Low-dimensional topology

(Org: **Duncan McCoy** (Université du Québec à Montréal) and/et **Patrick Naylor** (McMaster University))

HANS BODEN, McMaster University
The Gordon-Litherland pairing for knots in thickened surfaces

In 1978, Gordon and Litherland defined a bilinear pairing associated to a knot together with a choice of spanning surface, possibly non-orientable. They showed how to use it to compute the knot signature and other invariants of classical knots and links. This talk will discuss generalizations of the Gordon-Litherland pairing for homologically trivial knots in thickened surfaces, with a focus on applications to virtual knot concordance (joint with Homayun Karimi).

MAXIME FORTIER BOURQUE, Université de Montréal
The orthosystole of ideal polygons

We prove that the regular ideal n-gon maximizes the length of the shortest geodesic arc between non-consecutive sides among all ideal hyperbolic n-gons. This is joint work with Changjie Chen and Samuel Dobchies.

ADAM CLAY, University of Manitoba
Generalized torsion in 3-manifold groups

This talk will begin with a brief review of left- and bi-orderability of groups, and how each of these properties relates to torsion-freeness and generalized torsion-freeness. I will briefly discuss each of these properties in the context of 3-manifold groups, and then show how to construct a 3-manifold whose fundamental group is generalized torsion-free, yet not bi-orderable. This resolves a conjecture of Motegi and Teragaito, and is joint work with Tommy Cai.

MIKE MILLER EISMEIER, University of Vermont
ASD connections and cosmetic surgery

The cosmetic surgery conjecture predicts that, given a knot K in a 3-manifold, the oriented diffeomorphism type of surgery on K determines the surgery slope (up to oriented diffeomorphism). For knots in the 3-sphere, a sequence of restrictions coming from Heegaard Floer homology implies that if the cosmetic surgery is false for K, then r-surgery on K is not oriented diffeomorphic to (-r)-surgery, for some r in $\{2, 1, 1/2, 1/3, \dots\}$.

I will discuss how a quantitative enhancement of instanton homology rules out the cases $r = 1/n$, leaving only the possibility of 2-surgery.

ROBERT HARRIS, University of Waterloo
Exotic definite 4-manifolds and their fundamental groups

We will begin with a brief overview of the current landscape of exotic 4-manifolds with definite intersection forms and non-trivial fundamental groups. We will then discuss one of the recipes used for the building of such exotica while highlighting the necessary ingredients for these constructions. This is based on joint work with Patrick Naylor and B. Doug Park.

JEAN PIERRE MUTANGUHA, McGill University
Canonical decompositions of free-by-cyclic groups

Free-by-cyclic groups can be defined as mapping tori of free group automorphisms. I will discuss a dynamical decomposition of automorphisms that produces a canonical decomposition of the corresponding free-by-cyclic groups. This will involve a

discussion of attracting laminations for an automorphism, which is an extension of stable geodesic laminations for a surface homeomorphism. Similarly, the decomposition of free-by-cyclic groups is an extension of the JSJ decomposition of 3-manifolds. This talk is on joint work with Spencer Dowdall, Yassine Geurch, Radhika Gupta, and Caglar Uyanik.

CONNOR SELL, Université du Québec à Montréal
Cusp cross-sections of arithmetic hyperbolic manifolds

The cusps of a finite-volume hyperbolic $(n+1)$-manifold have cross-sections homeomorphic to compact n-manifolds that admit a flat structure. In 2009, McReynolds built on work of Long and Reid to prove that every compact flat n-manifold B occurs as a cusp cross-section of some hyperbolic $(n+1)$-manifold. In this talk, we will discuss a condition that determines whether a given flat manifold B occurs as a cusp cross-section in a given commensurability class C of arithmetic hyperbolic manifolds; in particular, some B can be obstructed from appearing some classes C. Joint work with Duncan McCoy.

KÜRŞAT SÖZER, McMaster University
Hopf Crossed-Module Coalgebras and Scalar Invariants of Maps from 3-Manifolds to 2-Types

In this talk, I will describe joint work with Alexis Virelizier that extends Kuperberg's 3-manifold invariant to the setting of 3-dimensional Homotopy Quantum Field Theories with 2-type targets. Crossed modules serve as algebraic models for connected 2-types; building on them, we develop involutory Hopf χ-coalgebras and the corresponding crossed-module-graded monoidal categories. These structures support a state-sum HQFT whose numerical output is a scalar invariant of a map $f\colon M \to B\chi$ from a closed, oriented 3-manifold to the classifying space of a crossed module χ. The construction reproduces Kuperberg's invariant when f is homotopic to the constant map and specializes to Virelizier's flat-bundle invariant when the source of χ is trivial. I will outline the algebraic ingredients, explain how they feed into the state-sum formalism, and discuss ongoing directions for comparing this new invariant with other quantum invariants.