### Monday, September 25, 2017

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<thead>
<tr>
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<tbody>
<tr>
<td>4:00pm-5:30pm</td>
<td><strong>Geometry &amp; Physics</strong> -- Thomas Lam (UM) <em>Mirror symmetry for flag varieties via the Langlands program</em> (Joint with GLNT (Group, Li and Number Theory) seminar at GLNT time slot and seminar room) -- 4088 East Hall</td>
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<td><strong>Integrable Systems and Random Matrix Theory</strong> -- Guilherme Silva (University of Michigan) <em>Products of coupled random matrices</em> -- 1866 East Hall</td>
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### Tuesday, September 26, 2017

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<td><strong>Financial/Actuarial Mathematics</strong> -- Archil Gulisashvili (Ohio University) <em>Implied volatility skew in rough stochastic volatility models. Moderate deviation regime</em> -- 1360 East Hall</td>
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<td><strong>Algebraic Geometry</strong> -- June Huh (Institute for Advanced Study) <em>Negative correlation and Hodge-Riemann relations</em> -- 4096 East Hall</td>
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### Thursday, September 28, 2017

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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Topology</strong> -- Tyrone Ghaswala (University of Waterloo) <em>Mapping class groups, coverings, braids and groupoids</em> -- 1866 East Hall</td>
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<td><strong>Preprint Algebraic Geometry Seminar</strong> -- Devlin Mallory (UM) <em>Toric degenerations of projective varieties (following Kaveh-Murata)</em> -- 1866 East Hall</td>
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Friday, September 29, 2017

3:00pm-4:00pm  **Applied Interdisciplinary Mathematics** -- Deniz Bilman (University of Michigan) *A robust inverse scattering transform for the focusing nonlinear Schroedinger equation* -- 1084 East Hall

3:00pm-4:00pm  **Student Representation Theory** -- Francesca Gandini (University of Michigan) *Introduction to Schur-Weyl duality* -- 1866 East Hall

3:10pm-4:00pm  **Student Algebraic Geometry** -- Andrew Odesky (UM) *Kahler Differentials in Algebraic Geometry* -- 3096 East Hall

4:00pm-5:30pm  **Arithmetic Geometry Learning Seminar** -- Ashwath Rabindranath (UM) *Elliptic modules* -- 1866 East Hall

4:00pm-5:00pm  **Junior Colloquium Series** -- Visu Makam (University of Michigan) *Degree bounds for invariant rings of quivers* -- 3096 East Hall

4:10pm-5:00pm  **Colloquium Series** -- Pham Tiep (Rutgers University) *Representations of finite groups and applications* -- 1360 East Hall

4:10pm-5:00pm  **Combinatorics** -- Alexey Bufetov (MIT) *Hall-Littlewood RSK algorithm* -- 4088 East Hall

4:10pm-5:00pm  **Student AIM Seminar** -- Yitong Sun (University of Michigan) *Basics of Statistical Learning Theory* -- 1084 East Hall
Geometry & Physics
Monday, September 25, 2017, 4:00pm-5:30pm
4088 East Hall
Thomas Lam (UM)

Mirror symmetry for flag varieties via the Langlands program (Joint with GLNT (Group, Li and Number Theory) seminar at GLNT time slot and seminar room)

I will talk about a mirror theorem for minuscule flag varieties. The mirror theorem asserts that two systems of differential equations coincide: one arising from quantum cohomology, and the other from a Landau-Ginzburg model. The idea of the proof is to recognize the former as a Galois object and the latter as an automorphic object, and apply the (ramified) geometric Langlands correspondence. Some surprising connections to Kloosterman sums and sheaves will appear. This is joint work with Nicolas Templier.

Integrable Systems and Random Matrix Theory
Monday, September 25, 2017, 4:00pm-5:00pm
1866 East Hall
Guilherme Silva (University of Michigan)

Products of coupled random matrices

This talk will be a gentle survey on products of random matrices from the perspective of a non-specialist. The focus will be on the general picture and recent developments rather than in technical details and proofs.
**Student Combinatorics Seminar**  
*Monday, September 25, 2017, 4:00pm-5:00pm*  
*3866 East Hall*  
**Will Dana (University of Michigan)**  
*An introduction to the critical group of a graph and discrete harmonic functions*

The critical group of a graph (also known as the sandpile group or Jacobian) is an abelian group associated to the graph which appears in a variety of contexts. Among other examples, versions of this group have arisen from the "sandpile" or "chip-firing" model of statistical physics, analogies with algebraic curves, and inverse problems on electrical networks.

In this talk, I'll introduce the critical group and give a brief survey of its different interpretations. I will then focus on some work done with David Jekel (UCLA) and others at the University of Washington REU, inspired by the electrical network angle, which helps uncover information about the graph hidden in the critical group. A description of the group as a space of "discrete harmonic functions" provides tools for computing critical groups of families of graphs, connecting the structure of the group to symmetry in the graph, and investigating a type of reducibility relevant to the inverse problem.

**Group, Lie and Number Theory**  
*Monday, September 25, 2017, 4:10pm-5:30pm*  
*4088 East Hall*  
**Thomas Lam (UM)**  
*Mirror symmetry for flag varieties via the Langlands program (Joint with Geometry & Physics seminar)*

I will talk about a mirror theorem for minuscule flag varieties. The mirror theorem asserts that two systems of differential equations coincide: one arising from quantum cohomology, and the other from a Landau-Ginzburg model. The idea of the proof is to recognize the former as a Galois object and the latter as an automorphic object, and apply the (ramified) geometric Langlands correspondence. Some surprising connections to Kloosterman sums and sheaves will appear. This is joint work with Nicolas Templier.

**Student Geometry/Topology**  
*Tuesday, September 26, 2017, 3:00pm-4:00pm*  
*1866 East Hall*  
**Salman Siddiqi (University of Michigan)**  
*The structure and dynamics of the geodesic flow*

I will give an overview of results that relate the geometry of a manifold to the dynamics of its geodesic flow. This talk should be accessible to anyone with knowledge of basic Riemannian geometry.
Student Commutative Algebra  
Tuesday, September 26, 2017, 3:00pm-4:00pm  
4088 East Hall  
Matt Stevenson (University of Michigan)  
*Abhyankar valuations are quasi-monomial, I*

This is the first of two talks devoted to a theorem of Ein-Lazarsfeld-Smith, which states that Abhyankar valuations are quasi-monomial. The goal of this first lecture is to introduce these interesting classes of valuations along with their invariants, with a heavy emphasis on examples. Time permitting, we will discuss Zariski's proof that divisorial valuations are characterized via two such invariants; this is a special case of the theorem of Ein-Lazarsfeld-Smith, whose proof will be discussed in the second lecture.

Student Arithmetic  
Wednesday, September 27, 2017, 3:00pm-4:00pm  
3866 East Hall  
Yiwang Chen (UM)  
*L-functions and Class number*

Due to the nature that the class number is closely related to how far the unique factorization will fail for a ring, it is important to calculate the class number. Historically, it was Dirichlet who fully proved the special case of the quadratic field using analytical method in 1839. In this talk, we will discuss what the class number formula is, sketching of the proof, and, if time allows, the connection to the quadratic forms.
Financial/Actuarial Mathematics  
Wednesday, September 27, 2017, 4:00pm-5:00pm  
1360 East Hall  
Archil Gulisashvili (Ohio University)  
*Implied volatility skew in rough stochastic volatility models. Moderate deviation regime*

The talk presents a joint work with C. Bayer, P. K. Friz, B. Horvath, and B. Stemper. We study correlated rough stochastic volatility models, in which the volatility is described by a function of a Volterra type Gaussian process. An important special case of such a volatility process is the exponential of fractional Brownian motion. In our work, we obtain small-time asymptotic formulas in a moderate deviation regime for the call pricing function and the implied volatility in certain rough volatility models. M. Forde and S. Zhang established a large deviation principle for fractional stochastic volatility models, and also found a semi-explicit formula for the rate (energy) function. One of the main results of our work is a sharp asymptotic formula for the Forde-Zhang energy function. This formula generalizes to a non-Markovian setting the known energy expansion due to Y. Osajima. Another main result of our work is a small-time asymptotic formula in the moderate deviation regime for the implied volatility and the implied volatility skew. The skew formula is a generalization of known formulas obtained by E. Alos, J. Leon, and J. Vives, and by M. Fukasawa.

Algebraic Geometry  
Wednesday, September 27, 2017, 4:10pm-5:30pm  
4096 East Hall  
June Huh (Institute for Advanced Study)  
*Negative correlation and Hodge-Riemann relations*

All finite graphs satisfy the two properties mentioned in the title. I will explain what I mean by this, and speculate on generalizations and interconnections. This talk will be non-technical: Nothing will be assumed beyond basic linear algebra.

RTG Seminar on Geometry, Dynamics and Topology  
Wednesday, September 27, 2017, 7:00pm-5:30pm  
3866 East Hall  
Harry Bray (U Michigan)  
*Lyapunov Exponents in Hilbert Geometry*

Any bounded convex domain in projective space admits a Finsler metric preserved by projective transformations called the Hilbert metric. This metric is Riemannian only when the domain is the ellipsoid, in which case one recovers the Beltrami-Klein model of hyperbolic space. We are interested in the Hilbert geodesic flow of compact quotients of these domains by discrete, torsion free groups of projective transformations. In the talk we discuss a result of Mickael Crampon which describes the Lyapunov exponents of this geodesic flow in terms of the Holder regularity of the boundary of the domain.
Topology  
Thursday, September 28, 2017, 3:00pm-4:00pm  
1866 East Hall  
Tyrone Ghaswala (University of Waterloo)  
*Mapping class groups, coverings, braids and groupoids*

Given a finite-sheeted, possibly branched covering space between surfaces, it's natural to ask how the mapping class group of the covering surface relates to the mapping class group of the base surface. In this talk, we will take a journey through this question for surfaces with boundary. It will feature appearances from the fundamental groupoid, the Birman-Hilden theorem, the Burau representation and new embeddings of the braid group in mapping class groups.

This is joint work with Alan McLeay.

Commutative Algebra  
Thursday, September 28, 2017, 3:00pm-4:00pm  
4088 East Hall  
Patricia Klein (University of Michigan)  
*Questions arising from Lech’s inequality*

Lech's inequality states that if $(R,m)$ is a local ring and $I$ is an $m$-primary ideal, then $e_I(R) \leq (\dim R)! e_m(R) \ell(R/I)$. We will discuss a family of related inequalities.

Differential Equations  
Thursday, September 28, 2017, 4:00pm-5:00pm  
4088 East Hall  
Tao Luo (City Univ. Hong Kong)  
*On the Free Surface Motion of Highly Subsonic Heat-conducting Inviscid Flows*

In this talk, I will present a recent result joint with Huihui Zeng on the free surface problem of a highly subsonic heat-conducting inviscid flow. Adopting a geometric approach developed by Christodoulou and Lindblad in the study of the free surface problem of incompressible inviscid flows, we give the a priori estimates of Sobolev norms in 2-D and 3-D under the Taylor sign condition by identifying a suitable higher order energy functional. The estimates for some geometric quantities such as the second fundamental form and the injectivity radius of the normal exponential map of the free surface are also given. I will discuss the issues of the strong coupling of large variation of temperature, heat-conduction, compressibility of fluids and the evolution of free surface, loss of symmetries of equations, and loss of derivatives in closing the bootstrap argument which is a key feature compared with Christodoulou and Lindblad's work.
Logic
Thursday, September 28, 2017, 4:00pm-5:30pm
3096 East Hall
Simon Cho (University of Michigan)
A Category Theoretic Perspective on Continuous Logic, II

Although classical model theory is largely formulated in terms of the framework of sets, there is a rich theory that casts model theoretic structures in a category theoretic setting, a project which began with Lawvere's thesis on "functorial semantics of algebraic theories" and has since grown into an important subfield of category theory. This interface between classical model theory and category theory continues to be an active area of research today.

In parallel, Lawvere also showed that structures - such as metric spaces - seemingly unrelated to categories arose naturally as examples of categories with appropriate enrichments $\mathbb{V}$ (for example $\mathbb{V} = \mathbb{R}$ in the case of metric spaces). Now continuous logic/metric model theory is a generalization of classical model theory that, roughly, replaces sets with metric spaces and equality with the metric; a natural question to ask is whether the above perspective on metric spaces combines with the way of interpreting classical logic into category theory to produce a way to interpret continuous logic into enriched category theory. This talk will answer this in the affirmative, under reasonable conditions.

Preprint Algebraic Geometry Seminar
Thursday, September 28, 2017, 4:10pm-5:30pm
1866 East Hall
Devlin Mallory (UM)
Toric degenerations of projective varieties (following Kaveh-Murata)

Let $R$ be a finitely generated positively graded algebra and domain with $X = \text{Proj}(R)$. We construct a sequence of $d = \dim(X)$ flat degenerations (over affine line and with reduced and irreducible fibres) that degenerate $X$ to a (not necessarily normal) projective toric variety. As a corollary, we deduce that if $H_R(m)$ is the Hilbert function of $R$, then there is an integer $n > 0$ such that the function $m \mapsto H_R(nm)$ is the Hilbert function of a graded finitely generated lattice semigroup.
We propose a modification of the standard inverse scattering transform for the focusing nonlinear Schrödinger equation (also other equations by natural generalization). The purpose is to deal with arbitrary-order poles and potentially severe spectral singularities in a simple and unified way. As an application, we use the modified transform to place the Peregrine breather solution and related “rogue wave” solutions in an inverse-scattering context for the first time. This allows one to directly study the stability of such solutions. The modified transform method also allows rogue waves to be generated on top of other structures by elementary Darboux transformations, rather than the generalized Darboux transformations in the literature.

In this talk we will introduce an important theorem in representation theory that shows a surprising and deep connection between the representations of the general linear group and the representations of the symmetric group. Both groups act on the n-fold tensor product, but to figure out which irreducible representations appear in this space (and in particular with which multiplicity), one needs to study the simultaneous action of the two groups. Schur-Weyl Duality tells us that when one studies the action of the two groups, the decomposition of the n-fold tensor product into irreducible representations is actually multiplicity free. This talk will be accessible to graduate students of all years, but some familiarity with partitions and group algebras will be beneficial.

In this elementary talk we’ll introduce the Kahler differentials and see some of their applications in algebraic geometry. First we will use them to define what it means for a variety to be smooth at a point. Then, we will make use of them to define the algebraic de Rham cohomology of an affine algebraic variety. We will compute some examples and see more interesting applications as time permits. The talk should be accessible to students currently in the algebraic geometry sequence.
Arithmetic Geometry Learning Seminar  
Friday, September 29, 2017, 4:00pm-5:30pm  
1866 East Hall  
Ashwath Rabindranath (UM)  
*Elliptic modules*

Junior Colloquium Series  
Friday, September 29, 2017, 4:00pm-5:00pm  
3096 East Hall  
Visu Makam (University of Michigan)  
*Degree bounds for invariant rings of quivers*

Colloquium Series  
Friday, September 29, 2017, 4:10pm-5:00pm  
1360 East Hall  
Pham Tiep (Rutgers University)  
*Representations of finite groups and applications*

In the first part of the talk we will survey some recent results on representations of finite groups. In the second part we will discuss applications of these results to various problems in group theory, number theory, and algebraic geometry.

Combinatorics  
Friday, September 29, 2017, 4:10pm-5:00pm  
4088 East Hall  
Alexey Bufetov (MIT)  
*Hall-Littlewood RSK algorithm*

The classical RSK algorithm is a profound combinatorial object which is closely related to properties of Schur symmetric functions. I will present a recent generalization of this algorithm to the case of Hall-Littlewood functions, and discuss its combinatorial and probabilistic properties. Based on a joint work with K. Matveev.
Student AIM Seminar  
Friday, September 29, 2017, 4:10pm-5:00pm  
1084 East Hall  
Yitong Sun (University of Michigan)  
Basics of Statistical Learning Theory

Statistical learning theory provides the general framework for analyzing the performance of supervised learning algorithms. In this talk, I will illustrate some basic concepts that are essential for the study of learning rate of an algorithm, using a simple example, where a weird distribution is successfully learned by a surprisingly simple algorithm. And at the end, I will briefly discuss the implication of Devroye’s No Free Lunch Theorem, and how the fast learning rate is possible for kernel support vector machine.