Titles and abstracts for TGTC 2014

Speaker: Benson Farb (University of Chicago) - Introductory Talk

Title: The topology of the space of polynomials

Abstract: In this talk I will explain from a topological viewpoint a string of ideas that begins in 1540 and that continues today: from unsolvability of the quintic to configuration spaces to Hilbert's 13th problem to complexity theory to cohomology of braid groups to combinatorial statistics for polynomials over finite fields. The story is an example of the power and applicability of topology. I will try to make this talk accessible to beginning graduate students.

Speaker: Nathan Dunfield (UIUC)

Title: Asymmetric hyperbolic L-spaces, Heegaard genus, and Dehn filling.

Abstract: An L-space is a rational homology 3-sphere with minimal Heegaard Floer homology. I will discuss the first examples of hyperbolic L-spaces with no symmetries. In particular, unlike all previously known L-spaces, these manifolds are not double branched covers of links in S^3. These are shown to exist via a mix of hyperbolic geometry, Floer theory, and verified computer calculations. I will also give related examples of 1-cusped hyperbolic 3-manifolds of Heegaard genus 3 with two distinct lens space fillings. These are the first examples where multiple Dehn fillings drop the Heegaard genus by more than one, which answers a question of Cameron Gordon. This is joint work with Neil Hoffman and Joan Licata.

Speaker: Yair Minsky (Yale)

Title: A relative bounded image theorem for skinning maps

Abstract: Thurston's skinning map played a pivotal role in his hyperbolization construction for Haken 3-manifolds. A crucial step is his theorem that, when a 3-manifold has acylindrical boundary, its skinning map has bounded image in the Teichmuller space of the boundary. In the cylindrical case this is false and there are various ways to get around this issue in Thurston's proof. We give a relative version of the bounded image theorem which clarifies a little bit the structure of the map in these cases, and also has some consequences for the topology of the boundary of the deformation space for such a manifold. Joint work with J. Brock, K. Bromberg and R. Canary.

Speaker: Rachel Roberts (Washington University in St. Louis)

Title: Approximating continuous foliations by contact structures

Abstract: Taut foliations, volume preserving flows, and tight contact structures are important topological structures on 3-manifolds. We will define these structures and describe some of the ways in which they are important. In particular, we will discuss these structures in the context of the following result of Eliashberg and Thurston: any smooth taut co-oriented foliation can be approximated by a pair of tight contact structures, one positive and one negative. I will discuss work, joint with Will Kazez, in which we show that the smoothness assumption on the foliation can be dropped; namely, any continuous co-oriented taut foliation can be approximated by a pair of tight contact structures, one positive and one negative.

Speaker: Benson Farb (University of Chicago) - Research Talk

Title: The topology of $\mathrm{SL}(n, \mathcal{O}_K)$

Abstract: This talk can be viewed as a case study in the interaction between number theory and topology. Let $\mathcal{O}_K$ be the ring of integers in a number field K. There is a beautiful circle of mathematical objects attached to the group $\mathrm{SL}(n, \mathcal{O}_K)$, such as: the corresponding locally symmetric manifold and its Borel-Serre compactification; the Bruhat-Tits building; the ideal class group of O_k; and the homology groups $H_*(\mathrm{SL}(n, \mathcal{O}_K); \mathbb{Q})$. The goal of this talk will be to explain what these objects are and how they connect to each other.

Our goal will be to describe a recent breakthrough in this direction. This is joint work with Tom Church and Andy Putman.

Speaker: Danny Calegari (University of Chicago)

Title: Roots, Schottky semigroups, and a proof of Bandt's Conjecture

Abstract: In 1985, Barnsley and Harrington defined a "Mandelbrot Set" M for pairs of similarities – this is the set of complex numbers z with norm less than 1 for which the limit set of the semigroup generated by the similarities $x \to zx$ and $x \to z(x-1) + 1$ is connected. Equivalently, M is the closure of the set of roots of polynomials with coefficients in $\{-1, 0, 1\}$. Barnsley and Harrington already noted the (numerically apparent) existence of infinitely many small "holes" in M, and conjectured that these holes were genuine. These holes are very interesting, since they are "exotic" components of the space of (2 generator) Schottky semigroups. The existence of at least one hole was rigorously confirmed by Bandt in 2002, but his methods were not strong enough to show the existence of infinitely many holes; one difficulty with his approach was that he was not able to understand the interior points of M, and on the basis of numerical evidence he conjectured that the interior points are dense away from the real axis. We introduce the technique of ***traps*** to construct and certify interior points of M, and use them to prove Bandt's Conjecture. Furthermore, our techniques let us certify the existence of infinitely many holes in M. This is joint work with Sarah Koch and Alden Walker.

Speaker: J. Elisenda Grigsby (Boston College)

Title: (Sutured) Khovanov homology and representation theory

Abstract: Abstract: Khovanov homology associates to a link L in the three-sphere a bigraded vector space arising as the homology groups of an abstract chain complex defined combinatorially from a link diagram. It detects the unknot (Kronheimer-Mrowka) and gives a sharp lower bound (Rasmussen, using a deformation of E.S. Lee) on the 4-ball genus of torus knots.

When L is realized as the closure of a braid (or more generally, of a "balanced" tangle), one can use a variant of Khovanov's construction due to Asaeda-Przytycki-Sikora and L. Roberts to define its *sutured* Khovanov homology, an invariant of the tangle closure in the solid torus. Sutured Khovanov homology distinguishes braids from other tangles (j. with Ni) and detects the trivial braid conjugacy class (j. with Baldwin).

In this talk, I will describe some of the representation theory of the sutured Khovanov homology of a tangle closure. It (perhaps unsurprisingly) carries an action of the Lie algebra $\mathfrak{sl}(2)$. More surprisingly, this action extends to the action of a slightly larger Lie superalgebra whose structure hints at a unification with the Lee deformation. This is joint work with Tony Licata and Stephan Wehrli.

Speaker: Jessica Purcell (BYU)

Title: Cusp volumes of alternating knots

Abstract: We show that the cusp volume of a hyperbolic alternating knot can be bounded above and below in terms of the twist number of an alternating diagram of the knot. This answers a question asked by Thistlethwaite on the cusp geometry of these knots. In addition to giving diagrammatical estimates on cusp volume, this also leads to geometric estimates on lengths of slopes, in terms of a diagram of the knot. All these estimates are explicit. This is joint work with Marc Lackenby.

Speaker: Martin Scharlemann (UCSB)

Title: The Schönflies Conjecture and its spin-offs

Abstract: We briefly review the resolution of the Schönflies Conjecture in all dimensions other than 4, discuss why the remaining conjecture is important, and the classic approach to its resolution. This approach has spawned much beautifully pictorial mathematics, without actually succeeding. An underlying theme is that, although the conjecture has not yet been settled, it interlocks with and has inspired much interesting topology in dimensions three and four.