Geometry and Topology of Manifolds in Low-Dimensions
Géometrie et topologie de variétés en basse dimension
(Org: **Hans U. Boden** (McMaster) and/et **Liam Watson** (Glasgow))

NIMA ANVARI, McMaster University
Cyclic Group Actions on Contractible Four-Manifolds

There are known infinite families of Brieskorn homology 3-spheres which can be realized as boundaries of smooth contractible 4-manifolds. Kwasik and Lawson found examples where the free periodic action on these Brieskorn spheres extend locally linearly to the contractible 4-manifold with one fixed point, but no such action exists smoothly. In this talk we give some background to this problem and discuss a new infinite family of examples. This is joint work with Ian Hambleton.

JOHN BALDWIN, Boston College
A refinement of the Ozsvath-Szabo contact invariant

I will describe a refinement of the Ozsvath-Szabo contact invariant in Heegaard Floer theory, defined in joint work with Shea Vela-Vick. Our invariant assigns to a contact structure ξ a number $t(\xi) \in \mathbb{Z}_{\geq 1} \cup \{\infty\}$, and extends Ozsvath-Szabo's invariant in the sense that $t(\xi) = \infty$ iff $c(\xi) \neq 0$. In addition, we prove that if ξ is overtwisted, then $t(\xi) = 1$. Interestingly, t appears to be a stronger invariant than c in that there exist ξ with $c(\xi) = 0$ but $t(\xi) > 1$. In this talk, I will focus on the construction of t and its basic properties—in particular, its relationship to fractional Dehn twist coefficients.

DROR BAR-NATAN, University of Toronto
Tangles, Wheels, Balloons

I will describe an invariant of tangles with values in wheels, almost generalize it to some balloons, and then tell you why I care. Spoilers: tangles are you know what, wheels are linear combinations of cyclic words in some alphabet, balloons are 2-knots, and one reason I care is because quantum field theory predicts more than I can actually get (but also less).

See also http://drorbn.net/CMS14

STEVE BOYER, UQAM
On the Neumann and Reid conjecture concerning knots with hidden symmetries

A key property in the study of commensurability classes of hyperbolic 3-manifolds is the presence, or not, of hidden symmetries. Though commensurability classes of hyperbolic knot complements without hidden symmetries are reasonably well understood, the case of knots with hidden symmetries remains mysterious. Neumann and Reid have conjectured that the only hyperbolic knots in the 3-sphere which admit hidden symmetries are the figure-eight knot and the two dodecahedral knots of Aitchison and Rubinstein. In this talk, I will report on joint work with Michel Boileau, Radu Cebanu, and Genevieve Walsh where we study the conjecture in the context of hyperbolic knots whose commensurability class admits reflections.

FRANCOIS CHARETTE, Max Planck Institute for Mathematics, Bonn
Quantum homology of orientable Lagrangian surfaces

In this talk I will explain how orientable Lagrangian surfaces behave in some sense like monotone Lagrangians. For this, the pearl complex introduced by Biran and Cornea will play a crucial role, as well as uniruling by holomorphic discs.

CHRIS CORNWELL, CIRGET, UQAM
Conormal tori and knot contact homology

To a knot K in S^3 one can associate a Legendrian torus (the conormal to K) in the unit cotangent bundle. While conormal tori are all topologically the same, it is possible that non-isotopic knots always produce conormal tori which are not Legendrian isotopic. We will discuss what can be said about this question from the view of knot contact homology.

ANDREW DONALD, Michigan State University
Embedding 3-manifolds smoothly in S^4

We discuss the question of when a closed 3-manifold can be smoothly embedded in the 4-sphere. An obstruction to embedding can be obtained from Donaldson's theorem on the intersection forms of definite 4-manifolds. This can be used to classify the connected sums of lens spaces which smoothly embed and gives restrictions on embedding for Seifert manifolds with non-orientable base surfaces or odd first Betti number.

DAVID DUNCAN, Michigan State University
From instantons to quilts with seam degenerations

Given a 4-manifold, we define a map that associates certain holomorphic quilts to low-energy instantons. We show this map is an embedding, and explain its implications for 4-manifold invariants. (This is joint work with J. McNamara and C. Woodward.)

JOSHUA GREENE, Boston College
Strong L-spaces

A strong L-space is a 3-manifold defined in terms of a combinatorial condition on a Heegaard diagram. Stong L-spaces comprise a proper subset of L-spaces, which makes them special from the point of view of Heegaard Floer homology. I will discuss joint work with Adam Levine concerning what we know about these spaces and some interesting open questions about them.

ERIC HARPER, McMaster University
Virtual knots, almost classical knots, and their Alexander invariants

Algebraic invariants of virtual knots such as the knot group and the augmented knot group carry intrinsic topological information about the knot. We can use Alexander invariants to help extract that information from the group structure. In virtual knot theory two augmented knot groups arise naturally, we will show that they are isomorphic.

Virtual knots that admit virtual knot diagrams that have Alexander numberings are called almost classical knots. Almost classical knots share many similarities with classical knots. For almost classical knots, the augmented knot group is determined by the classical knot group. By Nakamura et al., the first elementary ideal of the knot group for almost classical knots is principal. This leads us to define the Conway potential function for almost classical knots. Using techniques from virtual knot theory and Green's knot table, we tabulate almost classical knots up to six crossings.

MATT HEDDEN, Michigan State University
Obstructing the existence of algebraic curves in $\mathbb{C}P^2$ with prescribed singularities

A non-singular algebraic curve in the complex projective plane of degree d has topological genus $(d-1)(d-2)/2$. If the curve has singularities, yet topologically is still an embedded surface, then the genus will be lower. Heuristically, some of the topology gets pushed into the singularities. This talk will examine the question of which configurations of singularities can arise in algebraic curves of degree d that have some fixed topological genus. I will discuss new obstructions, which come from Floer homology, that imply the non-existence of algebraic curves with certain configurations of singularities. Refining our obstructions with algebro-geometric techniques leads to a classification of genus one curves with a single simple singularity. Perhaps surprisingly, the degrees and singularity types which arise are given by even terms in the Fibonnacci sequence. This is joint work with Maciej Borodzik and Charles Livingston

ALYSON HILDUM, McMaster University
Topological 4-manifolds with RAAG fundamental groups

For a non-simply connected 4-manifold M, the basic homotopy invariants are the fundamental group $\pi := \pi_1(M)$, the second homotopy group $\pi_2(M)$, the equivariant intersection form s_M, and the first k-invariant $k_M \in H^3(\pi; \pi_2(M))$. These four invariants give the quadratic 2-type of M,

$$Q(M) := [\pi_1(M), \pi_2(M), s_M, k_M].$$

In 2009, Hambleton, Kreck and Teichner showed that the quadratic 2-type determines the classification of topological 4-manifolds with geometrically 2-dimensional fundamental groups. In this talk, I'll present my joint work with Ian Hambleton in which we prove a similar result for topological spin 4-manifolds with certain fundamental groups called right-angled Artin groups (or RAAGs). A RAAG is a finitely generated group whose relators consist solely of commutators between generators.

CAGATAY KUTLUHAN, University at Buffalo
Sutured ECH is a natural invariant

A few years ago, Taubes showed that Hutchings's embedded contact homology (ECH) is canonically isomorphic to a version of Seiberg–Witten Floer cohomology. It follows as a consequence that ECH is a topological invariant of the underlying 3-manifold. More recently, Hutchings and Taubes showed that filtered ECH is only dependent on the choice of a contact form. In joint work with Steven Sivek, we prove an analog of the latter result for sutured ECH, defined by Colin, Ghiggini, Honda, and Hutchings for contact 3-manifolds with convex boundary, which are naturally sutured manifolds. Furthermore, we show that sutured ECH is a natural invariant, and that it admits a contact class that is preserved under maps induced by deformations of the contact structure relative to the boundary of the 3-manifold. The aim of this talk is to explain the mechanics of our proof, which uses a compactness result for solutions of the Seiberg–Witten equations on certain non-compact contact 3-manifolds and their symplectizations due to Taubes.

ADAM LEVINE, Princeton University
Satellite operators and piecewise-linear concordance.

Every knot in the 3-sphere bounds a piecewise-linear (PL) disk in the 4-ball, but Akbulut showed in 1990 that the same is not true for knots in the boundary of an arbitrary contractible 4-manifold. We strengthen this result by showing that there exists a knot K in a homology sphere Y (which is the boundary of a contractible 4-manifold) such that K does not bound a PL disk in any homology 4-ball bounded by Y. The proof relies on using bordered Heegaard Floer homology to show that the action of a certain satellite operator on the knot concordance group is not surjective.

JOHANNA MANGAHAS, University at Buffalo
Convex cocompactness in right-angled Artin groups

I will talk about joint work with Thomas Koberda and Sam Taylor on a version for right-angled Artin groups of convex cocompactness for subgroups of mapping class groups. The latter were defined by Farb and Mosher in partial analogy to convex cocompact hyperbolic manifold groups, and there are interesting connections between all three settings.

DANIEL RUBERMAN, Brandeis University
Smooth structures on contractible 4-manifolds

Joint work with Selman Akbulut. We show the existence of exotic smooth structures on contractible 4-manifolds. These structures are *absolute*, in the sense that they do not depend on a specific marking of the boundary. This is in contrast to the phenomenon of corks, which are exotic relative to an automorphism of their boundaries. The technique is to modify a relatively exotic manifold to give an exotic one with strong properties of the automorphism group of the boundary.

PETER SAMUELSON, University of Toronto
Character varieties and a deformed peripherial map

The Kauffman bracket skein module of a 3-manifold M is a quantization of the $SL_2(\mathbb{C})$ character variety of M, depending on a parameter q. We describe a conjecture with Y. Berest that the skein module of a knot complement is naturally a module over a 3-parameter algebra. When $q = 1$ we explain that this gives a (canonical) deformation of the peripherial map between the character varieties of the knot complement and the torus. If time permits we discuss some quantum corollaries as well.