

## Weekly Seminar & Events Bulletin

October 13th, 2019 - October 19th, 2019

Monday, October 14, 2019

12:00am-12:00am **Integrable Systems and Random Matrix Theory** -- () *Fall Break, no seminar* -- 1866 East Hall

Tuesday, October 15, 2019

12:00am-12:00am **Colloquium Series** -- Fall Break () *Fall Break* -- 1360 East Hall

Wednesday, October 16, 2019

3:00pm-4:00pm **Student Homotopy Theory** -- Haoyang Guo (University of Michigan) *Topological Hochschild homology* -- 1372 East Hall

3:00pm-4:00pm **Student Arithmetic** -- Lara Du (UM) *Newton Polygon* -- 3866 East Hall

4:00pm-5:20pm **Algebraic Geometry** -- Margaret Bilu (New York University) *Motivic Euler products in motivic statistics* -- 4096 East Hall

Thursday, October 17, 2019

3:00pm-4:00pm **Topology** -- Jenya Sapir (SUNY Binghamton) *Tessellations from long geodesics on surfaces* -- 3866 East Hall

3:00pm-4:00pm **Commutative Algebra** -- Devlin Mallory (University of Michigan) *Triviality of jet closures and the local isomorphism problem* -- 4088 East Hall

4:00pm-5:00pm **Colloquium Series** -- Aaron Pollack (Duke University) *Modular forms on exceptional groups* -- 1360 East Hall

Friday, October 18, 2019

3:00pm-4:00pm **Applied Interdisciplinary Mathematics (AIM)** -- Abbie Jacobs (University of Michigan, School of Information and Complex Systems) *Understanding social processes with empirical design and statistical inference (or, social networks, data, and you)* -- 1084 East Hall

3:00pm-4:00pm **Combinatorics** -- Jake Levinson (University of Washington) *A topological proof of the Shapiro-Shapiro Conjecture* -- 4096 East Hall

3:00pm-4:00pm **Colloquium Series** -- Sebastien Vasey (Harvard University) *Stability theory generalized to accessible categories* -- 1372 East Hall

4:00pm-5:00pm **Geometry** -- John Hubbard (Cornell/Marseille) *A new construction of pseudo-Anosov mappings* -- 3866 East Hall

**Abstracts for the week of October 13th, 2019 - October 19th, 2019**

**Integrable Systems and Random Matrix Theory**

**Monday, October 14, 2019, 12:00am-12:00am**

**1866 East Hall**

**()**

*Fall Break, no seminar*

**Colloquium Series**

**Tuesday, October 15, 2019, 12:00am-12:00am**

**1360 East Hall**

**Fall Break ()**

*Fall Break*

**Student Homotopy Theory**

**Wednesday, October 16, 2019, 3:00pm-4:00pm**

**1372 East Hall**

**Haoyang Guo (University of Michigan)**

*Topological Hochschild homology*

Topological Hochschild homology is a homology theory for ring spectra, generalizing the Hochschild homology for usual associative rings. This topological generalization allows to see more fruitful structures of homology, which may be hidden from the Hochschild homology. In this talk, we will introduce the construction and the basic properties of the Hochschild homology, and illustrate how the topological generalization provides us more insights about the theory. Time permitted, we will mention the recent application of the theory in the p-adic Hodge theory.

**Student Arithmetic**

**Wednesday, October 16, 2019, 3:00pm-4:00pm**

**3866 East Hall**

**Lara Du (UM)**

*Newton Polygon*

Newton polygons provide us with a tool for understanding roots of polynomials and studying irreducibility. In this talk, I'll give some examples of successful applications of Newton polygons and also discuss their limitations.

**Weekly Seminar & Events Bulletin**

October 13th, 2019 - October 19th, 2019

**Algebraic Geometry**

**Wednesday, October 16, 2019, 4:00pm-5:20pm**

**4096 East Hall**

**Margaret Bilu (New York University)**

*Motivic Euler products in motivic statistics*

The Grothendieck group of varieties over a field  $k$  is the quotient of the free abelian group of isomorphism classes of varieties over  $k$  by the so-called cut-and-paste relations. It moreover has a ring structure coming from the product of varieties. Many problems in number theory have a natural, more geometric counterpart involving elements of this ring. Thus, Poonen's Bertini theorem over finite fields has a motivic analog due to Vakil and Wood, which expresses the motivic density of smooth hypersurface sections as the degree goes to infinity in terms of a special value of Kapranov's zeta function. I will report on recent joint work with Sean Howe, where we prove a broad generalization of Vakil and Wood's result, which implies in particular a motivic analog of Poonen's Bertini theorem with Taylor conditions, as well as motivic analogs of many generalizations and variants of Poonen's theorem. A key ingredient for this is a notion of motivic Euler product which allows us to write down candidate motivic probabilities.

**Topology**

**Thursday, October 17, 2019, 3:00pm-4:00pm**

**3866 East Hall**

**Jenya Sapir (SUNY Binghamton)**

*Tessellations from long geodesics on surfaces*

I will talk about joint work of Athreya, Lalley, Wroten and myself. Given a hyperbolic surface  $S$ , a typical long geodesic arc will divide the surface into many polygons. We give statistics for the geometry of a typical tessellation. Along the way, we look at how very long geodesic arcs behave in very small balls on the surface.

**Commutative Algebra**

**Thursday, October 17, 2019, 3:00pm-4:00pm**

**4088 East Hall**

**Devlin Mallory (University of Michigan)**

*Triviality of jet closures and the local isomorphism problem*

Jet schemes are a higher order analogue of the tangent scheme of a variety; algebraically, just as the tangent scheme of a variety corresponds to derivations on its local rings, jet schemes corresponds to higher order (Hasse--Schmidt) derivations. It's a natural question to ask whether a morphism inducing an isomorphism on jet schemes must itself be an isomorphism. Towards this question, de Fernex, Ein, and Ishii introduced an ideal closure operation for local  $k$ -algebras  $(R, \mathfrak{m}, L)$ , the "jet closure". The triviality of this closure operation detects a positive answer to the preceding question, and so it's natural to ask whether this closure operation is always trivial. In this talk, we give an affirmative answer to this question under mild hypothesis (i.e., when  $L$  is separable over  $k$ ). Our methods are elementary, commutative-algebraic, and are inspired by similar techniques in tight closure theory.

**Colloquium Series**

**Thursday, October 17, 2019, 4:00pm-5:00pm**

**1360 East Hall**

**Aaron Pollack (Duke University)**

*Modular forms on exceptional groups*

When  $G$  is a reductive (non-compact) Lie group, one can consider automorphic forms for  $G$ . These are functions on the locally symmetric space  $X_G$  associated to  $G$  that satisfy some sort of nice differential equation. When  $X_G$  has the structure of a complex manifold, the *\_modular forms\_* for the group  $G$  are those automorphic forms that correspond to holomorphic functions on  $X_G$ . They possess close ties to arithmetic and algebraic geometry. For certain exceptional Lie groups  $G$ , the locally symmetric space  $X_G$  is not a complex manifold, yet nevertheless possesses a very special class of automorphic functions that behave similarly to the holomorphic modular forms above. Building upon work of Gan, Gross, Savin, and Wallach, I will define these modular forms and explain what is known about them.

## Weekly Seminar & Events Bulletin

October 13th, 2019 - October 19th, 2019

### Applied Interdisciplinary Mathematics (AIM)

Friday, October 18, 2019, 3:00pm-4:00pm

1084 East Hall

**Abbie Jacobs (University of Michigan, School of Information and Complex Systems)**

*Understanding social processes with empirical design and statistical inference (or, social networks, data, and you)*

The structure of social networks reflects important social processes, such as status, communities, and inequality---but separating signal from noise is nontrivial in social data. Statistical inference provides one point of entry: unpacking the assumptions behind random graph models, we can understand what tools will help us uncover meaningful social structure from noise. The empirical design of networks problems, however, is often overlooked but fundamentally changes the space of problems available. I will discuss single-graph ( $N=1$ ) problems and some of the surprising challenges behind many-graph ( $N \gg 1$ ) problems. Using random graph models, statistical inference, and empirical design, I will present a brief overview of how to understand networked processes in real systems---from families and firms to food webs and Facebook.

### Combinatorics

Friday, October 18, 2019, 3:00pm-4:00pm

4096 East Hall

**Jake Levinson (University of Washington)**

*A topological proof of the Shapiro-Shapiro Conjecture*

The Shapiro-Shapiro conjecture states the following. Let  $f : P^1$  to  $P^n$  be any map. If all inflection points of the map (roots of the Wronskian of  $f$ ) are all real, then the map itself can, after change of coordinates, be defined over  $R$  with real polynomials.

An equivalent statement is that certain real Schubert varieties in the Grassmannian intersect transversely -- a fact with broad combinatorial and topological consequences. The conjecture, made in the 90s, was proven by Mukhin-Tarasov-Varchenko in '05/'09 using methods from quantum mechanics.

I will present a proof of a generalization of the Shapiro-Shapiro conjecture, allowing the Wronskian to have complex conjugate pairs of roots. We decompose the real Schubert cell according to the number of such roots, and define an orientation of each connected component. For each part of this decomposition, we prove that the topological degree of the restricted Wronski map is an evaluation of a symmetric group character. In the case where all roots are real, this implies that the restricted Wronski map is a topologically trivial covering map; in particular, this gives a new proof of the Shapiro-Shapiro conjecture.

This is joint work with Kevin Purbhoo.

**Weekly Seminar & Events Bulletin**

October 13th, 2019 - October 19th, 2019

**Colloquium Series**

**Friday, October 18, 2019, 3:00pm-4:00pm**

**1372 East Hall**

**Sebastien Vasey (Harvard University)**

*Stability theory generalized to accessible categories*

A theorem of Erdős and Rado generalizes Ramsey's theorem to infinite cardinals: for each cardinal  $n$ , there exists a cardinal  $N$  so that each graph with  $N$  vertices contains either a clique or an independent set of size  $n$ . In the infinite case, one can take  $n = N$  if  $n$  is countable but in most other uncountable cases  $N$  must be much bigger than  $n$ . Stability theory is a branch of model theory studying certain definability conditions allowing us to take  $n = N$  for a large number of infinite cardinals. Historically, stability theory was first developed by Shelah for classes axiomatized by a first-order theory. In this talk, I describe a generalization to a large class of categories, accessible categories. I will also talk about recent progress on the eventual categoricity conjecture, resolved by Morley and Shelah for first-order but still open for accessible categories.

**Geometry**

**Friday, October 18, 2019, 4:00pm-5:00pm**

**3866 East Hall**

**John Hubbard (Cornell/Marseille)**

*A new construction of pseudo-Anosov mappings*