00pm| **Student Commutative Algebra** -- Jack Jeffries (University of Michigan)  
*Differential operators and symbolic powers* -- 4088 East Hall |                                            |
| 4:10pm-5:00pm| **Colloquium Series** -- Henry Kim (University of Toronto)  
*Number theoretic results in a family of number fields* -- 1360 East Hall |                                            |

### Wednesday, November 08, 2017

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<tr>
<th>Time</th>
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| 3:00pm-4:00pm| **Student Arithmetic** -- Brandon Carter (UM)  
*An introduction to Galois representations* -- 3866 East Hall |                                            |
| 4:00pm-5:00pm| **Financial/Actuarial Mathematics** -- Mark Schroder (Michigan State)  
*The Effects of Competition and Monitoring on R&D Investment: A Dynamic Approach* -- 1360 East Hall |                                            |
| 4:00pm-5:30pm| **RTG Seminar on Geometry, Dynamics and Topology** -- Tengren Zhang (CalTech)  
*The Goldman symplectic form on the Hitchin component* -- 3866 East Hall |                                            |
| 4:10pm-5:30pm| **Algebraic Geometry** -- Kirsten Wickelgren (Georgia Tech)  
*Motivic Euler numbers and an arithmetic count of the lines on a cubic surface* -- 4096 East Hall |                                            |

### Thursday, November 09, 2017

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker/Location</th>
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</table>
| 3:00pm-4:00pm| **Topology** -- Craig Westerland (University of Minnesota)  
*Fox-Neuwirth/Fuks cells, quantum shuffle algebras, and Malle’s conjecture for function fields* -- 1866 East Hall |                                            |
| 3:00pm-4:00pm| **Commutative Algebra** -- Jack Jeffries (University of Michigan)  
*A Zariski-Nagata theorem in mixed characteristic* -- 4088 East Hall |                                            |
| 4:00pm-5:30pm| **Logic** -- Andres Caicedo (Math Reviews)  
*Real-valued measurability and the extent of Lebesgue measure* -- 3096 East Hall |                                            |
| 4:10pm-5:30pm| **Preprint Algebraic Geometry Seminar** -- Shubhodip Mondal (UM)  
*Vanishing theorems of Kodaira type for Witt canonical sheaves (following Tanaka)* -- 1866 East Hall |                                            |
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<tr>
<td>1:00pm-2:00pm</td>
<td>Special Events</td>
<td>Diana Davis (Williams)</td>
<td>Three flavors of billiards</td>
<td>Nesbitt Room East Hall</td>
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<td>3:00pm-4:00pm</td>
<td>Applied Interdisciplinary Mathematics (AIM)</td>
<td>Chris Rycroft (Harvard University)</td>
<td>The reference map technique for simulating complex materials and multi-body interactions</td>
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<td>Quant Program Practitioner Seminar</td>
<td>Vijay Nair (Wells Fargo)</td>
<td>Risk Modeling in Banking &amp; Wells Fargo Quantitative Associate Program</td>
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<td>Student Representation Theory</td>
<td>Gilyoung Cheong (University of Michigan)</td>
<td>Rationality of Topological Zeta Functions</td>
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<td>4:10pm-5:00pm</td>
<td>Combinatorics</td>
<td>Benjamin Wyser (Oklahoma State U.)</td>
<td>Singularities of K-orbit closures and interval pattern avoidance</td>
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<td>4:10pm-5:00pm</td>
<td>Student AIM Seminar</td>
<td>Audra McMillan (University of Michigan)</td>
<td>Differential Privacy and Applications to Game Theory</td>
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<td>4:10pm-5:00pm</td>
<td>Colloquium Series</td>
<td>Peter May (University of Chicago)</td>
<td>Glimpses of equivariant algebraic topology</td>
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<td>Charlotte Chan (UM)</td>
<td>Connections to automorphic forms</td>
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Geometry & Physics
Monday, November 06, 2017, 4:00pm-6:00pm
4096 East Hall
Ronan Conlon (Florida International University)
Asymptotically conical Calabi-Yau manifolds

Asymptotically conical Calabi-Yau manifolds are non-compact Ricci-flat Kahler manifolds that are modelled on a Ricci-flat Kahler cone at infinity. I will report on ongoing work with Hans-Joachim Hein concerning the construction and classification of such manifolds.

Integrable Systems and Random Matrix Theory
Monday, November 06, 2017, 4:00pm-5:00pm
1866 East Hall
Asad Lodhia (University of Michigan)
A tutorial on Spiked PCA using Linear Spectral Statistics

In this talk we discuss recent work by Edgar Dobriban (2017) that uses linear spectral statistics of eigenvalues of sample covariance matrices to detect the existence of spikes in the regime that the classic spiked models do not have their largest eigenvalues leaving the bulk as in the BBP transition. Here the classic spiked model is where the covariance matrix of the n, p-dimensional random vectors is the identity plus a finite rank perturbation. It is known (Baik, Ben Arous and Peche 2005) in the regime that p/n -> gamma, that for large enough finite perturbation the leading eigenvalue of the sample covariance leaves the bulk of the Marcenko Pastur law (the BBP transition) and therefore can be used as a test for the existence of the finite rank perturbation. As it turns out a test based off of all of the eigenvalues can be more powerful in detecting the existence of the perturbation.
Student Combinatorics Seminar  
**Monday, November 06, 2017, 4:00pm-5:00pm**  
3866 East Hall  
**Jonathan Gerhard (University of Michigan)**  
*Pattern Avoidance and Combinatorial Statistics for Set Partitions and RGFs*

Pattern avoidance is a popular topic in combinatorics that can be studied for many objects - the most popular perhaps being permutations. In this talk, we will look at pattern avoidance in set partitions and restricted growth functions (RGFs). These objects are in bijection with each other but in some cases, their avoidance classes actually differ.

Describing the size of the avoidance class of a set partition/RGF is in itself an interesting and (usually) difficult task. Instead of doing this, we will be looking at the distribution over the avoidance classes of a set of combinatorial statistics on RGFs introduced by Michelle Wachs and Dennis White called $lb, ls, rb,$ and $rs$. These distributions often have interesting combinatorial or number theoretic interpretations.

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Group, Lie and Number Theory  
**Monday, November 06, 2017, 4:10pm-5:30pm**  
4088 East Hall  
**Alvaro Lozano-Robledo (University of Connecticut)**  
*A probabilistic model for the distribution of ranks of elliptic curves over $Q$*

In this talk, we propose a new probabilistic model for the distribution of ranks of elliptic curves in families of fixed Selmer rank, and compare the predictions with previous results, and with the databases of curves over the rationals that we have at our disposal. In addition, we document a phenomenon we refer to as Selmer bias that seems to play an important role in the data and in our models.

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Special Events  
**Tuesday, November 07, 2017, 11:30am-1:00pm**  
4866 East Hall  
**IBL Lunch**

*IBL Lunch*
Student Geometry/Topology
Tuesday, November 07, 2017, 3:00pm-4:00pm
1866 East Hall
John Kilgore (University of Michigan)
Weyl's law for singular projective algebraic varieties

It is a classical result that the spectrum of the Laplacian on a compact Riemannian manifold forms a sequence going to positive infinity and satisfies an asymptotic growth rate known as Weyl's law determined by the volume and dimension of the manifold. The spectrum of the Laplacian is an isometry invariant, and Weyl's law motivated Kac's famous question, "Can one hear the shape of a drum?" where he asked if spaces with the same spectrum are isometric. (Milnor showed the answer is no in general.) In this talk, I will explain why Weyl's law also holds for the non-singular locus of embedded, irreducible, singular projective algebraic varieties with the metric induced from the Fubini-Study metric of complex projective space. This non-singular locus is an open manifold with finite volume that comes from a very natural class of spaces studied heavily outside of differential geometry. I will discuss the difficulties that occur when considering Weyl's law for open manifolds and how they can be overcome for the case above using a heat kernel estimate of Li and Tian.

Student Commutative Algebra
Tuesday, November 07, 2017, 3:00pm-4:00pm
4088 East Hall
Jack Jeffries (University of Michigan)
Differential operators and symbolic powers

A classical theorem of Zariski and Nagata describes symbolic powers of prime ideals in polynomial rings in terms of differential operators. In this talk, we will introduce Grothendieck's notion of differential operators on commutative rings. Following Dao, De Stefani, Grifo, Huneke, and Nunez-Betancourt, we will give a proof of one of the containments in the Zariski-Nagata theorem. No previous experience with differential operators is required.

Colloquium Series
Tuesday, November 07, 2017, 4:10pm-5:00pm
1360 East Hall
Henry Kim (University of Toronto)
Number theoretic results in a family of number fields

Unconditional results without an unproved hypothesis such as the generalized Riemann hypothesis (GRH) are very weak for an individual number field. But if we consider a family of number fields, one can prove just as strong results as we would assume GRH, in the form: (1) average result in the family; (2) the result is valid for almost all members except for a density zero set. We will explain this philosophy using examples of logarithmic derivatives of L-functions, residues of Dedekind zeta functions, and least primes in a conjugacy class.
Student Arithmetic
Wednesday, November 08, 2017, 3:00pm-4:00pm
3866 East Hall
Brandon Carter (UM)
An introduction to Galois representations

The goal of this talk is to give an overview of Galois representations and how they fit in to the conjectural picture of modern number theory, starting with the 1- and 2-dimensional cases. Much of the talk will be fairly informal, but I will assume knowledge about algebraic number theory, elliptic curves, and group/Galois cohomology (the previous talks on elliptic curves should be enough).

Financial/Actuarial Mathematics
Wednesday, November 08, 2017, 4:00pm-5:00pm
1360 East Hall
Mark Schroder (Michigan State)
The Effects of Competition and Monitoring on R&D Investment: A Dynamic Approach

We examine a dynamic model of R&D investment by competing firms with an uncertain payoff and uncertain time to development success. The effect of competition on R&D investment depends critically on whether firms are able to monitor, and react to, each other's actions. In the absence of monitoring, competition speeds up investment and erodes option values. When monitoring is allowed, the Pareto-dominant closed-loop equilibrium is identical to the first-best cooperative equilibrium, with investment that is increasingly postponed as more firms enter the market. A novel approach, solving a sequence of pure-jump equilibria, is used to obtain the equilibrium in the Brownian limit.

Authors: Mohammad Rezaei and Mark Schroder
Let $S$ be a closed, orientable, connected surface of genus at least 2. We prove that any ideal triangulation on $S$ determines a symplectic trivialization (with respect to the Goldman symplectic form) of the tangent bundle of the Hitchin component. One can then consider the parallel flows with respect to the flat structure given by this trivialization. We give a geometric description of all such flows in terms of explicit deformations of Frenet curves, and prove that all such flows are Hamiltonian. Applying this to a particular ideal triangulation allows us to find a maximal family of Poisson commuting Hamiltonian flows on the Hitchin component. This generalizes the well-known fact that on Teichmüller space, the twist flows along a pants decomposition of $S$ is a maximal family of Poisson commuting Hamiltonian flows. This is joint work with Zhe Sun and Anna Wienhard.

A celebrated 19th century result of Cayley and Salmon is that a smooth cubic surface over the complex numbers contains exactly 27 lines. Over the real numbers, it is a lovely observation of Finashin-Kharlamov and Okonek-Teleman that while the number of real lines depends on the surface, a certain signed count of lines is always 3. We extend this count to an arbitrary field $k$ using an Euler number in $A_1$-homotopy theory. The resulting count is valued in the Grothendieck-Witt group of non-degenerate symmetric bilinear forms. This is joint work with Jesse Kass.
In 2002, Malle formulated a conjecture regarding the distribution of number fields with specified Galois group. The conjecture is an enormous strengthening of the inverse Galois problem; it is known to hold for abelian Galois groups, but for very few non-abelian groups.

We may reformulate Malle’s conjecture in the function field setting, where it becomes a question about the number of branched covers of the affine line (over a finite field) with specified Galois group. In joint work with Jordan Ellenberg and TriThang Tran, we have shown that the upper bound in Malle’s conjecture does hold in this setting.

The techniques used involve a computation of the cohomology of the (complex points of the) Hurwitz moduli spaces of these branched covers. Surprisingly (at least to me), these cohomology computations can be rephrased in terms of the homological algebra of certain braided Hopf algebras arising in combinatorial representation theory and the classification of Hopf algebras. This relationship can be leveraged to provide the upper bound in Malle’s conjecture.

One version of a classical result by Zariski and Nagata describes symbolic powers in polynomial rings over the complex numbers in terms of differential operators. Namely, the n-th symbolic power of a prime consists of the elements such that each differential operator of order at most n-1 sends the element into the prime ideal. This is known hold in polynomial rings over perfect fields, but fails in mixed characteristic. In this paper, we use p-derivations, a notion due to Buium and Joyal, to define a new kind of differential powers in mixed characteristic, and prove that this new object does coincide with the symbolic powers of prime ideals. This is joint work with Alessandro De Stefani and Eloisa Grifo.
Logic
Thursday, November 09, 2017, 4:00pm-5:30pm
3096 East Hall

Andres Caicedo (Math Reviews)

Real-valued measurability and the extent of Lebesgue measure

The existence of an atomlessly measurable cardinal is equivalent to the existence of a measure extending Lebesgue measure and defined on all sets of reals. I'll start the talk with some background on real-valued measurability, and proceed to argue that the assumption that there is some such cardinal actually has an effect on the extent of Lebesgue measure itself. The result goes beyond what can be granted arguing merely in terms of consistency strength.

Preprint Algebraic Geometry Seminar
Thursday, November 09, 2017, 4:10pm-5:30pm
1866 East Hall

Shubhodip Mondal (UM)

Vanishing theorems of Kodaira type for Witt canonical sheaves (following Tanaka)

Available at http://front.math.ucdavis.edu/1707.04036.

Special Events
Friday, November 10, 2017, 1:00pm-2:00pm
Nesbitt Room East Hall

Diana Davis (Williams)

Three flavors of billiards

The mathematical study of billiards extends well beyond the popular table game. I'll tell you about three different types of billiards (inner billiards, outer billiards and tiling billiards), and I'll explain some of the research I've done in two of these areas. This talk is directed at undergraduates and graduate students in all areas of math.

Food: A pizza lunch will be provided.
Applied Interdisciplinary Mathematics (AIM)
Friday, November 10, 2017, 3:00pm-4:00pm
1084 East Hall
Chris Rycroft (Harvard University)
*The reference map technique for simulating complex materials and multi-body interactions*

Conventional computational methods often create a dilemma for fluid-structure interaction problems. Typically, solids are simulated using a Lagrangian approach with a grid that moves with the material, whereas fluids are simulated using an Eulerian approach with a fixed spatial grid, requiring some type of interfacial coupling between the two different perspectives. Here, a fully Eulerian method for simulating structures immersed in a fluid will be presented. By introducing a reference map variable to model finite-deformation constitutive relations in the structures on the same grid as the fluid, the interfacial coupling problem is highly simplified. The method is particularly well suited for simulating soft, highly-deformable materials and many-body contact problems, and several examples will be presented.

Geometry
Friday, November 10, 2017, 3:00pm-5:00pm
3866 East Hall
Diana Davis (Williams)
*Tiling billiards and interval exchange transformations*

Tiling billiards is a new dynamical system where a beam of light refracts through a planar tiling. It turns out that, for a regular tiling of the plane by congruent triangles, the light trajectories can be described by interval exchange transformations. I will explain this surprising correspondence, and show that we get the Rauzy fractal as a billiard trajectory.

Quant Program Practitioner Seminar
Friday, November 10, 2017, 3:00pm-4:00pm
B844 East Hall
Vijay Nair (Wells Fargo)
*Risk Modeling in Banking & Wells Fargo Quantitative Associate Program*

This presentation has two parts. In the first part, I'll describe the role of statistical modeling and machine learning techniques in banking through selected applications. These will cover model development and validation for credit risk, "stress testing" for regulatory purposes, and anomaly detection for fraud. In the second part, I'll describe the Wells Fargo quantitative associate program and job opportunities. This will be very informal.
Student Representation Theory  
**Friday, November 10, 2017, 3:00pm-4:00pm**  
1866 East Hall  
Gilyoung Cheong (University of Michigan)  
*Rationality of Topological Zeta Functions*  

We will try our best to carefully read an old paper of MacDonald in 50 minutes, which computes the generating function whose n-th coefficient is given by the Poincare polynomial of n-th symmetric power of a fixed topological space. MacDonald's clever proof uses representation theory of symmetric groups. If you want to know how easy this talk will be, I am new to representation theory, still learning the material. Thus, there won't be any elaborate techniques, except one cohomology theorem due to Grothendieck, which we will blackbox. For me, this is a motivating example why I should care about representation theory, so I hope this provides a concrete application for the audience as well. Ignore the title if you don't care about Weil conjectures, but otherwise, skim through Ravi Vakil's notes in Arizona Winter School 2015, as I won't explain why I chose such a weird title.

Student Algebraic Geometry  
**Friday, November 10, 2017, 3:10pm-4:00pm**  
3096 East Hall  
Patrick Kelley (UM)  
*Integral models of varieties over the rationals*  

In this talk, we will introduce Spec(Z) and discuss how to view geometric objects living over it. Then, we will explore some examples and see how a variety defined over the rational numbers can be stretched into a model over the integers. Finally, we will define what it means for such a variety to have good or bad reduction modulo a prime. If time permits, we will also talk about elliptic curves over the rationals in more depth.

Arithmetic Geometry Learning Seminar  
**Friday, November 10, 2017, 4:00pm-4:45pm**  
1866 East Hall  
Bhargav Bhatt (UM)  
*Compactifications of Drinfeld modular varieties II*
The local structure of symmetric subgroup orbit closures on the flag variety is of importance in the theory of Harish-Chandra modules for real Lie groups. Thanks largely to work of McGovern and McGovern-Trapa, certain local properties of such orbit closures, such as smoothness, are known to be characterized by pattern avoidance in several cases. However, there are more refined local properties which cannot be characterized in the same way. I will describe a generalization of pattern avoidance, which we call interval pattern avoidance, which governs all reasonable local properties of K-orbit closures in the case where $G = \text{GL}(p+q)$ and $K = \text{GL}(p) \times \text{GL}(q)$. Although combinatorial in nature, this result follows from underlying geometry: An interval pattern embedding implies an isomorphism of two "slices" of the corresponding orbit closures. This work is joint with Alexander Woo and Alexander Yong.
When social scientists have to ask sensitive or personal questions, there is a real risk that the results will be inaccurate due to dishonest answers. In the 1960’s, S. L. Warner came up with a solution. He had participants (privately) flip a coin. If the coin came up heads, they told the truth. If it came up tails, they gave a random answer. He realized that if you gave people plausible deniability then they were more likely to tell the truth.

In the decades since, privacy violations from data analysis have become a much more pervasive problem. The field of privacy-preserving data analytics has developed to help alleviate these concerns, while still supporting meaningful data analysis. In this talk we will be focusing on one particular solution called "differential privacy". Differential privacy has at its core, a similar idea to Weber, that you have maintained someone's privacy if you give them plausible deniability. From a different view, differential privacy gives the guarantee that whatever (positive or negative) consequences that might happen to you as a result of the data analysis are almost equally as likely to occur whether or not your data is included.

We don't only lie because we are embarrassed. Sometimes we lie because the lie will result in someone else's action being more favorable towards us. For example, suppose I am being polled on how much I would pay for an apple. I might report a price below my true price, in the hope that the apple will be sold at the lower price. The pollster would like to design a system that encourages me to report truthfully. Even though I have no desire for privacy in this situation, it turns out that algorithms from the privacy literature can still help design such a system.

In this talk, we'll introduce differential privacy, mechanism design and the connection between them. We'll discuss a mechanism based on differential privacy such that each player is incentivized to tell the truth. This talk is based on this survey paper: http://www.cis.upenn.edu/~aaroth/Papers/PrivacyMDSurvey.pdf

From P.A. Smith to the present. Around 80 years ago, Smith proved the remarkable result that if a finite $p$-group $G$ acts on a compact space $X$ that has the mod $p$ homology of a sphere, then the fixed point space $X^G$ also has the mod $p$ homology of a sphere. Equivariant algebraic topology has developed in fits and starts ever since. I'll give some glimpses of current directions and questions.
Arithmetic Geometry Learning Seminar
Friday, November 10, 2017, 4:45pm-6:00pm
1866 East Hall
Charlotte Chan (UM)
Connections to automorphic forms