NEAT MAPS April 2023 Titles and Abstracts

April 1–2, 2023

Invited Lectures

Iva Halacheva (Northeastern University)

Title: Knot invariants and the Kashiwara-Vergne groups

Abstract: Many powerful invariants of knotted objects (such as knots, tangles, braids) have been shown to have deep connections to Lie theory. For instance, the existence of homomorphic expansions for parenthesized braids can be reformulated as the existence of Drinfeld associators governing the structure of braided monoidal categories. More recently, Bar-Natan and Dancso showed that homomorphic expansions for another family of knotted objects, welded foams, are in bijection with solutions to the Kashiwara-Vergne (KV) equations. In joint work with Dancso and Robertson, we show that the symmetry groups of KV equations can also be realized topologically as automorphisms of welded foams and their associated graded—arrow diagrams.

Matt Hogancamp (Northeastern University)

Title: Link homology operations

Abstract: It is a very natural and intriguing question to ask: "what sorts of homology operations can one define for a typical link (co)homology theory (such as Khovanov homology and its relatives)?". For instance the invariant of the unknot is a commutative algebra, and any choice of marked point on a link L then determines a natural action of the unknot algebra A on the homology of L. This action can be extended to an action of the Hochschild homology of A, by means of certain monodromy operators. The goal of this talk will be to sketch how one constructs such Hochschild homology actions, using the triply graded Khovanov-Rozansky homology as a running example. To illustrate the richness of these operations, we will then discuss how one uses them to construct an action of $\mathfrak{sl}(2)$ on triply graded Khovanov-Rozansky homology. The hard-Lefschetz property for the action of the raising and lowering operators "E" and "F") proves a conjecture of Dunfield–Gukov–Rasmussen on the symmetry of Khovanov-Rozansky homology. This result is joint work with Eugene Gorsky and Anton Mellit.

Inbar Klang (Columbia University)

Title: Equivariant factorization homology and tools for studying it

Abstract: In this talk, I will give an introduction to factorization homology and equivariant factorization homology. I will then discuss joint work with Asaf Horev and Foling Zou, in which we prove a "non-abelian Poincaré duality" theorem for equivariant factorization homology, and study the equivariant factorization homology of equivariant Thom spectra. In particular, this provides an avenue for computing certain equivariant analogues of topological Hochschild homology.

Rajan Mehta (Smith College)

Title: Frobenius objects in categories of relations and spans

Abstract: Frobenius algebras can be given a category-theoretic definition in terms of the monoidal category of vector spaces, leading to a more general definition of Frobenius object in any monoidal category. In this talk, I will describe Frobenius objects in categories where the objects are sets and the morphisms are relations or spans. These categories can be viewed as toy models for the symplectic category. The main result is that, in both cases, it is possible to construct a simplicial set that encodes the data of the Frobenius structure. The simplicial sets that arise in this way satisfy conditions that are closely connected to the 2-Segal conditions of Dyckerhoff-Kapranov and Galvez-Carrillo-Kock-Tonks. Commutative Frobenius objects in these categories give rise to surface invariants that can be Boolean or natural number valued. I will give some explicit examples where the invariants can be computed. This work is a very small first step in a bigger program aimed at better understanding the relationship between Poisson/symplectic geometry and topological field theory. Part of the talk will be devoted to giving an overview of this program. This is based on work with Ruoqi Zhang (arXiv:1907.00702), with Ivan Contreras and Molly Keller (arXiv:2106.14743), with Contreras, Adele Long, and Sophia Marx (arXiv:2208.14716), and work in progress with Contreras and Walker Stern.

Contributed Lectures

Leon Liu (Harvard)

Title: Braided monoidal 2-categories, knot homology, and 3+1D TQFTs

Abstract: Starting from Witten's seminal paper connecting Chern-Simons theory to the Jones polynomial, the story of 2+1D topological order, modular tensor categories, and knot polynomials is one of the most exciting intersections of mathematics and physics. In 2002, Khovanov defined the Khovanov homology, which categories the Jones polynomial. This raises a natural question: what 3+1D topological order, and braided monoidal 2-categories does these knot homology correspond to. In this talk we will give a partial answer to this question, by constructing a braided monoidal 2-category that can recover the Khovanov-HOMFLY homology, which specializes to the original Khovanov homology. This is joint work with Aaron Mazel-Gee, David Reutter, Catherina Stroppel, and Paul Weldrich.

Han Lou (University of Georgia)

Title: On the Hofer Zehnder Conjecture for Semipositive Symplectic Manifolds

Abstract: Arnold conjecture says that the number of 1-periodic orbits of a Hamiltonian diffeomorphism is greater than or equal to the dimension of the Hamiltonian Floer homology. In 1994, Hofer and Zehnder conjectured that there are infinitely many periodic orbits if the equality doesn't hold. In this talk, I will show that the Hofer-Zehnder conjecture is true for semipositive symplectic manifolds with semisimple quantum homology. This is a joint work with Marcelo Atallah.

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.

Nick Wawrykow (University of Michigan)

Title: Representation Stability for Disks in a Strip

Abstract: A disk configuration space is the space of ways of embedding open unit-diameter disks in a metric space. One of the simplest such configuration spaces is the configuration space of open unit-diameter disks in the infinite strip of width w. The homology groups of this disk configuration space have the structure of a "twisted" algebra. We give a finite presentation for this algebra, and use this presentation to prove that there is a way to add disks to these configuration spaces so that homology stabilizes in a representation theoretic sense.