## Weekly Seminar & Events Bulletin

February 6th, 2022 - February 12th, 2022

### Monday, February 07, 2022

<table>
<thead>
<tr>
<th>Time</th>
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<td>3:00pm-4:00pm</td>
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<td><em>Arithmetic Statistics Questions Inspired by Classical Knot Invariants</em> -- 4088 East Hall</td>
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<td><strong>Integrable Systems and Random Matrix Theory</strong> -- Ryosuke Odoi (Waseda University)</td>
<td><em>The constant problem of the tt</em>-Toda equations* -- ZOOM ID: 926 6491 9790 Virtual</td>
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<td><em>The sublinearly Morse boundary as a Model for the Poisson boundary</em> -- <a href="https://umich.zoom.us/j/97288641488">https://umich.zoom.us/j/97288641488</a> Virtual</td>
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<td><em>Resolutions over complete intersections</em> -- 3088 East Hall</td>
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<td><strong>Student AIM Seminar</strong> -- Yuanzhao Zhang (Santa Fe Institute) <em>Collective dynamics on networks: Synchrony, chimeras, and basins</em> -- Virtual</td>
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Abstracts for the week of February 6th, 2022 - February 12th, 2022

RTG Seminar on Number Theory
Monday, February 07, 2022, 3:00pm-4:00pm
4088 East Hall
Alison Miller (University of Michigan)

Arithmetic Statistics Questions Inspired by Classical Knot Invariants

Some classical knot invariants, such as the Seifert pairing, are arithmetic objects related to quadratic forms and ideal class groups. We discuss some interesting new questions in arithmetic statistics motivated by looking at these invariants arithmetically.

Integrable Systems and Random Matrix Theory
Monday, February 07, 2022, 4:00pm-5:00pm
ZOOM ID: 926 6491 9790 Virtual
Ryosuke Odoi (Waseda University)

The constant problem of the tt*-Toda equations

The tt* (topological-anti topological fusion) equations arose in the work of Cecotti and Vafa on supersymmetric quantum field theory, and the tt*-Toda equations are a special case of these equations. Solutions of the tt*-Toda equations can be considered as certain isomonodromic deformations of meromorphic connections. They can be parametrized by two kinds of data. One comes from the asymptotic behavior of the solutions, and the other one comes from the monodromy including Stokes matrices. Two kinds of data correspond to each other via the Riemann-Hilbert correspondence. We will see that this correspondence is symplectic and give a generating function explicitly, and we will see an application to the constant problem.
Complex Analysis, Dynamics and Geometry  
Monday, February 07, 2022, 4:00pm-5:00pm  
https://umich.zoom.us/j/97288641488 Virtual  
Kasra Rafi (University of Toronto)  
*The sublinearly Morse boundary as a Model for the Poisson boundary*

In algology with the Gromov boundary of a Gromov hyperbolic space, we define a notion of boundary that identifies the hyperbolic directions in a proper geodesic mantric space $X$. It turns out many arguments in the setting of Gromov hyperbolic spaces can be carried out with sub-linear error terms instead of uniform ones. For example, the notion of Morse geodesics can be replaced with $\kappa$-Morse geodesics for a given a sublinear function $\kappa$. We define the $\kappa$-boundary of $X$ to be the space of all $\kappa$-Morse quasi-geodesics rays. We show that this boundary, equipped with the coarse visual topology, is QI-invariant, metrizable and large. Namely, for a large class of groups, the generic direction is represented by a $\kappa$-Morse geodesic and the $\kappa$-boundary can be used as a topological model for the Poisson boundary of random walk in the group. The talk is based on several joint projects with Ilya Gekhtman, Yulan Qing and Giulio Tiozzo.

Donaldson-Thomas Theory  
Monday, February 07, 2022, 4:00pm-5:30pm  
4096 East Hall  
Andy Jiang ()  
*Obstruction theories and virtual fundamental classes*

RTG Representation Theory  
Monday, February 07, 2022, 4:00pm-5:15pm  
4088 East Hall  
Karthik Ganapathy (UM)  
*The Steinberg representation of $G$*

An algebraic group $G$ is geometrically reductive if for every nonzero $G$-invariant vector $v$ in a $G$-representation $V$, there exists a non-constant homogeneous $G$-invariant polynomial function on $V$ which does not vanish on $v$. We will see Haboush's proof that every reductive group is geometrically reductive. The main character of this proof is the Steinberg representation; the bulk of the talk will be about this representation.
Student Combinatorics  
Monday, February 07, 2022, 4:00pm-5:00pm  
3866 East Hall  
Amanda Schwartz (UM)  
Stanley-Reisner Rings and Simplicial Complexes

I will give an introduction to Stanley-Reisner theory which provides a connection between combinatorics and commutative algebra. I will discuss the correspondence between simplicial complexes and squarefree monomial ideals and some phenomena which arise from this such as the connections between f-vectors and Hilbert series and between Alexander duality and associated primes.

Student Dynamics/Geometry Topology  
Monday, February 07, 2022, 5:00pm-6:00pm  
3866 East Hall  
Sayantan Khan (University of Michigan)  
3-manifolds that fiber over the circle

In this talk, we will outline the basics of 3-manifold topology, describe Thurston's geometrization conjecturetheorem, and talk about manifolds that are fiber bundles over the circle. We will see how restricting attention to this class of manifolds turns the question of geometrization to a question about mapping class groups. Time permitting, we will also go the other way, i.e. deduce results about mapping classes from 3-manifold topology.

Student Commutative Algebra  
Tuesday, February 08, 2022, 3:00pm-4:00pm  
3088 East Hall  
Karthik Ganapathy (University of Michigan, Ann Arbor)  
Resolutions over complete intersections

For hypersurface rings, we saw last week that the (typically infinite) minimal free resolutions of a finitely generated module is periodic. In this talk, we will extend some of these results to higher codimensions using CI operators and the Eisenbud--Shamash construction.

This talk will be simultaneously livestreamed via Zoom.
Learning Seminar in Algebraic Combinatorics  
Wednesday, February 09, 2022, 12:00am-12:00am  
4096 East Hall  
Katie Waddle (University of Michigan)  
Quivers and Plabic Graphs

Quivers are the main combinatorial objects that correspond to cluster algebras. For the uninitiated, we will give a brief introduction to the kinds of quivers that appear, and the rules for mutating them. Then we will introduce plabic graphs, another tool for working with cluster structures. We will discuss moves on plabic graphs and describe how to recover quivers from them.

Financial/Actuarial Mathematics  
Wednesday, February 09, 2022, 4:00pm-5:00pm  
On Zoom Virtual  
Yan Dolinsky (University of Jerusalem)  
Utility Maximization with Peeking into the Future

In this work we study optimal investment when the investor can peek some time units into the future, but cannot fully take advantage of this knowledge because of quadratic transaction costs. In the Bachelier setting with exponential utility, we give an explicit solution to this control problem with intrinsically infinite-dimensional memory. This is made possible by solving the dual problem where we make use of the theory of Gaussian Volterra integral equations.

Joint work with P.Bank and M.Rasonyi.

Algebraic Geometry  
Wednesday, February 09, 2022, 4:00pm-5:20pm  
4096 East Hall  
Jesse Wolfson (UC Irvine)  
Essential dimension via prismatic cohomology

Let $A$ be a complex abelian variety. Using Bhatt and Scholze's prismatic cohomology, we show that for all but finitely many primes $p$, the multiplication-by-$p$ cover $p:A \to A$ is $p$-incompressible, as conjectured by Brosnan. As an application, we obtain new $p$-incompressibility results for congruence covers of Shimura varieties, extending previous work of Farb-Kisin-W, Brosnan-Fakhruddin, and Fakhruddin-Saini. This is joint work with Benson Farb and Mark Kisin.
RTG Seminar on Geometry, Dynamics and Topology  
Wednesday, February 09, 2022, 4:00pm-5:30pm  
3866 East Hall  
Richard Canary (U Michigan)  
*Counting and equidistribution for cusped Hitchin components*

We first describe the geometric theory of Hitchin representations of geometrically finite Fuchsian groups, which generalizes the work of Labourie and Fock-Goncharov on Hitchin representations of closed surface groups. Geodesic flows of geometrically finite Fuchsian groups are modelled by countable Markov shifts and we develop counting and equidistribution results for well-behaved potentials in the spirit of Lalley’s results for finite Markov shifts which apply in the setting of cusped Hitchin representations. This work is part of a program to develop a theory of the augmented Hitchin component which parallels the classical theory of augmented Teichmüller space. (Joint work with Harry Bray, Nyima Kao, Giuseppe Martone, Tengren Zhang and Andy Zimmer)

**Student Analysis**  
**Wednesday, February 09, 2022, 5:15pm-6:15pm**  
3866 East Hall  
Zoom Hangout!  

We'll be having a Zoom meet-and-greet/hangout! Feel free to bring your dinner and/or a snack with you to your computer and join us for some virtual camaraderie!

Zoom link: https://umich.zoom.us/j/96166521871  
Meeting ID: 961 6652 1871

**Teaching Mathematics**  
**Thursday, February 10, 2022, 1:00pm-2:30pm**  
4866 East Hall  
LCIT Discussion ()  
Discussion
Arithmetic Geometry Learning
Thursday, February 10, 2022, 4:00pm-5:30pm
4096 East Hall
Nick Rome ()
Brauer groups

Logic
Thursday, February 10, 2022, 4:00pm-5:30pm
2866 East Hall
Iian Smythe (UM)
A crash course in Borel equivalence relations

Abstract: In every part of mathematics, there are ways of describing when two objects are “the same”. When these objects are countable, or at least separable, the classes of objects under consideration (e.g., groups, graphs, metric spaces, etc) can often be realized as nice topological (or at least standard Borel) spaces, and the resulting notions of “the same” as Borel equivalence relations on those spaces. From here, the tools of descriptive set theory, as well as dynamics, group theory, and other areas, can be used to analyze the relative complexity of these equivalence relations, giving a global picture of classification problems across mathematics. In this talk, we will give a survey of the basic notions, examples, and results in this highly active area of set theoretic research.

Applied Interdisciplinary Mathematics (AIM)
Friday, February 11, 2022, 3:00pm-4:00pm
Virtual
Robert Krasny (University of Michigan)
Fast summation methods for long-range particle interactions

Many models in scientific computing involve long-range particle interactions, for example the Coulomb interaction of electrically charged particles. To address the cost of computing these interactions in large-scale computations, we present two fast summation methods based on barycentric Lagrange interpolation, a treecode (BLTC) and a fast multipole method where the interaction lists are formed by dual tree traversal (BLDFT). The methods are kernel-independent and a distributed memory implementation on multiple GPUs has been developed. The performance of the BLTC and BLDFT is demonstrated, and an application to the electrostatics of solvated biomolecules is presented.
Combinatorics
Friday, February 11, 2022, 3:00pm-4:00pm
4088 East Hall
Nir Gadish (University of Michigan)
From configurations on graphs to cohomology of M_{2,n}

The configuration space of particles on a graph is a classifying space for the graph's braid group and thus computes the group cohomology. If instead one considers compactly supported cohomology the resulting groups depend only on the genus of the graph, or "loop order", and admit a particularly interesting action by Out(F_g). In this talk I will explain how tropical geometry relates these latter representations to the cohomology of the moduli spaces M_{g,n} and discuss computational approaches.

Student Algebraic Geometry
Friday, February 11, 2022, 3:00pm-4:00pm
2866 East Hall
Brad Dirks (UM)
Theorems of Lefschetz on Cohomology

Given a smooth, projective complex variety X, Lefschetz has several theorems which describe the cohomology of X using hyperplane sections of X. We will cover these theorems, give sketches of their proofs, and explain some important applications of these theorems. Hodge theory (at the level of last semester's student AG talk) will play an important role.

Learning Seminar in Representation Stability
Friday, February 11, 2022, 4:00pm-4:50pm
1866 East Hall
Kyu Jun (UM)
Intro to representation theory of inverse monoids

I will be talking about the representation theory of finite inverse monoids. Especially, I will try to motivate why we should care about the representations of inverse monoids (some spoilers: FI# modules, Iwahori-Hecke algebra) I will tell you about properties of Rook monoids (or inverse symmetric monoids), and some submonoids of rook monoids.
Student AIM Seminar  
Friday, February 11, 2022, 4:00pm-5:00pm  
Virtual  
Yuanzhao Zhang (Santa Fe Institute)  
*Collective dynamics on networks: Synchrony, chimeras, and basins*

When nonlinear dynamical components interact through complex networks, interesting collective behaviors can emerge. A natural example is synchronization, in which system-level coherence spontaneously emerge from decentralized interactions. A large body of literature has focused on the emergence of global synchrony among identical components, generating important insights such as how network structures influence the local stability of synchrony. In this talk, I will explore extensions of this paradigm by adding complexities along three different directions: What happens when the components are allowed to be different (introducing disorder)? What new phenomena can we find when components are allowed to behave differently (partial synchrony and chimeras)? And, finally, what kind of landscapes will we find ourselves in when we zoom out from the vicinity of the synchronized state?

Preprint Algebraic Geometry  
Friday, February 11, 2022, 4:00pm-5:30pm  
4096 East Hall  
Andrew Snowden (UM)  
*The Fontaine-Mazur conjecture*