RGM 2023 Poster Session Abstracts

Yifeng Huang (University of British Columbia)

Title: Motive of the punctual Quot schemes on singular curves

Abstract: (Joint with Ruofan Jiang) The Quot scheme of degree-n rank-0 quotients of the trivial vector bundle O^d is a generalization of the Hilbert scheme of points; the latter is when d=1. We study the motive of these Quot schemes on the cusp singular curve using Gröbner stratification, proving a rationality result that extends the known one for Hilbert schemes of any singular curve. We give explicit computations in d<=3, which shows strong conjectural patterns that will lead to a formula for general d. These patterns include a functional equation, which extends the known one for Hilbert schemes of any Gorenstein curve.

Jae Hwang Lee (Colorado State University)

Title: A Quantum H^∗(G)-module via Quasimap Invariants

Abstract: For X a smooth variety or Deligne-Mumford stack, the quantum cohomology ring QH∗(X) is a deformation of the usual cohomology ring H∗(X), where the product structure is modified to incorporate quantum corrections. These correction terms are defined using Gromov-Witten invariants. For a GIT quotient V //G, the cohomology ring H∗(V //G) also has the structure of a H∗(G)-module. In this work, we use quasimap invariants with light points and a modified version of the WDVV equation to define a quantum deformation of this H∗(G)-module structure. Using localization, we explicitly compute this structure for the Hirzebruch surface of type 2. We conjecture that this new quantum module structure is isomorphic to the Batyrev ring when the target is a semipositive toric variety.

Weihong Xu (Virginia Tech)

Title: Quantum K-theory of incidence varieties

Abstract: We prove a conjecture of Buch and Mihalcea in the case of the incidence variety X=Fl(1, n-1, n) and determine the structure of its (T-equivariant) quantum K ring. In particular, we derive a positive Chevalley formula and a presentation for the equivariant quantum K ring of X, as well as a positive Littlewood--Richardson rule for the non-equivariant quantum K ring of X. Our proof is via the study of rationality properties of certain Gromov--Witten varieties, which are subvarieties of the Kontsevich moduli space of 3-pointed genus 0 stable maps to X. We also

conjecture a presentation for the quantum K ring of any flag variety Fl(r_1, ..., r_k, n). Part of this poster is based on joint work with W. GU, L. Mihalcea, E. Sharpe, and H. Zhang.

Shuo Zhang (University of Minnesota Twin Cities)

Title: Lagrangian Clean intersection

Abstract: Lagrangian surgery is a basic operation to obtain new Lagrangian submanifolds, discovered by Polterovich. It has been known that in Floer theory, Lagrangian surgery at a transversal intersection corresponds to the mapping cones of the morphism represented by the resolved intersections. If the Lagrangian submanifolds intersects cleanly, the expected operation in Fukaya category among the experts is the mapping cone of the morphism represented by the fundamental class of the clean intersection. In a joint work with Mak and Wu we'll prove this for exact Lagrangians.

Rob McConkey (Michigan State University)

Title: Linear Bounds on the Cross Cap Number of Links

Abstract: The cross-cap number of a link is an invariant which considers the non-orientable spanning surfaces of the link, similar to how the genus of a link depends on the orientable spanning surfaces. In 2014 Kalfagianni and Lee found linear bounds for the cross-cap number of alternating links in relation to the coefficients of the Jones Polynomial. But what happens when we begin to look beyond alternating links? We consider a couple of families of links where such linear bounds cannot be found. Then talk about a family where we can find linear bounds for the cross cap number with respect to the twist number.

Louisa Liles (University of Virginia)

Title: Z-double-hat, Brieskorn spheres, and (quantum) modularity

Abstract: Z-hat is a q-series invariant of negative definite plumbed 3-manifolds. It has been extended to the (q,t)-series Z-double-hat, which specializes to Z-hat when t=1. It is known that Z-hat of a Brieskorn sphere is a quantum modular form. We calculate Z-double-hat of Brieskorn spheres, and show that when t is any root of unity, the resulting q-series is a finite sum of modular and quantum modular forms.

Greyson Potter (Boston University)

Title: Non-perturbative topological recursion and SL(2,C) Chern-Simons Theory

Abstract: I will discuss the conjectured relationship between topological recursion and Chern-Simons theory with complex gauge group SL(2,C), known as the generalized volume conjecture (GVC) for hyperbolic knots. The conjecture states that there is asymptotic agreement between three generating functions: the colored Jones polynomials of the knot, the partition function of Chern-Simons theory with complex gauge group SL(2,C) associated to the knot complement, and the non-perturbative wave-function arising from topological recursion on the A-polynomial of the knot. I will also discuss a new algorithm for computing topological recursion via higher quantum Airy structures that uses graph sums and an efficient graph generation algorithm, which was used to verify the GVC to higher order than was previously accessible in several cases

Ming Zhang (UC San Diego)

Title: Quantum K-theory and Quot Scheme

Abstract: Quantum K-theory of Grassmannians was first studied by Buch and Mihalcea, and it has rich combinatorial structures. They used the ``quantum to classical principle'' and reduced the computation of three-pointed quantum K-invariants to that over a two-step flag manifold. In this poster, I will present a different approach to studying quantum K-invariants of Grassmannians using K-theoretic Quot scheme invariants. This is joint work in progress with Shubham Sinha.

Shunyu Wan and Yangxiao Luo (University of Virginia)

Title: Oriented Thompson links and grid diagram

Abstract: Given any oriented Thompson link which is represented by certain pair of binary trees with same leaf number, we construct a canonical grid diagram associated to it. Using the grid representation we show that the parity of leaf number is the same as the parity of number of link components. This is joint work with Yangxiao Luo.

Leonard Mushunje (Columbia University)

Title: High Dimensional Functional Data Analysis via Algebraic Geometry

Abstract: When regressing high-dimensional functional data, challenges are often encountered mainly for the in-sample than out-sample results and even worse when subjected to the curse of dimensionality. For example, on the in-sample, minimal bounds on the eigenvalues of the covariance matrix for the covariates, when using ridge regression, are not generally considered. This study aims to explore the in-sample MSPE properties of different regression methods (except ridge regression) and understand whether the eigenvalue lower bounding conditions are generally avoidable in high-dimensional Hilbert settings.

Tonie Scroggin (UC Davis)

Title: Computing (Co)homology on Two Strand Braid Varieties Using Cluster Algebras

Abstract: We define the braid variety as an link invariant. The homology of a braid variety is related to the Khovanov-Rozansky homology of a corresponding link, which is notoriously difficult to compute. The braid variety is isomorphic to a positroid variety; therefore, the braid variety has a cluster structure. Any cluster structure has a canonical 2-form with constant coefficients in all cluster charts, which gives an interesting class in de Rham cohomology of degree 2, and an interesting operator in link homology. Using the cluster structure, we compute the homology of the braid variety using the De Rham cohomology.

Alec Traaseth (University of Virginia)

Title: Combination Theorems for Discrete Convergence Groups

Abstract: The classical Klein-Maskit combination theorems give a way to construct new Kleinian groups out of simpler ones. In joint work with Teddy Weisman, we prove versions of these theorems in the setting of discrete convergence groups, a far reaching generalization which includes isometry groups of any Gromov-hyperbolic metric space.

Swan Klein (George Mason University)

Title: Combinatorial Formulas for the Equivariant Cohomology of Peterson Varieties

Abstract: Our goal was to verify a conjecture about the decomposition of the restriction of Schubert classes associated with transpositions to the Peterson variety into a linear combination of Peterson classes. Using a corollary of the AJS/Billey formula, we reduced the conjecture to a more concise combinatorial question about counting reduced words for transpositions embedded into long words. We uncovered an elegant visual framework for understanding these combinatorial questions and proved our conjecture in a specific subcase.

With future work, we hope to prove the remaining cases of the conjecture and extend our combinatorial strategy to as many types of Schubert classes as possible.