### Monday, November 18, 2019

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<td>Complex Analysis, Dynamics and Geometry -- Nicholas McCleerey (Northwestern University) Regularity of Geodesics of Kahler Metrics</td>
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<td>4:10pm-5:00pm</td>
<td>Group, Lie and Number Theory -- Yuan Liu (University of Michigan) Heuristics on the distribution of Galois groups of unramified extensions</td>
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<td>Student Analysis -- Anthony Della Pella (University of Michigan) Approximation via Partition Functions and the Interpolation Method</td>
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<td><strong>Arithmetic Geometry Learning</strong> -- Serin Hong (UM) <em>Globalization</em> -- 4096 East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Alex Hening (Tufts University) <em>Harvesting of populations in stochastic environments</em> -- 1084 East Hall</td>
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<td><strong>Combinatorics</strong> -- Helen Jenne (University of Oregon) <em>Combinatorics of the double-dimer model</em> -- 4096 East Hall</td>
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<td><strong>Preprint Algebraic Geometry</strong> -- Shizhang Li (UM) <em>Parallel transport for vector bundles on p-adic varieties, following Deninger and Werner</em> -- 2866 East Hall</td>
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Abstracts for the week of November 17th, 2019 - November 23rd, 2019

Student Combinatorics
Monday, November 18, 2019, 3:00pm-4:00pm
3096 East Hall
Harry Richman (UM)

Effective resistance, spanning trees, and series-parallel networks

In high school, you probably learned formulas for the effective resistance when combining resistors in series or in parallel. What you probably didn't learn in high school is that there is a great combinatorial formula for calculating effective resistance for an arbitrarily complicated resistor network. We will discuss this formula and some applications to tropical geometry.

Student Dynamics
Monday, November 18, 2019, 3:00pm-4:00pm
3866 East Hall
(No meeting) ()

RTG Seminar on Number Theory
Monday, November 18, 2019, 3:00pm-4:00pm
4088 East Hall
Tasho Kaletha (University of Michigan)

Introduction to Bruhat-Tits theory

Bruhat and Tits associate to a reductive p-adic group a simplicial complex called the Bruhat-Tits building that organizes various structures related to the group, including maximal compact subgroups, their connected variants, integral models, etc. We will give a brief overview of that theory and discuss the analogy with symmetric spaces for real reductive groups, and the relationship to spherical buildings.

Complex Analysis, Dynamics and Geometry
Monday, November 18, 2019, 4:00pm-5:00pm
3866 East Hall
Nicholas McCleerey (Northwestern University)

Regularity of Geodesics of Kahler Metrics

I'll talk about regularity of geodesics of Kahler metrics on a singular variety, following joint work with Jianchun Chu. Then, I'll discuss the related question of regularity of geodesic rays, with applications to the Hele-Shaw flow on a Riemann surface.
Student Algebraic Geometry
Monday, November 18, 2019, 4:00pm-5:00pm
B745 East Hall
Swaraj Pande (UM)

Characteristic p algebraic geometry

This talk will be an overview of some concepts and results that use the Frobenius map in characteristic p Algebraic Geometry. We will define various properties of the Frobenius map (in both local and global settings), state some consequences and see some sample proofs. Most of this talk will use only concepts from Math 631.

Student AIM Seminar
Monday, November 18, 2019, 4:00pm-5:00pm
B737 East Hall
Jack Wakefield (University of Michigan)

Incorporating Driver Variation into Scalar PDE Traffic Models

In this talk we will introduce macroscopic traffic modeling with scalar hyperbolic PDE (the LWR model), discuss some problems with these models, and outline promising directions towards fixing them. Macroscopic traffic models attempt to describe averaged quantities describing traffic flow like density of cars and their average velocity rather than the dynamics of individual cars. In the scalar case this reduces to a very simple model consisting only of conservation of mass, where we assume that the velocity of traffic can be characterized by its density. We will outline many ways these models are limited, present a few well-established `principles' for traffic modeling, and discuss phenomena we would like to observe. Finally, we will discuss novel approaches to remedy some of these problems by incorporating driver variance into scalar traffic models. Most notably, we will show that spontaneous formation of congested patterns from constant initial conditions in scalar traffic models is possible by introducing a relationship between density and velocity that includes stochastic perturbations.
We will first review several heuristics on the distributions of Galois groups of unramified extensions of global fields, which include the Cohen-Lenstra Heuristics regarding the class groups of quadratic fields and the Boston-Bush-Hajir Heuristics regarding the p-class tower groups of quadratic fields. We will then discuss how these heuristics relate to reasonable random group models, and then explain a new conjecture on the distribution of the Galois groups of the maximal unramified extensions of Galois $\mathbb{Q}$ number fields or function fields for a large family of finite groups $\Gamma$. Finally, we will give theorems in the function field case to support this new conjecture. This work is joint with Melanie Matchett Wood and David Zureick-Brown.

Student Analysis
Monday, November 18, 2019, 5:00pm-6:00pm
2866 East Hall
Anthony Della Pella (University of Michigan)

Approximation via Partition Functions and the Interpolation Method

I will define the notion of a partition function and give examples of how these objects are used in different areas ranging from physics to computer science. Tactics for approximating partition functions will be discussed including: Correlation Decay, Barvinok's Interpolation, and Monte Carlo methods. Time permitting, I will look at how the locations of complex zeros affect the computational complexity of this approximation problem.
Operators in Complex Analysis  
**Monday, November 18, 2019, 5:00pm-6:00pm**  
3096 East Hall  
**Luke Edholm (University of Michigan)**  
*Irregularities of the Bergman projection and substitute operators*  

Let $\Omega \subset \mathbb{C}^n$ be a domain and define the Bergman space $A^p(\Omega)$ to be the space of holomorphic $L^p$ functions on $\Omega$. Established $L^p$ mapping properties of the Bergman projection known to hold on large classes of smooth, bounded, pseudoconvex domains are shown to fail for a family of non-smooth, bounded, pseudoconvex domains. This presents challenges to the development of holomorphic approximation theorems and to the classification of dual spaces. Despite these challenges, new substitute operators are constructed which avoid the deficiencies present in the original Bergman projection. These operators allow for concrete statements of approximation and duality theorems in this setting. This work is joint with Debraj Chakrabarti and Jeff McNeal.

Chromatic Homotopy Theory  
**Monday, November 18, 2019, 5:30pm-6:30pm**  
3088 East Hall  
**Ruian Chen (UM)**  
*Classification of Formal group laws, Modules over $M_{FG}$ and Landweber's theorem.*  

Following lectures 14-16 from [http://www.math.harvard.edu/~lurie/252x.html](http://www.math.harvard.edu/~lurie/252x.html).

Student Commutative Algebra  
**Tuesday, November 19, 2019, 3:00pm-3:50pm**  
4088 East Hall  
**Lukas Scheiwiller (University of Michigan)**  
*Introduction to Cohen-Macaulay rings*  

In this talk, we will introduce the definition of Cohen-Macaulay rings and study some of their properties. The goal is to convince the listener that Cohen-Macaulay rings are a natural generalisation of regular rings over which we have good control. The talk will be very basic and is meant as an honest introduction.

Student Geometry/Topology  
**Tuesday, November 19, 2019, 3:00pm-4:00pm**  
3866 East Hall  
**Sayantan Khan (UM)**  
*A proof of Mostow rigidity*  

In this talk, we'll see Mostow's original proof of the rigidity theorem for hyperbolic manifolds. This proof will be fairly elementary, and we'll offload all the hard work to one analysis lemma which we will not prove, so this talk should be understandable by anyone who knows what a manifold is.
Colloquium Series  
**Tuesday, November 19, 2019, 4:00pm-5:00pm**  
1360 East Hall  
**Vladimir Sverak (University of Minnesota)**  
*PDE aspects of fluid flows and simpler models*

In many situations our best mathematical models for fluid flows are the Navier-Stokes and the Euler equations. In this talk we will focus on incompressible flows. We will discuss some of the open questions concerning the equations in parallel with similar questions for simpler models for which it is possible to make a more complete analysis.

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Student Homotopy Theory  
**Wednesday, November 20, 2019, 3:00pm-4:00pm**  
1372 East Hall  
**Yunze Lu (University of Michigan)**  
*Kervaire invariant one problem continued*

In this talk I will explain the outline and ideas of the proof of the Kervaire invariant one problem.

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Student Arithmetic  
**Wednesday, November 20, 2019, 3:00pm-4:00pm**  
3866 East Hall  
**Bogdan Zavyalog (Stanford University)**  
*Etale Cohomology and Weil Conjectures*

I will explain the construction of etale cohomology and how they can be used to prove (the easy part) of Weil Conjectures.

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RTG Seminar on Geometry, Dynamics and Topology  
**Wednesday, November 20, 2019, 4:00pm-5:30pm**  
3866 East Hall  
**Ilya Khayutin (Northwestern)**  
*Ilya Khayutin (Northwestern): Periodic Geodesics on the Modular Curve: From Linnik to Duke*

The complex modular curve is a non-compact hyperbolic surface that plays a fundamental role in number theory and homogeneous dynamics. The periodic geodesics on the modular curve carry important information about real quadratic fields and their class groups. I will introduce these objects and will discuss two perspectives on the equidistribution of packets of closed geodesics: a dynamical approach going back to Linnik in the 50's and a harmonic analytic approach which culminates in Duke's theorem from the 80's.
Financial/Actuarial Mathematics  
**Wednesday, November 20, 2019, 4:00pm-5:00pm**  
1360 East Hall  
Nicolas Hernandez (UM)  
*An adverse selection approach to power pricing*

We study the optimal design of electricity contracts among a population of consumers with different needs. This question is tackled within the framework of Principal-Agent problems in presence of adverse selection. The particular features of electricity induce an unusual structure on the production cost, with no decreasing returns to scale. We are nevertheless able to provide an explicit solution for the problem at hand. The optimal contracts are either linear or polynomial with respect to the consumption. Whenever the outside options offered by competitors are not uniform among the different types of consumers, we exhibit situations where the electricity provider should contract with consumers with either low or high appetite for electricity.

Algebraic Geometry  
**Wednesday, November 20, 2019, 4:00pm-5:20pm**  
4096 East Hall  
Aaron Pixton (MIT/University of Michigan)  
*Kappa rings and boundary vanishing*

The moduli space of compact type curves of genus g is an open locus inside the moduli space of stable curves consisting of those curves with compact Jacobians. The full intersection theory of this compact type moduli space is not very well understood, but in 2009 Pandharipande determined the structure of the kappa ring, a small subring of its Chow ring. After reviewing this work, I'll explain how to use it to construct a nonzero class that restricts to zero on every boundary divisor of the moduli space. I'll conclude by giving a few conjectures related to a similar class on the moduli space of stable curves.

Topology  
**Thursday, November 21, 2019, 3:00pm-4:00pm**  
3866 East Hall  
Ilya Khayutin (Northwestern)  
*Non-accumulation of periodic torus orbits*

The 'linearization' technique is a powerful method in homogeneous dynamics to control the time a unipotent orbit spends in the vicinity of a closed homogeneous subset. This method relies on the polynomial nature of a unipotent flow and does not extend to diagonalizable actions.

I will describe a new arithmetic approach to bound the accumulation of periodic orbits of higher-rank diagonalizable groups. This method plays a major role in the recent progress on the Michel-Venkatesh mixing conjecture.
Commutative Algebra
Thursday, November 21, 2019, 3:00pm-4:00pm
4088 East Hall
Monica Lewis (University of Michigan)

Frobenius actions and the closed support problem

Let $S$ be a complete intersection presented as $R/J$ for $R$ a regular ring of prime characteristic $p > 0$ and $J$ an ideal generated by a regular sequence of length $c$ (the codimension of $S$). Let $I$ be an ideal containing $J$. Must the support of every module of the form $H^{i}_I(S)$ be a Zariski closed set? Independent results of Hochster and Núñez-Betancourt (2017) or Katzman and Zhang (2017) confirm that this is indeed the case when $c = 1$ (that is, when $S$ is a hypersurface). The question is open in higher codimension, and remains a problem of significant interest. Hochster and Núñez-Betancourt's hypersurface strategy depends on two key ingredients: control over the associated primes of $H^{i+1}_I(J)$, and the finite generation of certain $R\{F\}$-modules. Our goal in this talk is twofold. First, we will present our results from 2019 showing that, in many important cases within the $c > 1$ setting, the associated primes of $H^{i+1}_I(J)$ can be impossible to control independently of $\text{Ass } H^{i}_I(S)$. Second, we will present recent joint work with Eric Canton on the additional structure (including a simplicial complex of $R\{F\}$-submodules) that becomes present only through a *non-standard* Frobenius action on the local cohomology of $S$, referred to as the Fedder action. When $c = 1$, we show how this additional structure can be used to recover the well-known closed support result for hypersurfaces. In higher codimension, it leads to a number of fascinating (and currently open) finite generation questions surrounding the Fedder action. A positive answer to these questions would circumvent the need to control $\text{Ass } H^{i+1}_I(J)$, and imply a positive answer to the closed support problem in higher codimension.

Arithmetic Geometry Learning
Thursday, November 21, 2019, 4:00pm-5:30pm
4096 East Hall
Serin Hong (UM)

Globalization
We consider the harvesting of a population in a stochastic environment whose dynamics in the absence of harvesting is described by a one dimensional diffusion. Using ergodic optimal control, we find the optimal harvesting strategy which maximizes the asymptotic yield of harvested individuals. When the yield function is the identity, we show that the optimal strategy has a bang-bang property: there exists a threshold $x^* > 0$ such that whenever the population is under the threshold the harvesting rate must be zero, whereas when the population is above the threshold the harvesting rate must be at the upper limit. We provide upper and lower bounds on the maximal asymptotic yield, and explore via numerical simulations how the harvesting threshold and the maximal asymptotic yield change with the growth rate, maximal harvesting rate, or the competition rate. Finally, we look at the optimal harvesting strategies when one deals with a complex ecosystem of interacting species.

Combinatorics
Friday, November 22, 2019, 3:00pm-4:00pm
4096 East Hall
Helen Jenne (University of Oregon)
Combintorics of the double-dimer model
In this talk we will discuss a new result about the double-dimer model: under certain conditions, the partition function for double-dimer configurations of a planar bipartite graph satisfies an elegant recurrence, related to the Desnanot-Jacobi identity from linear algebra. A similar identity for the number of dimer configurations (or perfect matchings) of a graph was established nearly 20 years ago by Kuo and others and has applications to random tiling theory and the theory of cluster algebras. This work was motivated in part by the potential for applications in these areas.

Junior Colloquium Series
Friday, November 22, 2019, 4:00pm-5:00pm
3088 East Hall
Kartik Prasanna (Michigan)
Arithmetic of algebraic cycles (Research at Michigan Series)
Algebraic cycles on varieties over number fields behave very differently than over the complex numbers. I will explain some of the differences, and discuss some of the open problems in the area.
Geometry
Friday, November 22, 2019, 4:00pm-5:00pm
3866 East Hall
Dídac Martínez-Granado (Indiana University)
From curves to currents

Geodesic currents are measures introduced by Bonahon in 1986 that realize a suitable closure of the space of closed curves on a surface. Bonahon proved that intersection number and hyperbolic length for curves extend to geodesic currents. Since then, many other functions defined on the space of curves have been extended to currents, such as negatively curved lengths, lengths from singular flat structures or stable lengths for surface groups. In this talk, we explain how a function defined on the space of curves satisfying some simple conditions can be extended continuously to geodesic currents. The most important of these conditions is that the function decreases under smoothing of essential crossings. Our theorem subsumes previous extension results. Furthermore, it gives new extensions such as extremal length. This is joint work with Dylan Thurston.

Preprint Algebraic Geometry
Friday, November 22, 2019, 4:00pm-5:30pm
2866 East Hall
Shizhang Li (UM)
Parallel transport for vector bundles on p-adic varieties, following Deninger and Werner