## Monday, October 21, 2019

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<tr>
<th>Time</th>
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<tr>
<td>12:00pm-12:50pm</td>
<td><strong>Mathematical Biology</strong> -- Nigel Goldenfeld (Univ of Illinois Urbana-Champaign Dept of Physics)</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Student Combinatorics</strong> -- Yutong Li () <strong>Tokuyama's Formula and Ice Models</strong> -- 3096 East Hall</td>
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<td><strong>RTG Seminar on Number Theory</strong> -- Michal Zydor (University of Michigan) <strong>Integral quadratic forms, theta series and modular forms</strong> -- 3866 East Hall</td>
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<td>4:00pm-5:00pm</td>
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<td><strong>Geometry &amp; Physics</strong> -- Shuai Wang (Columbia University) <strong>Relative Gromov-Witten theory and vertex operators</strong> -- 4096 East Hall</td>
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<td>4:10pm-5:00pm</td>
<td><strong>Group, Lie and Number Theory</strong> -- Isabel Vogt (Stanford University) <strong>Low degree points on curves</strong> -- 4088 East Hall</td>
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<td>5:00pm-6:00pm</td>
<td><strong>Student Analysis</strong> -- Yueqiao Wu (University of Michigan) <strong>The Complex Monge-Ampère Equation</strong> -- 2866 East Hall</td>
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<td>5:00pm-6:00pm</td>
<td><strong>Operators in Complex Analysis</strong> -- Yunus Zeytuncu (University of Michigan-Dearborn) <strong>An Analog of the Weyl Law for the Kohn Laplacian on CR Manifolds</strong> -- 3096 East Hall</td>
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<td>5:30pm-6:30pm</td>
<td><strong>Chromatic Homotopy Theory</strong> -- Shubhodip Mondal (UM) <strong>Homology of MU, complex orientation and statement of Quillen’s theorem.</strong> -- 3088 East Hall</td>
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## Tuesday, October 22, 2019

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## Wednesday, October 23, 2019

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<td><strong>Student Homotopy Theory</strong> -- Angela Maennela (University of Michigan) <strong>Characteristic classes</strong> -- 1372 East Hall</td>
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### Thursday, October 24, 2019

3:00pm-4:00pm  **Commutative Algebra** -- Zhan Jiang (University of Michigan) *This talk is postponed because of the CRLT presentation 3-5. No seminar this week.* -- 4088 East Hall

4:00pm-5:30pm  **Arithmetic Geometry Learning** -- Shizhang Li (UM) *Solid abelian groups, II* -- 4096 East Hall

5:00pm-6:00pm  **Topology** -- Aaron Calderon (Yale) *(SPECIAL TIME AND PLACE)* New coordinates for Teichmüller space and applications to flat and hyperbolic geometry -- 335 West Hall

5:30pm-6:30pm  **Quant Program Practitioner** -- Mark Schmude (MSCI) MSCI -- LSA3254

### Friday, October 25, 2019

3:00pm-4:00pm  **Applied Interdisciplinary Mathematics (AIM)** -- Hanliang Guo (University of Michigan) *Building towards a scalable computational framework of ciliary-flow in complex geometries* -- 1084 East Hall

3:00pm-4:00pm  **Combinatorics** -- Alexander Garver (University of Michigan) *Chapoton triangles and nonkissing complexes* -- 4096 East Hall

3:00pm-3:50pm  **Geometry** -- Nikhil Savale (Univ. of Cologne) *Spectrum and abnormalities in sub-Riemannian geometry* -- 3866 East Hall

3:00pm-4:00pm  **Special Events** -- Jack Burkart (Stony Brook University) *Dimension in Holomorphic Dynamics* -- 2866 East Hall

4:00pm-5:00pm  **Geometry** -- Ben Schmidt (MSU) *Preserve one, preserve all* -- 3866 East Hall

4:00pm-5:00pm  **Junior Colloquium Series** -- Shravan Veerapaneni (Michigan) *Fast and accurate methods for solving Stokes equations on moving domains* *(Research at Michigan Series)* -- 3088 East Hall

4:00pm-5:30pm  **Preprint Algebraic Geometry** -- Bogdan Zavyalov (Stanford/UM) *Purity for the Brauer group, following Cesnavicus* -- 2866 East Hall
Abstracts for the week of October 20th, 2019 - October 26th, 2019

Mathematical Biology
Monday, October 21, 2019, 12:00pm-12:50pm
335 West Hall
Nigel Goldenfeld (Univ of Illinois Urbana-Champaign Dept of Physics)
Stochastic Turing Patterns in Oceans, Brains and Biofilms

Why are the patterns of plankton in the ocean so patchy? Why do frequently described geometrical hallucinations tend to fall into one of four different classes of pattern? Why don't we see hallucinations all the time? And why do populations in ecosystems tend to have noisy cycles in abundance? This talk explains how these phenomena all arise from the discreteness of the underlying entities, be they the on-off states of neurons or the numbers of bacteria in a fluid volume of ocean, or the number of signaling molecules in a biofilm. I explain how tools from statistical mechanics can yield insights into these phenomena, and report on a range of studies that include the operation of the primate visual cortex, the behavior of signalling molecules in a forward-engineered synthetic biofilm, and the fluctuating patterns and populations of marine organisms.

Student Combinatorics
Monday, October 21, 2019, 3:00pm-4:00pm
3096 East Hall
Yutong Li ()
Tokuyama's Formula and Ice Models

A classical result in combinatorial representation theory states that irreducible characters of general linear groups may be defined as a sum over semi-standard Young tableaux. It turns out that a generating function due to Tokuyama, which recovers a deformation of the Weyl character formula, can be expressed in a similar spirit. In this talk, we will explore the connection between different combinatorial interpretations of Tokuyama's formula and, in particular, introduce a type of statistical mechanical model known as the six-vertex, or "ice-type" models.
Student Dynamics  
Monday, October 21, 2019, 3:00pm-4:00pm  
3866 East Hall  
Sayantan Khan (UM)  
Counting orbit points and Patterson-Sullivan measures

In this talk, we’ll see how one counts the orbit points under the action of a cocompact lattice (i.e. the fundamental group of a compact hyperbolic surface), and how tools from dynamics are useful in doing so. We will then attempt to do the same for a larger class of groups, namely convex cocompact groups (which are fundamental groups of certain infinite volume hyperbolic surfaces), and in the attempt, discover the need for a measure on the boundary of the hyperbolic space with certain remarkable properties. This will be the Patterson-Sullivan measure, and we’ll see how to construct it, and time permitting, use this to count orbit points of convex-cocompact groups.

RTG Seminar on Number Theory  
Monday, October 21, 2019, 3:00pm-4:00pm  
4088 East Hall  
Michal Zydor (University of Michigan)  
Integral quadratic forms, theta series and modular forms

I will talk about the problem of representing integers by integral quadratic forms and its relation to theta series and modular forms.

Complex Analysis, Dynamics and Geometry  
Monday, October 21, 2019, 4:00pm-5:00pm  
3866 East Hall  
Jeffrey Diller (University of Notre Dame)  
A transcendental dynamical degree

Any plane rational self-map $f: \mathbb{P}^2 \to \mathbb{P}^2$ has an ‘algebraic degree’ defined to be the common degrees of its components in homogeneous coordinates. The sequence $(\deg f^n)$ always grows like a power $L^n$ of some number $L$, the ‘dynamical degree’, which is a fundamental invariant for the dynamics of $f$. The dynamical degree is (in some sense) typically an integer, equal to the degree of $f$, and there are only countably many possibilities for its value in general. Nevertheless, I will describe joint work with Jason Bell and Mattias Jonsson in which we give a specific example where the first dynamical degree turns out to be a transcendental number.
Geometry & Physics
Monday, October 21, 2019, 4:00pm-5:00pm
4096 East Hall
Shuai Wang (Columbia University)
Relative Gromov-Witten theory and vertex operators

We study the relative Gromov-Witten theory on $T^*\mathbb{P}^1 \times \mathbb{P}^1$ and show that certain equivariant limits give us the relative invariants on $\mathbb{P}^1 \times \mathbb{P}^1$. By formulating the quantum multiplications on $\text{Hilb}(T^*\mathbb{P}^1)$ computed by Devash Maulik and Alexei Oblomkov as vertex operators and computing the product expansion, we demonstrate how to get the insertion and tangency operators computed by Yaim Cooper and Rahul Pandharipande in the equivariant limits.

Student Algebraic Geometry
Monday, October 21, 2019, 4:00pm-5:00pm
B745 East Hall
Will Dana (UM)
A Biased Introduction to Weighted Projective Space

After one learns how to associate affine schemes to rings, the typical next step in a course in algebraic geometry is to add the extra structure of a grading, and associate projective schemes to graded rings. However, one aspect of this which is rarely explored is what happens when we mess around with the grading of a ring while keeping its ring structure the same.

When we apply the Proj construction to a polynomial ring with nonstandard grading, we get "weighted projective space", a type of variety which resembles ordinary projective space in some ways, but is notably different in others. In this talk, we'll examine the basic properties of weighted projective spaces and get a sense for their shape. We'll also see examples of how using weighted projective space as an ambient space in place of the conventional version allows us to realize projective varieties in interesting new ways.

This will be a relaxed talk, and most of it should be accessible to anyone who has an idea of what "Proj" means.
In this talk we will discuss an arithmetic analogue of the gonality of a curve over a number field: the smallest positive integer $e$ such that the points of residue degree bounded by $e$ are infinite. By work of Faltings, Harris--Silverman and Abramovich--Harris, it is well-understood when this invariant is 1, 2, or 3; by work of Debarre--Fahlaoui these criteria do not generalize to $e$ at least 4. We will study this invariant using the auxiliary geometry of a surface containing the curve and devote particular attention to scenarios under which we can guarantee that this invariant is actually equal to the gonality. This is joint work with Geoffrey Smith.

Monge-Ampère equations arise in many areas of math, most notably in differential geometry, optimal transport and fluid dynamics. In this talk, we will focus on the Dirichlet problem for the complex Monge-Ampère equation in a strictly pseudoconvex domain with continuous data. After briefly recalling how Perron method works for finding the solution to the classical Laplacian equation, we will see how the same method leads to the solution to the Dirichlet problem for the complex Monge-Ampère equation. Time permitting, we will also briefly mention what Monge-Ampère type equations look like in a more general setup, e.g. on complex manifolds or over different ground fields, and explore how they relate to the geometry of Kähler manifolds, or more generally the geometry of projective varieties. No background in pdes or several complex variables will be assumed.

In this talk, we present some recent calculations on the distribution of eigenvalues of the Kohn Laplacian on CR manifolds. In particular, we calculate the asymptotic expansion of the eigenvalue counting function on the sphere.
Chromatic Homotopy Theory  
**Monday, October 21, 2019, 5:30pm-6:30pm**  
3088 East Hall  
**Shubhodip Mondal (UM)**  
*Homology of MU, complex orientation and statement of Quillen’s theorem.*  

Following lecture 6 and 7 from http://www.math.harvard.edu/~lurie/252x.html.

Student Commutative Algebra  
**Tuesday, October 22, 2019, 3:00pm-3:50pm**  
4088 East Hall  
**Eric Canton (University of Michigan)**  
*F-Words*  

An introduction to F-singularities.

Student Geometry/Topology  
**Tuesday, October 22, 2019, 3:00pm-4:00pm**  
3866 East Hall  
**Harry Richman (UM)**  
*What is the Jacobian of a curve?*  

Lots of mathematicians like using Jacobians, and not all of them like to use the same definition. In this talk I will give my favorite definition of the Jacobian, which applies for both algebraic and tropical curves. I will discuss examples and state some results about their topological and combinatorial properties.

Colloquium Series  
**Tuesday, October 22, 2019, 4:00pm-5:00pm**  
1360 East Hall  
**Sam Payne (University of Texas at Austin)**  
*Tropical curves, graph homology, and top weight cohomology of $M_g$*  

I will discuss the topology of a space of stable tropical curves of genus $g$ with volume 1. The reduced rational homology of this space is canonically identified with the top weight cohomology of $M_g$ and also with the homology of Kontsevich’s graph complex. As one application, we show that $H^{4g-6}(M_g)$ grows exponentially with $g$. This disproves a recent conjecture of Church, Farb, and Putman as well as an older, more general conjecture of Kontsevich. As another application, we prove a formula conjectured by Zagier for the $S_n$-equivariant top weight Euler characteristic of $M_{g,n}$.

Based on joint work with M. Chan, C. Faber, and S. Galatius.
Student Homotopy Theory  
**Wednesday, October 23, 2019, 3:00pm-4:00pm**  
1372 East Hall  
**Angela Maennela (University of Michigan)**  
*Characteristic classes*

As characteristic classes is a broad topic I will mainly focus on Chern classes, more specifically their axiomatic definition and their construction via curvature.

Student Arithmetic  
**Wednesday, October 23, 2019, 3:00pm-4:00pm**  
3866 East Hall  
**Jason Liang (UM)**  
*Q-Rational Equivalences Between Curves*

I will discuss issues which arise when studying Q-rational equivalences between curves which are equivalent over some field extension of Q.

Algebraic Geometry  
**Wednesday, October 23, 2019, 4:00pm-5:30pm**  
4096 East Hall  
**Yunqing Tang (IAS)**  
*Picard ranks of reductions of K3 surfaces over global fields*

For a K3 surface $X$ over a number field with potentially good reduction everywhere, we prove that there are infinitely many primes modulo which the reduction of $X$ has larger geometric Picard rank than that of the generic fiber $X$. A similar statement still holds true for ordinary K3 surfaces over global function fields. In this talk, I will present the proofs via the intersection theory on GSpin Shimura varieties and also discuss various applications. These results are joint work with Ananth Shankar, Arul Shankar, and Salim Tayou and with Davesh Maulik and Ananth Shankar.
RTG Seminar on Geometry, Dynamics and Topology
Wednesday, October 23, 2019, 4:00pm-5:30pm
3866 East Hall
Aaron Calderon (Yale)

Measured laminations in flat and hyperbolic geometry

The set of simple closed curves is of integral importance in the study of Riemann surfaces; passing to its completion, the space of measured laminations, often reveals new underlying structure. Measured laminations play many roles in Teichmüller theory, from geometric (compactifying Teichmüller space) to analytic (parametrizing quadratic differentials) to dynamic (describing Teichmüller geodesic flow). Beginning from first definitions, I will survey some of these applications, leading towards a discussion of two different analogues of unipotent flow adapted to a given lamination. This talk is meant as a prelude to my talk tomorrow.

Commutative Algebra
Thursday, October 24, 2019, 3:00pm-4:00pm
4088 East Hall
Zhan Jiang (University of Michigan)

This talk is postponed because of the CRLT presentation 3-5. No seminar this week.

TBA

Arithmetic Geometry Learning
Thursday, October 24, 2019, 4:00pm-5:30pm
4096 East Hall
Shizhang Li (UM)

Solid abelian groups, II
Topology
Thursday, October 24, 2019, 5:00pm-6:00pm
335 West Hall
Aaron Calderon (Yale)

(SPECIAL TIME AND PLACE) New coordinates for Teichmüller space and applications to flat and hyperbolic geometry

There is a deep yet mysterious connection between the hyperbolic and singular flat geometry of Riemann surfaces. Using Thurston and Bonahon's "shear coordinates," Mirzakhani related the earthquake and horocycle flows on Teichmüller space, two notions of unipotent flow coming from hyperbolic, respectively flat, geometry. In this talk, I will introduce "shear-shape coordinates" for Teichmüller space, which can be used to extend Mirzakhani's conjugacy. These coordinates also yield information about the global structure of certain subloci in both Teichmüller space and its cotangent bundle of quadratic differentials. This is joint work (in progress) with James Farre.

Quant Program Practitioner
Thursday, October 24, 2019, 5:30pm-6:30pm
LSA3254
Mark Schmude (MSCI)

Mark Schmude is a graduate of the University of Michigan's Master of Science in Financial Engineering program. He current works for MSCI in Ann Arbor as Executive Director of Client Coverage. Along with a representative from MSCI's human resources team, Mark will talk to Quant students about his career path in quantitative finance and how they can prepare for the job market.
Applied Interdisciplinary Mathematics (AIM)
Friday, October 25, 2019, 3:00pm-4:00pm
1084 East Hall
Hanliang Guo (University of Michigan)
Building towards a scalable computational framework of ciliary-flow in complex geometries

Cilia are hair-like organelles that protrude from epithelial cell-surfaces. Being one of the most conserved micro-structures in nature, cilia are critical building-blocks of life. In particular, it is known for decades that our airway systems require the periodic movements of cilia to transport mucus that carries out the dusts and toxic particles. More recently, people have realized that being the "conveyor-belt" of unwanted particles are far from the sole function of ciliary-flows. For example, cilia can create fluid-mechanical micro environments for the active recruitment of the specific microbiome of the host; ciliary-flows in the brain ventricles behave like a "switch" that reliably and periodically alters the flow pattern. Despite the fact that cilia grow in greatly complex geometries, existing numerical works have focused on simple geometries and idealized boundary conditions such as periodic, free-space or half-space flows. In this talk, we will present a newly developed hybrid numerical method for simulating ciliary flows in complex geometries. The confining geometries are treated by FMM accelerated boundary integral method while the ciliary flows are treated by the method of regularized stokeslet. With a few examples, we demonstrate the effects of having a complex geometry on fluid transport and mixing. We will also showcase the simulated ciliary-flow in an extremely complicated, experimentally obtained human organ.

Combinatorics
Friday, October 25, 2019, 3:00pm-4:00pm
4096 East Hall
Alexander Garver (University of Michigan)
Chapoton triangles and nonkissing complexes

For any finite real reflection group W, Chapoton defined three polynomials enumerating combinatorial objects associated with W: the F-triangle $F(x,y)$, the H-triangle $H(x,y)$, and the M-triangle $M(x,y)$. In particular, $F(x,y)$ enumerates faces of the cluster complex associated with W. Chapoton conjectured certain identities satisfied by $F(x,y)$ and $H(x,y)$ and by $F(x,y)$ and $M(x,y)$, which were later proved by Thiel and Athanasiadis, respectively. We present analogues of these three polynomials given the initial data of a nonkissing complex in the sense of Petersen, Pylyavskyy, and Speyer. The cluster complex associated with the symmetric group is a special case of the nonkissing complex. We prove the analogue of Chapoton’s $F(x,y)$ and $H(x,y)$ identity and conjecture the analogue of his $F(x,y)$ and $H(x,y)$ identity. This joint work with Thomas McConville.
Weekly Seminar & Events Bulletin  
October 20th, 2019 - October 26th, 2019

Geometry  
Friday, October 25, 2019, 3:00pm-3:50pm  
3866 East Hall  
Nikhil Savale (Univ. of Cologne)  
Spectrum and abnormals in sub-Riemannian geometry  

We prove several relations between spectrum and dynamics including wave trace expansion, sharp/improved Weyl laws, propagation of singularities and quantum ergodicity for the sub-Riemannian (sR) Laplacian in the four dimensional quasi-contact case. A key role in all results is played by the presence of abnormal geodesics and represents the first such appearance of these in sub-Riemannian spectral geometry.

Special Events  
Friday, October 25, 2019, 3:00pm-4:00pm  
2866 East Hall  
Jack Burkart (Stony Brook University)  
Dimension in Holomorphic Dynamics  

Holomorphic dynamics studies the iteration of rational, polynomial, or general entire functions. The Julia set of such a function can informally be though of as the set of all points where the sequence determined by the function and its iterates fails to be equicontinuous, so that nearby points follow different trajectories under iteration. Computer images suggest the Julia set has a rich fractal structure.

In this talk, we will define various notions of dimension (Hausdorff, Minkowski, and packing) used to study fractals. We will discuss relevant dimension results for Julia sets of polynomial/rational functions, and compare these results to what is known about the iteration of (transcendental) non-polynomial entire functions. We will conclude by a discussion of my recent result constructing the first known examples of transcendental entire functions with fractional packing dimension.

Geometry  
Friday, October 25, 2019, 4:00pm-5:00pm  
3866 East Hall  
Ben Schmidt (MSU)  
Preserve one, preserve all  

The 1953 Beckman-Quarles theorem asserts that a function f from a Euclidean space of dimension at least two to itself with the property that d(f(x), f(y))=1 whenever d(x,y)=1 is an isometry. I’ll discuss a conjectural Riemannian generalization of this theorem and some supporting results. Based on joint work with Meera Mainkar.
Junior Colloquium Series  
Friday, October 25, 2019, 4:00pm-5:00pm  
3088 East Hall  
Shravan Veerapaneni (Michigan)  
*Fast and accurate methods for solving Stokes equations on moving domains (Research at Michigan Series)*

From blood flow to subsurface flows, particulate flows are ubiquitous. Direct numerical simulations of dense particle suspensions in viscous fluids, governed by Stokes equations, are extremely challenging yet critically important to bring insights into their macro-scale flow behavior. We will give an overview of research conducted by current (and past) graduate students in our department that helped overcome several computational bottlenecks in these problems using tools from complex analysis, potential theory, PDEs and numerical analysis. We will discuss how these methods can be useful in the design of microfluidic chips, shape optimization and in understanding the complex physics of soft particulate flows.

Preprint Algebraic Geometry  
Friday, October 25, 2019, 4:00pm-5:30pm  
2866 East Hall  
Bogdan Zavyalov (Stanford/UM)  
Purity for the Brauer group, following Cesnavicus

https://arxiv.org/abs/1711.06456