YOUNG GEOMETRIC GROUP THEORY X
NEWCASTLE UNIVERSITY

26-30 JULY 2021

LIGHTNING TALKS, 26 JULY

All times are British summer time = UTC+1

SERIES A

10.30 **Henry Bradford**

Title When are wreath products Hopfian?

Abstract I shall pose the above question, and say a few words about why I think it is interesting.

10.36 **Monika Kudlinska**

Title Fibering of free-by-cyclic groups via polytopes

Abstract It is a curious fact that any 3-manifold which fibers over the circle with fiber a genus 2 surface, and whose first homology has rank at least 2, also fibers over the circle by surfaces of arbitrarily large genus. We will see why the analogous statement is true for a free-by-cyclic group $F_n \rtimes \mathbb{Z}$, and how it is possible to control all such fiberings via a polytope which lives in the first cohomology of the group.

10.42 **Vladimir Vankov**

Title Obscure hyperbolic-like groups

Abstract Given that this project started at a past YGGT, it seems fitting to talk about it here. We underline the importance of studying maps to finite groups by using this to build uncountably many groups which act uniformly properly on a hyperbolic space, yet are not virtually torsion-free. Featuring joint work with R. Kropholler.

10.48 **Sam Shepherd**

Title A version of omnipotence for virtually special cubulated groups

Abstract Omnipotence is a group property that allows you to control the orders of a collection of elements in a finite quotient. I will describe my new result, which is a version of omnipotence for virtually special cubulated groups.

10.54 **Kevin Li**

Title Classifying spaces for families, their cohomology, and related topics

Abstract Classifying spaces for families of subgroups are certain G-spaces that occur naturally and are of great importance in geometric group theory. I will introduce these classifying spaces via an example and mention my work on their bounded cohomology and the connection to categorical invariants such as Farber's topological complexity.

11.15 **Raphael Appenzeller**

Title The tree of a non-Archimedean hyperbolic plane.

Abstract We are used to do geometry over the real numbers. In this quick talk we see what happens when we instead use the non-Archimedean ordered field $\mathbb{R}(X)$ to define the hyperbolic plane. The resulting metric space is a tree, more specifically a $\mathbb{Q}$-tree.

11.21 **Macarena Arenas**

Title Linear Isoperimetric Functions for Surfaces in Hyperbolic Groups

Abstract One of the main characterisations of word-hyperbolic groups is that they are the groups with a linear isoperimetric

function. That is, for a compact 2-complex X, the hyperbolicity of its fundamental group is equivalent to the existence of a linear isoperimetric function for disc diagrams D –>X. It is likewise known that hyperbolic groups have a linear annular isoperimetric function and a linear homological isoperimetric function. I will talk about these isoperimetric functions, and about a (previously unexplored) generalisation to all homotopy types of surface diagrams. This is joint work with Dani Wise.

11.27 **Luke Elliott**

Title Automorphisms of the Brin-Thompson groups nV

Abstract I will briefly describe the ideas of a recent paper in which I use transducers to make an algebraic connection between the automorphism groups of V and its higher dimensional analogues.

11.33 **Daniel Berlyne**

Title Hierarchical hyperbolicity of graph braid groups

Abstract Consider a finite collection of particles lying on a finite graph. The configuration space of these particles is the collection of all possible ways the particles can be arranged on the graph with no two particles at the same point. As we move through the configuration space, the particles move along the graph, without colliding. The braid group on our graph is then defined to be the fundamental group of this configuration space. By discretising the motion of the particles, we obtain a combinatorial version of the configuration space, which can be shown to be a special cube complex. Moreover, this cube complex deformation retracts onto the original configuration space, meaning the braid group is unchanged. In particular, this implies graph braid groups are hierarchically hyperbolic groups. I use this hierarchically hyperbolic structure to obtain characterisations of hyperbolicity and acylindrical hyperbolicity for graph braid groups, recovering two theorems of Genevois. I also obtain a new characterisation of relative hyperbolicity, modulo a conjecture.

11.39 **Soumya Dey**

Title Zipping maps and their orbits

Abstract We shall briefly discuss about an ongoing work with Dr. Gianluca Faraco, which concerns some interesting mapping classes of surfaces of infinite type, which we call 'zipping maps', and the orbits of their action on the Teichmüller space.

12.00 **Alexander Zakharov**

Title An analogue of the strengthened Hanna Neumann conjecture for virtually free groups

Abstract The Friedman–Mineyev theorem, earlier known as the (strengthened) Hanna Neumann conjecture, gives a sharp estimate for the rank of the intersection of two subgroups in a free group.;We obtain an analogue of this inequality for any two subgroups in a virtually free group and in virtually free products of left-orderable groups. Joint work with Anton Klyachko.

12.06 **Sam Hughes**

Title Groups quasi-isometric to right-angled Artin groups

Abstract I will briefly survey the literature on the quasi-isometric rigidity of right-angled Artin groups. I will then give some new examples of when this rigidity fails.

12.12 **Annette Karrer**

Title Contracting boundaries of right-angled Coxeter groups

Abstract Every complete CAT(0) space has a topological space associated to it, called the contracting or Morse boundary. This boundary indicates how similar the CAT(0) space is to a hyperbolic space. Charney–Sultan proved this boundary is a quasi-isometry invariant, i.e. it can be defined for CAT(0) groups.

Interesting examples arise among right-angled Coxeter groups (RACGs) and right-angled Artin groups (RAAGs). Each such group is defined by a finite, simplicial graph, and acts geometrically on an associated CAT(0) cube complex. Despite these similarities, the contracting boundaries of RAAGs and RACGs behave differently. Charney–Cordes–Sisto showed that the contracting boundary of every RAAG is totally disconnected. Moreover, they showed that it is empty, a Cantor space, an omega-Cantor space, or consists of two points. In contrast to RAAGs, many diffrent topological spaces arise as Morse boundaries of RACGs and it is often difficult to determine whether a RACG has totally disconnected contracting boundary or not.

In this short talk, I will present a conjecture about RACGs with totally disconnected contracting boundaries. I will define a graph class satisfying this conjecture (this is the main result of my PhD) and will show a picture of a counterexample proving that this conjecture is wrong in general. This is a joint project with Marius Graeber, Nir Lazarovich, and Emily Stark in which we study surprising circles in contracting boundaries of RACGs.

12.18 George Kontogeorgiou

Title Equivariant Cayley Complex Embeddings

Abstract Finite groups which admit faithful topological actions over $\mathbb{S}^3$ are exactly those with Cayley complexes which are (equivariantly) embeddable in $\mathbb{S}^3$. I will attempt to explain this in five minutes.

12.24 Corentin Le Coz

Title Amenable groups can almost contain expanders

Abstract I will talk about the separation profiles of some groups constructed by Brieussel and Zheng. We will focus on applications: the existence of hyperfinite sequences of graphs with arbitrarily large distortion in Lp spaces, and the existence of graphs of asymptotic dimension one that do not coarsely embed in any finite product of trees of bounded degree, answering a natural question raised by a theorem of Dranishnikov.

13.30 **Francisco Nicolás**

Title Kähler groups and finitely generated groups acting on trees

Abstract I will present some restrictions on Kähler groups that admit as a normal subgroup a finitely generated group acting on a tree. I will focus on the case when the finitely generated group is the fundamental group of a closed oriented surface of genus greater or equal than 2.

13.36 **Gabriel Pallier**

Title Sublinear coarse structures and Lie groups

Abstract Between geodesic metric spaces (e.g. Cayley graphs of finitely generated groups), quasiisometries are the coarse equivalences, that is, the maps that preserve a collection of entourages, each of them formed by pairs of points separated by a given bounded distance. I will discuss on what happens if one slightly changes the coarse structures by allowing the entourages to grow slowly to infinity. Especially, can one characterize the new coarse equivalences, and recover some rigidity results in the spirit of quasiisometric rigidity? I will focus on negatively curved Lie groups and formulate one result involving the pinching of sectional curvature.

13.42 **Francesco Fournier-Facio**

Title Ultrametric analogues of Ulam stability

Abstract Intuitively, a group Γ is stable with respect to a family of metric groups $\mathcal{G}$ if all almost-homomorphisms $\Gamma \to G \in \mathcal{G}$ are close to true homomorphisms. This is a well-studied question when the family $\mathcal{G}$ consists of unitary groups, or symmetric groups. We will explain some peculiar behaviours of this problem when the groups in $\mathcal{G}$ are ultrametric, for instance groups of integral p-adic matrices.

13.48 **Zhiqiang Xiao**

Title Gaps in the lattices of topological group topologies

Abstract We'll discuss adout some results of predecessors and successors of locally compact groups.

13.54 **Liam Stott**

Title A class of increasing homeomorphism groups naturally isomorphic to diagram groups

Abstract Deep connections between groups of increasing homeomorphisms and diagram groups are suggested when one considers properties and examples of each. There is limited work on direct connections. Following from existing work of Guba and Sapir, it is reasonable to ask: for which groups of increasing homeomorphisms does there exist a natural faithful representation as a diagram group? In this talk I will introduce a class of such groups.

14.00 **Nayab Khalid**

Title The rotation distance between two binary rooted trees.

Abstract A rotation in a binary tree is a local restructuring of the tree, executed by collapsing an internal edge of the tree to a point, thereby obtaining a node with three children, and then re-expanding the node of order three in the alternative way. The rotation distance between a pair of trees with the same number of nodes is the minimum number of rotations needed to convert one tree into another. There has been a great deal of interest in the problems (initially presented by Culik and Wood in 1982 and Sleater, Tarjan and Thurston in 1988): what is the maximum rotation distance between any pair of n-node binary trees? Is there a polynomial time algorithm (in the number of nodes of the trees) to determine the rotation distance between a given pair of trees?

SERIES B

21.30 **Ignat Soroko**

Title How many groups of type FP_2 are there?

Abstract Groups of type FP_2 are the homological analog of finitely presented groups. While the latter are only countably many up to isomorphism, the former ones comprise uncountably many classes up to isomorphism (Leary '18) and up to quasi-isometry (R.Kropholler-Leary-S. '20). The same is true even for FP_2 groups having a fixed polynomial homological Dehn function (Brady-R.Kropholler-S. '20).

21.36 **Francis Wagner**

Title Torsion Subgroups of Groups with Quadratic Dehn Function

Abstract The Dehn function of a finitely presented group, first introduced by Gromov, is a useful invariant that is closely related to the solvability of the group's word problem. A finitely presented group is word hyperbolic if and only if it has subquadratic (and thus linear) Dehn function. Ghys and de la Harpe show that no hyperbolic group can have a (finitely generated) infinite torsion subgroup. We show that this property does not carry over to any class of groups of larger Dehn function, producing the first examples of groups with quadratic Dehn function that contain a finitely generated infinite torsion subgroup.

21.42 **Conan Gillis**

Title Random Artin Groups

Abstract The study of random RAAGs and RACGs, i.e. RAAGs and RACGs;defined on random graphs, has in recent years become a lively area of research.;While general Artin and Coxeter groups are very well-represented in the literature, they have received little attention in the random context, with the one study of random Coxeter groups by A. Deibel being very recent, and no work at all being done on random Artin groups.;Here, we will apply a random graph model of Deibel's to study Artin

Groups, and more specifically to determine the asymptotic probabilities of an Artin Group having certain properties (such as being two-dimensional) as the number of generators goes to infinity.

21.48 **Rylee Lyman**

Title Outer Space for Free Products of Finite and Cyclic Groups

Abstract Guirardel and Levitt define an Outer Space for a free product G—a space for the outer automorphism group of G to act on. This space admits a simplicial spine, which is locally finite when G is a free product of finitely many finite and cyclic groups. In this lightning talk I will introduce this spine and describe a system of paths in it which correspond to Whitehead automorphisms of the free product. I will mention some theorems-in-progress, some of which are joint work with Lee Mosher.

21.54 **Thomas Ng**

Title Efficient generation of free subgroups in extensions

Abstract A subgroup is efficiently generated when a copy can be generated by words whose word length is uniformly bounded over all generating sets.;Efficient generation is a central tool in determining which groups have uniform exponential growth and is particularly natural is the setting of non-positive curvature.;I will discuss joint work with Robert Kropholler and Rylee Lyman that describes when efficient generation of free subgroups is inherited by group extensions. One consequence of our work is that automorphism groups of one-ended hyperbolic groups satisfy a uniform exponential growth alternative.

22.00 **Lorenzo Ruffoni**

Title Graphical splittings of Artin kernels

Abstract A main feature of the theory of right-angled Artin groups (RAAGs) consists in the fact that the algebraic properties of the group can be described in terms of the combinatorial properties of the underlying graph. We investigate how this can be exploited in the study of Artin kernels, i.e. subgroups of RAAGs obtained as kernels of integral characters. In the case of chordal graphs we obtain a sharp dichotomy for Artin kernels. For block graphs we obtain an explicit rank formula, and discuss some applications to the study of fibrations and BNS invariants of RAAGs. (Joint work with M. Barquinero and K. Ye).

22.15 **Yandi Wu**

Title Quasi-isometric rigidity of surface group amalgams

Abstract Determining the quasi-isometric rigidity of a certain class of groups has long been an important question in geometric group theory. One class of groups of interest are hyperbolic surface group amalgams, fundamental groups of hyperbolic surfaces glued along closed curves, which have close connections to Right-Angled Coxeter Groups. Using the work of Stark, Dani, and Thomas, we explore some known results useful towards determining whether certain classes of surface group amalgams are QI rigid and some future directions.

22.21 **Oussama Bensaid**

Title Coarse Embeddings between Symmetric Spaces and Euclidean Buildings

Abstract The notion of coarse embeddings was introduced by Gromov in the 80's under the name of "placements". It is a generalization of quasi-isometric embeddings when the control functions are not necessarily affine. I am particularly interested in coarse;embeddings between symmetric spaces and euclidean buildings. The quasi-isometric case is very well understood thanks to the rigidity results of symmetric spaces and

buildings of higher rank by Kleiner-Leeb and Eskin-Farb in the 90s, which says in particular that the rank of these spaces is a monotone invariant under quasi-isometric embeddings. This is no longer the case for coarse embeddings as shown by horospherical embeddings for example. However, we can show that in the absence of a Euclidean factor in the domain, the rank is monotonous under coarse embeddings.

22.27 **Sami Douba**

Title Proper CAT(0) actions of unipotent-free linear groups

Abstract We discuss the relationship between various forms of linearity and the availability of well-behaved actions on complete CAT(0) spaces for finitely generated groups.

22.33 **Chaitanya Tappu**

Title The Mapping Class Group acts continuously on the Moduli space of Marked Hyperbolic* Structures

Abstract In this talk, I will define the moduli space of marked hyperbolic structures of the first kind on any surface of negative (but not necessarily finite) Euler characteristic, with emphasis on infinite type surfaces. The natural action of the mapping class group of the surface on this marked moduli space is continuous.

22.39 **Chenxi Wu**

Title Stable length on free factor, free splitting complexes and handlebody groups

Abstract Thurston described surface maps that have the same mapping torus using a norm on H^1 and the fibered cones, and Dowdall-Kapovich-Leininger described the analogy of these concepts in the setting of train track maps on graphs. With Hyungryul Baik and Dongyurl Kim, I found bounds on the stable translation length of free factor and free splitting complexes for these train track maps and used them to find new estimates

on curve complex translation length in handlebody groups.

22.45 **Josiah Owens**

Title Subgroup Convergence in Generalized Lamplighter Groups

Abstract Each subgroup of a lamplighter group may be represented by a triple consisting of a nonnegative integer, a subgroup of the base group (of the lamplighter group), and a particular element of the base group. We consider the convergence of subgroups of a lamplighter group with respect to the Chabauty topology on the space of subgroups and consider the limit behavior of the terms in their corresponding triples.

22.51 **Chloe Avery**

Title Stable Torsion Length

Abstract This talk is a brief introduction to stable torsion length in a group, which is the stable word length with respect to the set of all torsion elements. Stable torsion length vanishes in crystallographic groups, and a linear programming algorithm computes a lower bound for stable torsion length in free products of groups. Moreover, in free products of finite abelian groups, stable torsion length is rational.