Schedule 'Groups, Graphs, Action!'

Monday, October 19

11:00 - 11:50 **Harald Helfgott**: *The diameter of the symmetric group: ideas and tools*

12:00 - 13:30 Lunch break

13:30 - 14:20 **Clara Löh**: *Gradient invariants of groups vs. simplicial volumes*

14:30 - 15:20 **Mark Hagen**: *Hierarchical hyperbolicity*

15:30 - 16:00 Coffee break

16:00 - 16:50 **Alexandre Martin**: *The geometry of Higman groups*

17:00 - 17:50 **Dani Wise**: *Nonpositive immersions and counting cycles*

19:00 - ... Conference Dinner

Tuesday, October 20

10:00 - 10:50 **Yash Lodha**: *Nonamenable finitely presented groups of piecewise projective homeomorphisms*

11:00 - 11:50 **Alejandra Garrido**: *The congruence subgroup property for groups acting on rooted trees*

12:00 - 13:30 Lunch break

13:30 - 14:20 **Agelos Georgakopoulos**: *The planar Cayley graphs are effectively enumerable*

14:30 - 15:20 **Nicolas Bergeron**: *Torsion homology growth in arithmetic groups*

15:30 - 16:00 Coffee Break

16:00 - 16:50 **Henry Bradford**: *Tales of the Solovay-Kitaev Procedure: Diameter, Expansion and the Quantum Computer*

17:00 - ... Swim in the lake

Wednesday, October 21

09:00 - 09:50 **John Mackay**: *Fixed point properties for groups acting on L^p spaces*

10:00 - 10:50 **Rufus Willett**: *Haagerup and Kazhdan properties for expanders*

11:00 - 11:30 Coffee Break

11:30 - 12:20 **Martin Finn-Sell**: *Almost quasi-isometries and the construction of more groups without property A*

12:30 - 13:30 Lunch break

14:00 - 14:50 Seminar *Groupes et Analyse*

Damian Sawicki: *Warped cones, profinite completions, coarse embeddings and property A*

Abstracts

Nicolas Bergeron: *Torsion homology growth in arithmetic groups*

When does the amount of torsion in the homology of an arithmetic group grow exponentially with the covolume ? Few years ago, Akshay Venkatesh and I have proposed conjectural precise conditions. In this talk I will discuss recent progress toward this conjecture and explain some of its relations to Gromov-Thurston norm, (higher) cost as well as rank and deficiency gradient.

Henry Bradford: Tales of the Solovay-Kitaev Procedure: Diameter, Expansion and the Quantum Computer

In 1991 Solovay and Kitaev independently announced a solution to the quantum compilation problem, which had up to then been a major obstruction to the possibility of quickly implementing quantum algorithms. The key to their solution lies in an analysis of commutator words in the group SU(d). A closely analogous study of commutators in other groups has since shed light on a variety of problems in group theory. In this talk we discuss two of them: finding upper bounds for the diameters of finite groups, and constructing new examples of expander graphs.

Martin Finn-Sell: *Almost quasi-isometries and the construction of more groups without property A*

I will define an almost quasi-isometry and explain their role in the construction of groups without property A. Following this, I will outline two proofs, one operator algebraic and one coarse geometric, of a recent permanence result concerning almost quasi-isometries and property A and explain the consequences with regards to the construction of more random groups without property A.

Alejandra Garrido: *The congruence subgroup property for groups acting on rooted trees*

The property in the title is defined analogously to the congruence subgroup property for linear groups: namely, a group G acting faithfully on a rooted tree has the congruence subgroup property if each of its finite index subgroups contains the stabilizer of some level of the tree. This means that the only finite quotients of G are the obvious ones, given by the action on finite subtrees. A much-studied class of groups with faithful actions on rooted trees is that of (weakly) branch groups (the most famous examples in this class are the Grigorchuk group and Gupta–Sidki groups). We will see that, for these groups, having the congruence subgroup property is independent of the weakly branch action. We will also see examples of groups with and without this property. Among those with the congruence subgroup property there are finitely generated not torsion groups, providing examples of infinite, finitely generated, residually finite, not torsion groups whose profinite completion is a pro-p group.

Agelos Georgakopoulos: The planar Cayley graphs are effectively enumerable

We show that a group admits a planar, finitely generated Cayley graph if and only if it admits a special kind of group presentation we introduce, called a planar presentation. Planar presentations can be recognised algorithmically. As a consequence, we obtain an effective enumeration of the planar Cayley graphs, yielding in particular an affirmative answer to a question of Droms et al. asking whether the planar groups can be effectively enumerated. This builds on the techniques of myself and Hamann, which led to the classification of 3-regular planar Cayley graphs.

Joint work with Matthias Hamann.

Mark Hagen: Hierarchical hyperbolicity

I'll define "hierarchically hyperbolic spaces", focusing on the example of right-angled Artin groups. This class of spaces includes mapping class groups, many cubical groups, and fundamental groups of most 3–manifolds, and is closed under forming sufficiently nice graphs of spaces. Hierarchical hyperbolicity of a group implies several properties reminiscent of negative/nonpositive curvature. After discussing the definition and some examples, I'll focus on one of these properties, namely acylindrical hyperbolicity of hierarchically hyperbolic groups.

Harald Helfgott: *The diameter of the symmetric group: ideas and tools*
(joint work with Laszlo Pyber)

Given a finite group G and a set A of generators, the diameter $\mathrm{diam}(\Gamma(G, A))$ of the Cayley graph $\Gamma(G, A)$ is the smallest ℓ such that every element of G can be expressed as a word of length at most ℓ in $A \cup A^{-1}$. We are concerned with bounding $\mathrm{diam}(G) := \max_A \mathrm{diam}(\Gamma(G, A))$.

It has long been conjectured that the diameter of the symmetric group of degree n is polynomially bounded in n. In 2011, Helfgott and Seress gave a quasipolynomial bound $\exp((\log n)^{(4+\epsilon)})$. We will discuss how to improve the bound and simplify the proof. This is work in progress.

Clara Löh: Gradient invariants of groups vs. simplicial volumes

Residually finite chains of subgroups lead to gradient invariants such as the rank gradient, Betti number gradients, torsion gradients, etc.. On the geometric side, chains of finite coverings of manifolds lead to stable integral simplicial volume. In this talk, we will see how gradient invariants of groups can be bounded from above in terms of stable integral simplicial volume. Moreover, we will discuss dynamical versions of these estimates. This talk is partially based on joint work with Roberto Frigerio, Cristina Pagliantini, and Roman Sauer.

Yash Lodha: Nonamenable finitely presented groups of piecewise projective homeomorphisms

Monod introduced examples of groups of piecewise projective homeomorphisms, which he demonstrated are non amenable despite the fact that they do not contain non abelian free subgroups. In joint work with Justin Moore, I isolated examples of finitely presented groups of piecewise projective homeomorphisms with the same property. Further, I showed that these groups are also of type F_∞. In recent work with Burillo and Reeves, we investigated the normal subgroup structure of these groups. In this talk I will present a survey of these groups and discuss their striking properties.

Alexandre Martin: The geometry of Higman groups

The Higman group was constructed as the first example of a finitely presented infinite group without non-trivial finite quotients. Despite this pathological behaviour, I will describe striking similarities with mapping class groups of hyperbolic surfaces, outer automorphisms of free groups and special linear groups over the integers. The main object of study will be the cocompact action of the group on a CAT(0) square complex naturally associated to its standard presentation. This action, which turns out to be intrinsic, can be used to explicitly compute the automorphism group of the Higman group, and to show that the group is both Hopfian and co-Hopfian, among other things. I will also mention the action of generalised Higman groups on associated CAT(-1) polyogonal complexes, and show that their dynamical properties push the analogy with mapping class groups even further.

John Mackay: *Fixed point properties for groups acting on L^p spaces*

Groups can be investigated by considering how they can act on suitable spaces. For example, the notion of Kazhdan's property (T), relating to how groups can act on Hilbert spaces, has been used

very successfully for many applications over the last fifty years. More recently, similar definitions have been used to study actions on other L^p spaces. After outlining some of this story, I'll explain why actions of certain random groups on L^p spaces have fixed points. (Joint work with Cornelia Drutu.)

Rufus Willett: Haagerup and Kazhdan properties for expanders

For this talk, an expander is a sequence of sparse, highly connected graphs. Expanders are known to give rise to a lot of unusual analytic behaviour, and in particular to counterexamples to Baum-Connes type conjectures. Ill survey some of this (without assuming any knowledge of K-theory, or operator algebras). Ill then explain why some expanders are worse than others from this point of view roughly, there are coarsely invariant analogues of the Haagerup property (or a-T-menability), and Kazhdans property (T) for expanders which lead to quite different behaviours and how various examples fit into this scheme. Ill also explain what this has to do with constructions of 'Gromov monster' type groups, and with attempts to fix the motivating conjectures.

The talk will mainly be based on joint work with Paul Baum, Erik Guentner, John Roe, and Guoliang Yu.

Dani Wise: Nonpositive immersions and counting cycles

The "nonpositive immersion" property is a condition on a 2-complex X that generalizes being a surface. When X has this property, its fundamental group appears to have has some very nice properties which I will discuss. I will spend the remainder of the talk outlining a proof that the nonpositive immersion property holds for a 2-complex obtained by attaching a single 2-cell to a graph. This was proven recently with Joseph Helfer and also independently by Lars Louder and Henry Wilton.

Damian Sawicki: *Warped cones, profinite completions, coarse embeddings and property A*

Ten years ago J. Roe introduced the concept of warping a metric according to an action of a finitely generated group and applied it to infinite cones over compact G-spaces. Depending on geometric properties of acting groups or dynamic properties of actions, the resulting warped cones exhibit different, often quite unusual, large-scale properties. I will recall the construction and present some recent progress, including a construction of warped cones without property A yet coarsely embeddable into Hilbert space and ones coarsely non-embeddable into large classes of Banach spaces (Joint work with Piotr Nowak).