Titles and abstracts for: "Groups and Manifolds" at the University of Regensburg, September 25-29 (2017)

Oleg Bogopolski (Heinrich-Heine-Universität Düsseldorf)

Title. Verbally closed subgroups of relatively hyperbolic groups.

Abstract. Let $X = \{x_1, x_2, \dots\}$ be a countable infinite set of variables and $F(X)$ be the free group with basis X. The following notion was introduced by A.G. Myasnikov and V. Roman'kov in 2014.

Definition. A subgroup H of a group G is called *verbally closed* if for any word $w(x_1, \dots, x_n) \in F(X)$ and any element $h \in H$ the equation $w(x_1, \dots, x_n) = h$ has a solution in G if and only if it has a solution in H.

Obviously, if H is a retract of G, then H is verbally closed in G. A.G. Myasnikov and V. Roman'kov showed that verbally closed subgroups of a finitely generated free group are retracts. Furthermore they raised the following problem: Prove that verbally closed subgroups of a torsion-free hyperbolic group are retracts.

Our main result is the following theorem.

Theorem. Suppose that a finitely presented group G is hyperbolic relative to a collection of subgroups $\{P_\lambda \mid \lambda \in \Lambda\}$. Let H be a non-elementary finitely generated subgroup of G, which contains a loxodromic element and does not normalize a nontrivial finite subgroup of G. If H is verbally closed in G, then H is a retract of G.

Corollary. Suppose that a torsion-free finitely presented group G is hyperbolic relative to a collection of subgroups $\{P_\lambda \mid \lambda \in \Lambda\}$. Let H be a finitely generated subgroup of G containing a loxodromic element. If H is verbally closed in G, then H is a retract of G.

This is a joint work with Denis Osin.

Michel Boileau (Aix Marseille Université)

Title. On the Tits alternative for 3-dimensional Poincar duality groups.

Abstract. We will discuss some properties of PD(3) groups and give a necessary and sufficient condition for a coherent PD(3) group to contain a non abelian free group. We will also discuss when the profinite completion of a PD(3) group is infinite and some related properties. This is a joint work with Steve Boyer.

Michelle Bucher (Université de Genève)

Title. Vanishing simplicial volume for certain affine manifolds.

Abstract. Abstract: Affine manifolds, i.e. manifolds which admit charts given by affine transformations, remain mysterious by the very few explicit examples and their famous open conjectures: the Auslander Conjecture, the Chern Conjecture and the Markus Conjecture. After reviewing the current state of knowledge on these conjectures, I will present an intermediate conjecture, somehow between the Auslander Conjecture and the Chern Conjecture, involving the simplicial volume, a topological invariant of manifolds introduced by Gromov in the beginning of the 80s. In a joint work with Chris Connell and Jean-Franois Lafont, we prove the latter intermediate conjecture under some hypothesis, thus providing further evidence for the veracity of the Auslander and Chern Conjectures.

Roberto Frigerio (Università di Pisa)

Title. Ergodic theory and integral approximations of Gromov's simplicial volume.

Abstract. The simplicial volume is a homotopy invariant of closed manifolds defined by Gromov in 1982. For a manifold M, it is bounded from above by the minimal number of top-dimensional simplices in a triangulation of M, and roughly speaking it measures the minimal size of triangulations of M "with real coefficients". A long-standing conjecture by Gromov asserts that, for aspherical manifolds, the vanishing of the simplicial volume implies the vanishing of the Euler characteristic. In this talk I describe an approach to this conjecture that makes use of integral approximations of the simplicial volume in towers of coverings, as well as of ergodic actions of the fundamental group of M on suitable probability spaces. Joint work with C. Löh, C. Pagliantini and R. Sauer.

Alexander Gaifullin (Center for Advanced Studies)

Title. Small covers of graph-associahedra and realization of cycles.

Abstract. The classical problem on realization of cycles posed by Steenrod in 1940s is the question: If any integral homology class of a topological space can be realized as a continuous image of the fundamental class of a smooth closed manifold? In 1954 Thom showed that the answer is negative but it becomes positive over rationals, i.e., any homology class becomes realizable being multiplied by certain nonzero integer.

The latter result motivates the following natural problem: Find classes C of n-dimensional manifolds that are sufficient to realize multiples of all n-dimensional homology classes, i.e., such that any n-dimensional homology class of any topological space can be realized with certain multiplicity by an image of the fundamental class of a manifold in class C. In 2008 the author showed that in every dimension n there exists a manifold M such that for the class C one can take the class of all finite-fold coverings of M. Manifolds satisfying this condition were called URC-manifolds (from 'Universal for Realization of Cycles'). In the talk we shall describe a recent construction providing new examples of URC-manifolds. Namely, for an important class of simple polytopes called graph-associahedra, we shall show that their small covers (i.e., manifolds glued in a special way out of 2^n copies of the polytope) are URC-manifolds.

Bernhard Hanke (Universität Augsburg)

Title. Γ-structures and symmetric spaces.

Abstract. Γ-structures are weak forms of multiplications on closed oriented manifolds. As shown by Hopf the rational cohomology algebras of manifolds admitting Γ-structures are free over odd degree generators. We prove that this condition is also sufficient for the existence of Γ-structures on manifolds which are nilpotent in the sense of homotopy theory. This includes homogeneous spaces with connected isotropy groups.

Passing to a more geometric perspective we show that on compact oriented Riemannian symmetric spaces with connected isotropy groups and free rational cohomology algebras the canonical products given by geodesic symmetries define Γ-structures. This extends work of Albers, Frauenfelder and Solomon on Γ-structures on Lagrangian Grassmannians.

Joint work with P. Quast.

Sebastian Hensel (Universität Bonn)

Title. Virtual homology representations of mapping class groups.

Abstract. The action of the mapping class group of a surface on the first homology of that surface is very well understood, and a valuable tool in the study of mapping class groups. Recently, it has become clear that the action of (subgroups) on the homology of finite covers of the surface carry much more delicate information, and are related to important open problems in mapping class groups. In this talk, we will survey known properties of these representations, present open questions, and in particular discuss relations to topological questions concerning extending surface homeomorphisms to 3-manifolds.

Holger Kammeyer (Karlsruhe Institute for Technology)

Title. Cyclic knot coverings and transcendental numbers.

Abstract. The asymptotic behavior of homological invariants along towers of coverings is a well studied problem for knots and 3-manifolds. As an example, the exponential growth rate of torsion in the first homology is given by the Mahler measure of the Alexander polynomial for cyclic coverings and conjecturally proportional to the hyperbolic volume if the coverings converge to the universal one. The problem can be restated in terms of a certain invariant called L^2-torsion. Considering the corresponding problem for yet another L^2-invariant, the Novikov-Shubin numbers, the rate at which certain spectral gaps are shrinking becomes relevant. We show that this rate is determined by how well some real numbers can be approximated by rational ones; which is an open problem in transcendental number theory.

Jean-Francois Lafont (Ohio State University)

Title. Aspherical products which do not support Anosov diffeomorphisms.

Abstract. We show that the product of infranilmanifolds with certain aspherical closed manifolds do not support Anosov diffeomorphisms. As a special case, we obtain that products of a nilmanifold and negatively curved manifolds of dimension at least three do not support Anosov diffeomorphisms. This is joint work with Andrey Gogolev.

Ian Leary (University of Southampton)

Title. Quasi-isometry classes of cocompact acyclic manifolds.

Abstract. Recently I constructed continuously many (isomorphism types of) groups of type FP as 'generalized Bestvina-Brady groups'. Robert Kropholler, Ignat Soroko and I have now shown that there are continuously many quasi-isometry types of the same groups. As a corollary, via Davis's trick, we construct a closed manifold with continuously many quasi-isometry classes of acyclic regular covers. I will discuss our work and some of the results we use.

Claudio Llosa Isenrich (University of Oxford)

Title. Kähler groups and subdirect products of surface groups.

Abstract. A Kähler group is a group which can be realised as fundamental group of a compact Kähler manifold. I shall begin by explaining why such groups are not arbitrary and then address Delzant-Gromov's question of which subgroups of direct products of surface groups are Kähler. We will give a new construction of Kähler subgroups of direct products of surface groups by mapping products of closed Riemann surfaces onto an elliptic curve. These groups have exotic finiteness properties. for every r at least three the construction produces Kähler groups which admit a classifying space with finite $(r-1)$-skeleton, but do not have any classifying space with finitely many r-cells. We will then explain how this construction can be generalised to higher dimensions.

Wolfgang Lück (Universität Bonn)

Title. Hyperbolic groups with spheres as boundary and a stable version of the Cannon Conjecture.

Abstract. Let G be a torsion-free hyperbolic group and let n greater or equal to 6 be an integer. We prove that G is the fundamental group of a closed aspherical manifold M if the boundary of G is homeomorphic to an $(n-1)$-dimensional sphere, and in this case M is unique up to homeomorphism. We also present a stable version of the Cannon Conjecture hyperbolic groups for 3-manifolds.

Saul Schleimer (University of Warwick)

Title. From veering triangulations to pseudo-Anosov flows.

Abstract. Veering triangulations, introduced by Agol, are a specialisation of Lackenby's taut ideal triangulations. Agol used these to study families of pseudo-Anosov mappings. Agol and Gueritaud extended work of Gueritaud to show that if N is a closed manifold, equipped with a pseudo-Anosov flow Φ without perfect fits, then N_Φ admits an associated veering triangulation. Here N_Φ is the cusped manifold obtained from N by drilling the singular orbits of Φ.

We prove a partial converse of their result. If M is a cusped manifold equipped with a veering triangulation (with a certain mild side condition) then $M(r)$ admits an associated pseudo-Anosov flow without perfect fits. Here $M(r)$ is a Dehn filling of M where the slope r avoids a finite collection of lines. This is joint work with Henry Segerman.

Kevin Schreve (University of Michigan)

Title. Action dimension and L^2-cohomology.

Abstract. The action dimension of a group G is the minimal dimension of contractible manifold that G acts on properly discontinuously. Conjecturally, if a group has nontrivial L^2 cohomology in dimension n, the action dimension of G is bounded below by $2n$. I will discuss this conjecture for graph products of fundamental groups of aspherical manifolds, and if there is time fundamental groups of complex hyperplane complements. This is joint work with Mike Davis and Giang Le.

Peter Schwer (Karlsruhe Institute for Technology)

Title. Shadows of elements in a Euclidean Coxeter group.

Abstract. We introduce shadows of elements w in a Euclidean Coxeter group as certain subset of the Coxeter complex obtained by lightning w from a certain direction. We study various shadows of elements in Coxeter groups and show that they have interesting applications. We will use them to prove Kostant-type convexity theorems for Euclidean buildings, compute dimensions of certain varieties and to bound reflection length of elements in Euclidean Coxeter groups.

Alessandro Sisto (ETH)

Title. Quasiflats in hierarchically hyperbolic spaces.

Abstract. The notion of hierarchically hyperbolic space provides a common framework to study mapping class groups, Teichmueller spaces with either the Teichmueller or the Weil-Petersson metric, CAT(0) cube complexes admitting a proper cocompact action, fundamental groups of non-geometric 3-manifolds, and other examples. I will discuss the result that any top-dimensional quasi-flat in a hierarchically hyperbolic space lies within finite Hausdorff distance from a finite union of standard orthants, a result new for both mapping class groups and cube complexes. Also, I will discuss how this can be used to reduce proving quasi-isometric rigidity results to much more manageable, (mostly) combinatorial problems that require no knowledge about the geometry of HHSs. Joint work with Jason Behrstock and Mark Hagen.

Richard Weidmann (Christian-Albrechts-Universität zu Kiel)

Title. Meridional rank versus bridge number.

Abstract. It is an old question of Cappell and Shaneson whether the meridional rank and the bridge number of a knot agree. We discuss some recent progress in this question, in particular we answer the question in the affirmative for some large classes of groups. This is joint work with Michel Boilau, Ederson Dutra and Yeonhee Jang.

Jesse Wolfson (University of California Irvine)

Title. Coincidences of homological densities, predicted by arithmetic.

Abstract. Basic questions in analytic number theory concern the density of one set in another (e.g. square-free integers in all integers). Motivated by Weil's number field/function field dictionary, we introduce a topological analogue measuring the homological density of one space in another. In arithmetic, Euler products can be used to show that many seemingly different densities coincide in the limit. By combining methods from manifold topology and algebraic combinatorics, we discover analogous coincidences for limiting homological densities arising from spaces of 0-cycles (e.g. configuration spaces of points) on smooth manifolds and complex varieties. We do not yet understand why these topological coincidences occur. This is joint work with Benson Farb and Melanie Wood.

Daniel Woodhouse (Technion)

Title. Determining Commensurability of Simple Surface Amalgams Via a Common Model Geometry.

Abstract. A model geometry for a finitely generated group is a proper geodesic metric space on which the group acts properly and cocompactly. If two groups have a common model geometry, the Milnor-Schwarz Lemma tells us that the groups are quasiisometric. In contrast, two quasi-isometric groups do not, in general, have a common model geometry.

A simple surface amalgam is obtained by taking a finite collection of compact surfaces, each with a single boundary component, and gluing them together by identifying their boundary curves. We consider the fundamental groups of such spaces and show that commensurability is determined by having a common model geometry. This gives a relatively simple family of groups that are quasi-isometric, but are neither commensurable, nor act on the same common model geometry.

This work is joint with Emily Stark.