Conference on Geometric Group Theory

Peking University, Beijing, China
July 16-20, 2018

Supported by
Beijing International Center for Mathematical Research(BICMR)

Speakers:

Rémi Coulon (Université de Rennes 1)
Matthew Durham (University of California, Riverside)
Jonah Gaster (McGill University)
Ilya Gekhtman (University of Toronto)
Jinsong Liu (AMSS)
Yi Liu (Peking University)
Jiming Ma (Fudan University)
Katsuhiko Matsuzaki (Waseda University)
Frédéric Paulin (Paris-Sud Orsay)
Leonid Potyagailo (Université de Lille 1)
Yulan Qing (University of Toronto)
Kasra Rafi (University of Toronto)
Lawrence Reeves (University of Melbourne)
Weixu Su (Fudan University)
Zhe Sun (Tsinghua University)
Ryokichi Tanaka (Tohoku University)
Yunhui Wu (Tsinghua University)
Xiangdong Xie (Bowling Green State University)

Organization Committee:

Xiang Fu (BICMR)
Lawrence Reeves (University of Melbourne)
Wenyuan Yang (BICMR)

Conference on Geometric Group Theory

Schedule

Time	Monday July 16	Tuesday July 17	Wednesday July 18	Thursday July 19	Friday July 20
9:00-9:30	**Registration**				
9:30-10:20	**Kasra Rafi**	**Leonid Potyagailo**	**Frédéric Paulin**	**Xiangdong Xie**	**Lawrence Reeves**
10:20-10:50	Break	Break	Break Conference photo	Break	Break
10:50-11:40	**Jinsong Liu**	**Ryokichi Tanaka**	**Yulan Qing**	**Rémi Coulon**	**Weixu Su**
11:40-15:00	Lunch	Lunch	Lunch	Lunch	Lunch
15:00-15:50	**Yunhui Wu**	**Jiming Ma**	Free Discussion	**Katsuhiko Matsuzaki**	13:30-14:20 **Yi Liu**
15:50-16:20	Break	Break		Break	Break
16:20-17:10	**Zhe Sun**	**Jonah Gaster**		**Ilya Gekhtman**	14:50-15:40 **Matthew Durham**
17:10-18:00	Free Discussion	Free Discussion		Free Discussion	End of conference
18:00	Dinner	Dinner	Conference Dinner	Dinner	

Lecture Room, Jiayibing Building, Jingchunyuan 82, BICMR (国际数学中心镜春园 82 号甲乙丙楼报告厅)

Conference venue:
Lecture Room, Jiayibing Building, Jingchunyuan 82, BICMR (镜春园82号甲乙丙楼报告厅)

Hotel:
FX Hotel ZhongGuanCun (富驿时尚酒店中关村店).
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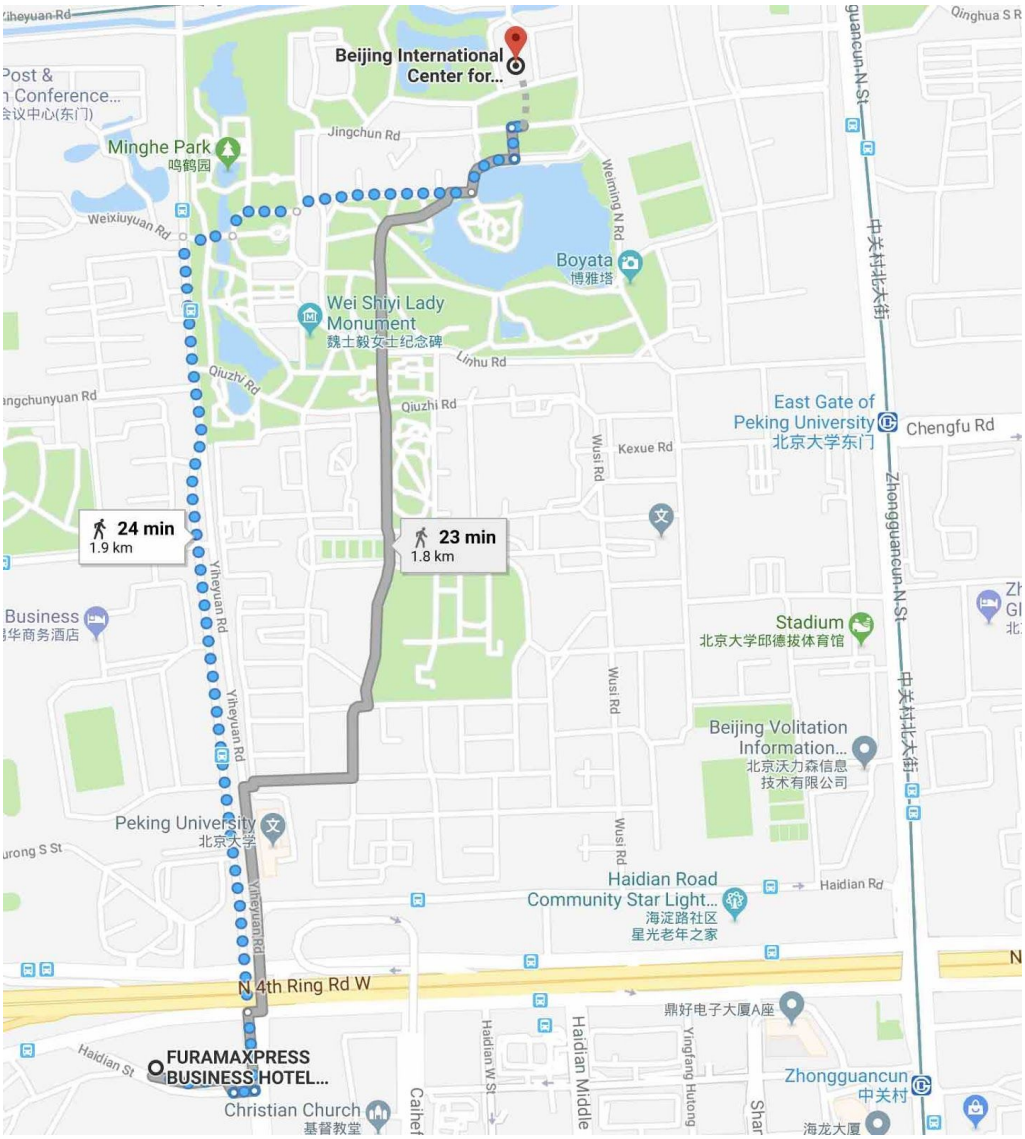

Here is some tips on how to arrive to BICMR from Airport and Railway station:
http://bicmr.pku.edu.cn/content/page/9.html

Title and abstracts:

Rémi Coulon (Université de Rennes 1, France)

Title: Growth gap in hyperbolic groups and amenability

Abstract:

(joint work with Françoise Dal'Bo and, Andrea Sambusetti / Rhiannon Dougall, Barbara Schapira and Samuel Tapie)

Given a finitely generated group G acting properly on a metric space X, the exponential growth rate of G with respect to X measures "how big" the orbits of G are. If H is a subgroup of G, its exponential growth rate is bounded above by the one of G. In this work we are interested in the following question: what can we say if H and G have the same exponential growth rate?

This problem has both a combinatorial and a geometric origin. For the combinatorial part, Grigorchuck and Cohen proved in the 80's that a group Q = F/N (written as a quotient of the free group) is amenable if and only if N and F have the same exponential growth rate (with respect to the word length). About the same time, Brooks gave a geometric interpretation of Kesten's amenability criterion in terms of the bottom of the spectrum of the Laplace operator. He obtained in this way a statement analogue to the one of Grigorchuck and Cohen for the deck automorphism group of the cover of certain compact hyperbolic manifolds. These works initiated many fruitful developments in geometry, dynamics and group theory.

We focus here on the class of groups with a certain action on a Gromov hyperbolic space and propose a framework that encompasses both the combinatorial and the geometric point of view. In particular, we prove that if G is a hyperbolic group then the growth rate of H and G coincide if and only if H is co-amenable in G. In addition if G has Kazhdan property (T) we prove that there is a gap between the growth rate of G and the one of its infinite index subgroups. This method extends to a much larger class of groups containing among others relatively hyperbolic groups with parabolic gap.

Matthew Durham (Yale University, USA)

Title: Geometrical finiteness and Veech subgroups of mapping class groups

Abstract:

I will discuss work in progress with Dowdall, Leininger, and Sisto, in which we aim to develop a notion of geometrical finiteness for subgroups of mapping class groups. Motivated by the theory of convex cocompact subgroups, which are precisely those which determine hyperbolic surface group extensions, I will describe some hyperbolic properties of the surface group extensions coming from lattice Veech subgroups.

Jonah Gaster (McGill University, Canada)

Title：Coloring curves on surfaces

Abstract:

In the context of proving that the mapping class group has finite asymptotic dimension, Bestvina-Bromberg-Fujiwara exhibited a finite coloring of the curve graph, i.e. a map from the vertices to a finite set so that vertices of distance one have distinct images. In joint work with Josh Greene and Nicholas Vlamis we give more attention to the minimum number of colors needed. We show: The separating curve graph has chromatic number coarsely equal to $g \log(g)$, and the subgraph spanned by vertices in a fixed non-zero homology class is uniquely $g-1$-colorable. Time permitting, we discuss related questions, including an intriguing relationship with the Johnson homomorphism of the Torelli group.

Ilya Gekhtman (University of Toronto, Canada)

Title: Critical exponents and invariant random subgroups in negative curvature

Abstract:

Invariant random subgroups (IRS) are conjugacy invariant probability measures on the space of subgroups in a given group G. They arise as point stabilizers of probability measure preserving actions. Invariant random subgroups can be regarded as a

generalization both of normal subgroups and of lattices. As such, it is interesting to extend results from the theories of normal subgroups and of lattices to the IRS setting.

We prove such a result: the critical exponent of an infinite IRS in an isometry group of a Gromov hyperbolic space (such as a rank 1 symmetric space, or a hyperbolic group) is almost surely greater than half the Hausdorff dimension of the boundary. If the subgroup is of divergence type, we show its critical exponent is in fact equal to the dimension of the boundary. If G has property (T) we obtain as a corollary that an IRS of divergence type must in fact be a lattice. The proof uses ergodic theorems for actions of hyperbolic groups. This is joint work with Arie Levit.

Jinsong Liu (AMSS, China)

Title: A global estimate of discrete Riemann mappings

Abstract:

In order to study low dimensional topology, W. Thurston introduced Circle Packing. And he conjectured a connection between Circle packing and the Riemann mappings. Rodin-Sullivan proved Thurston's conjecture that his scheme converges to the Riemann mapping. If the domain Ω is bounded and simply connected with smooth boundary, we will give a global estimate.

Yi Liu (Peking University, China)

Title: Virtual homological spectral radii for automorphisms of surfaces

Abstract:

A surface automorphism is an orientation-preserving self-homeomorphism of a compact orientable surface. A virtual property for a surface automorphism refers to a property which holds up to lifting to some finite covering space. It has been conjectured by C. T. McMullen that any surface automorphism of positive mapping-class entropy possesses a virtual homological eigenvalue which lies outside the unit circle of the complex plane. In this talk, I will review some background and outline a proof of the conjecture.

Jiming Ma (Fudan University, China)

Title: 3-manifold subgroups in certain topologically negatively curved 4-manifold groups

Abstract :

For any positive x large enough, it is well-known there are infinitely many closed hyperbolic 3-manifolds with volume bounded above by x. We show that for a hyperbolic group G, there are only finitely many 3-manifolds subgroups in G with volume bounded above. Moreover if G is the Coxeter group with nerve a flag-no-square triangulation of an integral homology 3-sphere, in particular G is the Coxeter group over the famous 120-cell, we also give a lower bound on the number of 3-manifolds subgroups in G of bounded volume.

Katsuhiko Matsuzaki (Waseda University, Japan)

Title: Half the critical exponent

Abstract:

In this talk, we are concerned with half the critical exponent of the Poincare series of discrete groups acting isometrically on the hyperbolic space. We consider the following two results and their generalizations.

(1) For a discrete group G of divergence type, the critical exponent δ(N) of any non-trivial normal subgroup N of G is strictly greater than half of that for G.

(2) Assume that a free group G of finite rank acts on its Cayley graph X isometrically. For any subgroup H of G, if its critical exponent δ(H) is greater than half of that for G, then the bottom of the spectrum for the discrete Laplacian on the quotient graph H\X can be given in terms of δ(H).

Frédéric Paulin (Pari

In this talk, we will give a graphical theory of integral indefinite binary Hamiltonian forms f analogous to the one by Conway for quadratic forms and the one of Bestvina-Savin for Hermitian forms. With O the ring of Hurwitz integers in Hamilton's quaternion algebra, we define the waterworld of f, analogous to Conway's river and Bestvina-Savin's ocean, and use it to give a combinatorial description of the values of f on OxO. The main tool is 5-dimensional hyperbolic geometry, and the study of its lattice of 2-by-2 invertible matrices with coefficients in O. This is joint work with Jouni Parkkonen.

Leonid Potyagailo (University of Lille, France)

Title: Martin and Floyd boundaries of finitely generated groups

Abstract:

The talk is based on two recent preprints

1. [GGPY], I. Gekhtman, V. Gerasimov, L.P. W. Yang, "Martin boundary covers Floyd boundary" (arXiv:1708.02133),

2. [DGGP], M. Dussaule, I. Gekhtman, V. Gerasimov, L.P. The Martin boundary of relatively hyperbolic groups with virtually abelian parabolic subgroups" (arXiv:1711.11307).

We study two different compactifications of finitely generated groups. One is the Martin compactification which comes from the random walks on the Cayley graph of a group equipped with a symmetric probability measure whose support generates the group. It is the Busemann (horofunction) compactification of the graph equipped with the Green distance associated to a random walk. The second compactification is the Floyd compactification which is the Cauchy completion of the Cayley graph equipped with a distance obtained by rescaling of the word distance by a suitable function. The corresponding boundaries are the remainders of the group in these compactications, they play important roles in the analytic and geometric group theory.

Our first main result from [GGPY] states that the identity map on the group extends to an equivariant and continuous map between Martin and Floyd compactications. We

also prove that the preimage of a conical point by this map is a point; the latter result implies that once the group admits a geometrically finite action on a compactum the induced map between the Martin boundary and the limit set of the action is injective outside of a countable subset of bounded parabolic points. The proofs of these results are based on our generalization of the Ancona inequality proved by A. Ancona for hyperbolic groups in 80's.

Using these results we describe in [DGGP] the Martin compactication of a relatively hyperbolic groups whose maximal parabolic subgroups are virtually abelian. In case of a nonuniform lattice acting on the real hyperbolic space, it is obtained as the closure of the space with a maximal invariant system of disjoint horoballs at parabolic fixed points removed. A topological description of the Martin boundary of relatively hyperbolic groups with respect to virtually nilpotent subgroups remains a largely open and intriguing question.

Yulan Qing (University of Toronto, Canada)

Title: Loops with Large Twist Get Short Along Quasi-geodesics in $Out(Fn)$

Abstract:

Given an element ϕ in $Out(Fn)$, we discuss what is the "generalized intersection number" associated with this element. There are several natural paths connecting the origin to ϕ in $Out(Fn)$, for example, a path associate to sequence of Stalling folds and paths induced by the shadow of standard geodesics in Outer space. We use the intersection number to show that neither of these paths is, in general, a quasi-geodesic in $Out(Fn)$.

Zhe Sun (Tsinghua University, China)

Title：Generalized McShane identity and Goncharov-Shen potential

Abstract：

(Joint work with Yi Huang) Let \hat{S}=(S,m_b) where S is a connected oriented Riemann surface of negative Euler characteristic with non-empty boundary

component/puncture and m_b belongs to the boundary of S which is finite. Goncharov and Shen introduced a family of Landau-Ginzberg partial potentials on the Fock-Goncharov A_{SL_n, \hat{S} } moduli space, where G is a semisimple Lie group and S. They used these potentials to tropicalized the moduli space to find the canonical basis in the dual side and formulate a mirror symmetry conjecture. This potential is the markoff equation for decorated Teichmuller space A_{ PSL(2,R), S_{1,1} }. We obtain a family of generalized Mcshane identities by splitting these partial potentials for the punctured case A_{PSL(n,R),S_{g,m}}(R_{>0}) and H_n(S) boundary case, A_{SL_n, \hat{S} } crowned case.

Moreover, we also find new phenomena of the triple ratio which only appear in the higher rank case, like boundedness in mapping class group orbit, Fuchsian rigidity. As applications, we find generalized collar lemmas which involve lambda_i/lambda_{i+1} length spectral, discreteness of that length spectral and higher rank Thurston metric. In general, we hope one can obtain the identities by splitting additive functions on the Gromov boundary of a hyperbolic group.

Kasra Rafi (University of Toronto, Canada)

Title: Strong Contractibility of geodesics in the mapping class group.

Abstract:

We show that the axis of a pseudo-Anosov homeomorphism in the mapping class group may not have the strong contractibility property. Specifically, we show that, after choosing a generating set carefully, one can find a pseudo-Anosov homeomorphism f, a sequence of points x_k and a sequence of radii R_k so that the ball B(x_k, R_k) is disjoint from the axis of f, but the closest point projection of B(x_k, R_k) to the axis of f has a diameter at least c log(R_k). We also show that the shadow of a geodesic in mapping class group to the curve graph does not have to be a quasi-geodesic. This is a joint work in Yvon Verberne.

Lawrence Reeves (University of Melbourne, Australia)

Title: TBA

Weixu Su (Fudan University, China)

Title: Horospheres in Teichmüller space and mapping class group

Abstract:

Horospheres in Teichmuller space are level sets of extremal length functions. We show that every diffeomorphism of Teichmuller space to itself that preserves horospheres is an element of the extended mapping class group. We relate horospheres to level sets of Busemann functions and obtain a new proof of Royden's Theorem (that the isometry group of the Teichmuller metric is the extended mapping class group). The work is jointed with Dong Tan.

Ryokichi Tanaka (Tohoku University, Japan)

Title: Dimension of harmonic measures in hyperbolic spaces

Abstract:

We show exact dimensionality of harmonic measures associated with random walks on groups acting on a hyperbolic space under finite first moment condition, and establish the dimension formula by the entropy over the drift. We also treat the case when a group acts on a non-proper hyperbolic space acylindrically. Applications of this formula include continuity of the Hausdorff dimension with respect to driving measures and Brownian motions on regular coverings of a finite volume Riemannian manifold.

Yunhui Wu (Tsinghua University, China)

Title: Geometry of complex bounded domains with finite-volume quotients

Abstract:

We first show that for a bounded pseudoconvex domain with a manifold quotient of finite-volume in the sense of Kahler-Einstein measure, the identity component of the automorphism group of this domain is semi-simple without compact factors. This

partially answers an open question in [Fra95]. Then we will discuss several applications. For examples, (1). the automorphism group of the Griffiths domain in $\C^2$ is discrete; (2). finite-volume version of Nadel-Frankel's solution for the Kahzdan conjecture, which in particular implies discreteness of the automorphism group of the Teichmuller space of Riemann surfaces that is due to Royden; and so on. This is a joint work with Kefeng Liu.

Xiangdong Xie (Bowling Green State University, USA)

Title: Rigidity of maps between nilpotent Lie groups

Abstract: In this talk I will survey some recent results on the rigidity (and non-rigidity) of quasi-isometries, biLipschitz maps and quasiconformal maps between simply connected nilpotent Lie groups. These results are motivated by the quasi-isometric classification question of simply connected nilpotent Lie groups and the rigidity question of quasi-isometries between negatively curved homogeneous manifolds.

The talk will cover the following topics.

1. Non-rigidity of quasi-isometries: I will describe examples of quasi-isometries of any simply connected nilpotent Lie group that are at infinite distance from any affine maps.

2. Rigidity of quasiconformal maps between simply connected nilpotent Lie groups:

I will survey results showing that very often quasiconformal maps between simply connected nilpotent Lie groups are biLipschitz. Conjecturally only Euclidean groups and Heisenberg groups allow non-biLipschitz quasiconformal maps.

3. Uniform quasiconformal groups: I will describe a new approach to conjugate uniform quasiconformal groups (of certain simply connected nilpotent Lie groups) into the conformal group.

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