

MANIFOLDS AND GROUPS IN BOLOGNA, III

Main Speakers

NAOMI ANDREW (UNIVERSITY OF OXFORD)

Title: Two Generator Subgroups of Free-by-Cyclic groups

Abstract: In general, it is hard to characterise all subgroups of a given group - even hyperbolic groups still have many mysteries here. However, restricting the complexity in some way can make the problem tractable: subgroups of free groups, or of surface groups are not so bad, and cyclic subgroups don't cause too many problems. Two generators is a lot more than one, but progress can still be made: in 1979, Jaco and Shalen characterised the two-generator subgroups of fundamental groups of certain orientable three manifolds.

I will talk about work with Edgar Bering, Ilya Kapovich and Stefano Vidussi characterising the two-generator subgroups of mapping tori of free groups, using ideas from Feighn and Handel's proof of coherence for these groups.

MACARENA ARENAS (UNIVERSITY OF CAMBRIDGE)

Title: Curve surgeries and shortest geodesics

Abstract: In this talk we will discuss the connection between combinatorial properties of minimally self-intersecting curves on a surface S and the geometric behaviour of geodesics on S when S is endowed with a Riemannian metric. In particular, we will explain the interplay between a smoothing, which is a type of surgery on a curve that resolves a self-intersection, and k -systoles, which are shortest geodesics having at least k self-intersections, and we will present some results that partially elucidate this interplay.

CARLO COLLARI (UNIVERSITY OF PISA)

Title: Groebner methods and graph homologies

Abstract: In this talk we show how to apply the framework developed by Sam and Snowden to study structural properties (e.g. bound on rank and order of torsion) of graph homologies, in the spirit of Ramos, Miyata and Proudfoot. In particular, we focus on magnitude homology for graphs, which was introduced by Hepworth and Willerton.

The talk is organized as follows; we start with a short introduction to modules over categories and to the theory of Groebner categories. Then, we introduce magnitude homology and see some examples. Finally, we will see how to use the theory of Groebner categories to obtain information on magnitude (co)homology. Time permitting I will also describe how to extend some of the results presented to other graph homology theories.

This talk is based on joint work with Luigi Caputi and Eric Ramos.

JAMES FARRE (MPI MIS, LEIPZIG)

Title: Horocycles, Lipschitz maps, and laminations

Abstract: The geodesic flow on the unit tangent bundle of a hyperbolic surface is a prototypical example of an Anosov flow, exhibiting rich, structurally stable dynamics. While invariant measures and closed sets for the geodesic flow can be quite complicated, the closely related horocycle flow exhibits striking rigidity. For example, on a closed surface, every horocycle is dense and equidistributed in its unit tangent bundle; this is very far from being true for geodesics.

Despite this rigidity, the behavior of horocycles remains mysterious in the setting of hyperbolic surfaces with infinite topology. In this talk, I will explore the dynamics of horocyclic trajectories for a particular class of infinite-area regular covers of closed hyperbolic surfaces. Surprisingly, these trajectories are intimately connected to an exceptional set for the geodesic flow: the distance-minimizing geodesic lamination. Both objects arise naturally in a geometric optimization problem: what does an optimal Lipschitz map to the circle in a given homotopy class look like? This is joint work with Or Landesberg and Yair Minsky.

MITUL ISLAM (MPI MIS, LEIPZIG)

Title: Divergence in the Hitchin component

Abstract: The SL_3 Hitchin component is a moduli space of deformations of Fuchsian groups inside $SL_3(\mathbb{R})$. This is an example of a higher rank Teichmüller space and can be seen from several perspectives - analytic, algebraic, or dynamical. For each of these points of view, there is a natural notion of "divergence to infinity". In this talk, we will discuss the relationships between these notions of divergence and show that they are often incompatible. This is work in progress with Beibei Liu and Giuseppe Martone.

STAVROULA MAKRI (INSTITUT DÉ MATHÉMATIQUES DE TOULOUSE)

Title: On sections of configurations of points on orientable surfaces

Abstract: In this talk, we will examine the configuration space of distinct, unordered points on compact orientable surfaces of genus g , denoted S_g . Specifically, we will focus on the section problem, which concerns the addition of n distinct points to an existing configuration of m distinct points on S_g , ensuring that the new points vary continuously with respect to the initial configuration. This problem is equivalent to the splitting problem in surface braid groups. We will present the results we have obtained by approaching the problem using tools from braid group theory, as well as by approaching the problem geometrically using the theory of Jenkins-Strebel differentials.

LORENZO RUFFONI (BINGHAMTON UNIVERSITY)

Title: A Singer conjecture for right-angled Coxeter groups with nerve a surface

Abstract: A 3-pseudomanifold is a cell complex that looks like a 3-manifold, but with some vertices whose links are surfaces of positive genus instead of 2-spheres. Examples arise from right-angled Coxeter groups (RACGs) with nerve a triangulation of a surface, and also occur inside certain closed aspherical 4-manifolds. We will discuss how to compute the L^2 homology for a class of negatively curved 3-pseudomanifolds. As an application, we address a conjecture of Davis-Okun about the aforementioned RACGs and also obtain that they are virtually algebraically fibered and incoherent. This is joint work with G. Walsh.

Divergence in the Hitchin component

MATTHIAS USCHOLD (UNIVERSITY OF REGENSBURG)

Title: A dynamical upper bound to logarithmic torsion homology growth

Abstract: We introduce an invariant of dynamical systems (i.e. a group acting on a probability measure space). When considering the dynamical system given by the profinite completion, this invariant is an upper bound to logarithmic torsion homology growth. I will explain why this dynamical viewpoint can be beneficial and explain the main ideas of a result that this invariant behaves indeed in a "dynamical" way. This is based on ongoing joint work with K. Li, C. Löh, M. Moraschini and R. Sauer.

Junior Speakers

SOFIA AMONTOVA (UNIVERSITY OF GENEVA)

Title: On invariants of representations for complex hyperbolic lattices

Abstract: Numerical invariants for representations of complex hyperbolic lattices Abstract. Consider the representations $\text{Hom}(\pi_1(M), G)$ for M some manifold and G an interesting Lie group. An approach for a classification of these was kickstarted by Goldman in the 80s leading to the emergence of higher Teichmüller theory, nowadays an actively growing field. This motivates to study the nature of numerical invariants of representations in such a context. As such, whenever M is a compact manifold, one may consider characteristic numbers associated to representations and classically those take integral values. We focus on the case when M is a non-compact complex hyperbolic manifold of finite volume with cusps. In this context, we consider the Euler number and Degree of representations, that can also be understood as renormalizations of volumes and Toledo invariants respectively. The goal of this talk is to define these invariants and answer the respective integrality questions; joint work with Michelle Bucher.

VALENTINA BAIS (SISSA)

Title: Some examples of small irreducible exotic 4-manifolds with free abelian fundamental group

Abstract: In a joint work with Rafael Torres and Daniele Zuddas, we pin down the homeomorphism type of some closed oriented 4-manifolds with free abelian fundamental group. Such examples come in infinite families and are produced via torus-surgery-based constructions from some closed non-simply-connected 4-manifolds with small Euler characteristics appearing in the work of Akhmedov-Park, Baldridge-Kirk and Torres. The diffeomorphism types are distinguished by the Seiberg-Witten invariants and any two homeomorphic 4-manifolds in these collections become diffeomorphic after connected summing with a single copy of a product of two 2-spheres. In this talk, I will explain the notion of equivariant intersection form of a closed oriented 4-manifolds and I will sketch the main ideas beyond the computation of this invariant for the examples in our main result. This algebraic tool is indeed the main ingredient for understanding the homeomorphism type of closed oriented 4-manifolds with fundamental group \mathbb{Z} and \mathbb{Z}^2 , as implied by classification results by Freedman-Quinn, Stong-Wang and Hambleton-Kreck-Teichner.

FILIPPO BIANCHI (UNIVERSITY OF PISA)

Title: Spin mapping class groups and 4-manifolds

Abstract: Some 4-manifolds - those that admit Lefschetz fibrations - can be represented by positive relators in the mapping class group of a surface. Generalizing this idea, it is possible to represent any closed, smooth, orientable 4-manifold; in this talk, I will focus on the spin case. As an application, I will sketch a proof of a classical result of Rokhlin on the signature of spin 4-manifolds.

ELENA BOGLIOLO (UNIVERSITY OF PISA)

Title: Bounded cohomology of some groups acting on trees

Abstract: We present a family of groups acting on a regular tree defined by prescribing the local action almost everywhere. Since their introduction by Le Boudec, these groups have provided valuable examples for addressing various group-theoretic questions. In this talk, we prove a condition for the vanishing of their continuous bounded cohomology. Moreover, we show that when this condition is not satisfied, the continuous bounded cohomology in degree two is infinite-dimensional.

ALBERTO CASALI (UNIVERSITY OF PISA)

Title: Topological volumes and complete affine manifolds

Abstract: Affine manifolds are manifolds that admit an atlas with locally affine transition functions. A long-standing conjecture by Chern predicts the vanishing of the Euler characteristic for closed affine manifolds. For these manifolds the Euler characteristic is dominated by the simplicial volume, leading Bucher—Connell—Lafont to ask whether the simplicial volume of closed affine manifolds vanishes. In turn, the simplicial volume of a closed manifold is always dominated by its minimal volume entropy. In this talk we will review the properties of these invariants and we will show that for certain complete affine manifolds both the simplicial volume and the minimal volume entropy vanish. Our result also answers a question by Lück on the simplicial volume of aspherical manifolds in this setting. This is based on a joint work with Marco Moraschini.

BRUNO DULAR (UNIVERSITY OF LUXEMBOURG)

Title: Rigidity of hyperbolic three-manifolds with respect to their bending lamination

Abstract: Unlike surfaces, a closed hyperbolic three-manifold has a unique hyperbolic structure. Non-closed hyperbolic three-manifolds, however, have a large deformation space of hyperbolic structures. By the simultaneous uniformization theorem, such structures are entirely parametrized by “data at infinity”, which is a conformal structure on the ideal boundary. Thurston conjectured that they are also parametrized by data which is internal to the manifold: the measure of the bending of the boundary of its convex core. I will present joint work with Jean-Marc Schlenker, in which we prove this conjecture in the “generic case, i.e. the case of convex-cocompact hyperbolic three-manifolds. This results in a more geometric parametrization of their deformation space.

FRANZISKA HOFMANN (UNIVERSITY OF REGENSBURG)

Title: Products and normed chain complexes

Abstract: Let R be a normed ring. Then the ℓ^1 -norm on the singular chain complex with R -coefficients given by the basis of singular simplices induces a semi-norm on singular homology. In this talk, we discuss why the semi-norm of products of classes in singular homology is expected to behave differently over \mathbb{Z} than over \mathbb{R} . This is based on results on the norm on the homology of the tensor product of normed chain complexes. Ongoing work with Clara Löh.