Speaker: Rhea Palak Bakshi (University of California, Santa Barbara)

Title: Algebraic Structures and Torsion in Integral Skein Modules

Abstract: Skein modules, introduced independently by Przytycki and Turaev, extend polynomial link invariants from S^3 to arbitrary 3-manifolds by imposing local skein relations on the free module generated by links. Among these, the Kauffman bracket skein module has played a central role in connecting low-dimensional topology, quantum invariants, character varieties, and topological quantum field theory. While recent work of Gunningham, Jordan, and Safronov shows that the Kauffman bracket skein module of a closed 3-manifold is finite-dimensional over $\mathbb{Q}(A)$, the integral theory over $\mathbb{Z}[A^{\pm 1}]$ is considerably more subtle. In this setting, torsion phenomena become essential, finite generation may fail, and basic structural questions remain open even for natural classes of 3-manifolds.
In this talk, I will discuss the current state of the integral theory of Kauffman bracket skein modules, with an emphasis on torsion, connected sums, and the contrast between the generic and integral settings. I will also present recent examples and results illustrating the complexity of these modules, and discuss several open problems concerning their algebraic structure.

Speaker: Giulio Belletti (Université Catholique de Louvain)

Title: Obstructing embeddings of 3-manifolds with quantum invariants

Abstract: In this talk I will address the general question of whether two given 3-manifolds embed in each other. I will explain what can and cannot be achieved by classical techniques such as homology and hyperbolic volume. Then I will present a result that formalizes the intuition that these sort of embeddings should be rare: if N embeds in M, there is a "small perturbation" (in some sense) that does not. The central technique used to obstruct these generic embeddings is the Frohman–Kania-Bartoszynska ideal and the Reshetikhin-Turaev TQFT (joint work with Renaud Detcherry).

Speaker: Francis Bonahon (University of Southern California)

Title: Asymptotics of quantum invariants

Abstract: When the quantum parameter q is a root of unity, the representation theory of the quantum Teichmuller space of a punctured surface associates an invariant to the data of a diffeomorphism of the surface and of a $PSL_2(\mathbb{C})$-character preserved by the diffeomorphism (plus some information at the punctures). As we let the order of q tend to infinity, the asymptotic behavior of this invariant seems related to the hyperbolic volume of the mapping torus of the diffeomorphism. I will discuss progress on this conjecture for the case when the surface is the one-puncture torus, with an emphasis on the new analytic methods developed for this purpose. This is joint work with Helen Wong and Tian Yang.

Speaker: Matt Harper (Michigan State University)

Title: Alexander and Jones-type properties of the Links-Gould polynomial

Abstract: The Links-Gould (LG) polynomials are two-variable link invariants arising from the quantum supergroup $U_q(\mathfrak{sl}(2|1))$, exhibiting hybrid behavior between the Jones and Alexander polynomials. I will survey some recent results illustrating this theme. The basic LG invariant provides a

lower bound on the Seifert genus and this bound extends to its colored versions. It has been verified by Garoufalidis and Li that the 2-colored Links-Gould polynomial detects the genus for all 352.2 million prime knots with up to 19 crossings. We also prove a conjecture of Geer and Patureau-Mirand that the Links-Gould invariant admits a specialization to the Akutsu-Deguchi-Ohtsuki (ADO) invariant at a sixth root of unity. Finally, we establish analogs of Jones-Wenzl idempotents for LG and formulate an analog of the Fox conjecture, supported by computational evidence.
This is joint work, in various combinations, with Stavros Garoufalidis, Rinat Kashaev, Ben-Michael Kohli, Jiebo Song, Guillaume Tahar, and Emmanuel Wagner.

Speaker: Matthew Hedden (Michigan State University)

Title: Floer homology and positive braids

Abstract: I'll provide a complete calculation of the second-to-top knot Floer homology group of the closure of a positive braid. For prime knots in this family, in particular, we show that the rank is one. Such knots are fibered, and recent connections of knot Floer homology to dynamics yield, as corollary, that their monodromies can be isotoped to be fixed point free. Our work raises a number of natural questions and indicates some directions for future study, which I'll try to highlight. This is joint work with Zhechi Cheng.

Speaker: Diana Hubbard (City University of New York)

Title: The fractional Dehn twist coefficient and rank bounds for categorified link invariants

Abstract: The fractional Dehn twist coefficient (FDTC) is a number that measures the amount of twisting a mapping class of the surface effects about a chosen boundary component. In this talk I will define the FDTC, discuss its context in low-dimensional topology and geometry, and talk about recent work with Fraser Binns showing that there are bounds on the ranks of link Floer homology (of fibered links) and annular Khovanov homology (of the closures of braids) arising from the FDTC.

Speaker: David Jordan (University of Edinburgh)

Title: Finiteness for skein categories

Abstract:
Abstract: The skein category of a surface S is an enhancement of its skein algebra in which we allow skeins at the boundaries of $S \times I$. By definition, this category has infinitely many objects, labelled by all the possible endings of skeins on S. In this talk I will explain a conjecture we made with Gunningham and Vazirani that, when the quantum parameter is generic and the surface is closed, this category is Morita equivalent to a finite subcategory (consisting of only finitely many labels for endpoints).
With Gunningham and Vazirani, we proved the conjecture for SL_N and for GL_N, but only in genus one (and zero). Detcherry and I proved this for the Kauffman bracket skein module (corresponding to $G = SL_2$) for closed surfaces of any genus. I will outline the proof, which is completely elementary.

Speaker: Tye Lidman (North Carolina State University)

Title: Ideal broken Lefschetz fibrations

Abstract: We consider a class of four-manifolds we call ideal broken Lefschetz fibrations which have the advantage that their topology can be studied using tools from the world of three-manifolds. This leads to some new constructions of exotic four-manifolds. This is joint with Lisa Piccirillo.

Speaker: Shashini Marasinghe (Michigan State University)

Title: Seifert fibered manifolds and the Chen-Yang volume conjecture

Abstract:
This talk provides an introduction to the volume conjecture and the quantum invariants behind it. I will recall how the Reshetikhin-Turaev invariants are built from the skein-theoretic $SO(3)$-TQFT, explain how the Turaev-Viro invariants arise from them, and state the generalized volume conjecture. I will then describe joint work with R. Detcherry and E. Kalfagianni, where we study the large-r asymptotic behavior of the Turaev-Viro invariants $TV_r(M; e^{2\pi i/r})$ of 3-manifolds with toroidal boundary under the operation of gluing a Seifert-fibered 3-manifold along a component of ∂M. We show that the Turaev-Viro invariants volume conjecture is closed under this operation, and as an application, we prove the conjecture for Seifert fibered 3-manifolds with orientable orbifold base. No background in quantum topology will be assumed.

Speaker: Allison Moore (Virginia Commonwealth University)

Title: Series valued invariants of plumbed 3-manifolds with root lattices

Abstract: The Z-hat series is a physically-motivated, quantum invariant of plumbed three-manifolds introduced by Gukov-Pei-Putrov-Vafa. In the negative-definite case, radial limits of the GPPV q-series has been shown to recover the WRT invariants. I will discuss how to construct a more general series Y that is twisted by a root lattice, building on work of Gukov-Manolescu, Akhmechet-Johnson-Krushkal, Park and Ri. As input, our series requires a reduced plumbing tree, a spin-c structure, a root lattice, and a piece of auxiliary data called a âWeyl assignment.â The resulting series Y is invariant under the Neumann moves on plumbing trees, is equivariant with respect to the action of the Weyl group, and recovers Z-hat as a special case. The series Y is well-defined for plumbed manifolds that are not definite. We also define a variation of Y for knot complements, and show that it satisfies gluing and splitting formulas. Time permitting, I will discuss the form this series takes for specific examples of Brieskorn spheres, or comment on questions that arise when considering non-prime manifolds and TQFT-like properties. This is joint work with N. Tarasca.

Speaker: Jessica Purcell (Monash University)

Title: The geometry of rod packings in the 3-torus

Abstract: Using tools from 3-manifold geometry and topology, we describe recent geometric results on our study of a family of links in the 3-torus called rod packings. These links were originally described by crystallographers. Their complements have many intriguing hyperbolic geometric properties. We discuss both recent progress and open questions. This work is joint with Connie Hui and Norm Do.

Speaker: Radmila Sazdanovic (North Carolina State University)

Title: Geometry of Knot Invariants

Abstract: Recent advances in topological data analysis (TDA) and artificial intelligence (AI) provide a new framework for studying the geometry of large collections of knot invariants. In this talk, we explore relationships among knot invariants by studying the geometry of large datasets of knots represented through collections of classical and homological invariants. Using data derived from the Jones polynomial and Khovanov homology, we investigate how this geometry relates to two classical concordance invariants: the knot signature and Rasmussen's s-invariant. The resulting geometric perspective reveals both expected patterns and surprising exceptions, showing how data-driven methods can generate new mathematical questions and guide the search for conjectures and counterexamples.

Speaker: Adam Sikora (University of New York at Buffalo)

Title: Stated skein algebras, quantum groups, and canonical bases

Abstract: We present an overview of the stated SL(n)-skein algebras of surfaces and their rich interplay with representation theory and quantum algebra. In particular, we illustrate how they provide geometric realizations of fundamental structures such as Drinfeld quantum doubles, quantum groups, and Kashiwara-Lusztig (dual) canonical bases.

Speaker: Patricia Sorya (University of Ottawa)

Title: On the number of shared Dehn surgeries between two knots

Abstract: Dehn surgery along a knot in the 3-sphere is one of the simplest ways to construct 3-manifolds. It is performed by gluing a solid torus to the exterior of the knot according to a rational parameter p/q. A folklore theorem states that for any pair of distinct knots, performing p/q-Dehn surgery on each knot yields homeomorphic manifolds for at most finitely many slopes p/q. In this talk, we discuss a proof based on the JSJ decomposition of knot exteriors. In particular, for any given pair of distinct knots, it provides an effective bound on the maximal number of shared surgeries between the knots.

Speaker: Anastasiia Tsvietkova (Rutgers University)

Title: Polynomially many surfaces in a hyperbolic 3-manifold

Abstract: We give an upper bound for the number of compact essential orientable non-isotopic surfaces, with Euler characteristic at least some constant K, properly embedded in a finite-volume hyperbolic 3-manifold M, closed or cusped. This bound is a polynomial function of the volume of M, with degree that depends linearly on K. The proof develops an analog of normal surface theory, but for stable minimal surfaces, by selecting and adjusting a thick geodesic triangulation of a part of M.

Speaker: Joshua Wang (Princeton University)

Title: Link homology and loop homology

Abstract: I will make the observation that the Khovanov homology of $T(2, m)$ stabilizes to the homology of the free loop space of the 2-sphere as m goes to infinity. The main theorem suggests that this is not merely a coincidence: the k-colored $sl(N)$ homology of $T(2, m)$ stabilizes to the homology of the free loop space of the complex Grassmannian $Gr(k, N)$.

Speaker: Helen Wong (Claremont McKenna College)

Title: Relationships between skein algebras **Abstract:** In joint work with Chloe Marple, we found an unexpected homomorphism between the Kauffman bracket skein algebra for the closed torus and the Roger-Yang skein algebra for the twice-punctured annulus. In this talk, we will discuss some applications of the homomorphism as well as compare it with the few other examples of homomorphisms between skein algebras.

Speaker: Matt Young (Utah State University)

Title: $\widehat{Z}$-invariants for Lie superalgebras

Abstract:
$\widehat{Z}$-invariants of 3-manifolds were introduced in the physics literature by Gukov, Pei, Putrov and Vafa in the context of 3d $\mathcal{N} = 2$ supersymmetric gauge theory with the goal of categorifying the Reshetikhin–Turaev invariants of 3-manifold. $\widehat{Z}$-invariants depend on the input data of a Lie (super)algebra and some discrete geometric data on the 3-manifold, such as a Spin^c-structure. At a mathematical level, $\widehat{Z}$-invariants are rather poorly understood with work having largely been focused on the case $\mathfrak{sl}(2)$. The goal of this talk is to explain a connection between $\widehat{Z}$-invariants and 3-manifold invariants associated to non-semisimple categories of representations of quantum supergroups. I will focus on the simplest examples of $\mathfrak{osp}(1|2)$ and $\mathfrak{gl}(1|1)$. Based on work with Francesco Costantino, Matthew Harper and Adam Robertson.