POSTER SESSION SCHEDULE

AGNES @ DARTMOUTH FALL 2024

Session Details

- **Date:** Saturday November 9th
- **Time:** 6:30PM – 8PM
- **Location:** Hanover Inn Grand Foyer

Poster Presentations

1. *I-functions of flag manifolds and of their cotangent bundles*
   Presenter: Kamyar Amini (Virginia Tech)
   Abstract: The K-theoretic J-function in Gromov-Witten theory is a generating function for one-point genus-zero Gromov-Witten invariants. Ciocan-Fontanine, Kim, and Maulik defined the moduli space of quasimaps and introduced the I-function, which is analogous to the J-function in Gromov-Witten theory, focusing on maps to GIT quotients. Okounkov utilized this moduli space to define a vertex function that acts as a generating function counting quasimaps to Nakajima varieties, such as the cotangent bundle of flag manifolds. By considering the hyper-quot compactification of the moduli space of maps to flag manifolds, we introduce a new class using the I-function and a generating function on flag manifolds, through which we recover Okounkov's vertex function for the cotangent bundles.

2. *Vanishing cycles for secant varietie*
   Presenter: Daniel Brogan (Stony Brook University)
   Abstract: We study the singularities of the higher secant varieties of a rational normal curve in projective space. These varieties are given by the vanishing of certain ideals of a Hankel matrix, whose entries are identical on each anti-diagonal. We discuss the Milnor fiber associated to the determinant of this matrix and compute its cohomology. This leads to a computation of the nearby and vanishing cycles for this function.

3. *The Mirror to the Logarithmic Hilbert Scheme of Points on* $\mathbb{P}^2$
   Presenter: Sayan Chattopadhyay (University of Georgia)
   Abstract: Brief description of the poster. The Gross-Siebert program gives a recipe to construct mirrors to log Calabi-Yau varieties. We apply their program to the Logarithmic Hilbert Scheme of two points on $\mathbb{P}^2$ and explicitly describe the canonical scattering diagram. We also identify an specific family in this mirror which is isomorphic to the spherical part of the GL_2 DAHA. This is joint work with Pierrick Bousseau.

4. *The fibering genus of Fano hypersurfaces*
Presenter: Benjamin Church (Stanford University)
Abstract: The "fibering genus" of X is the minimal genus of a rational fibration on X by curves. The fibering genus of a variety has been studied in work of Konno, Ein–Lazarsfeld, and Voisin in the non-Fano range. However, this measure of irrationality, unlike covering gonality or covering genus, can be interesting even for rationally-connected varieties. We prove lower bounds on the fibering genus of very general Fano hypersurfaces. In particular, we exhibit Fano varieties with arbitrarily large fibering genus. As an application, we rule out Mori fiber space structures of low relative dimension on very general Fano hypersurfaces giving a weak analog of "birational superrigidity" in higher index. The method follows Kollár's technique of degeneration to p-cyclic covers in characteristic p. The main difficulty is to ensure the degenerated fibration in curves over characteristic p is generically smooth for which a crucial input is Tate's genus change formula.

5. *Algebraic Skew Embedding for Curves*
Presenter: Andy Day (Penn State)
Abstract: Given a smooth manifold X, a totally skew embedding of X is an embedding of X into an euclidean space $\mathbb{R}^N$ such that for any two distinct points $x, y \in X$, their embedded tangent spaces in $\mathbb{R}^N$ neither intersect nor contain parallel lines. The concept can be generalized to algebraic skew embeddings of complex smooth varieties into complex projective spaces. In this talk, we establish an upper bound and a lower bound of the minimal dimension N such that there exists a skew embedding into the space $\mathbb{CP}^N$ for a given smooth variety X. In particular, we classify the algebraic curves in terms of their minimal skew embedding dimension N.

6. *Cohomology of Moduli Space of Multiscale Differentials in Genus 0*
Presenter: Prabhat Devkota (Stony Brook University)
Abstract: We prove that the rational cohomology ring of moduli space of multiscale differentials in genus 0 is generated by the boundary divisors. The main idea is the technique of the Chow-Künneth generation Property and the observation that the intersection of a collection of boundary divisors in the moduli space is irreducible. Similarly, we also characterize the cases in which the moduli space is a smooth variety, and in these cases, we prove that the integral cohomology ring is generated by the boundary divisors.

7. *GKZ Hypergeometric Systems and Their Applications to Mirror Symmetry*
Presenter: Zengrui Han (Rutgers University)
Abstract: Homological mirror symmetry predicts the existence of an isotrivial family of triangulated categories over the stringy Kähler moduli space associated to an affine toric Gorenstein singularity. This family underlies the derived equivalences between different crepant resolutions of such a singularity. While the construction of this family is still an open problem, its de-categorification is known as the GKZ hypergeometric system and is relatively well-understood. In this project, we studied the duality and analytic continuation of such systems, along with their applications to local mirror symmetry (Hori-Vafa mirrors).

8. *Motivic enumerative invariants of algebraic stacks.*
Presenter: Andrés Ibáñez Núñez (Columbia University)
Abstract: The Euler characteristic of a complex algebraic variety is the alternating sum of its Betti numbers. However, moduli spaces in algebraic geometry are often not varieties but Artin stacks $\mathcal{X}$, and for them the Euler characteristic is undefined, since there may be infinitely many nonzero Betti numbers.

When $\mathcal{X}$ parametrises objects in an abelian category, Joyce defined a meaningful notion of Euler characteristic of $\mathcal{X}$ using the motivic Hall algebra, a structure that heavily depends on the underlying abelian category. This was in turn used to define Donaldson–Thomas invariants by Joyce–Song.

I will explain how to define motivic Hall algebra like structures for general stacks and how this yields a definition of Euler characteristic and of Donaldson–Thomas invariants that is valid for nonlinear moduli problems, like G-bundles or G-local systems. A crucial ingredient is the stack of filtrations of $\mathcal{X}$, defined by Halpern–Leistner.

This is joint work with Chenjing Bu and Tasuki Kinjo.

9. *Residues of Logarithmic Connections and the Equivariant Riemann-Roch Formula*
Presenter: Alexandros Kafkas (Purdue University)
Abstract: Given a finite group action on a nonsingular projective surface X, a line bundle L on X is called equivariant if the action of G extends to L in a compatible way. This induces a G-action on the cohomology groups $H^*(X, L)$. The virtual Euler characteristic of L is the character of the virtual representation $H^0(X, L) - H^1(X, L) + H^2(X, L)$ of G. We will give an approach to calculating the virtual Euler characteristic by using logarithmic connections and residue theorems.

10. *Finiteness of p-resolutions*
Presenter: Aditya Khurmi (UMass Amherst)
Abstract: Kollár-Shepherd-Barron discovered a correspondence between the components of the versal base space and the so called p-resolutions of singularities, which are certain partial resolutions of a normal surface singularity. An algorithm on computing all p-resolutions is known when the singularity is cyclic-quotient, however not much is known in the general case. I prove that there are a finite number of p-resolutions over any normal surface singularity and give an algorithm for special cases.

11. *Connected components of generalized strata of meromorphic differentials with linear residue conditions.*
Presenter: Myeongjae Lee (Stony Brook University)
Abstract: Strata of differentials are interesting objects studied in various fields such as Teichmuller dynamics, topology and algebraic geometry. Generalized strata are subsets of the strata of meromorphic differentials, where certain sets of residues summing up to zero. We present the classification of the connected components of these strata.

12. *Motivic classes of stacks in finite characteristic and applications to stacks of bundles with connections*
Presenter: Ruoxi Li (University of Pittsburgh)
Abstract: We will first discuss the motivations for motivic classes coming from point counting over finite fields. Then we will give the definitions of the motivic classes of schemes, in particular we explain that an extra relation is needed in finite characteristic. We will introduce motivic zeta functions that are universal versions of local zeta functions.

For the second part, we will focus on the motivic classes of stacks. In particular, we will give a version of Hua's formula for bundles with automorphisms and the explicit formulas for the motivic classes of moduli of bundles with connections.

13. *Threefolds containing all curves are rationally connected*
Presenter: Sixuan Lou (University of Illinois at Chicago)
Abstract: Any smooth projective curve embeds into $\mathbb{P}^3$. More generally, any curve embeds into a given rationally connected variety of dimension at least 3. We prove conversely that if every curve embeds into a threefold X, then X is rationally connected. In particular, "all curves embed" is a birational property for threefolds.

14. *On the locus of curves mapping to a fixed target*
Presenter: Federico Moretti (Stony Brook university)
Abstract: Suppose Y is a smooth variety equipped with a top form. We prove a simple theorem giving a sharp lower bound on the geometric genus of a family of subvarieties of Y, in terms of the dimension of this family. Two elementary applications are presented. On the one hand, we show that for a very general curve C and a very general hypersurface $Y \subset \mathbb{P}^{n+1}$ of degree $\geq 2n+1$, any map $C \to Y$ is constant. On the other hand, we give a lower bound on the genus of a family of curves with an isotrivial factor in the associated family of Jacobians; we also characterize the families of curves attaining this bound as the families of degree 2 branched covers of a fixed curve.

15. *(Toward) an Algorithm to Explicitly Produce a Regular Model of a Hyperelliptic Curve in "Bad" Mixed Characteristic (0, 2): A Criterion to Verify Regularity, and Requisite Blowups via Inductive Valuations*
Presenter: James Myer (The CUNY Graduate Center)
Abstract: We discuss progress toward an algorithm to explicitly produce a regular model of a hyperelliptic curve in *bad* mixed characteristic (0, 2) via normalization (in the function field of the hyperelliptic curve — always meant in the sequel) of a candidate *Obus-Srinivasan* model of the projective line described explicitly by Andrew Obus & Padmavathi Srinivasan via inductive ((Saunders) Mac Lane) valuations, and a criterion to verify its regularity. The normalization of a point on an Obus-Srinivasan model whose tube avoids a certain *bad* locus — the (union of the) monodromy disc(s) — and so *doesn't contain any genus* — is conjectured to enjoy a hyperlocal proxy model of the projective line whose corresponding valuations are inductive, and thus, afford us an explicit description of the blowups to which they correspond.

16. *An analogue of Greenberg pseudo-null conjecture for CM fields*
Presenter: Peikai Qi (Michigan State University)
Abstract: We will give an analogue of Greenberg's pseudo-null conjecture for CM fields. Let K be a CM field and K^+ be the unique totally real subfield of K. Assume that primes above p in K^+ all splits in K. Let $\mathfrak{P}_1, \mathfrak{P}_2, \cdots, \mathfrak{P}_s, \tilde{\mathfrak{P}}_1, \tilde{\mathfrak{P}}_2, \cdots, \tilde{\mathfrak{P}}_s$ be prime ideas in K above p, where $\tilde{\mathfrak{P}}_i$ is the complex conjugation of $\mathfrak{P}_i$. We show that there is unique $\mathbb{Z}_p$-extension of K unramified outside $\mathfrak{P}_1, \mathfrak{P}_2, \cdots, \mathfrak{P}_s$ if Leopoldt's conjecture holds for K. We also show that such $\mathbb{Z}_p$-extension for CM field has similar properties as cyclotomic $\mathbb{Z}_p$-extension of a totally real field. We also give some criteria for Iwasawa invariant $\mu = \lambda = 0$. The work is joint with Matt Stokes.

17. *Amitsur subgroup of Fano threefolds*
Presenter: Shreya Sharma (University of South Carolina)
Abstract: The Amitsur subgroup of a smooth Fano G-variety measures the obstruction to G-linearization of line bundles on it. It is an equivariant birational invariant. The Amitsur subgroup of such varieties has already been described in cases of dimensions 1 and 2. A natural next step is to compute it for Fano varieties of dimension 3. In this talk, we discuss the Amitsur subgroup of smooth Fano threefolds defined over the field of complex numbers.

18. *Stability conditions on surface root stacks.*
Presenter: Yu Shen (Michigan State University)
Abstract: We construct tilt stability conditions on surface root stacks and show that they have support property with respect to the rational Chen-Ruan cohomology.

19. *G-theory of simplicial toric varieties*
Presenter: Zeyu Shen (Rutgers University-New Brunswick)
Abstract: Let k be an algebraically closed field. Let X be a simplicial toric variety over k. When X is affine, it has the form $\operatorname{Spec} k[\sigma^\vee \cap \mathbb{Z}^n]$ for an n-dimensional simplicial cone σ in $\mathbb{R}^n$, where n is the Krull dimension of the variety.Let $G_0(X)$ denote the Grothendieck group of coherent sheaves on X. Then $G_0(X)$ is isomorphic to $\mathbb{Z} \oplus F^1G_0(X)$, where $F^1G_0(X)$ is the first step of the filtration on $G_0(X)$ by codimension of support. In our case, the $F^1G_0(X)$ is always a finite abelian group. In dimension 2, $F^1G_0(X)$ is cyclic of order $|\delta|$, where δ is the determinant of the matrix taking the minimal generators of the simplicial cone σ as its columns. In dimension 3, $F^1G_0(X)$ is an extension of the Chow group $A^1(X)$ by the Chow group $A^2(X)$. The Chow group $A^1(X)$ has order $|\delta|$ in all dimensions. And the order of the Chow group $A^2(X)$ is conjectured to divide $|\delta|$ when $\dim(X) = 3$.

G_0 fits into a larger picture called the G-theory of a Noetherian scheme. Let $M(X)$ denote the abelian category of coherent sheaves on a Noetherian scheme X. G-theory of X is defined as the algebraic K-theory of the abelian category $M(X)$. In particular, for every non- negative integer n, the n-th G-theory group $G_n(X)$ is defined as the n-th K-group of the abelian category $M(X)$. I compute all the G-theory groups for affine toric surfaces and weighted projective spaces of the form $\mathbb{P}(1, a, b)$.And $G_0(X)$ is computed for any weighted projective plane.

20. *3 x 3 Magic Squares (of Squares!)*
Presenter: Benjamin Singer (Dartmouth College)
Abstract: The question of the existence of a 3 x 3 magic square comprised entirely of square integers has remained unsolved since Gauss posed it in the mid-18th century. We take an arithmetic-geometric approach to this problem by examining the variety it cuts out, which is a complete intersection surface of general type.

21. *On the weak Lefschetz property for ideals generated by powers of general linear forms*
Presenter: Pankaj Singh (University of South Carolina)
Abstract: We provide a description of initial ideals for almost complete intersections generated by powers of general linear forms and prove that WLP in a fixed degree d holds when the number of variables n is sufficiently large compared to d. In particular, we show that if $n \geq 3d-2$ then WLP holds for the ideal generated by squares at the degree d spot and for $n \geq \frac{3d-3}{2}$ WLP holds for ideal generated by cubes at the degree d spot. Finally, we prove that WLP fails for the ideal generated by squares when $n < 3d-2$ at the dth spot by finding an explicit element in the kernel of the multiplication by a general linear form. This shows that our bound on n is sharp in the case of the squares.

22. *Dual complex of genus one mapping spaces*
Presenter: Terry Song (University of Cambridge)
Abstract: The dual complex of a smooth variety encodes the combinatorial structure that underlies all its possible normal crossings compactifications. We prove that the dual complexes of genus zero and genus one mapping spaces are contractible (in degrees > 0 and > 1 respectively) via an explicit deformation retraction. In genus one, the key geometric input comes from the Vakil-Zinger space and its tropical interpretation due to Ranganathan - Santos-Parker - Wise. Joint work with Siddarth Kannan (MIT).

23. *Embedding of Projective Planes in the Hilbert Scheme of* K3 *Surfaces*
Presenter: Yeqiu Wang (Brown University)
Abstract: We explore the ample cones of K3 surfaces and their Hilbert schemes, focusing on the embedding of projective planes. The main result establishes that hyperkähler varieties of $K3^{[2]}$-type admit smooth embeddings of projective planes.