### Monday, October 01, 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Dynamics</strong> -- Bradley Zykoski (University of Michigan) <em>Counting simple geodesics, part I: Integration over moduli space</em> -- 1060 East Hall</td>
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<tr>
<td>4:00pm-5:20pm</td>
<td><strong>Group, Lie and Number Theory</strong> -- Serin Hong (University of Michigan) <em>Harris-Viehmann conjecture for Rapoport-Zink spaces of Hodge type</em> -- 4088 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Student Combinatorics</strong> -- Will Dana (University of Michigan) <em>Electrifying Random Trees</em> -- 3866 East Hall</td>
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<td>4:00pm-5:00pm</td>
<td><strong>Integrable Systems and Random Matrix Theory</strong> -- Peter Miller (University of Michigan) <em>Some Interesting Solutions of the Painlevé-III Equation</em> -- 1866 East Hall</td>
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<tr>
<td>4:00pm-6:00pm</td>
<td><strong>Geometry &amp; Physics</strong> -- Ming Zhang (Michigan) <em>Verlinde/Grassmanian Correspondence</em> -- 4096 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Topology</strong> -- Jeremy Miller (Purdue University) <em>(SPECIAL DAY &amp; TIME) Integral generation of Steinberg modules</em> -- 3088 East Hall</td>
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### Tuesday, October 02, 2018

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>11:30am-1:00pm</td>
<td><strong>Teaching Mathematics</strong> -- Discussion <em>(Learning Community on Inclusive Teaching, F18 Discussion 1)</em> -- 4866 East Hall</td>
</tr>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Geometry/Topology</strong> -- Nicholas Wawrykow (University of Michigan) <em>Mostow Rigidity</em> -- 1866 East Hall</td>
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<tr>
<td>3:00pm-3:50pm</td>
<td><strong>Student Commutative Algebra</strong> -- Devlin Mallory (University of Michigan) <em>Valuation Rings</em> -- 4088 East Hall</td>
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<tr>
<td>5:10pm-6:00pm</td>
<td><strong>Colloquium Series</strong> -- Walter Schachermayer (University of Vienna) <em>Van E enam Lecture 1: The Amazing Power of Dimensional Analysis in Finance: Market Impact and the Intraday Trading Invariance Hypothesis</em> -- 1360 East Hall</td>
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### Wednesday, October 03, 2018

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<tbody>
<tr>
<td>3:00pm-3:50pm</td>
<td><strong>Student Arithmetic</strong> -- Alex Horawa (University of Michigan) <em>Modular forms and elliptic curves</em> -- 4096 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Financial/Actuarial Mathematics</strong> -- Walter Schachermayer (University of Vienna) <em>Van E enam Lecture 2: Cover's Universal Portfolio, Stochastic Portfolio Theory and the Numeraire Portfolio</em> -- 1360 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:20pm</td>
<td><strong>Algebraic Geometry</strong> -- Shigeru Mukai (Kyoto) <em>Abelian surfaces of degree 10 and Fano 3-folds of degree 22</em> -- 4096 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:30pm</td>
<td><strong>RTG Seminar on Geometry, Dynamics and Topology</strong> -- Giuseppe Martone (U(M)) <em>Positive coordinates for Higher Teichmueller spaces</em> -- 3866 East Hall</td>
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### Thursday, October 04, 2018

**1:00pm-2:30pm**  
**Student Homotopy Theory** -- Montek Gill (University of Michigan)  
*The (infinity,1)-category of spaces and the stable (infinity,1)-category of spectra* -- 2866 East Hall

**3:00pm-4:00pm**  
**Commutative Algebra** -- Mel Hochster (University of Michigan)  
*A survey of recent breakthroughs and remaining conjectures* -- 4088 East Hall

**4:00pm-5:00pm**  
**Financial/Actuarial Mathematics** -- Walter Schachermayer (University of Vienna)  
*Van Eenum Lecture 3: A Trajectorial Interpretation of Doob's Martingale Inequalities.* -- 1360 East Hall

**4:00pm-5:00pm**  
**Differential Equations** -- Pengyu Le (Umich)  
*Perturbations of Null Hypersurfaces and the Null Penrose Inequality* -- 4088 East Hall

**4:00pm-5:00pm**  
**Student Algebraic Geometry** -- James Hotchkiss (UM)  
*An Introduction to Monodromy* -- 3866 East Hall

**4:00pm-5:30pm**  
**Logic** -- Andreas Blass (Univ. of Michigan)  
*Choice from finite sets* -- 3096 East Hall

### Friday, October 05, 2018

**3:00pm-4:00pm**  
**Applied Interdisciplinary Mathematics (AIM)** -- Pavel Bochev (Sandia National Laboratories)  
*Compatible mesh-free methods* -- 1084 East Hall

**3:00pm-4:00pm**  
**Geometry** -- Yair Minsky (Yale)  
*Stable cubulations and barycenters in the mapping class group* -- 3866 East Hall

**3:00pm-4:00pm**  
**Combinatorics** -- Eric Bucher (Xavier University)  
*Locally acyclic cluster algebras and reddening sequences* -- 2866 East Hall

**4:00pm-5:00pm**  
**Student AIM Seminar** -- Pavel Bochev (Sandia National Laboratory)  
*National Lab Career Path Q&A* -- 1084 East Hall

**5:00pm-6:00pm**  
**Student Machine Learning** -- Saibal De (University of Michigan)  
*Active Classification using Adaptive Sub-modularity* -- 4088 East Hall
Student Dynamics
Monday, October 01, 2018, 3:00pm-4:00pm
1060 East Hall
Bradley Zykoski (University of Michigan)

Counting simple geodesics, part I: Integration over moduli space

Two weeks ago, Salman told us about the methods used to asymptotically count the number of closed geodesics on a hyperbolic surface. What if we change the question, and only try to count simple closed geodesics (i.e., those without self-intersections)? This week, I will tell part of the story of how Maryam Mirzakhani addressed this question. Her approach requires us to know how to integrate certain functions over the moduli space of bordered Riemann surfaces, and so I will focus on a formula she has given us for doing this.

Group, Lie and Number Theory
Monday, October 01, 2018, 4:00pm-5:20pm
4088 East Hall
Serin Hong (University of Michigan)

Harris-Viehmann conjecture for Rapoport-Zink spaces of Hodge type

The l-adic cohomology of Rapoport-Zink spaces, or more generally local Shimura varieties, is expected to realize many cases of the local Langlands correspondence. Along this line is a conjecture by Harris and Viehmann, which roughly predicts that when the underlying Rapoport-Zink space is not basic, the l-adic cohomology of the space should be parabolically induced, thereby containing no supercuspidal representations. In this talk, we will discuss a result towards this conjecture when the underlying Rapoport-Zink space is of Hodge type and "Hodge-Newton reducible". The main strategy is to embed our Rapoport-Zink space to an appropriate space of EL type, for which the conjecture is already known to hold. If time permits, we will also discuss other applications of this strategy.
Student Combinatorics  
**Monday, October 01, 2018, 4:00pm-5:00pm**  
3866 East Hall  
**Will Dana (University of Michigan)**  
*Electrifying Random Trees*

A fundamental construction on a graph is that of a spanning tree: a subgraph that connects all the vertices using as few edges as possible. From a probabilistic point of view, there are a couple of natural questions about spanning trees: How can we generate one at random such that they are all equally likely? And what does a "typical" spanning tree look like?

In this talk, we'll demonstrate a simple algorithm answering the first question using random walks, and then use it to approach a specific question in the vein of the second one: what is the probability of a random spanning tree containing a given edge? In the process, we'll encounter a shocking connection with the theory of electrical networks, in which relevant probabilities are given by physical quantities in an electrical network based on the graph.

Integrable Systems and Random Matrix Theory  
**Monday, October 01, 2018, 4:00pm-5:00pm**  
1866 East Hall  
**Peter Miller (University of Michigan)**  
*Some Interesting Solutions of the Painleve-III Equation*

This talk will survey two recent studies of solutions of the Painleve-III equation. First, we describe work with T. Bothner and Y. Sheng on the asymptotic behavior of rational solutions of the Painleve-III equation in the limit where the degree is large. Then we turn to a class of rational solutions of a different equation, namely the focusing nonlinear Schrodinger equation, which are believed to model rogue waves. In work with D. Bilman and L. Ling we studied the fundamental rogue wave solutions in the limit of large order, and found a new transcendental solution of the focusing nonlinear Schrodinger equation that we call the rogue wave of infinite order. This solution turns out to also satisfy ordinary differential equations in the Painlevé-III hierarchy.

Geometry & Physics  
**Monday, October 01, 2018, 4:00pm-6:00pm**  
4096 East Hall  
**Ming Zhang (Michigan)**  
*Verlinde/Grassmanian Correspondence*
Assuming the generalized Riemann hypothesis, we show that the Steinberg module of SL_n of a number ring is generated by integral apartments if and only if the ring is Euclidean. Our methods give new examples of rings where the cohomological dimension of SL_n agrees with the virtual cohomological dimension. This is joint with Peter Patzt, Jennifer Wilson, and Dan Yasaki.

In this session we will continue to discuss issues of Inclusivity in mathematics. Readings for discussion will be posted at http://www.math.lsa.umich.edu/~glarose/dept/teaching/icit.html.

In two dimensions the topology of a hyperbolic manifold permits a great deal of flexibility in the manifold's metric structure. The study of the space of equivalent Riemannian metrics is the focus of Teichmueller theory. In three dimensions such an analogous theory would be trivial: the structure of a hyperbolic manifold is uniquely determined by its fundamental group. In this talk I will discuss this fact, a result of Mostow (1968), and sketch a version of Gromov's 1981 proof based on the notion of simplicial volume. If time permits I will discuss ideas inspired by Mostow rigidity including Margulis superrigidity.
Valuation rings are ubiquitous throughout commutative algebra, algebraic geometry, and beyond. Beyond their innate interest, they provide a convenient and unifying framework in which to discuss integral closure of rings and ideals, birational models of varieties, and algebraic analogues of the topological notions of compactness and Hausdorff-ness. They also serve as a natural motivation and introduction for the study of nonnoetherian rings. In this talk, we'll define valuation rings and give plenty of examples in both the noetherian and nonnoetherian cases; after discussing some of their basic properties, we'll focus on how valuation rings can be used to study integral closures, singular rings, and various valuative criteria.

The talk will be example-based and should be accessible to students currently taking 614.

Colloquium Series
Tuesday, October 02, 2018, 5:10pm-6:00pm
1360 East Hall
Walter Schachermayer (University of Vienna)
Van Eenam Lecture 1: The Amazing Power of Dimensional Analysis in Finance: Market Impact and the Intraday Trading Invariance Hypothesis

A basic problem when trading in financial markets is to analyze the prize movement caused by placing an order. Clearly we expect - ceteris paribus - that placing an order will move the price to the disadvantage of the agent. This price movement is called the market impact. Following the recent work of A. Kyle and A. Obizhaeva we apply dimensional analysis - a line of arguments wellknown in classical physics - to analyze to which extent the square root law applies. This universal law claims that the market impact is proportional to the square root of the size of the order. We also analyze the dependence of the trading activity on a stock, i.e. number of trades per unit of time, in dependence of some suitable explanatory variables. Dimensional analysis leads to a 2/3 law: the number of trades is proportional to the power 2/3 of the exchanged risk. The mathematical tools of this analysis reside on elementary linear algebra. Joint work with Mathias Pohl, Alexander Ristig and Ludovic Tangpi.
Student Arithmetic
Wednesday, October 03, 2018, 3:00pm-3:50pm
4096 East Hall
Alex Horawa (University of Michigan)
Modular forms and elliptic curves

The key step in the proof of Fermat’s Last Theorem is the celebrated modularity conjecture, asserting that “any elliptic curves is modular”. To understand what this means and why this statement would be reasonable, one must first go the other way: show that “any modular form is elliptic” (under some conditions). The goal of this talk is to outline this construction without assuming familiarity with modular forms or elliptic curves. Time permitting, I’ll also discuss how this allows to associate a Galois representation to a modular form.

Financial/Actuarial Mathematics
Wednesday, October 03, 2018, 4:00pm-5:00pm
1360 East Hall
Walter Schachermayer (University of Vienna)
Van Eenam Lecture 2: Cover’s Universal Portfolio, Stochastic Portfolio Theory and the Numeraire Portfolio

Cover’s celebrated theorem states that the long run yield of a properly chosen “universal” portfolio is almost as good as that of the best retrospectively chosen constant rebalanced portfolio. The “universality” refers to the fact that this result is model-free, i.e., not dependent on an underlying stochastic process. We extend Cover’s theorem to the setting of stochastic portfolio theory: the market portfolio is taken as the numeraire, and the rebalancing rule need not be constant anymore but may depend on the current state of the stock market. By fixing a stochastic model of the stock market this model-free result is complemented by a comparison with the numeraire portfolio. Roughly speaking, under appropriate assumptions the asymptotic growth rate coincides for the three approaches mentioned in the title of this paper. We present results in both discrete and continuous time.

Algebraic Geometry
Wednesday, October 03, 2018, 4:00pm-5:20pm
4096 East Hall
Shigeru Mukai (Kyoto)
Abelian surfaces of degree 10 and Fano 3-folds of degree 22

The (compactified) moduli of abelian surfaces of degree 10 with bilevel structure is a small contraction of the blow-up of the projective space at 60 points. I will give two proofs. One is analytic and uses good automorphic forms constructed by Gritsenko-Nikulin. The other is algebraic and uses U22, one of the Umemura 3-folds, and Reye congruences.
Shear and lambda-lengths coordinates parametrize two different versions of the Teichmüller space of a surface S with boundary and marked points.

Fock and Goncharov greatly generalized this picture by connecting it to Lusztig's theory of total positivity. Among other things, they introduced two new (dual) Higher Teichmüller spaces for S, and they proved that each of these spaces admits a "positive part". Moreover, they parametrized these positive parts using coordinates for moduli spaces of flags. The coordinate changes are explicitly described using tools coming from cluster algebras.

This series of talks will start by recalling the classical examples in an easy-to-generalize framework. As a consequence, very little background will be needed.

Student Homotopy Theory
Thursday, October 04, 2018, 1:00pm-2:30pm
2866 East Hall
Montek Gill (University of Michigan)
The (infinity,1)-category of spaces and the stable (infinity,1)-category of spectra

I will introduce (infinity,1)-categories (via the model of quasicategories, often called just infinity-categories) and some basics associated to them, such as (infinity,1)-colimits and (infinity,1)-limits. I will then describe the construction of the (infinity,1)-category of spaces. I will also introduce stable (infinity,1)-categories and describe how to construct the stable (infinity,1)-category of spectra.

Commutative Algebra
Thursday, October 04, 2018, 3:00pm-4:00pm
4088 East Hall
Mel Hochster (University of Michigan)
A survey of recent breakthroughs and remaining conjectures

This is the third of three talks that will discuss recent progress on the direct summand conjecture, existence of big Cohen-Macaulay modules and algebras, the local homological conjectures more generally, Stillman's conjecture, the Eisenbud-Goto conjecture, and the Buchsbaum-Eisembud-Horrocks conjecture. I will present what is known, and, in each case, a substantial question or set of questions that remains open.
Financial/Actuarial Mathematics  
Thursday, October 04, 2018, 4:00pm-5:00pm  
1360 East Hall  
Walter Schachermayer (University of Vienna)  
Van Eenam Lecture 3: A Trajectorial Interpretation of Doob’s Martingale Inequalities.

We present a unified approach to Doob’s Lp maximal inequalities for $1 \leq p < \infty$. The novelty of our method is that these martingale inequalities are obtained as consequences of elementary deterministic counterparts. The latter have a natural interpretation in terms of robust hedging. Moreover, our deterministic inequalities lead to new versions of Doob's maximal inequalities. These are best possible in the sense that equality is attained by properly chosen martingales.
Differential Equations
Thursday, October 04, 2018, 4:00pm-5:00pm
4088 East Hall
Pengyu Le (Umich)

Perturbations of Null Hypersurfaces and the Null Penrose Inequality

The Penrose inequality is a conjectured inequality between the area of the horizon and the mass of a black-hole spacetime. The null Penrose inequality is the case where it concerns the area of the horizon and the Bondi mass at null infinity along a null hypersurface. An effective method to prove Penrose-type inequalities is to exploit the monotonicity of the Hawking mass along certain foliations, e.g. the Riemannian Penrose inequality is proven by this method using the inverse mean curvature flow by Huisken and Ilmanen [HI] (another approach is the conformal flow by Bray [Br]). In his thesis [S], Sauter constructed the constant mass aspect function foliation aiming to prove the null Penrose inequality. The behavior of the foliation at past null infinity is an obstacle for his method. An idea to overcome this difficulty, which is suggested in the end of [S], is to vary the null hypersurface to achieve the desired behavior of the foliation at null infinity, leading to a spacetime version of the Penrose inequality. To formalise this idea, one need to study perturbations of null hypersurfaces. I will talk about my work on the study of perturbations of null hypersurfaces and its application to the null Penrose inequality.

References
[S] Sauter, J. Foliations of Null Hypersurfaces and the Penrose Inequality, Diss. ETH No.17842.

Student Algebraic Geometry
Thursday, October 04, 2018, 4:00pm-5:00pm
3866 East Hall
James Hotchkiss (UM)

An Introduction to Monodromy

The goal of this talk is to present an informal introduction to the subject of monodromy in families of algebraic varieties. After reviewing the classification of quadric surfaces, I will construct a family of quadric surfaces whose rulings are exchanged under monodromy. Then I will introduce the (local) monodromy representation, and explain the relationship between monodromy and limits of subvarieties described by the Local Invariant Cycle Theorem. The algebro-geometric prerequisites will be minimal; for instance, the geometry of quadric surfaces will be developed from scratch. Some familiarity with singular cohomology will be assumed in the second half of the talk.
I'll discuss weak forms of the axiom of choice, A(I,n), saying that every I-indexed family of n-element sets has a choice function. (Here I is just a set and n a natural number, but to avoid trivialities I should be infinite and n should be at least 2.) More specifically, I'll discuss implications of the following two sorts, where Z is a finite set of natural numbers.

Global: If A(I,z) holds for all I and all z in Z, then A(I,n) holds for all I.

Local: For all I, if A(I,z) holds for all z in Z then A(I,n) holds.

After giving a couple of examples, I'll discuss the connection between such implications and group-theoretic properties of Z and n. There are also connections with number-theoretic questions about representations of numbers as sums of primes. Finally, in the unlikely event that time permits, I'll say something about a connection with topos theory.
Particle and mesh-free methods offer significant computational advantages in settings where quality mesh generation required for many compatible PDE discretizations may be expensive or even intractable. At the same time, the lack of underlying geometric grid structure makes it more difficult to construct mesh-free methods mirroring the discrete vector calculus properties of mesh-based compatible and mimetic discretization methods. In this talk we survey ongoing efforts at Sandia National Laboratories to develop new classes of locally and globally compatible meshfree methods that attempt to recover some of the key properties of mimetic discretization methods.

We will present two examples of recently developed "mimetic"-like meshfree methods. The first one is motivated by classical staggered discretization methods. We use the local connectivity graph of a discretization particle to define locally compatible discrete operators. In particular, the edge-to-vertex connectivity matrix of the local graph provides a topological gradient, whereas a generalized moving least-squares (GMLS) reconstruction from the edge midpoints defines a divergence operator. The second method can be viewed as a meshfree analogue of a finite volume type scheme. In this method, the metric information that would be normally provided by the mesh, such as cell volumes and face areas, is reconstructed algebraically, without a mesh. This reconstruction process effectively creates virtual cells having virtual faces and ensures a local conservation property matching that of mesh-based finite volumes. In contrast to similar recent efforts our approach does not involve a solution of a global optimization problem to find the virtual cell volumes and faces areas. Instead, we determine the necessary metric information by solving a graph Laplacian problem that can be effectively preconditioned by algebraic multigrid.

Several numerical examples will illustrate the mimetic properties of the new meshfree schemes. The talk will also review some of the ongoing work to build a modern software toolkit for mesh-free and particle discretizations that leverages Sandia's Trilinos library and performance tools such as Kokkos.

This is joint work with N. Trask, M. Perego, P. Bosler, P. Kuberry, and K. Peterson.
Geometry  
Friday, October 05, 2018, 3:00pm-4:00pm  
3866 East Hall  
Yair Minsky (Yale)  

*Stable cubulations and barycenters in the mapping class group*

The coarse geometry of mapping class groups is analogous in many ways to that of CAT(0) cube complexes. Behrstock-Hagen-Sisto showed that one can model coarse convex hulls of finite sets in the group, quasi-isometrically, by such cube complexes. We strengthen this construction, using ideas of Bestvina-Bromberg-Fujiwara-Sisto, to obtain a certain stability property in which the cubical structure itself changes in a controlled way under change of the data. This can then be applied to prove the existence of a coarse barycenter map for finite sets, as well as a bicombing of the group. Joint work with Matt Durham and Alessandro Sisto.

Combinatorics  
Friday, October 05, 2018, 3:00pm-4:00pm  
2866 East Hall  
Eric Bucher (Xavier University)  

*Locally acyclic cluster algebras and reddening sequences*

In this talk we show that a reddening sequence exists for any quiver which is Banff. The proofs are combinatorial and rely on the direct sum construction for quivers. In general, Banff quivers define locally acyclic cluster algebras which are known to coincide with their upper cluster algebras. The existence of reddening sequences for these quivers is consistent with a conjectural relationship between the existence of either a maximal green or reddening sequence and a cluster algebra's equality with its upper cluster algebra. Moreover, this completes a verification of the conjecture for Banff quivers.

Student AIM Seminar  
Friday, October 05, 2018, 4:00pm-5:00pm  
1084 East Hall  
Pavel Bochev (Sandia National Laboratory)  

*National Lab Career Path Q&A*

Dr. Bochev will discuss the national lab career path and open the floor to questions.

Student Machine Learning  
Friday, October 05, 2018, 5:00pm-6:00pm  
4088 East Hall  
Saibal De (University of Michigan)  

*Active Classification using Adaptive Sub-modularity*

Adaptive sub-modularity is a relatively new topic in Machine Learning. In this talk, I will discuss how it is used in the context of active learning for classification problems.