### Monday, April 01, 2019

<table>
<thead>
<tr>
<th>10:00am-11:00am</th>
<th><strong>Student Homotopy Theory</strong> -- Simon Cho (University of Michigan) <em>A brief introduction to Cisinski model structures</em> -- 3088 East Hall</th>
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<tbody>
<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Student Dynamics</strong> -- Salman Siddiqi (UM) <em>Accessibility and correlation decay</em> -- 3866 East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Financial/Actuarial Mathematics</strong> -- Yili Zhang (UM) <em>On the asymptotic optimality of the comb strategy for prediction with expert advice</em> -- 3088 East Hall</td>
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<td>3:00pm-3:50pm</td>
<td><strong>Special Events</strong> -- Roman Vershynin (University of California, Irvine) <em>Hashing</em> -- 2866 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:20pm</td>
<td><strong>Group, Lie and Number Theory</strong> -- Yong Suk Moon (Purdue University) <em>p-divisible groups and relative crystalline representations</em> -- 4088 East Hall</td>
</tr>
<tr>
<td>4:00pm-6:00pm</td>
<td><strong>Geometry &amp; Physics</strong> -- Yang Zhou (Harvard) <em>Quasimap wall-crossing for GIT quotients</em> -- 4096 East Hall</td>
</tr>
<tr>
<td>7:00pm-8:00pm</td>
<td><strong>Geometric Quantization and Symplectic Geometry</strong> -- Alejandro Uribe (UM) <em>Real vs complex polarizations</em> -- 4088 East Hall</td>
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### Tuesday, April 02, 2019

| 11:30am-1:00pm   | **Teaching Mathematics** -- Discussion () *LCIT Discussion* -- 4866 East Hall |
| 1:00pm-2:30pm     | **Special Events** -- Roman Vershynin (University of California, Irvine) *Random tensors* -- 2866 East Hall |
| 3:00pm-4:00pm     | **Student Geometry/Topology** -- Nicholas Wawrykow (University of Michigan) *Out(F_n) and the Free Factor Complex* -- 1866 East Hall |
| 3:00pm-3:50pm     | **Student Commutative Algebra** -- Anna Brosowsky (University of Michigan) *Regular Rings and Auslander-Buchsbaum-Serre* -- 3866 East Hall |
| 4:00pm-5:00pm     | **Colloquium Series** -- Tara Holm (Cornell University) *Understanding Symplectic Geometry through Polytopes and Lattice Points.* -- 1360 East Hall |

### Wednesday, April 03, 2019

| 1:00pm-3:00pm     | **Special Events** -- Qingtang Su (UM) *Grad Thesis Defense: Long time behavior of 2d water waves* -- 3088 East Hall |
| 2:00pm-4:00pm     | **Special Events** -- Han Huang (UM) *Grad Thesis Defense: High Dimensional Phenomenon in Convex Geometry and Spectral Theorem of Random Graphs* -- 2866 East Hall |
| 4:00pm-5:00pm     | **Financial/Actuarial Mathematics** -- Justin Sirignano (UIUC) *CANCELED. Mean Field Analysis of Neural Networks in Machine Learning* -- 1360 East Hall |
| 4:00pm-5:00pm     | **Student Arithmetic** -- Patrick Kelley (UM) *Generalizing Modular Forms* -- 3088 East Hall |
| 4:00pm-5:20pm     | **Algebraic Geometry** -- Eva Elduque (University of Wisconsin) *On the signed Euler characteristic property for subvarieties of abelian varieties* -- 4096 East Hall |
| 4:00pm-5:30pm     | **RTG Seminar on Geometry, Dynamics and Topology** -- Harry Bray (UM) *TBA* -- 3866 East Hall |
| 5:00pm-6:00pm     | **Differential Equations** -- Anne-Sophie De Suzzoni (Ecole Polytechnique, France) (**SPECIAL TIME**) *Asymptotics for the Hartree equation* -- 4088 East Hall |
| 5:30pm-6:30pm     | **Special Events** -- Ben Orlin (math teacher, author, and cartoonist) *Public Lecture: The Unlikely Friendship of Math and Science* -- 1324 East Hall |
### Thursday, April 04, 2019

<table>
<thead>
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<th>Time</th>
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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Topology</strong> -- Mark Greenfield (University of Michigan) <em>Isometric submersions of Teichmüller spaces</em></td>
<td>4096 East Hall</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Commutative Algebra</strong> -- Patricia Klein (University of Kentucky) <em>Generalizations of determinantal ideals</em></td>
<td>3866 East Hall</td>
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<tr>
<td>4:00pm-12:00am</td>
<td><strong>Differential Equations</strong> -- Tao Luo (City University Hong Kong) <em>Some Singular Limits in Plasma or Fluids in the Presence of Boundaries or Initial Layers</em></td>
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<tr>
<td>4:00pm-5:00pm</td>
<td><strong>Student Algebraic Geometry</strong> -- Sanal Shivaprasad (UM) <em>The Torelli theorem</em></td>
<td>B735 East Hall</td>
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### Friday, April 05, 2019

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<td>2:30pm-3:30pm</td>
<td><strong>Quant Program Practitioner</strong> -- Dimitrios Liakakos (Sun Trading LLC) <em>TBA</em></td>
<td>B844 East Hall</td>
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<tr>
<td>3:00pm-4:00pm</td>
<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Nadia Drenska (University of Minnesota) <em>PDE approaches to two problems from prediction with expert advice</em></td>
<td>1084 East Hall</td>
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<td>3:00pm-4:00pm</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Combinatorics</strong> -- Jenna Rajchgot (University of Saskatchewan) <em>Type D quiver representation varieties, double Grassmannians, and symmetric varieties</em></td>
<td>4088 East Hall</td>
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<td>4:00pm-4:50pm</td>
<td><strong>Junior Colloquium Series</strong> -- Sunny Yang Xiao (Brown) <em>What I am talking about when I talk about diversity and inclusion</em></td>
<td>3088 East Hall</td>
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**Student Homotopy Theory**  
Monday, April 01, 2019, 10:00am-11:00am  
3088 East Hall  
Simon Cho (University of Michigan)  
*A brief introduction to Cisinski model structures*

A model structure on a category gives a way to do homotopy theory in that category. In general, setting up a model structure is difficult; Cisinski gives a quite general recipe for constructing a cofibrantly generated model structure on a given category provided certain ingredients such as a cylinder and a set of anodyne maps. The purpose of this talk is to introduce this recipe and see how it may be used.

**Student Dynamics**  
Monday, April 01, 2019, 3:00pm-4:00pm  
3866 East Hall  
Salman Siddiqi (UM)  
*Accessibility and correlation decay*

I'll explain how accessibility leads to chaotic behaviour in hyperbolic flows, and sketch a way to extend this to flows that act isometrically on the central foliation. No familiarity with dynamics will be assumed.

**Financial/Actuarial Mathematics**  
Monday, April 01, 2019, 3:00pm-4:00pm  
3088 East Hall  
Yili Zhang (UM)  
*On the asymptotic optimality of the comb strategy for prediction with expert advice*

For the problem of prediction with expert advice in the adversarial setting with geometric stopping, we compute the exact leading order expansion for the long time behavior of the value function. Then, we use this expansion to prove that as conjectured in Gravin et al. [12], the comb strategies are indeed asymptotically optimal for the adversary in the case of 4 experts.

Joint work with E. Bayraktar (UM) and I. Ekren (FSU).
Hashing is a technique widely used in coding theory and cryptography. Although hashing is an interesting mathematical object, it is surprisingly little known to the mainstream mathematicians. I will focus on one specific result on hashing, namely the Leftover Hash Lemma of Impagliazzo, Levin, and Luby (1989). We will express it as a result in extremal combinatorics, give a probabilistic proof of it, and derive a result of Abbe, Shpilka and Wigderson (2015) on linear independence of random tensors. Unfortunately, methods based on hashing only work over finite fields, so in the next lecture we present a different approach.

Group, Lie and Number Theory
Monday, April 01, 2019, 4:00pm-5:20pm
4088 East Hall
Yong Suk Moon (Purdue University)

$p$-divisible groups and relative crystalline representations

Let $k$ be a perfect field of characteristic $p > 2$, and let $R$ be a relative base ring over $W(k)$ with ramification degree $e$ satisfying some mild conditions. We show that if $e < p-1$, then every crystalline representation of the etale fundamental group of $\text{Spec}(R[1/p])$ with Hodge-Tate weights in $[0, 1]$ arises from a $p$-divisible group over $R$. This is a joint work with Tong Liu.

Geometry & Physics
Monday, April 01, 2019, 4:00pm-6:00pm
4096 East Hall
Yang Zhou (Harvard)

Quasimap wall-crossing for GIT quotients

For a large class of GIT quotients $X=W//G$, Ciocan-Fontanine--Kim--Maulik and many others have developed the theory of epsilon-stable quasimap invariants. They are conjecturally equivalent to the Gromov--Witten invariants of $X$ via explicit wall-crossing formulae, which have been proved in many cases, including targets with good torus action and complete intersections in a product of projective spaces.

In this talk, we will give a proof for all targets in all genera. The main ingredient is the construction of some moduli space with $\mathbb{C}^*$ action whose fixed-point loci precisely correspond to the terms in the wall-crossing formulae.
Matroids are useful and interesting combinatorial objects. The talk will begin with the definition of a matroid and several examples. In particular, no prior knowledge of matroids is assumed. We will then discuss some applications of matroids to game theory and algorithms. If time permits, we will also discuss a recent proof of Rota's conjecture by Adiprasito, Huh and Katz, at the intersection of Hodge theory and combinatorics.

Real vs complex polarizations

In cases when one has a completely integrable system on a Kähler manifold with a quantizing line bundle, one can try to understand the interplay between the real and the complex polarizations. I will start with the toric case and then discuss what is known about the Gelfand-Cetlin system. The Bergmann kernel will make its appearance for the first time.

Random tensors

In contrast to random matrix theory, the theory of random tensors is poorly understood. This is surprising given the popularity of tensor methods in modern algorithmic applications. I will prove that tensor powers of independent random vectors are well conditioned with high probability. The argument uses and develops various tools of high-dimensional probability.
Student Geometry/Topology
Tuesday, April 02, 2019, 3:00pm-4:00pm
1866 East Hall
Nicholas Wawrykow (University of Michigan)
Out(F_n) and the Free Factor Complex

Combinatorial structures can provide a wealth of information about the groups that act upon them, e.g., the curve complex can be used to show the mapping class group of surface is "relatively hyperbolic." In a similar way the free factor complex of Hatcher and Vogtmann reveals much about elements of Out(F_n). I will discuss the topology and geometry of the free factor complex. In turn I will explain what the structure of the free factor complex, namely that it is Gromov hyperbolic, means for Out(F_n).

Student Commutative Algebra
Tuesday, April 02, 2019, 3:00pm-3:50pm
3866 East Hall
Anna Brosowsky (University of Michigan)
Regular Rings and Auslander-Buchsbaum-Serre

A regular ring is of interest in algebraic geometry, as it corresponds to a non-singular affine variety. In this talk, we will define regular rings and give several examples. The talk will culminate in the Auslander-Buchsbaum-Serre theorem, which provides a nice equivalence of regular local rings with several finiteness conditions on projective dimension.

Colloquium Series
Tuesday, April 02, 2019, 4:00pm-5:00pm
1360 East Hall
Tara Holm (Cornell University)
Understanding Symplectic Geometry through Polytopes and Lattice Points.

Topology is often called "rubber sheet geometry" and is described as "floppy" while geometry is more "rigid". Symplectic geometry, the natural geometry of classical mechanics, is floppier than Riemannian geometry but more rigid than topology. I will give an overview of this floppy/rigid spectrum. We will then explore how the geometry and topology of symmetries in this context relate to properties of polytopes, motivated by many pictures and examples. I will conclude with how some of my recent work, joint with Daniel Cristofaro-Gardiner, Alessia Mandini and Ana Rita Pires, comes to feature continued factions, counting lattice points, and the Philadelphia subway system.
In this thesis we study two problems concerning the long time behavior of the two dimensional water waves.

In the first project, we study the motion of the two dimensional inviscid incompressible, infinite depth water waves with point vortices in the fluid. We show that the Taylor sign condition \( \frac{\partial P}{\partial \mathbf{n}} \geq 0 \) can fail if the point vortices are sufficient close to the free boundary, so the water waves can be subject to the Taylor instability. Assuming the Taylor sign condition, we prove that the water wave system with point vortices is locally wellposed in Sobolev spaces. Moreover, we show that if the water waves is initially symmetric with a certain symmetric vortex pair traveling downwards, then the free interface remains smooth for a long time, and for initial data of size \( \epsilon \ll 1 \), the lifespan of the solution is at least \( O(\epsilon^{-2}) \).

In the second project, we rigorously justify the Peregrine soliton from the full water waves. The Peregrine soliton \( Q(x,t) = e^{it}(1 - \frac{4(1+2it)}{1+4x^2+4t^2}) \) is an exact solution of the 1d focusing nonlinear Schrödinger equation (NLS) \( iB_t + B_{xx} = -2|B|^2B \), having the feature that it decays to \( e^{it} \) at the spatial and time infinities, and with a peak and troughs in a local region. It is considered as a prototype of the rogue waves by the ocean waves community. The 1D NLS is related to the full water wave system in the sense that asymptotically it is the envelope equation for the full water waves. In this project, working in the framework of water waves which decay non-tangentially, we give a rigorous justification of the NLS from the full water waves equation in a regime that allows for the Peregrine soliton. As a byproduct, we prove long time existence of solutions for the full water waves equation with small initial data in space of the form \( \mathbb{H}^s(\mathbb{R}) + \mathbb{H}^{s'}(\mathbb{T}) \), where \( s \geq 4, s' > s + \frac{3}{2} \).
Grad Thesis Defense: High Dimensional Phenomenon in Convex Geometry and Spectral Theorem of Random Graphs

In this thesis, we study high dimensional phenomena arising in convexity and probabilistic combinatorics. The main object of the first part is high dimensional convex bodies. We study random almost spherical sections of a convex body, which is related to Dvoretzky’s theorem. We also investigate the mass distribution in a convex body with respect to its maximum volume ellipsoid. Furthermore, we study the approximation of convex bodies by polytopes with few facets. We also construct a special class of convex bodies which we use to define affine surface area.

The second part of the thesis is devoted to the study of nodal domains of Erdős-Rényi graphs. An Erdős-Rényi graph $G(n,p)$ is a random graph with $n$ vertices where any two vertices are connected by an edge with probability $p$ independently of other edges. Consider an eigenvector of the adjacency matrix of such random graph. A nodal domain corresponding to this eigenvector is a connected component of the set of vertices where the vector has a constant sign. It was proved by Dekel et. al. that with high probability, there are exactly two nodal domains for every non-leading eigenvector. We show that the sizes of these two nodal domains are almost exactly equal to each other.

Financial/Actuarial Mathematics

CANCELED. Mean Field Analysis of Neural Networks in Machine Learning

Neural network models in machine learning have revolutionized fields such as image, text, and speech recognition. There is also growing interest in using neural networks for applications in science, engineering, medicine, and finance. Despite their immense success in practice, there is limited mathematical understanding of neural networks. We mathematically study neural networks in the asymptotic regime of simultaneously (A) large network sizes and (B) large numbers of stochastic gradient descent training iterations. We rigorously prove that the neural network satisfies a Law of Large Numbers (LLN) and a Central Limit Theorem (CLT). The LLN is the solution of a nonlinear partial differential equation while the CLT satisfies a stochastic partial differential equation.
Since the creation of modular forms in the 19th century, people have been altering portions of the definition to create more general functions to study. In this talk, I will introduce different generalizations of modular forms that people have come up with including Maass forms, half-integral weight forms, vector-valued forms, Hilbert forms, and Siegel forms. If time permits, then we can also discuss harmonic weak Maass forms, which are a combination of several of the previous ideas.

Algebraic Geometry
Wednesday, April 03, 2019, 4:00pm-5:20pm
4096 East Hall
Eva Elduque (University of Wisconsin)
On the signed Euler characteristic property for subvarieties of abelian varieties

Franecki and Kapranov proved that the Euler characteristic of a perverse sheaf on a semi-abelian variety is non-negative. This result has several purely topological consequences regarding the sign of the (topological and intersection homology) Euler characteristic of a subvariety of an abelian variety, and it is natural to attempt to justify them by more elementary methods. In this talk, we'll explore the geometric tools used in the proof of the signed Euler characteristic property. Joint work with Christian Geske and Laurentiu Maxim.

RTG Seminar on Geometry, Dynamics and Topology
Wednesday, April 03, 2019, 4:00pm-5:30pm
3866 East Hall
Harry Bray (UM)
TBA
Differential Equations
Wednesday, April 03, 2019, 5:00pm-6:00pm
4088 East Hall
Anne-Sophie De Suzzoni (Ecole Polytechnique, France)

(**SPECIAL TIME**) Asymptotics for the Hartree equation

In this talk, we will present one model (in the mean field limit) for large systems of particles interacting via a potential $w$. This model is a Hartree equation on random fields in $\mathbb{R}^d$ that admits equilibria related to thermodynamical equilibria. We study the asymptotic stability of these equilibria. One issue that arises is the fact that these equilibria are not localised in space, their laws are invariant by translation in space. We prove a scattering result around these equilibria under some assumptions on $w$. The proof is based on a high frequency/low frequency analysis and a reformulation of the problem. (Joint work with Charles Collot).

Special Events
Wednesday, April 03, 2019, 5:30pm-6:30pm
1324 East Hall
Ben Orlin (math teacher, author, and cartoonist)
Public Lecture: The Unlikely Friendship of Math and Science

On the one hand, there's science: the clear-eyed, hard-nosed, the pragmatic empiricist. On the other hand, there's math: the poet, the dreamer, the hunter of wild abstractions. How do these two intellectual traditions regard one another? And why is it that the most useless-sounding math - from knot theory to meta-logic to non-Euclidean geometry - often turns out to be the most useful? Prerequisites: basic human curiosity; tolerance for bad drawings; the willingness to participate in a silly debate. In short: all are welcome!

Topology
Thursday, April 04, 2019, 3:00pm-4:00pm
4096 East Hall
Mark Greenfield (University of Michigan)
Isometric submersions of Teichmueller spaces

We study holomorphic and isometric submersions between Teichmueller spaces of finite-type surfaces. Our main result is that (possibly excepting low-genus phenomena) any such map is a forgetful map obtained by filling in punctures. This generalizes Royden's theorem which states that the isometry group of a Teichmueller space is the mapping class group of the underlying surface (again excepting low-genus phenomena). In this talk, after discussing some background and related results, we will give an overview of the proof, including how we adapt and utilize analytic methods originally developed by Markovic for generalizing Royden’s theorem to infinite-type surfaces. This is joint work with Dmitri Gekhtman.
Commutative Algebra
Thursday, April 04, 2019, 3:00pm-4:00pm
3866 East Hall
Patricia Klein (University of Kentucky)
Generalizations of determinantal ideals

Myriad techniques have been developed over the past several decades to study ideals generated by $t$-minors of $mxn$ matrices of indeterminates. The varieties they determine are known to be normal, Cohen-Macaulay domains. These results were first due to Hochster and Eagon in 1971. In this talk, we will describe how liaison theory can be used to recover the Cohen-Macaulay component of these results and extend them to other types of varieties, such as minors of mixed size in a ladder of a symmetric matrix of indeterminates. This approach, due to Gorla, Migliore, and Nagel, also shows that the natural generators of the ideal form a Groebner basis with respect to any diagonal term order. We will close by describing progress on an open problem surrounding another family of ideals conjectured to exhibit these same desirable properties held by determinantal ideals. This talk is based on joint work with Nathan Fieldsteel.

Differential Equations
Thursday, April 04, 2019, 4:00pm-12:00am
4088 East Hall
Tao Luo (City University Hong Kong)
Some Singular Limits in Plasma or Fluids in the Presence of Boundaries or Initial Layers

In this talk, I will first present a result on some singular limits problems of viscous plasma (joint with Qiangchang Ju & Xin Xu) in the presence of physical boundaries as the Debye length and viscosity tend to zero. The nonlinear stability of the approximation solutions involving the strong boundary layer due to the break-down of the quasi-neutrality near the boundary will be discussed. Another part of the talk will be on the zero relaxation limit problem from the thermal non-equilibrium to equilibrium of gas dynamics in the presence of initial layers and physical boundaries based on the joint work with Chengjie Liu.

Student Algebraic Geometry
Thursday, April 04, 2019, 4:00pm-5:00pm
B735 East Hall
Sanal Shivaprasad (UM)
The Torelli theorem

We will begin by talking about the classical Torelli theorem; we will define the Jacobian variety associated to a curve, the polarization of a Jacobian variety and then state the classical Torrelli theorem. We will then talk about the period mapping and possible generalizations that can be made.

Quant Program Practitioner
Friday, April 05, 2019, 2:30pm-3:30pm
B844 East Hall
Dimitrios Liakakos (Sun Trading LLC)
TBA
Applied Interdisciplinary Mathematics (AIM)
Friday, April 05, 2019, 3:00pm-4:00pm
1084 East Hall
Nadia Drenska (University of Minnesota)

PDE approaches to two problems from prediction with expert advice

This talk involves two problems from online machine learning, specifically 'prediction with expert advice'. The two problems are a deterministic and a probabilistic instance of repeated two-person games; in both cases an agent uses 'expert advice' to invest optimally, in a worst case setting, against an adversarial market. The methods used are from viscosity solutions of PDEs and Optimal Control Theory.

This is work in collaboration with Robert Kohn (NYU Courant) and with Jeffrey Calder (University of Minnesota).

Geometry
Friday, April 05, 2019, 3:00pm-4:00pm
3866 East Hall
Sunny Yang Xiao (Brown)

Classifying incompressible surfaces in hyperbolic mapping tori

One often gains insight into the topology of a manifold by studying its sub-manifolds. Some of the most interesting sub-manifolds of a 3-manifold are the "incompressible surfaces", which, intuitively, are the properly embedded surfaces that can not be further simplified while remaining non-trivial. In this talk, I will present some results on classifying orientable incompressible surfaces in a hyperbolic mapping torus whose fibers are 4-punctured spheres. I will explain how such a surface gives rise to a path which satisfies certain combinatorial properties in the arc complex of the 4-punctured sphere. This extends and generalizes results of Floyd, Hatcher, and Thurston.
Combinatorics
Friday, April 05, 2019, 3:00pm-4:00pm
4088 East Hall
Jenna Rajchgot (University of Saskatchewan)
Type D quiver representation varieties, double Grassmannians, and symmetric varieties

Since the 1980s, mathematicians have found connections between orbit closures in type A quiver representation varieties and Schubert varieties in type A flag varieties. For example, singularity types appearing in type A quiver orbit closures coincide with those appearing in Schubert varieties in type A flag varieties (Bobinski-Zwara); combinatorics of type A quiver orbit closure containment is governed by Bruhat order on the symmetric group (follows from work of Zelevinsky, Kinser-R); and multiple researchers have produced formulas for classes of type A quiver orbit closures in equivariant cohomology and K-theory in terms of Schubert polynomials, Grothendieck polynomials, and related objects.

After recalling some of this type A story, I will discuss joint work with Ryan Kinser on type D quiver representation varieties. I will describe explicit embeddings which completes a circle of links between orbit closures in type D representation varieties, B-orbit closures (for a Borel subgroup B of GL_n) in certain symmetric varieties GL_n/K, and B-orbit closures in double Grassmannians Gr(a, n) x Gr(b, n). I will end with a few consequences on singularities (recovering work of Bobinski-Zwara), combinatorics or orbit closure containment, and torus equivariant K-theory.

Junior Colloquium Series
Friday, April 05, 2019, 4:00pm-4:50pm
3088 East Hall
Sunny Yang Xiao (Brown)
What I am talking about when I talk about diversity and inclusion

In 2016 we started the Horizons seminar at Brown University, a brand new seminar dedicated to raising awareness of issues of diversity and inclusion in STEM fields, providing career advancement advice to graduate students, and promoting the work of traditionally under-represented mathematicians. Since then I've been asked many questions about it: why do we do it? How does it work? In this talk I'll share the founding story of the Horizons seminar. In particular, I will explain how the experience of organizing this seminar helped me reconcile my identity as a mathematician with my belief that mathematics should be for human flourishing. Questions and discussions are especially welcome at this talk.