

GEOMETRY OF GROUPS AND 3-MANIFOLDS:
STATE OF THE ART AND PERSPECTIVES

CIRM, LUMINY, 19 - 23 FEBRUARY, 2018

Abstracts

Tarik Aougab

Thermodynamic metrics for moduli of graphs

Abstract: We explore two Riemannian metrics on moduli spaces of metric graphs. The motivation for each is that the definition is analogous to a characterization of the Weil-Petersson metric on the classical moduli space of curves. We show that for any graph, each metric is incomplete, extending and generalizing work of Policott–Sharp and Kao. For any rose in one of these two metrics, we completely characterize the metric completion: it resembles the Deligne–Mumford completion of the classical moduli space.

This represents work in progress with Matt Clay and Yo’av Rieck.

Javier Aramayona

The first integral cohomology of pure mapping class groups

Abstract: We will start by recalling the proof of a classical result of Powell, which asserts that mapping class groups of finite-type surfaces of genus at least three have trivial abelianization. In stark contrast, we will show that this is no longer the case if the surface is allowed to have infinite type; more concretely, we will explain how to construct non-trivial integer-valued homomorphisms from mapping class groups of infinite-genus surfaces. Further, we will give a description the first integral cohomology group of pure mapping class groups in terms of the first homology of the underlying surface.

This is joint work with Priyam Patel and Nick Vlamis.

Hyungryul Baik

Asymptotic translation length in curve complexes

Abstract: We study asymptotic translation length in curve complexes of the pseudo-Anosov monodromies of primitive elements in Thurston’s fibered cone. We also discuss the minimal asymptotic translation length of pure brain groups and pure mapping class groups.

This talk represents joint work with Hyunshik Shin and Chenxi Wu.

Florent Balacheff

Systolic geometry and simplicial complexity for groups

Abstract: Twenty years ago Gromov asked about how large is the set of isomorphism classes of groups whose systolic area is bounded from above. Introducing a new combinatorial invariant for finitely presentable groups called simplicial complexity we obtain a quite satisfactory answer to his question.

This is joint work with I. Babenko and G. Bulteau.

Pierre-Emmanuel Caprace***Lattices in products of trees and commensurators of free groups***

Abstract: The study of lattices in products of trees was pioneered by D. Wise, and Burger-Mozes in the late 1990's. Their seminal works revealed that the class of finitely generated groups admitting a Cayley graph that is isomorphic to the Cartesian product of two trees is very rich: it contains not only products of virtually free groups, but also certain S-arithmetic groups and some finitely presented virtually simple groups, among many others. The goal of this talk is to overview this fascinating subject, emphasizing some key open problems. I will also present recent advances relying on the Classification of the Finite Simple Groups, and a connection to a question by Lubotzky-Mozes-Zimmer on commensurators of free groups.

Victor Chepoi***Helly graphs: local-to-global characterization, bicombing, and examples***

Abstract: In this talk, we will provide a local-to-global characterization of Helly graphs as graphs in which the clique complex is simply connected and the set of maximal cliques satisfies the Helly property. As a second result, we will show that Helly groups (i.e., groups acting geometrically on Helly graphs) are biautomatic.

We will consider several examples of cell complexes which under local operations lead to Helly graphs and groups. From Lang's (2013) results follows that hyperbolic groups are Helly. By a folklore result, thickenings of CAT(0) cube complexes are also Helly, thus cubulable groups are Helly. We will extend this result by showing that thickenings of swm-graphs with respect to their dual polar subgraphs are Helly. Other examples of Helly groups are C(4)-T(4) graphical small cancellation groups and 7-systolic groups.

Helly graphs are the discrete analogs of injective metric spaces. Analogously to the cubulation that associates to any wall system a CAT(0) cube complex, to any metric space one can associate its injective hull, i.e., the smallest injective metric space into which the first space embeds (Isbell, 1964 and Dress, 1984).

The talk is based on a joint work with J. Chalopin, D. Osajda, and H. Hirai, **Weakly modular graphs and nonpositive curvature**, *Memoirs of AMS* (to appear) and on ongoing work of the same set of authors and A. Genevois.

Stefan Friedl***Exceptional 3-manifolds***

Abstract: We say a manifold M is exceptional if for any n all degree n covers of M are homeomorphic. For example closed surfaces and all tori are exceptional. We classify exceptional 3-manifolds.

This is based on joint work with Jungwhan Park, Bram Petri and Aru Ray.

Anthony Genevois***Quasi-median graphs and group theory***

Abstract: The goal of this talk is to give an overview of the applications of quasi-median graphs, a class of graphs generalising CAT(0) cube complexes, to geometric group theory. Groups which will be considered include graph products, some lamplighter groups, and Thompson's groups.

Mark Hagen

Panel collapse

Abstract: Various interesting statements in geometric group theory boil down to promoting an action of a group G on a $CAT(0)$ cube complex to an action on a tree (or, at least, a simpler $CAT(0)$ cube complex). These include: Stallings's theorem on ends of groups, the Nielsen realisation theorem for finite subgroups of $Out(F_n)$, and the Kropholler conjecture. I will describe a procedure for passing from an action of a group G on a $CAT(0)$ cube complex to a "lower-complexity" such action under a condition on the hyperplane-stabilisers satisfied in the above three situations. From this, one can recover the first two theorems and some special cases of the Kropholler conjecture. Time permitting, I will discuss possible future applications to the Nielsen realisation problem for automorphisms of right-angled Artin groups. Most of this talk is on joint work with Nicholas Touikan; some joint work with Henry Wilton will also be mentioned.

Camille Horbez

Automorphisms of hyperbolic groups and growth

Abstract: Let G be a torsion-free hyperbolic group, let S be a finite generating set of G , and let f be an automorphism of G . We want to understand the possible growth types for the word length of $f^n(g)$, where g is an element of G . Growth was completely described by Thurston when G is the fundamental group of a hyperbolic surface, and can be understood from Bestvina-Handel's work on train-tracks when G is a free group. We address the general case of a torsion-free hyperbolic group G ; we show that every element in G has a well-defined exponential growth rate under iteration of f , and that only finitely many exponential growth rates arise as g varies in G . In addition, we show the following dichotomy: every element of G grows either exponentially fast or polynomially fast under iteration of f .

This is a joint work with Rémi Coulon, Arnaud Hilion and Gilbert Levitt.

Alessandra Iozzi

Complex groups, 3-manifolds and volumes

Abstract: Let M be a 3-manifold. A finite volume hyperbolization corresponds to a lattice injection of the fundamental group of M into $SL(2, \mathbb{C})$ and we can think of the volume of the manifold as an invariant of this injection. We extend this invariant to arbitrary representations of the fundamental group of M into $SL(n, \mathbb{C})$ and we characterize the representations that correspond to its maximal value. While the invariant has been previously considered in an ad hoc way by various authors using ideal triangulations of the manifold, our definition of the invariant depends of the study of the bounded cohomology of $SL(n, \mathbb{C})$ in degree three. We will illustrate recent progress towards the study of representations of 3-manifold groups into complex groups.

Cyril Lecuire

Quasi-isometric rigidity of 3-manifold groups

Abstract: We will discuss the quasi-isometric rigidity of 3-manifold groups: A finitely generated group that roughly (when viewed from far away) looks like the fundamental group of a compact 3-manifold contains a finite index subgroup isomorphic to the fundamental group of a compact 3-manifold.

This a joint work with Peter Haissinsky.

Ken'ishi Ohshika***Discontinuous motions of Cannon-Thurston maps***

Abstract: In his survey article in the Bulletin of the AMS, Thurston asked if the Cannon-Thurston maps move continuously (either uniformly or pointwise) in the deformation spaces of Kleinian surface groups. In this talk, I shall present a criterion for Cannon-Thurston maps to move pointwise discontinuously, and show at which points the continuity of motions breaks down. This is joint work with Mahan Mj.

Constantin Vernicos***On Hilbert's geometry***

Abstract: To be clarified

Genevieve Walsh***Planar boundaries of relatively hyperbolic groups***

Abstract: We give some interesting examples of relatively hyperbolic groups with planar Bowditch boundary. When the Bowditch boundary is S^2 , we prove an analog of a result of Bestvina and Mess. A group pair (G, \mathcal{P}) has S^2 Bowditch boundary exactly when it is a Poincaré duality pair. This talk is based on joint work with Bena Tshishiku and also on joint work with Chris Hruska.

Richard Weidmann***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 answer this question in the affirmative for some new classes of knots.

This is joint work with Michel Boileau, Ederson Dutra and Yeonhee Jang.
