MANIFOLDS AND GROUPS IN BOLOGNA, II

Main Speakers

Monika Kudlinska (University of Oxford)

Title: Fibering in manifolds and groups

Abstract: A group is said to fiber algebraically if it admits a homomorphism onto the infinite cyclic group with finitely generated kernel. Recently, Kielak generalised the work of Agol to show that algebraic fibering is detected by the vanishing of L2-homology in groups which satisfy the so-called RFRS condition. The main focus of this talk is to discuss interesting consequences of admitting algebraic fibrations for groups, with applications ranging from finding exotic subgroups of hyperbolic groups, to analysing the geometry of groups whose (co)homology satisfies a Poincaré–Lefschetz duality.

Kevin Li (University of Regensburg)

Title: Vanishing of torsion homology growth

Abstract: For a residually finite group, we consider the growth of torsion in group homology along a residual chain. It is the analogue of ℓ^2-Betti numbers for torsion. We establish a vanishing criterion that has good inheritance properties. Ongoing work with Clara Löh, Marco Moraschini, Roman Sauer, and Matthias Uschold.

Maria Beatrice Pozzetti (University of Heidelberg)

Title: What are higher rank Teichmüller theories?

Abstract: Classical Teichmüller theory can be understood as the study of a connected component in the variety parametrising rapresentations from the fundamental group of a topological surface of genus at least 2 in the group $\mathrm{PSL}_2(\mathbb{R})$ of isometries of the hyperbolic space. I will discuss joint work with Beyrer-Guichard-Labourie-Wienhard in which we develop a similar theory for some Lie groups G other than $\mathrm{PSL}_2(\mathbb{R})$.

George Raptis (University of Regensburg)

Title: Simplicial homotopy theory and bounded cohomology

Abstract: Simplicial sets offer a convenient common framework for the bounded cohomology of topological spaces and of groups. I will revisit and discuss several aspects of bounded cohomology in the context of simplicial sets, focusing on its interactions with simplicial homotopy theory and the comparison with usual cohomology. This is partly based on joint work with K. Li and M. Moraschini.

Davide Spriano (University of Oxford)

Title: Curve graphs for CAT(0) spaces

Abstract: The curve graph of a surface is a combinatorial object that encodes geometric property of a surface and it is a key ingredient in linking geometric properties and algebraic properties in low-dimensional topology. In this talk I will present an analogue of the curve graph for the class of CAT(0) spaces, and discuss some developments. This is joint work with Harry Petyt and Abdul Zalloum.

Paula Truöl (MPIM Bonn)

Title: 3-braid knots with maximal topological 4-genus

Abstract: In a joint work with S. Baader, L. Lewark and F. Misev, we classify 3-braid knots whose topological 4-genus coincides with their Seifert genus using McCoy's (un)twisting method and the Xu normal form. We also give upper bounds on the topological 4-genus of positive and strongly quasipositive 3-braid knots. In the talk, we will define the relevant terms and provide some context for our results.

Junior Speakers

Giuseppe Bargagnati (University of Pisa)

Title: Action of mapping class groups on de Rham quasimorphisms

Abstract: The group of automorphisms of a group acts naturally on the space of quasimorphisms by precomposition. In 2023, Fournier-Facio and Wade proved that for a large class of groups there exists an infinite- dimensional space of quasimorphisms invariant for this action. Since their construction is non-explicit, it makes sense to ask whether some interesting subspaces of quasimorphisms admit or not fixed points for the action above. We will focus our attention on de Rham quasimorphisms, which were introduced by Barge and Ghys in the 80s. In this case, the (outer) automorphisms coincide with the (extended) mapping class group. We will prove that there are no non-trivial subspaces of de Rham quasimorphisms which are invariant for this action.

Pietro Capovilla (SNS Pisa)

Title: Simplicial volume and glueings

Abstract: Simplicial volume is a homotopy invariant of manifolds introduced by Gromov to study their metric and rigidity properties. As every good notion of volume, we would expect it to behave nicely with respect to glueings. Unfortunately, this is not always the case. I will discuss under which conditions on the glueing the simplicial volume is additive, with a particular interest for aspherical manifolds.

Paolo Cavicchioli (University of Bologna)

Title: Equivalence of plats in handlebodies

Abstract: This seminar elucidates the equivalence between links in handlebodies, depicted by plat closed mixed braids. We introduce an algorithm detailing the braiding process and explore the Hilden subgroup of the mixed braid group. Additionally, a concise overview of the proof of the result will be provided.

Jacopo Guoyi Chen (SNS of Pisa)

Title: Computing the twisted L^2-Euler characteristic

Abstract: The *twisted L^2-Euler characteristic* is a homotopy invariant of CW complexes introduced in a 2018 article by Friedl and Lück. Since the invariant agrees with the Thurston norm on a large class of 3-manifolds, it appears quite promising for the study of fibrations over the circle in more general spaces, especially higher dimensional manifolds. We present an algorithm that computes the twisted L^2-Euler characteristic, employing Oki's *matrix expansion algorithm* to indirectly evaluate the Dieudonné determinant of certain matrices. The algorithm needs to run for an extremely long time to certify its outputs, but a truncated, human-assisted version produces very good results in many cases, including hyperbolic link complements, closed census 3-manifolds, free-by-cyclic groups, and higher-dimensional examples, such as the fiber of the Ratcliffe-Tschantz 5-manifold.

Gemma Di Petrillo (University of Trento)

Title: Quaternions and isometries of the hyperbolic 5-space.

Abstract: It is a well-known fact that the group of orientation-preserving isometries of the hyperbolic n-space is isomorphic to the matrix group $SO^+(n,1)$. When $n = 2$ and $n = 3$, these groups have a "friendlier" description as the 2×2 matrix groups $PSL(2,\mathbb{R})$ and $PSL(2,\mathbb{C})$. By identifying $\mathbb{R}^4$ with the quaternion algebra H, we will see that something similar happens in the $n = 5$ case: more precisely, we will show that $SO^+(5,1)$ is isomorphic to $PSL(2,\mathbb{H})$ - the space of 2×2 quaternionic matrices with Dieudonné determinant equal to 1. At the end of the talk, I will give an idea on how these results can be applied to try and understand

deformations of complete hyperbolic 3-manifolds (with finite volume) in the 5-dimensional hyperbolic space. This is based on a joint work with Bruno Martelli.

Martina Jørgensen (ETH Zurich)

Title: A combinatorial higher rank hyperbolicity condition

Abstract: We introduce the notions of asymptotic rank and injective hulls before investigating a coarse version of Dress' $2(n+1)$-inequality characterising metric spaces of combinatorial dimension at most n. This condition, referred to as (n, δ)-hyperbolicity, reduces to Gromov's quadruple definition of δ-hyperbolicity for $n = 1$. The ℓ^∞ product of n δ-hyperbolic spaces is (n, δ)-hyperbolic and, without further assumptions, any (n, δ)-hyperbolic space admits a slim $(n + 1)$-simplex property analogous to the slimness of quasi-geodesic triangles in Gromov hyperbolic spaces. Using tools from recent developments in geometric group theory, we look at some examples related to symmetric spaces of non-compact type and Helly groups. Joint work with Urs Lang.

Giorgio Mangioni (Heriot-Watt University)

Title: Rigidity properties of (random quotients of) mapping class groups

Abstract: A theorem of Ivanov states that the mapping class group of a finite-type surface is also the automorphism group of a simplicial complex associated to the surface, the complex of curves. In other words, any automorphism of the complex of curves is somewhat "rigid", since it can only come from a homeomorphism of the surface. This fact, which is the starting point of the geometric group theory of mapping class groups, can then be used to prove other "rigidity" results, such as that every quasi-isometry is within finite Hausdorff distance from the multiplication by some group element, and that every group automorphism is inner.

In this talk, we first review the literature on the above results, giving a sketch of how one can see them as "corollaries" of Ivanov's theorem. Then we show that, assuming a forthcoming result of Abbott-Berlyne-Ng-Rasmussen, the same type of properties are enjoyed by random quotients of mapping class groups.

Alice Merz (University of Pisa)

Title: The Alexander and Markov theorems for links with symmetries

Abstract: The Alexander theorem (1923) and the Markov theorem (1936) are two classical results in knot theory that show respectively that every link can be represented as the closure of a braid and that braids that have the same clo- sure are related by a finite number of simple operations, namely conjugation and (de-)stabilization. In this talk we will construct an equivariant closure operator that takes in input two braids with a particular symmetry, called palindromic braids, and outputs a link that is preserved by an involution. Links with such symmetry are called strongly involutive, and when we restrict ourselves to knots they form a well-studied class of knots, called strongly invertible. We will hence give analogues of the Alexander and Markov theorems for the equivariant closure operator. In fact we will show that every strongly involutive link is the equivariant closure of two palindromic braids, drawing a parallel to the Alexander theorem. Moreover, we will see that any two pairs of palin- dromic braids yielding the same strongly involutive link are related by some operations akin to conjugation and (de-)stabilization.

Edoardo Rizzi (SNS of Pisa)

Title: Some cusp-transitive hyperbolic 4-manifolds

Abstract: We realize 4 of the 6 closed orientable flat 3-manifolds as a cusp section of an orientable finite-volume hyperbolic 4-manifold whose symmetry group acts transitively on the set of cusps.

Anna Roig Sanchis (Sorbonne University)

Title: On the length spectrum of random hyperbolic 3-manifolds

Abstract: We are interested in studying the behaviour of geometric invariants of hyperbolic 3-manifolds, such as the length of their geodesics. A way to do so is by using probabilistic methods. That is, we consider a set of hyperbolic manifolds, put a probability measure on it, and ask what is the probability that a random manifold has a certain property. There are several models of construction of random manifolds. In this talk, I will explain one of the principal probabilistic models for 3 dimensions and I will present a result concerning the length spectrum -the set of lengths of all closed geodesics- of a 3-manifold constructed under this model.

Matthias Uschold (University of Regensburg)

Title: Torsion homology growth and cheap rebuilding of inner-amenable groups

Abstract: Inner-amenability is a weak form of amenability, which is satisfied e.g. by products where one factor is infinite amenable. Some properties of amenable groups extend to inner-amenable groups, e.g. the vanishing of the first ℓ^2-Betti number. In this talk, we will treat logarithmic torsion homology growth. One tool for showing vanishing of this invariant is the cheap rebuilding property of Abért, Bergeron, Frączyk and Gaboriau. Certain inner-amenable groups have this property in degree one, thus extending vanishing results that were already known for amenable groups.