• Mladen Bestvina, University of Utah

*Isometric rigidity of the complex of free factors*

(joint work with Martin Bridson)

The fundamental theorem of projective geometry states that any function that sends points to points and lines to lines and preserves incidence (essentially) comes from a projective transformation. We prove the same theorem in the context of free groups.

• Michael Boshernitzan, Rice University

*Quantitative Poincare recurrence for the unit interval, an unconventional packing problem and Lagrange spectrum of interval exchanges*

(joint work with Vincent Delecroix)

We sketch the proofs of the following two results involving the same optimal constant $\frac{1}{\sqrt{5}}$.

**Theorem 1** (on recurrence in $[0, 1]$). Let $T : [0, 1] \to [0, 1]$ be a Lebesgue measure preserving map (not necessarily continuous). Then $\liminf_{n \to \infty} n|T^n x - x| \leq \frac{1}{\sqrt{5}}$, for a.a. $x \in [0, 1]$.

The golden mean rotation $x \to x + \frac{\sqrt{5} - 1}{2}$ (mod 1) shows that the constant $\frac{1}{\sqrt{5}}$ in the above result is optimal. Result 1 extends the classical Hurvitz’s theorem [Hu1891] on approximation of irrational numbers by rationals and also improves the result $\liminf_{n \to \infty} n|T^n x - x| \leq 1$ (for a.a. $x \in [0, 1]$) in [Bo93] proved under the assumptions of Theorem 1.

A set $\Lambda \subset \mathbb{C} = \mathbb{R}^2$ is called 1-distant if $|\Re(u-v) \cdot \Im(u-v)| \geq 1$, for all $u, v \in \Lambda$, $u \neq v$.

**Theorem 2** (on packing). The upper density of any 1-distant set $\Lambda \subset \mathbb{R}^2$ does not exceed $\frac{1}{\sqrt{5}}$.

The lattice $\Lambda = \mathbb{Z}(-1, 1) \oplus \mathbb{Z}(\frac{\sqrt{5} - 1}{2}, \frac{\sqrt{5} + 1}{2})$ provides an example of an 1-distant set which has density $\frac{1}{\sqrt{5}}$.

Theorem 2 is used in the proof of Theorem 1. It also applies for explicit calculation of the bottom of the Lagrange spectrum of interval exchanges, the problem recently considered by P. Hubert, L. Marchese and C. Ulcigrai [HMU15].
References


• Lewis Bowen, University of Texas

*Cheeger constants and $L^2$ Betti numbers*

Does there exist a sequence of free subgroups $F_k$ of the isometry group of hyperbolic $n$-space such that the Cheeger constant of the quotient space $H^n/F_k$ tends to zero as $k$ tends to infinity? I will explain how to answer this when $n$ is even using $L^2$ Betti numbers and a generalization of Lück approximation due to Gabor Elek.

• Noel Brady, University of Oklahoma

*Asymptotic geometry of subgroups of CAT(0) groups*

The asymptotic geometry of subgroups of CAT(0) groups can be very different from that of the ambient groups. We describe some of these differences in the contexts of filling invariants and of asymptotic cones.

• Emmanuel Breuillard, Université Paris-Sud

*Unique trace, $C^*$-simplicity and the Furstenberg boundary*

The last 12 months have seen a dramatic change of scenery in the problems of determining which discrete groups have unique trace and which are $C^*$-simple. I will describe these new developments.

• Tullio Ceccherini-Silberstein, Rome (ITALY)

*Expansive actions of countable amenable groups, homoclinic points, and the Myhill property*

(joint work with Michel Coornaert)

Let $X$ be a compact metrizable space equipped with a continuous action of a countable amenable group $G$. Suppose that the dynamical system $(X, G)$ is expansive and is the quotient by a uniformly bounded-to-one factor map of a strongly irreducible subshift. Let $\tau : X \to X$ be a continuous map commuting with the action of $G$. We prove that if there is no pair of distinct $G$-homoclinic points in $X$ having the same image under $\tau$, then $\tau$ is surjective. This result extends the Myhill implication in the Garden of Eden theorem for cellular automata over amenable groups, and applies in particular to elementary basic sets of Axiom A diffeomorphisms.
• Artem Dudko, Stony Brook University

*On Koopman, groupoid and quasi-regular representations and weakly branch groups*

(joint work with Rostislav Grigorchuk)

The three types of representations listed in the title are among the main sources of examples of unitary group representations. Spectral properties of these representations are in a direct relation with spectral properties of groups and Schreier graphs. We show that for an ergodic measure class preserving action of a countable group $G$ on a standard Borel space the associated groupoid and quasi-regular representations are weakly equivalent and weakly contained in the Koopman representation. Our key examples are weakly branch groups. I will present results on representations associated to actions of weakly branch groups on boundaries of rooted trees and corollaries related to invariant random subgroups, centralizers of group actions, spectra of operators of these representations, etc.

• Damien Gaboriau, École Normale Supérieure de Lyon

*Geometric dimension and approximations in orbit equivalence*

My talk will consider two types of invariants/properties in measured group theory.

I will present a joint work in progress with Clinton Conley, Andrew Marks and Robin Tucker-Drob about the geometric dimension of probability measure preserving (pmp) group actions. Treeability coincides with geometric dimension = 1 and it consists in equipping, in a measurable way, every orbit with the structure of a tree. We show for instance that:
- Every (!) free pmp action of the fundamental group of a compact surface is treeable.
- Every free pmp action of the fundamental group of an aspherical 3-dimensional closed orientable manifold either is amenable or has geometric dimension = 2.

In a joint work with Robin Tucker-Drob we initiate a general study of the notion approximation for pmp equivalence relations, just like hyperfiniteness (which plays a central role in orbit equivalence), consists in approximation by finite subrelations. We obtain for instance a non-approximability result for non-amenable groups generated by two commuting finitely generated infinite subgroups, one of them action in a strongly ergodic manner. This result has the consequence in Bernoulli percolation on Cayley graphs of such groups, that the uniqueness threshold $p_u$ doesn’t itself belong to the uniqueness phase.

• Kate Juschenko, Northwestern University

*On the interval exchange transformation group and its subgroups*

TBA

• Martin Kassabov, Cornell University

*Almost commuting permutations and quantified soficity*

(joint work with Harald Helfgott)

Suppose we are given two permutations in a large symmetric group which almost commute, i.e., the support of the commutator is relatively small. The soficity and the amenability of the group $\mathbb{Z}^2$ implies that it is possible to modify these permutations and make the commute. In this talk I will explain what is the relative size of the modification of the permutations needed to achieve that, the argument is almost entirely geometric and almost does not use any group theory.
• Alex Lubotzky, Hebrew University

*High dimensional expanders and Ramanujan complexes*

(joint work with Tali Kaufman and David Kazhdan)

Expander graphs in general, and Ramanujan graphs, in particular, have played a major role in computer science in the last 4 decades and more recently also in pure math. In recent years a high dimensional theory of expanders is emerging. A notion of topological expanders was defined by Gromov who proved that the complete $d$-dimensional simplicial complexes are such. He raised the basic question of existence of such bounded degree complexes of dimension $d > 1$.

We show that this is indeed the case for $d = 2$. While it is still an open problem whether the Ramanujan complexes of dimension 2 are topological expanders, we show that the 2-skeletons of the Ramanujan complexes of dimension 3 are such! This is achieved by some new mod 2 isoperimetric/systolic inequalities.

• Russell Lyons, Indiana University

*Random orderings and unique ergodicity of automorphism groups*

(joint work with Omer Angel and Alexander Kechris)

Is there a natural way to put a random total ordering on the vertices of a finite graph? Natural here means that all finite graphs get an isomorphism-invariant random ordering and induced subgraphs get the random ordering that is inherited from the larger graph. Thus, the uniformly random ordering is natural; are there any others? What if we restrict to certain kinds of graphs? What about finite hypergraphs or finite metric spaces? We discuss these questions and sketch how their answers give unique ergodicity of corresponding automorphism groups; for example, in the case of graphs, the group is the automorphism group of the infinite random graph.

• Igor Lysenok, Steklov Mathematical Institute and Stevens Institute of Technology

*Once more on free Burnside groups $B(m, n)$*

The Novikov-Adian theorem states that a non-cyclic Burnside group $B(m, n)$ of odd exponent $n$ greater or equal 665 is infinite. Starting from the original approach, all known proofs of the infiniteness of $B(m, n)$ utilize the idea that the group can be described in terms of some iterated small cancellation condition. In the last decade, several explicit implementations of small cancellation condition were introduced which can be applied in a more general setup to groups acting on a hyperbolic metric space. We will discuss yet another implementation more suited to the original Burnside problem. This is a part of a reasonably accessible proof that $B(m, n)$ is infinite for odd $n$ with rather moderate bound $n > 2100$.

• Alan Reid, University of Texas

*Recognizing the figure-eight knot group by its finite quotients*

This talk will describe how to recognize the figure-eight knot group amongst compact 3-manifold groups by finite quotients.
• Mark Sapir, Vanderbilt University

*On subgroups of the R. Thompson group F*

(joint work with Gili Golan)

We answered several questions of V. Jones about certain subgroup of Fth at encodes all oriented knots and links. We also answer questions by D. Savchuk and S. Schleimer about maximal subgroups of F. In particular, we show that F is quasi-residually finite.

• Tatiana Smirnova-Nagnibeda, Université de Genève

*Subshifts, substitutions and spectra of Schreier graphs*

We will consider the family of groups \{G_\xi\}, parametrized by infinite sequences in 0, 1, 2. It was introduced by Grigorchuk, who showed that all but a countable number of these groups have intermediate growth. The groups are all generated by 4 elements and act on the binary tree. The induced action on the boundary of the tree gives rise to infinite linear Schreier graphs which in turn define a family of subshifts \{\Omega_\xi\}. We study this family in the space of all subshifts on 4 letters and use its properties to describe the spectra of Schreier graphs of the groups \{G_\xi\}. If the time permits we will discuss how our results can be generalized to a wider class of groups acting on rooted trees.
1 Yago Antolín, Vanderbilt University

Degree of commutativity in infinite groups

(joint work with A. Martino and E. Ventura)

In a finitely generated groups, we count the numbers of pairs of elements in a ball of radius \( n \) which commute, and register the proportion of these among all possible pairs. Taking the limit of these numbers provides us the degree of commutativity of the group. We conjecture that the degree of commutativity is positive if and only if the group is virtually abelian and I will present some results in this direction.

2 Mohammad Bardestani, University of Ottawa

Isotropic quadratic forms and the Borel chromatic number of quadratic graphs

(joint work with Keivan Mallahi Karai)

For a field \( F \) and a quadratic form \( Q \) defined on an \( n \)-dimensional vector space \( V \) over \( F \), let \( G_Q \), called the quadratic graph associated to \( Q \), be the graph with the vertex set \( V \) where vertices \( u, w \) in \( V \) form an edge if and only if \( Q(v - w) = 1 \). Quadratic graphs can be viewed as natural generalizations of the unit-distance graph featuring in the famous Hadwiger-Nelson problem. In the present talk, we will prove that for a local field \( F \) of characteristic zero, the Borel chromatic number of \( G_Q \) is infinite if and only if \( Q \) represents zero non-trivially over \( F \). The proof employs a recent spectral bound for the Borel chromatic number of Cayley graphs, combined with an analysis of certain oscillatory integrals over local fields. As an application, we will also answer a variant of question 525 proposed in the 22nd British Combinatorics Conference 2009.

3 Robert Bieri, SUNY Binghamton

Groups of piecewise isometric permutations of lattice points

I will talk about first steps into what looks like a worthwhile project: Let \( \Omega = \Gamma \sigma \) be an orbit of a discrete group of isometries of Euclidean or hyperbolic \( n \)-space with a convex polyhedral fundamental domain. We define a notion of \( \Gamma \)-polyhedral pieces \( S \) of \( \Omega \) and call a permutation \( \sigma \) of \( \Omega \) piecewise \( \Gamma \)-isometric if \( \Omega \) is the disjoint union of such pieces and \( \sigma \) restricts on each of them to an element of \( \Gamma \). The focus then is on the groups \( G(S) \) of all piecewise isometric permutations on \( S \) and their finiteness properties. Together with Heike Sach I consider the two most basic cases: Euclidean \( \mathbb{Z}^n \) and the \( SL_2(\mathbb{Z}) \)-orbit in the hyperbolic plane. The finiteness properties of the groups \( G(S) \) on polyhedral pieces \( S \) of \( \mathbb{Z}^n \) are accessible (by Ken Brown’s method), while \( G(SL_2(\mathbb{Z})) \) is closely related to Thompson’s prominent group \( V \).
4 Collin Bleak, University of St Andrews

On finite generation for groups of homeomorphisms of the Cantor space

(joint work with James Hyde)

We study conditions, both algebraic and dynamic, which together imply that a group of homeomorphisms of Cantor space will be two-generated. The conditions are fairly broad, and are similar to those in the Higman/Epstein arguments towards simplicity of such groups. For instance, the conditions are sufficiently basic to prove 2-generation for all of the simple relatives of R. Thompson’s group $V$, such as the Higman groups $G_{n,r}$ (for $n$ even) and the Brin-Thompson groups $nV$.

5 Bill Bogley, Oregon State University

Groups Arising at the Transition to Asphericity

(joint work with Gerald Williams, University of Essex)

Some group presentations are aspherical and some are not. By examining the transition from aspherical presentations to non-aspherical ones, Gerald Williams (University of Essex) and I have identified three families $J$, $K$, $L$ of two-generator two-relator groups that are poised between finite and infinite groups. We have completed an analysis of the family $J$, which satisfies a strong form of the Tits Alternative, and which contains an infinite family of efficient metabelian finite groups. I will describe combinatorial, algebraic, and number theoretic aspects of the $J$ groups, including applications to the theory of cyclically presented groups and the appearance of Mersenne numbers and other conjecturally infinite families of primes in the group orders. The families $K$ and $L$ contain nonsolvable finite groups, but the analysis is just beginning for these groups.

6 Ievgen Bondarenko, National Taras Shevchenko University of Kyiv

Non-residually finite CAT(0) groups and bireversible automata

(joint work with Bohdan Kivva)

We will discuss a connection between bireversible automata, square complexes and CAT(0) groups. I will show how to construct non-residually finite CAT(0) groups from any bireversible automaton with infinite automaton group.

7 Inna Bumagin, Carleton University

Makanin-Razborov diagrams over relatively hyperbolic groups

(joint work with Nicholas Touikan)

Let $G$ be a finitely generated relatively hyperbolic group. Our goal is to give a description of the set of homomorphisms $\text{Hom}(L, G)$ from a finitely generated $G$-limit group $L$ to $G$ in terms of a finite directed rooted tree. This is work in progress.
8 Mike Cantrell, University of Illinois, Chicago

Asymptotic shapes for ergodic families of metrics on nilpotent groups

Let \( \Gamma \) be a finitely generated virtually nilpotent group. We consider three closely related problems: (i) convergence to a deterministic asymptotic cone for an equivariant ergodic family of inner metrics on \( \Gamma \), generalizing Pansu’s theorem; (ii) the asymptotic shape theorem for First Passage Percolation for general (not necessarily independent) ergodic processes on edges of a Cayley graph of \( \Gamma \); (iii) the sub-additive ergodic theorem over a general ergodic \( \Gamma \)-action. The limiting objects are given in terms of a Carnot-Carathéodory metric on the graded nilpotent group associated to the Mal’cev completion of \( \Gamma \).

9 Fabienne Chouraqui, University of Haifa, campus Oranim

On left orders in Garside groups

A group \( G \) is left-orderable if there exists a total ordering \( \leq \) of its elements which is invariant under left multiplication, that is \( g \leq h \) implies \( fg \leq fh \) for all \( f, g, h \) in \( G \). If the order \( \leq \) is also invariant under right multiplication, then \( G \) is said to be bi-orderable. P. Dehornoy proved that \( B_n \), the braid group with \( n \geq 3 \) strands, is left-orderable but not bi-orderable, and if \( n \geq 5 \) none of these orders is Conradian. The question whether every Garside group is left-orderable arose. It is a very natural question as the Garside groups extend the braid groups in many respects and it motivated our research in the context of the structure group of a non-degenerate symmetric set-theoretical solution of the quantum Yang-Baxter equation. This group is a Garside group that satisfies many interesting properties and it is also a Bieberbach group. We show that this group is not bi-orderable and we discover that the question whether it is left-orderable has a wide range of answers. Indeed, there exist structure groups with space of left orders homeomorphic to the Cantor set and all left orders Conradian, while there exist others that are even not unique product groups (example given by E. Jespers and I. Okniński).

10 Jorge Delgado, Universitat Politècnica de Catalunya

Enriched pullbacks and the intersection problem

(joint work with Enric Ventura)

We extend to the family of free-abelian times free groups the classical Stallings theory describing subgroups of the free group as automata. This approach provides an alternative way of understanding several algorithmic results already proved in [1], and a promising way for attacking new ones.

In particular, I will discuss its application to the intersection problem within this family using an adaptation of the pull-back technique to this new framework.

References:

11 Jonas Deré, KU Leuven Kulak

Which manifolds admit expanding maps?

In 1981, M. Gromov completed the proof that every manifold admitting an expanding map is, up to finite cover, homeomorphic to a nilmanifold. Since then it was an open question to give an algebraic characterization of the nilmanifolds admitting an expanding map. During my talk, I will start by introducing
the basic notions of expanding maps and nilmanifolds. Then I explain how the existence of such an expanding map only depends on the covering Lie group and on the existence of certain gradings on the corresponding Lie algebra. One of the applications is the construction of a nilmanifold admitting an Anosov diffeomorphism but no expanding map, which is the first example of this type.

12 Casey Donoven, University of St Andrews

*Conjugates of Thompson Group $V$ in the Rational Group*

(joint work with Collin Bleak and Julius Jonusas)

I will present some joint work with Collin Bleak and Julius Jonusas on isomorphisms between supergroups of Thompson group $V$. These supergroups, $V_n(G)$, will under certain conditions be conjugates of $V$ within the rational group. I will also mention some general results on conjugates of $V$ by synchronous transducers.

13 Bruno Duchesne, Lorraine University

*Amenable Invariant Random Subgroups*

(joint work with Uri Bader and Jean Lécureux)

Recently, Invariant random subgroups (IRS) caught attention, in particular because of the relation with Benjamin-Schramm convergence of geometric objects. IRS are probability measures on the set of closed subgroups of a given group $G$, which are invariant under conjugation. It was a question to understand what IRS can be supported on amenable groups. With Uri Bader and Jean Lécureux, we show that amenable IRS are supported on subgroups of the amenable radical.

14 Murray Elder, The University of Newcastle, Australia

*Using random walks to detect amenability in finitely generated groups*

(joint work with Cameron Rogers, Newcastle)

We use random walks to experimentally compute initial terms of the cogrowth series for a finitely presented group. We also propose candidates for a Følner sequence for any amenable group, and for the amenable radical of any non-amenable group, based on convergence properties of random walk.

15 Mariia Fedorova, Taras Shevchenko National University of Kyiv

*Automaton actions of free products of groups*

The class of groups admitting faithful finite state actions on regular rooted trees is closed under direct sums and finite extensions. The question whether or not this class is closed under free products is still open (see Problem 16.85 from Kourovka Notebook). In the talk free products of finite number of finite groups are considered. For every free product of this form a series of embeddings into the group of finite state automorphisms of some regular rooted tree is constructed. Basic properties of Shreier graphs connected with these embeddings are studied.
16  Talia Fernos, University of North Carolina, Greensboro

*The Poisson-Furstenberg Boundary and CAT(0) Cube Complexes*

CAT(0) cube complexes are fascinating objects of study, thanks in part to the interplay between two metrics they naturally admit, which lead to the visual and Roller boundaries. Under standard assumptions, the Roller Boundary carries a stationary measure making it the Furstenberg-Poisson Boundary of a random walk on the acting group $G$. This generalizes previous work of Nevo-Sageev. In this talk, we will discuss the geometry of the Roller Boundary and the proof of this theorem, with an emphasis on the case of a tree.

17  Maranda Franke, University of Nebraska – Lincoln

*Geodesic Language Complexity and Group Structure*

A finitely generated group has solvable word problem if its language of geodesics is computable. The complexity of this language has connections to algebraic and geometric properties of the group. Hermiller, Holt, and Rees showed abelian groups have piecewise excluding geodesic language for any finite generating set and give a construction of generating sets for which virtually abelian groups have piecewise testable geodesic language. In this talk, I will show a proper subset of virtually abelian groups have piecewise excluding geodesic language for some finite generating set.

18  Daniel Franz, University of Virginia

*Quantifying the Residual Finiteness of Linear Groups*

In a similar vein as subgroup growth, one can study the residual finiteness growth of a residually finite group. I will discuss the normal and non-normal residual finiteness growth of linear groups. In particular, I will show precise asymptotics for Chevalley groups over rings of integers in both characteristic 0 and $p$. These asymptotics depend only on the dimension of the Chevalley group or of its maximal parabolic subgroup.

19  Funda Gultepe, University of Illinois at Urbana-Champaign

*Constructing fully irreducible automorphisms of the free group via geometric Dehn twisting*

By using a notion of a geometric Dehn twist we prove that when projections of two $\mathbb{Z}$-splittings to the free factor complex are far enough from each other in the free factor complex, Dehn twist automorphisms corresponding to the $\mathbb{Z}$-splittings generate a free group of rank 2. Moreover, every element from this free group is either conjugate to a power of one of the Dehn twists or it is a fully irreducible outer automorphism of the free group.

20  Neha Gupta, University of Illinois Urbana-Champaign

*The primitivity index function for a free group, and untangling closed curves on surfaces*

(joint work with Ilya Kapovich, arXiv:1411.5523)

A theorem of Scott shows that any closed geodesic on a surface lifts to an embedded loop in a finite cover. Our motivation is to find a worst-case lower bound for the degree of this cover, in terms of the length of the original loop. Using probabilistic methods we establish lower bounds for certain analogous functions, like the Primitivity Index Function and the Simplicity Index Function, in a free group. These lower bounds, when applied in a suitable way to the surface case, give us some lower bounds for our motivating question.
21 Emily Hamilton, Cal Poly, San Luis Obispo

_Double Coset Separability of Abelian Subgroups of Hyperbolic n-Orbifold Groups_

A subset $X$ of a group $G$ is said to be separable if it is closed in the profinite topology. Let $M = \mathbb{H}^n/\Gamma$ be a closed hyperbolic orbifold of dimension $n \geq 2$. We show that if $H$ and $K$ are abelian subgroups of $\Gamma$ and $g \in \Gamma$, then the double coset $HgK$ is separable in $\Gamma$. We generalize this result to cocompact lattices in linear, semisimple Lie groups of (real) rank one.

22 Susan Hermiller, University of Nebraska

_Determining solvability of groups of homeomorphisms_  
(joint work with Collin Bleak and Tara Brough)

The group $G$ of orientation-preserving piecewise-linear homeomorphisms of the unit interval includes many important subgroups, most notably R. Thompson’s group $F$. For any finitely generated subgroup $H$ of $G$, we use dynamical properties of the generating homeomorphisms to show that the derived length of $H$ is bounded above by the number of $H$-orbit classes of the breakpoints of the generators. Applying this result to ‘computable’ subgroups of $G$ (including $F$), we give an algorithm which determines whether or not any given finite subset of such a computable group generates a solvable group.

23 Delaram Kahrobaei, City University of New York, GC, NY-CCT

_On the Conjugacy Problem in Certain Metabelian Groups_  
(joint work with Conchita Martinez-Perez, Zaragoza, Spain, and my PhD student Jonathan Gryak GC, CUNY)

We consider groups of the form $G = B \rtimes Q$ which are a split extension with both groups $B$ and $Q$ abelian. Note that such groups are split metabelian groups of finite Prüfer rank, torsion-free, and finitely generated, where $B \subseteq Q^n$ a free abelian group.

We will focus on the case when the group $G$ is given by a presentation of the form

$$G = \langle q_1, \ldots, q_n, b_1, \ldots, b_s \mid [q_i, q_j] = 1, [b_l, b_m] = 1, b_l^{q_i} = q_l b_l q_l^{-1} = b_l^{q_i \cdot b_1^{m_1} b_2^{m_2} \cdots b_s^{m_s}} \rangle.$$

In particular, we prove the following theorems:

**Theorem 1** The time complexity of the conjugacy problem for the group $G$ mentioned above is at most exponential.

**Theorem 2** Assume that up to conjugation

$$Q \leq \{\text{Matrices } \begin{pmatrix} I_{n_1} & M \\ 0 & I_{n_2} \end{pmatrix} \text{ with } n_1 + n_2 = n \text{ (fixed)}\}.$$  

Then the time complexity of the conjugacy problem is polynomial.
24 Kajal Das, ENS de Lyon

Some interactions and comparisons between quasi-isometry (QI) and $L^p$-measure equivalence for finitely generated discrete groups

$L^p$-measure equivalence ($L^p$-ME), $0 < p \leq \infty$, is a sub-equivalence relation of measure equivalence (ME) with some $L^p$ integrable condition on the ‘cocycle maps’ arising from a measure equivalence relation. For $0 < p \leq \infty$, the cases $p = 1$ [integrable measure equivalence(IME)] and $p = \infty$ [uniform measure equivalence(UME)] are the most interesting ones. In the first part of my talk, I will discuss some recent results for IME and UME and I will mention about a result, proved last year by myself with Romain Tessera, where we gave the first example of a pair of groups which are QI and ME, but not IME.

In the second part of my talk, I will discuss on a result proved by myself recently where I showed that if the ‘box spaces’ of two residually finite groups are quasi-isometric, then the two groups are UME. In a similar way, we show that if the box space of one group can be coarsely embedded inside the box space of another group, then there is a ‘UME-embedding’ of the first group inside the second one. I will give a brief sketch of the proof of this result. Using this result, we can distinguish the box spaces of some classes of groups up to coarse embedding and quasi-isometry. If time permits, I will discuss some of these applications.

25 Sang Rae Lee, Texas A&M University

Twisted subgroups of Houghton’s groups

A Houghton’s group $H_n$ consists of translations at infinity of $n$ rays of discrete points. It is known that $H_n$ has type $F_{n-1}$ but not $F_n$. We construct a twisted subgroup $G$ of $H_4 \times H_4$ such that $G$ has type $F_3$ but not $F_4$ and that $G$ does not contain a subgroup isomorphic to the free abelian group of rank 2. We also discuss possible generalization of the construction to answer the question.

Are there groups of type $F_{n-1}$ but not $F_n$ which do not contain a subgroup isomorphic to the free abelian group of rank 2 ($n \geq 4$)?

26 Kostya Medynets, United States Naval Academy

A rigidity theorem for generalized odometers

(joint work with Maria Isabel Cortez)

We show that generalized odometers are continuously orbit equivalent if and only if the sequences of finite-index subgroups defining the systems are virtually isomorphic. For minimal equicontinuous $\mathbb{Z}^d$-systems the continuous orbit equivalence implies that the acting groups have finite index subgroups (having the same index) whose actions are piecewise conjugate. This result extends M. Boyle’s flip-conjugacy theorem originally established for $\mathbb{Z}$-actions. As a corollary, we obtain a dynamical classification of the restricted isomorphism between generalized Bunce-Deddens $C^*$-algebras. We also show that the full group associated with a generalized odometer is amenable if and only if the acting group is amenable.

27 Devin Murray, Brandeis University

Contracting Boundaries of CAT(0) Groups

There are a number of different notions for the boundary of a non-positively curved group. In many cases, they are powerful tools in understanding the algebraic structure of the group as well as the dynamics of group actions. Charney and Sultan introduced a new boundary for CAT(0) spaces called the contracting
boundary which has a number of properties that make it particularly well suited for studying groups which act isometrically on CAT(0) spaces. I will introduce the main definitions and present a number of results about the contracting boundary of CAT(0) groups including some results about subgroups, dynamics and a topological classification of hyperbolic CAT(0) groups.

28 Daniela Nikolova-Popova, Florida Atlantic University

On the Covering Number of Small Symmetric Groups and Some Sporadic Simple Groups

(joint work with L.C. Kappe, and E. Swarz)

We say that a group $G$ has a finite covering if $G$ is a set theoretical union of finitely many proper subgroups. The minimal number of subgroups needed for such a covering is called the covering number of $G$, denoted by $\sigma(G)$. Let $S_n$ be the symmetric group on $n$ letters. For odd $n$ Maroti determined $\sigma(S_n)$ with the exception of $n = 9$, and gave estimates for $n$ even showing that $\sigma(S_n) \leq 2n - 2$. Using GAP calculations, as well as incidence matrices and linear programming, we show that $\sigma(S_8) = 64$, $\sigma(S_{10}) = 221$, and $\sigma(S_{12}) = 761$. We also show that Maroti’s result for odd $n$ holds without exception proving that $\sigma(S_9) = 256$. We establish in addition that the Mathieu group $M_{12}$ has covering number 208, and improve the estimate for the Janko group $J_1$ given by P.E. Holmes.

29 Mark Pengitore, Purdue University

Effective Conjugacy of Nilpotent Groups

In this talk, we will give a solution the conjugacy problem via finite quotients for finitely generated nilpotent groups. We make that solution effective by following the work of Blackburn. Specifically, we give upper and lower bound estimates, in terms of word length, of the size of the finite quotients needed to separate two conjugacy classes.

30 Eviatar Procaccia, Texas A&M University

Stationary Eden model on groups

We consider two stationary versions of the Eden model, in graphs of the form $G \times \mathbb{Z}^+$, where $G$ is a Cayley graph, resulting in an infinite covering forest. Under weak assumptions on the edge weight distribution and by relying on ergodic theorems and mass transport we prove that almost surely all trees are finite. This generalizes results of Deijfen and Häggström for the two-type Richardson model in $\mathbb{Z}^d$.

31 Doron Puder, IAS, Princeton

Word Measures on Unitary Groups

(joint work with Michael Magee)

We study measures induced by free words on the unitary groups $U(n)$: let $w$ be a word in the free group $F_r$ on $r$ generators $x_1, \ldots, x_r$. For every $i = 1, \ldots, r$ substitute $x_i$ with an independent, Haar-distributed random element of $U(n)$ and evaluate the product defined by $w$ to obtain a random element in $U(n)$. The measure of this element is called the $w$-measure on $U(n)$.

Let $Tr_w(n)$ denote the expected trace of a random unitary matrix sampled from $U(n)$ according to the $w$-measure. It was shown by Voiculescu (91’) that for $w \neq 1$, this expected trace is $o(n)$ asymptotically in
We relate the numbers $Tr_w(n)$ to the theory of commutator length of words and obtain a much stronger statement. Our analysis also sheds new light on the solutions of the equation $[u_1,v_1]...[u_g,v_g] = w$ in free groups.

32 Kristen Pueschel, Cornell University

*Dehn functions for mapping tori of RAAGs*

The (algebraic) mapping torus for group $G$ with automorphism $\phi : G \to G$, is the HNN extension of $G$ for which conjugation by the stable letter performs $\phi$. In the case that $G$ is free or free-abelian, it is understood how the Dehn function of the mapping torus depends on the automorphism $\phi$. Since properties shared by both free and free-abelian groups often translate to partially commutative groups (RAAGs), we naturally wonder how the Dehn function for the mapping torus of a RAAG depends on the automorphism $\phi$. We answer this question for RAAGs of rank 3.

33 Vladimir Shpilrain, CUNY

*Semigroups of linear functions*

(joint work with Alice Medvedev and Bianca Sosnovski)

Motivated by applications to hashing, we address the question of when two linear functions (of one variable) generate a free semigroup under composition.

34 Simon M Smith, City University of New York (City Tech)

*Simple totally disconnected locally compact groups via groups acting on locally finite graphs*

The study of locally compact groups divides into investigating those which are connected, and those which are totally disconnected. The solution to Hilbert’s Fifth Problem showed that connected locally compact groups are projective limits of connected Lie groups, and because of this their structure is now relatively well-understood. On the other hand, the class of totally disconnected locally compact (tdlc) groups contains all discrete groups (and therefore all groups) and so it was thought that very little in general could be said about their structure. This changed in 1994 when George Willis proved that tdlc groups admit a scale function. The scale function on a tdlc group $G$ measures the translation length of elements in $G$ acting by conjugation on the set of compact open subgroups of $G$.

Roggi Möller recovered Willis’ work by looking only at groups acting on locally finite graphs. Thinking about tdlc groups in this way allows those who work primarily with finitely generated groups to begin thinking about the theory of tdlc groups. In this talk, I will discuss a well-known open problem concerning simple tdlc groups that I solved recently using groups which act on locally finite graphs.

35 Ignat Soroko, University of Oklahoma

*Dehn functions of subgroups of right-angled Artin groups*

(joint work with Noel Brady)

The question of what is a possible range for the Dehn functions (a.k.a. isoperimetric profile) for certain classes of groups is a natural and interesting one. Due to works of many authors starting with Gromov, we
know a lot about the isoperimetric profile for the class of all finitely presented groups. Much less is known for other natural classes of groups, such as subgroups of CAT(0) groups or of right-angled Artin groups. In this talk I will give the relevant definitions and present a series of subgroups of certain right-angled Artin groups having their Dehn functions polynomial of arbitrary degree. They are built in several stages. First we produce certain free-by-cyclic groups for which the conjugating automorphism is growing polynomially with a prescribed degree \( d \). Then we form their doubles (in the sense of Bieri) and prove that their Dehn functions grow polynomially with degree \( d + 2 \). To establish embeddings of the latter groups to right-angled Artin groups, we build special (in the sense of Haglund and Wise) covers for the presentation 2-complexes of these groups.

36 Tim Susse, University of Nebraska – Lincoln

*The Geometry of Random Right-angled Coxeter Groups*

(joint work with Jason Behrstock, Victor Falgas-Ravry and Mark Hagen)

We will begin by presenting a model, based on the Erdos-Renyi random graph model, of producing random right-angled Coxeter groups. We will discuss two strong connectedness properties of the generating graph and give thresholds at which these properties are generic. We will then describe strong connections between the structure of the generating graph and the geometry of the corresponding group due to Dani-Thomas and Behrstock-Hagen-Sisto. Together, these imply that at a wide range of densities, a random right-angled Coxeter group almost surely has quadratic divergence.

37 Jone Uria, University of the Basque Country

*On the Congruence Subgroup Problem for GGS groups*

The GGS groups, named after Grigorchuk, Gupta and Sidki, are a family of subgroups of automorphisms of the \( p \)-adic tree \( T \). In this talk we define the Congruence Subgroup Problem for subgroups of \( Aut(T) \) and we solve it for these GGS groups.

38 Dmytro Vavdiyuk, Taras Shevchenko National University of Kyiv

*Two-generated self-similar groups*

We consider a specific family of two-generated self-similar groups. Each group of this family acts by automorphisms on a regular binary rooted tree. One of its generators generates a cyclic self-similar group and the states of the first level of both generators are powers of this generator. We characterize isomorphism classes of groups of this family.

39 Shi Wang, The Ohio State University

*Barycentric straightening and bounded cohomology*

(joint work with Jean Lafont)

We show that, for an \( n \)-dimensional symmetric space of rank \( r \geq 2 \) (excluding \( SL(3,\mathbb{R})/SO(3) \) and \( SL(4,\mathbb{R})/SO(4) \)), the \( p \)-Jacobian has uniformly bounded norm, provided \( p \geq n - r + 2 \). As a consequence,
for the corresponding non-compact, connected, semisimple real Lie group $G$, in degrees $p \geq n - r + 2$, every degree $p$ cohomology class has a bounded representative. This answers Dupont’s problem in small codimension. We also give examples of symmetric spaces where the barycentrically straightened simplices of dimension $n - r$ have unbounded volume, showing that the range in which we obtain boundedness of the $p$-Jacobian is very close to optimal.

40 Yilong Yang, UCLA

Diameter bounds for finite simple groups of large rank

(joint work with Arindam Biswas)

Given any non-abelian finite simple group $G$ and any generating set $S$, it is conjectured by Babai that the Cayley graphs should always diameters $O(\log |G|)$. This conjecture has been verified for all finite simple groups of Lie type with bounded ranks, but little progress is made in the cases with large ranks. Motivated by the methods of Helfgott and Seress for symmetric groups, we obtained an improved diameter bounds for finite simple groups of Lie type with large ranks of $O(1)^{O(n \log n)}$, when the size of the base field is bounded.