BIRS Workshop 19w5040 on *Discrete Subgroups of Lie Groups* (December 8–13, 2019)

Monday

Jeff Danciger 9:00–9:50am

Affine actions with Hitchin linear part

Properly discontinuous actions of a surface group on $\mathbb{R}^d$ by affine transformations were shown to exist by Danciger-Gueritaud-Kassel. We show, however, that if the linear part of an affine surface group action is in the Hitchin component, then the affine action is not properly discontinuous. The key case is that of linear part in $\mathrm{SO}(n, n-1)$, so that $\mathbb{R}^d = \mathbb{R}^{n,n-1}$ is the model for flat pseudo-Riemannian geometry of signature $(n, n-1)$. Here, the translational parts determine a deformation of the linear part into $\mathrm{SO}(n, n)$ Hitchin representations and the crucial step is to show that such representations are not Anosov in $\mathrm{SL}(2n, \mathbb{R})$ with respect to the stabilizer of an n-plane. Joint with Tengren Zhang.

Giuseppe Martone 10:30–10:55am

Sequences of Hitchin representations of Tree-Type

In this talk we describe non-trivial sufficient conditions on a diverging sequence of Hitchin representations so that its limit in the Parreau boundary can be described as an action on a tree. These non-trivial conditions are given in terms of Fock-Goncharov coordinates on moduli spaces of positive tuples of flags.

Joan Porti 11:00–11:25am

Twisted Alexander polynomials and hyperbolic volume for three-manifolds

Given a hyperbolic 3-manifold with cusps, we consider the composition of a lift of its holonomy in $\mathrm{SL}(2, \mathbb{C})$ with the irreducible representation in $\mathrm{SL}(n, \mathbb{C})$, that yields a twisted Alexander polynomial $A_n(t)$, for each natural n. We prove that, for a complex number z with norm one $\log |A_n(z)|/n^2$ converges to the hyperbolic volume of the manifold divided by 4π, as $n \to \infty$. This generalizes and uses a theorem of W. Mueller for closed manifolds on analytic torsion. This is joint work with L. Bénard, J. Dubois and M. Heusener.

(*optional*)
Meet in the Corbett Hall Lounge (CH 5210) at **1:00pm**
for a one-hour **guided tour of The Banff Centre**.

(Monday afternoon talks are on the next page)

Sara Maloni 2:00–2:50pm

The geometry of quasi-Hitchin symplectic Anosov representations

In this talk we will discuss quasi-Hitchin representations in $\mathrm{Sp}(4,\mathbb{C})$, which are deformations of Fuchsian (and Hitchin) representations which remain Anosov. These representations acts on the space $\mathrm{Lag}(\mathbb{C}^4)$ of complex lagrangian grassmanian subspaces of $\mathbb{C}^4$. This theory generalises the classical and important theory of quasi-Fuchsian representations and their action on the Riemann sphere $\mathbb{C}P^1 = \mathrm{Lag}(\mathbb{C}^2)$. In the talk, after reviewing the classical theory, we will define Anosov and quasi-Hitchin representations and we will discuss their geometry. In particular, we show that the quotient of the domain of discontinuity for this action is a fiber bundle over the surface and we will describe the fiber. The projection map comes from an interesting parametrization of $\mathrm{Lag}(\mathbb{C}^4)$ as the space of regular ideal hyperbolic tetrahedra and their degenerations. (This is joint work with D. Alessandrini and A. Wienhard.)

Tengren Zhang 4:00–4:25pm

Regularity of limit curves of Anosov representations

Anosov representations are representations of a hyperbolic group to a non-compact semisimple Lie group that are "geometrically well-behaved". In the case when the target Lie group is $\mathrm{PGL}(d,\mathbb{R})$, these representations admit a limit set in $d-1$ dimensional projective space that is homeomorphic to the boundary of the group. Under some irreducibility conditions, we give necessary and sufficient conditions for when this limit set is a $C^{1,a}$ sub manifold. This is joint work with A. Zimmer.

Kostas Tsouvalas 4:30–4:55pm

Characterizing Benoist representations by limit maps

Anosov representations of word hyperbolic groups form a rich class of discrete subgroups of semisimple Lie groups, generalizing classical convex cocompact groups of real rank one Lie groups. A large class of projective Anosov representations are Benoist representations. In this talk, we are going to give a characterization of Benoist representations in terms of the existence of limit maps. This is joint work with Richard Canary.

Problem session 7:30–9:00pm

Tuesday

Andrei Rapinchuk 9:00–9:50am

Eigenvalue rigidity for Zariski-dense subgroups

Anna Felikson 10:30–10:55am

Coxeter groups, quiver mutations and hyperbolic manifolds

Mutations of quivers were introduced by Fomin and Zelevinsky in the beginning of 2000's in the context of cluster algebras. Since then, mutations appear (sometimes completely unexpectedly) in various domains of mathematics and physics. Using mutations of quivers, Barot and Marsh constructed a series of presentations of finite Coxeter groups as quotients of infinite Coxeter groups. We will discuss a generalization of this construction leading to a new invariant of bordered marked surfaces, and a geometric interpretation: it occurs that presentations constructed by Barot and Marsh give rise to a construction of geometric manifolds with large symmetry groups, in particular to some hyperbolic manifolds of small volume with proper actions of Coxeter groups. This work is joint with Pavel Tumarkin.

Suhyoung Choi 11:00–11:25am

Closed affine manifolds with partially hyperbolic linear holonomy

We will try to show that closed manifolds of negative curvature do not admit complete special affine structures whose linear parts are partially hyperbolic in the dynamical sense. Furthermore, they cannot admit complete affine structures with semi-simple P-Anosov linear holonomy groups. Finally, we will present an attempt to show that closed affine manifolds cannot have partially hyperbolic linear holonomy.

Meet in the TCPL foyer at **11:30am** to be in the **conference photo**.
It will be taken outdoors, so dress appropriately for the weather.

Chen Meiri 2:00–2:50pm

First order rigidity of higher-rank arithmetic groups

In many contexts, there is a dichotomy between lattices in Lie groups of rank one and lattices in Lie groups of higher-rank. I will talk about a manifestation of this dichotomy in Model Theory. Based on joint works with Nir Avni and Alex Lubotzky.

Igor Rapinchuk 3:30–4:20pm

Abstract homomorphisms of algebraic groups and applications

I will discuss several results on abstract homomorphisms between the groups of rational points of algebraic groups. The main focus will be on a conjecture of Borel and Tits formulated in their landmark 1973 paper. Our results settle this conjecture in several cases; the proofs make use of the notion of an algebraic ring. I will mention several applications to character varieties of finitely generated groups and representations of some non-arithmetic groups.

Wednesday

Alla Detinko 9:00–9:50am

Zariski density and computing with infinite linear groups

We present recent developments in a novel domain of computational group theory: computing with infinite linear groups. Special consideration is given to algorithms for Zariski dense subgroups. This includes a computer realization of the strong approximation theorem, and algorithms for arithmetic groups. We illustrate applications of our methods to the solution of problems further afield by computer experimentation.

This is joint work with Dane Flannery and Alexander Hulpke.

Michael Lipnowski 10:30–10:55am

Building grids on $\Gamma\backslash X$ for $\Gamma < \mathrm{SL}_n(\mathbb{Z})$ admitting membership testing

Arie Levit 11:00–11:25am

Quantitative weak uniform discreteness

I will discuss a quantitative variant of the Kazhdan-Margulis theorem generalized to probability measure preserving actions of semisimple groups over local fields. The talk is based on a joint work with Gelander and Margulis.

Plinio G. P. Murillo 11:30–11:55am

Systole growth on arithmetic locally symmetric spaces

The systole of a Riemannian manifold is the shortest length of a non-contractible closed geodesic. The purpose of this talk is to survey recent results in systole growth along congruence covers of arithmetic manifolds, and how this information interact with the geometry and the topology of the covers.

Thursday

Alex Kontorovich 9:00–9:50am

Sphere packings and arithmetic

We will discuss recent progress in understanding Apollonian-like sphere packings and more general objects, with connections to arithmetic hyperbolic groups, both reflective and non.

Cornelia Drutu 10:30–11:20am

Effective equidistribution of expanding horospheres

Andrew Zimmer 2:00–2:50pm

Convex cocompact actions of non-hyperbolic groups

In this talk, I will discuss some results concerning convex cocompact subgroups of the projective linear group (as defined by Danciger-Guéritaud-Kassel). These are a special class of discrete subgroups which act convex cocompactly on a properly convex domain in real projective space. In the case when the subgroup is word hyperbolic, these are well studied objects: the inclusion representation is actually an Anosov representation. The non-hyperbolic case is less understood and will be the focus of this talk. This is joint work with Mitul Islam.

Nicolas Tholozan 4:00–4:50pm

Exotic compact quotients of pseudo-Riemannian symmetric spaces

Let M be a Gromov–Thurston manifold. With Daniel Monclair and Jean-Marc Schlenker, we construct proper and cocompact actions of the fundamental group of M on a certain pseudo-Riemannian symmetric space. I will explain this construction, and how it relates to the existence of a globally hyperbolic anti-de Sitter manifold with Cauchy hypersurface homeomorphic to M.

Friday

Dmitry Kleinbock 9:00–9:50am

Khintchine-type theorems via L^2 estimates for Siegel transform

Recently there has been a surge of activity in quantifying the density of values of generic quadratic forms at integer points. I will present some new and quite general results in this direction obtained via the so-called Siegel-Rogers method, which has recently been utilized by Athreya and Margulis, and later by Kelmer and Yu. This work is joint with Mishel Skenderi.

Ilya Gekhtman 10:30–10:55am

Gibbs measures vs. random walks in negative curvature

The ideal boundary of a negatively curved manifold naturally carries two types of measures. On the one hand, we have conditionals for equilibrium (Gibbs) states associated to Hoelder potentials; these include the Patterson-Sullivan measure and the Liouville measure. On the other hand, we have stationary measures coming from random walks on the fundamental group.

We compare and contrast these two classes. First, we show that both of these of these measures can be associated to geodesic flow invariant measures on the unit tangent bundle, with respect to which closed geodesics satisfy different equidistribution properties. Second, we show that the absolute continuity between a harmonic measure and a Gibbs measure is equivalent to a relation between entropy, (generalized) drift and critical exponent, generalizing previous formulas of Guivarc'h, Ledrappier, and Blachere-Haissinsky-Mathieu. This shows that if the manifold (or more generally, a CAT(-1) quotient) is geometrically finite but not convex cocompact, stationary measures are always singular with respect to Gibbs measures.

A major technical tool is a generalization of a deviation inequality due to Ancona saying the so called Green distance associated to the random walk is nearly additive along geodesics in the universal cover.

Part of this is based on joint work with Gerasimov-Potyagailo-Yang and part on joint work with Tiozzo.

Beibei Liu 11:00–11:25am

Hausdorff dimension and geometric finiteness in Hyperbolic spaces

Geometric finiteness is a nice property for an n-dimensional hyperbolic manifold, and one way to determine the geometric finiteness is to describe the limit set which consists of conical limit points and parabolic fixed points. On the other hand, the limit sets of geometrically infinite Kleinian groups contain infinitely many nonconical limit points. One can ask questions relating the measure-theoretic size of the limit set, conical limit set or non-conical limit set to the geometric finiteness. In this talk, we will review some existing results and conjectures about Kleinian groups with small Hausdorff dimension, and small critical exponents.

Check out of your room **by noon**. (Return the key to the Professional Development Centre.)
Other BIRS facilities (Corbett Lounge, Reading Room, and TCPL) are available until 3pm.