# Monday

9:00 - 9:45 Coffee & bagels

9:45 - 10:45
***Overview***
**Dani Wise**, McGill University

11:00 - 12:00
***Aspherical groups and manifolds with extreme properties***
**Mark Sapir**, Vanderbilt University
I prove that every finitely generated group with recursive aspherical presentation complex embeds into a group with finite aspherical presentation complex. Using Gromov's random groups and the Davis' trick, this implies existence of aspherical manifolds whose fundamental groups do not coarsely embed into Hilbert spaces, do not satisfy property A, have infinite asymptotic dimension and do not satisfy the Baum-Connes conjecture with coefficients.

12:00 - 1:30 Lunch

1:30 - 2:30
***Nonpositively Curved Cube Complexes***
**Dani Wise**, McGill University
Definitions/ Examples /Graph Groups /Hyperplanes Disk diagrams over cube complexes, and applications to hyperplanes, and convexity / Local isometries / Cores, Hulls, and Superconvexity.

2:45 - 3:45
***Square Complexes and Simplicial Non-positive Curvature***
**Piotr Przytycki**, Polish Academy of Sciences
Joint work with Tomasz Elsner. We prove that each nonpositively curved square VH-complex can be turned functorially into a locally 6-large simplicial complex of the same homotopy type. It follows that any group acting geometrically on a CAT(0) square VH-complex is systolic. In particular the product of two finitely generated free groups is systolic, which answers a question of Daniel Wise. On the other hand, we exhibit an example of a compact non-VH nonpositively curved square complex, whose fundamental group is neither systolic, nor even virtually systolic.

3:45 - 4:15 Coffee

# Tuesday

9:00 - 9:45 Coffee & bagels

9:45 - 10:45
***Special Cube Complexes***
**Dani Wise**, McGill University

Hyperplane pathology definition/ Separability Criteria for Virtual Specialness / Canonical Completion and Retraction / Separability in the hyperbolic case/ Wall-injectivity, a commutative diagram, and wall projection controls retraction.

11:00 - 12:00
***Quasi-trees Associated to CAT(0) Cube Complexes***
**Mark Hagen**, McGill University

The 'contact graph' of a CAT(0) cube complex encodes both the crossing and osculation relations on its hyperplanes. For any CAT(0) cube complex, the contact graph is quasi-isometric to a tree. I will sketch a proof of this fact and survey some of its consequences, for weak and strong hyperbolicity of cubulated groups relative to hyperplane stabilizers, and for embeddability (and non-embeddability) of cube complexes into products of finitely many trees.

12:00 - 1:30 Lunch

1:30 - 2:30
***Virtual Specialness of Malnormal Amalgams of Special Groups***
**Dani Wise**, McGill University

Fantasy proof/ a bit of reality/ trivial wall projection lemma/ the symmetry lemma/ sketch of Separability.

2:45 - 3:45
***How to Cubulate Groups***
**Chris Hruska**, University of Wisconsin Milwaukee

If a group G acts on a CAT(0) cube complex, the action induces a very rich structure on the group. Sageev showed that actions on CAT(0) cube complexes correspond to "codimension-1" subgroups, which coarsely separate the group into two complementary components. We think of these components as "halfspaces" and the cutting subgroup as a "wall".

Some groups admit codimension-1 subgroups, and some don't. Indeed the existence of actions on cube complexes is closely related to representation theoretic notions such as Kazhdan's Property (T) and its strong negation, a-T-menability.

I will discuss "cubulations" of groups: how to construct them and how to recognize some of their basic finiteness properties.

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3:45 - 4:15 Coffee

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4:15 - 5:15
***Recitation***
**Mark Hagen and Piotr Przytycki**

## Wednesday

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9:00 - 9:45 Coffee & bagels

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9:45 - 10:45
***Cubulating Malnormal Amalgams of Cubulated Groups***
**Dani Wise**, McGill University

Examples of systems of walls in graphs of groups / Extending Walls / Constructing Turns / Cubulating malnormal amalgams.

11:00 - 12:00
***Contracting boundaries of CAT(0) spaces***
**Ruth Charney**, Brandeis University

Boundaries of hyperbolic spaces play a central role in the study of hyperbolic groups. CAT(0) boundaries are less effective since they are not quasi-isometry invariant. We study the subspace of the visual boundary of a CAT(0) space consisting of contracting rays. We show that this contracting boundary is quasi-isometry invariant and isolates hyperbolic-like behavior in the visual boundary.

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12:00 - 1:30 Lunch

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1:30 - 2:30
***Cubical Small Cancellation Theory***
**Dani Wise**, McGill University

Cubical presentations /The Fundamental theorems of small-cancellation theory /Pieces and Reduced diagrams / (possibly move to 7)bounding pieces and producing examples /Rectified Diagrams /Assigning angles and the Combinatorial Gauss-Bonnet Theorem.

2:45 - 3:45
***A 'transversal' for minimal invariant sets in the boundary of a CAT(0) group***
**Eric Swenson**, Brigham Young University

We introduce new techniques for studying boundary dynamics of CAT(0) groups. For a group $G$ acting geometrically on a CAT(0) space $X$ we show there is a flat $F \subset X$ of maximal dimension whose boundary sphere intersects every minimal $G$-invariant subset of $\partial X$. As a result we derive a necessary and sufficient dynamical condition for $G$ to be virtually-Abelian, as well as a new approach to Ballmann's rank rigidity conjecture.

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3:45 - 4:15 Coffee

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4:15 - 5:15
***Residual finiteness of amalgams***
**Ian Agol**, UC Berkeley

I'll discuss some work of Haglund and Wise which gives a criterion for when an amalgamated product is residually finite (and has various stronger properties). I'll discuss some ramifications of this criterion.

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6:00 p.m. Banquet

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# Thursday

9:00 - 9:45 Coffee & bagels

9:45 - 10:45
***Walls in Cubical Small-Cancellation Theory***
**Dani Wise**, McGill University
Walls in classical C(1/6) small-cancellation / Wallspace Cones /. Producing Wallspace Cones / Walls in X* and their quasiconvexity.

11:00 - 12:00
***The First Order Theory of Free Products of Groups***
**Zlil Sela**, Hebrew University
Around 1956 R. Vaught asked the following natural question. Let A,B,C,D be arbitrary groups. Suppose that A and B have the same first order theory (such groups are called elementarily equivalent), and so do C and D. Do A*C and B*D have the same first order theory? (i.e., is elementary equivalence preserved under free products of groups?)

A similar question for (generalized) direct products (of general structures) was answered affirmatively by Mostowski in 1952, and later generalized by Feferman and Vaught in 1959. On the other hand Olin proved in 1974 that the answer to Vaught's question is negative if we replace groups by semigroups.

We develop a geometric structure theory that is based on the tools that were developed to solve Tarski's problem on the first order theory of a free group to answer Vaught's problem affirmatively. This structure theory suggests a generalization of Tarski's problem to free products of arbitrary groups, as well as other (somehwat surprising) results in model theory over groups. It suggests open questions, and will probably have Generalizations in quite a few directions.

12:00 - 1:30 Lunch

1:30 - 2:30
***The Malnormal Special Quotient Theorem***
**Dani Wise**, McGill University
Case study: $< a, b | W_1^{n_1}, \ldots, W_r^{n_r} >$ / Annular Diagrams and almost malnormality / Classification of Flat Annuli and doubly collared annulus theorem.

2:45 - 3:45
***Subsurface projections and bumping in deformation spaces***
**Yair Minsky**, Yale University
Curve complexes of surfaces and their subsurfaces play a role in studying the geometry of mapping class groups and of hyperbolic 3-manifolds. We will discuss how these interactions allow us to study the deformation space of a Kleinian group, and in particular to establish local connectivity and "non-bumping" at various points in the boundaries of these deformation spaces. Joint work with Brock, Bromberg and Canary.

3:45 - 4:15 Coffee

4:15 - 5:15
***Recitation***
**Mark Hagen and Piotr Przytycki**

# Friday

9:00 - 10:00
***The structure of groups with a quasiconvex hierarchy***
**Dani Wise**, McGill University

The plan / Auxiliary HNN / Induction on Height/

10:10 - 11:10
***Twisted Alexander polynomials, hyperbolic geometry, and knot genus***
**Nathan Dunfield**, University of Illinois Urbana-Champaign

A hyperbolic knot has an associated Alexander polynomial that is twisted by the holonomy representation of the hyperbolic structure. I will discuss properties of this invariant and give evidence that it is extremely good at detecting knot genus and fibering. This is joint work with Stefan Friedl and Nicholas Jackson.

11:20 - 12:20
***The relatively hyperbolic setting***
**Dani Wise**, McGill University

Separability/ virtual specialness of Cube complexes with Hierarchies/ Cubulating easier rel. hyp. graphs of groups.

## Speakers

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## Organizers

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