Geometric Group Theory
Théorie géométrique des groupes
(Org: **Dan Margalit** (Georgia Institute of Technology) and/et **Dani Wise** (McGill University))

TARIK AOUGAB, Brown University
Weil-Petersson analogs for metric graphs

Thurston observed that given a sequence of closed geodesics on a surface which are in some sense uniformly distributed, by taking a certain kind of limit, their length functions can be used to define a Riemannian metric over Teichmuller space. Wolpert later proved that this metric is essentially the Weil-Petersson metric. Using this dynamical characterization, Pollicott-Sharp and Kao have defined Weil-Petersson analogs on moduli spaces of metric graphs, and have investigated their properties in some low-rank cases. We will summarize and motivate some of these constructions, and describe some ongoing and preliminary results regarding the large scale properties of these metrics in arbitrary rank. This represents joint work with Matt Clay and Yo'av Rieck.

JASON BEHRSTOCK, CUNY
Quasiflats in hierarchically hyperbolic spaces

Hierarchically hyperbolic spaces provide a uniform framework for working with many important examples, including mapping class groups, right angled Artin groups, Teichmuller space, and others. In this talk I'll provide an introduction to studying groups and spaces from this point of view and discuss some new results about quasiflats in this context. This is joint work with Mark Hagen and Alessandro Sisto.

PALLAVI DANI, Louisiana State University
Subgroup distortion in hyperbolic groups

The distortion function of a subgroup measures the extent to which the intrinsic word metric of the subgroup differs from the metric induced by the ambient group. Olshanskii showed that there are almost no restrictions on which functions arise as distortion functions of subgroups of finitely presented groups. This prompts one to ask what happens if one forces the ambient group to be particularly nice, say, for example, to be hyperbolic. I will survey which functions are known to be distortion functions of subgroups of hyperbolic groups. I will then describe joint work with Tim Riley which adds to this list: we construct free subgroups of hyperbolic groups with distortion functions $2^{n^{p/q}}$, for all integers $p > q > 0$.

TULLIA DYMARZ, University of Wisconsin - Madison
A model for random nilpotent groups

In Gromov's density model, a random group is either trivial or hyperbolic and in particular never nilpotent. We use the fact that every torsion free nilpotent group can be realized as a subgroup of the group of all upper triangular matrices with integer entries to present a model for random nilpotent groups. Our random nilpotent groups are subgroups of this group of matrices generated by elements given by random walks on a fixed generating set. By varying the size of the matrices and the length of the subgroup generators we prove results on the 'step' (i.e. the length of the lower central series) of a random nilpotent group. This is joint work with K. Delp and A. Schaffer-Cohen.

TALIA FERNOS, University of NC, Greensboro
Regular Isometries of CAT(0) Cube Complexes are Plentiful

A rank-1 isometry of an irreducible CAT(0) space is an isometry that exhibits hyperbolic-type behavior regardless of whether the ambient space is indeed hyperbolic. A regular isometry of an (essential) CAT(0) cube complex is an isometry that is rank-1 in

each irreducible factor. In a joint work with Lecureux and Matheus, we study random walks and deduce that regular isometries are plentiful, provided the action is nonelementary. This generalizes previous results of Caprace-Sageev and Caprace-Zadnik (where it is assumed that the acting group has lattice-type properties).

DAVID FUTER, Temple University
Geometrizing generic few-relator groups

Given a presentation of a group G with many more generators than relations, where the relations are random long words, we construct a 2-dimensional complex with nice geometry whose fundamental group is G. This complex is built out of hyperbolic polygons, glued by isometry along the edges, with a negative curvature condition at the vertices. The entire construction is guided and locally modeled on the dual 2-skeleton of a triangulated 3-manifold. As a consequence of this "geometric realization" of the group, we learn that G is hyperbolic and enjoys several other pleasant group-theoretic properties. For instance, G is orderable, and all finitely generated subgroups are undistorted, hyperbolic, and separable. This is joint work with Dani Wise.

JINGYIN HUANG, McGill University
Virtual specialness without hyperbolicity

We are interested in determining when a nonpositively curved cube complex X has a finite special cover, without assuming that $\pi_1 X$ is word-hyperbolic. Typical counterexamples are irreducible lattices acting on products of trees. In the Bass-Serre trees of such examples, one can find an infinite ascending chain of subtrees such that their pointwise stabilizers become smaller and smaller. We define a notion called "finite generalized height" that excludes such pathologies, and we prove that any graph of non-positively curved cube complexes having hyperbolic vertex groups and finite generalized height is virtually special. This is joint work with D. Wise.

RITA JIMENEZ-ROLLAND, Universidad Nacional Autónoma de México
Powers of the Euler class for the pure mapping class group

In this talk I will present work in progress on the vanishing and non-vanishing behaviour of the powers of the Euler class for the pure mapping class group of an orientable surface. This is joint work with Solomon Jekel.

JOHANNA MANGAHAS, University at Buffalo
Normal right-angled Artin group subgroups of mapping class groups

Free normal subgroups of mapping class groups abound, by the result of Dahmani, Guirardel, and Osin that the normal closure of high powers of pseudo-Anosovs is free. At the other extreme, if a normal subgroup contains a mapping class supported on too small a subsurface, it can never be isomorphic to a right-angled Artin group, by work of Brendle and Margalit. I will talk about a case right in between: a family of normal subgroups isomorphic to non-free right-angled Artin groups. We also recover, expand, and make constructive the result of Dahmani, Guirardel, and Osin about free normal subgroups. We do this by creating a version of their "windmill" construction tailor-made for the projection complexes introduced by Bestvina, Bromberg, and Fujiwara. This is joint work with Matt Clay and Dan Margalit.

JASON MANNING, Cornell University
Cubulations from improper actions

We give criteria by which an improper action of a hyperbolic group on a cube complex can be promoted to a proper one. In the case where the cube complex is a tree, we recover Wise's Quasi-convex Hierarchy Theorem. (Note though that we use this theorem heavily in our proof.) This is joint work with Daniel Groves.

EDUARDO MARTINEZ-PEDROZA, Memorial University
Subgroups of relatively hyperbolic groups of relative dimension 2

A remarkable result of Gersten states that the class of hyperbolic groups of cohomological dimension 2 is closed under taking finitely presented subgroups. We prove the analogous result for toral relatively hyperbolic groups of dimension 2 with respect to the family of parabolic subgroups. The proof relies on an algebraic approach to relative homological Dehn functions, and a new characterization of relative hyperbolicity. In the talk, I will describe the result and some applications, and briefly describe some of the tools used in the proof.

PRIYAM PATEL, University of California, Santa Barbara
Algebraic and topological properties of big mapping class groups

The mapping class group of a surface is the group of homeomorphisms of the surface up to isotopy (a natural equivalence). Mapping class groups of finite type surfaces have been extensively studied and are, for the most part, well-understood. There has been a recent surge in studying surfaces of infinite type and in this talk, we shift our focus to their mapping class groups, often called big mapping class groups. The groups arise naturally when studying group actions on surfaces (dynamics) and foliations of 3-manifolds. In contrast to the finite type case, there are many open questions regarding the basic algebraic and topological properties of big mapping class groups. Until now, for instance, it was unknown whether or not these groups are residually finite. We will discuss the answer to this and several other open questions after providing the necessary background on surfaces of infinite type. This work is joint with Nicholas G. Vlamis.

BALAZS STRENNER, Georgia Institute of Technology
Fast computation in mapping class groups

The talk will be on a project, joint with Dan Margalit and Oyku Yurttas, whose goal is to give a framework for fast computation in mapping class groups. We show that there is a quadratic-time algorithm that computes the Nielsen-Thurston type of a mapping class (finite order, pseudo-Anosov or reducible). It also finds the reducing curves and the stretch factors and invariant foliations on pseudo-Anosov components.

JING TAO, University of Oklahoma
Coarse geometry of the Thurston metric

I will describe some ongoing work to study the behavior of geodesics in the Thurston metric on Teichmuller space.

SAM TAYLOR, Temple University
Largest projections for random walks

We show that the largest subsurface projection distance between a marking and its image under the nth step of a random walk grows logarithmically in n, with probability approaching 1 as n goes to infinity. As an application, we confirm a conjecture of Rivin about the asymptotic behavior of systole in random mapping tori.

This is joint work with Alessandro Sisto.

BENA TSHISHUKU, Harvard University
Obstructions to Nielsen realization

Let M be a manifold, and let $Mod(M)$ be its mapping class group. The Nielsen realization problem for diffeomorphisms asks, "Can a given subgroup $G < Mod(M)$ be lifted to the diffeomorphism group $Diff(M)$?" This question about group actions is related to a question about flat connections on fiber bundles with fiber M. In the case M is a closed surface, the answer is

"yes" for finite G (by work of Kerckhoff) and "no" for $G = Mod(M)$ (by work of Morita). For most infinite $G < Mod(M)$, we don't know. I will discuss some obstructions that can be used to show that certain groups don't lift. Some of this work is joint with Nick Salter.