

Low-Dimensional Topology
6-10 January 2020

Abstracts

Nathan Dowlin (Columbia University)

Title: An algebraically defined knot Floer type invariant

Abstract: Given a link L , I will describe an algebraically defined chain complex $C(L)$ which is motivated by holomorphic disc counts in a certain Heegaard diagram. The complex comes equipped with a filtration with respect to which the E_2 page is the Khovanov homology of L , and the E_∞ page is conjecturally the knot Floer homology of L . This complex also has a local description which assigns to each open braid a bimodule over an algebra A . This algebra turns out to be isomorphic to the algebra used in Ozsvath-Szabo's recent bordered knot Floer homology construction, and ignoring the filtration, our bimodules are homotopy equivalent to the knot Floer homology bimodules. This is joint work with Akram Alishahi.

Marco Golla (University of Nantes)

Title: Möbius bands and the square peg problem

Abstract: The square peg problem asks whether every Jordan curve in the plane contains the vertices of a square. Inspired by Hugelmeier's approach for smooth curves, we give a topological proof for (locally) 1-Lipschitz functions using Möbius bands and elementary 4-dimensional topology.

Peter Kronheimer (Harvard University)

Title: Genus versus double-points for immersed surfaces, and some concordance invariants of knots

Abstract: If X is a simply-connected closed 4-manifold containing an oriented embedded surface S of genus g , is there always an immersed sphere S' which represents the same homology class and has only g transverse double-points? This is an open question, though a "relative" version of the question (concerning surfaces in the 4-ball bounding a given knot in the 3-sphere) is known to have a negative answer. This talk will ask whether there are additive invariants of knots which can be used to detect this distinction between genus and double-points. A later talk at this meeting, by Tom Mrowka, will examine further aspects of the tools from gauge theory that are used

Adam Levine (Duke University)

Title: Khovanov homology, ribbon concordance, and split cobordisms

Abstract: I will first discuss my result (joint with Ian Zemke) that a ribbon concordance induces an injection on Khovanov homology. I will then discuss more recent work with Onkar Singh Gujral that extends this result to the case of a concordance that is merely strongly homotopy ribbon, meaning that its complement is built out of 1- and 2-handles. The latter result depends on showing that the cobordism maps on Khovanov homology fail to detect 4-dimensional linking between surfaces.

Francesco Lin (Princeton University)

Title: The Froyshov invariant and closed geodesics

Abstract: In previous work, we showed that certain hyperbolic rational homology spheres are L-spaces by looking at their volume and the lengths of closed geodesics. In this talk, I will discuss how to interpret the Froyshov invariant of these manifolds in terms of closed geodesics. This is work in progress joint with M. Lipnowski.

Andrew Lobb (University of Durham)

Title: Concordance and $sl(n)$ knot cohomologies

Abstract: I shall talk about past and ongoing work with Lukas Lewark in extracting concordance information from Khovanov-Rozansky quantum $sl(n)$ knot cohomologies. In particular I'll discuss a homomorphism from the concordance group to a certain abelian group of indecomposable cochain complexes. The $sl(2)$ (Khovanov homology) case is equivalent to Rasmussen's invariant. But for new applications one can even use $sl(3)$ cohomology over the field of two elements. Doing this, we find an infinitely generated free subgroup (generated by quasi-alternating knots) in the quotient of the concordance group by quasipositive knots. No prior knowledge of quantum knot cohomologies will be assumed.

Maggie Miller (Princeton University)

Title: Concordance of light bulbs

Abstract: In 2017, Gabai proved the light bulb theorem, showing that if R and R' are 2-spheres homotopically embedded in a 4-manifold with a common dual, then with some condition on 2-torsion in $\pi_1(X)$ one can conclude that R and R' are smoothly isotopic. Schwartz later showed that this 2-torsion condition is necessary, and Schneiderman and Teichner then obstructed the isotopy whenever this condition fails. I showed that when R' does not have a dual, we may still conclude the spheres are smoothly concordant.

I will talk about these various definitions and theorems as well as current joint work with Michael Klug generalizing the result on concordance to the situation where R has an immersed dual (and R' may have none), which is a common condition in 4-dimensional topology.

Tomasz Mrowka (Massachusetts Institute of Technology)

Title: Bar Natan in the wild

Abstract: This is a continuation of Kronheimer's talk. I will describe in some detail a variant of Instanton Floer homology for knots or more generally webs (embedded trivalent graphs) in 3-manifolds. The interesting twist in the story is introducing a local coefficient group which seems to require the use of webs (rather than knots). For certain specializations of this local system the resulting homology groups admit a spectral sequence whose E_2 -term is Bar-Natan's variant of Khovanov homology providing a geometric interpretation of that theory.

András Némethi (Renyi Institute)

Title: Delta invariant of curves on rational surface singularities

Abstract: We prove that if $(C,0)$ is a reduced curve germ on a rational surface singularity $(X,0)$ then its (abstract analytic) delta invariant can be recovered by a concrete expression associated with the embedded topological type of the pair (X,C) . We also connect our formulae with the local correction term at singular points of the global Riemann-Roch formula, valid for projective normal surfaces.

Lisa Piccirillo (Brandeis University and Massachusetts Institute of Technology)

Title: The trace embedding lemma and spinelessness

Abstract: In this talk I will discuss new applications of the trace embedding lemma to the study of piecewise-linear surfaces and exotica in dimension four. I will give a quick argument that for any orientable surface Σ there are 4-manifolds homotopy equivalent to Σ which admit a topologically locally flat spine but don't admit a piecewise linear spine. This will lead to the construction of (infinitely many) pairs of homeomorphic 4-manifolds W and W' (homotopy equivalent to S^2) which have smooth structures distinguished by several formal properties: W' is diffeomorphic to a knot trace but W is not, W' contains S^2 as a smooth spine but W does not even contain S^2 as a piecewise-linear spine, W' is geometrically simply connected but W is not, and W' does not admit a Stein structure but W does.

Jacob Rasmussen (University of Cambridge)

Title: An $SL_2(\mathbb{R})$ Lin invariant

Abstract: X.S. Lin defined an invariant of knots in S^3 by counting irreducible SU_2 representations of the knot group with fixed meridional holonomy. I'll define a similar invariant with $SL_2(\mathbb{R})$ in place of SU_2 and give some applications to left-orderability of branched covers and Dehn fillings. This is joint work with Nathan Dunfield.

Sarah Rasmussen (University of Cambridge)

Title: Left orders and taut foliations in Heegaard genus 2

Abstract: I will describe a work in progress for constructing cooriented taut foliations from fundamental group left orders for closed oriented irreducible 3-manifolds of Heegaard genus 2. With time permitting, I shall discuss progress towards generalising this construction to higher Heegaard genus 3-manifolds.

Arunima Ray (MPIM Bonn)

Title: Embedding spheres in knot traces

Abstract: We characterise when the generator of π_2 of a knot trace can be represented by a locally flat embedded 2-sphere with abelian fundamental group of the complement, in terms of classical and computable invariants of the corresponding knot. This is a joint project with Feller, Miller, Nagel, Orson, and Powell.

Daniel Ruberman (Brandeis University)

Title: The monopole Lefschetz number

Abstract: Suppose that K is a knot in a homology sphere Y , and let Y' be its n -fold cyclic branched cover, which we assume to be a rational homology sphere. A generator for the group of covering transformations acts on the monopole homology of Y' . We calculate the Lefschetz number of the induced map on the reduced homology in terms of gauge theoretic invariants of Y and Y' , and the Tristram-Levine signatures of K . We give a number of applications, including criteria for showing that Y' is not an L-space. This is joint work with Jianfeng Lin and Nikolai Saveliev.

Steven Sivek (Imperial College London)

Title: Instantons and L-space surgeries

Abstract: I will describe recent joint work with John Baldwin in which we study the framed instanton homology of Dehn surgeries on knots. Using a new decomposition of cobordism maps in this theory, analogous to the Spinc decomposition in the hat version of Heegaard Floer homology, we show that “instanton L-space knots” are fibered and strongly quasipositive, and we conclude that the A-polynomial detects infinitely many torus knots. I will also describe work in progress allowing us to compute the framed instanton homology of nearly all rational Dehn surgeries on infinitely many knots which have no L-space or Seifert fibered surgeries.

Ian Zemke (Princeton University)

Title: Ribbon concordances and knot Floer homology

Abstract: In this talk we will describe how knot Floer homology gives an obstruction to ribbon concordance. The proof uses functorial properties of knot Floer homology, as well as a simple doubling trick. We will describe some applications, and also some related work concerning Khovanov homology as well as torsion invariants in knot Floer homology. Portions of this talk are joint with Andras Juhasz, Adam Levine, and Maggie Miller.