Program for the workshop on Complex Geometry and Geometric Group Theory, Karlsruhe

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Corey Bregman: Relatively geometric actions of complex hyperbolic lattices.

Abstract. Delzant and Gromov showed that any homomorphism from a Kaehler group to a hyperbolic group acting properly and cocompactly on a CAT(0) cube complex must factor through a uniform lattice in $\mathrm{SO}(2,1)$. Relatively geometric actions on CAT(0) cube complexes were introduced by Einstein and Groves to allow for non-proper actions of group pairs, and generalize results concerning cubulated hyperbolic groups to relatively hyperbolic groups. In this talk we show that uniform and non-uniform lattices in $\mathrm{PU}(n,1)$ for $n \geq 2$ do not admit relatively geometric actions on CAT(0) cube complexes, extending the results of Delzant-Gromov to the non-proper setting. This work is joint with Kejia Zhu.

Benoît Claudon: Characterizing quotients of complex tori.

Abstract. In a joint work with Patrick Graf and Henri Guenancia we studied a singular analogue of Yau's theorem saying that a compact Kähler manifold whose first and second Chern classes vanish admits an étale cover by a complex torus. To generalize this kind of result to the klt case, we establish a singular version of the Bogomolov-Gieseker inequality. Our proof finally relies on the recent Decomposition Theorem for Kähler Ricci flat spaces (a result of Bakker–Guenancia–Lehn).

Ya Deng: Hyperbolicity and representation of fundamental groups of quasi-projective varieties.

Abstract. Non-abelian Hodge theories in both Archimedean and non-archimedean settings are important tools in studying fundamental groups of quasi-projective varieties. In this talk I will explain the recent progress on representation of fundamental groups of quasi-projective varieties and its application to hyperbolicity. It is based on two joint works with Brotbek, Daskalopoulos, Mese and Cadorel, Yamanoi.

Martin Deraux: A smooth complex hyperbolic surface with one end.

Abstract. I will survey some methods that allow us to construct complex hyperbolic surfaces of finite volume, to write down presentations for their fundamental group, and to count the ends of finite covers. One nice application of these techniques produces an example of a smooth complex hyperbolic surface with a single end.

Sami Douba: A real hyperbolic lattice in each dimension with Zariski-dense surface subgroups.

Abstract. For each $n \geq 3$, we exhibit a nonuniform arithmetic lattice in $\mathrm{SO}(n,1)$ containing Zariski-dense surface subgroups.

Gavril Farkas: Topological invariants of groups via Koszul modules.

Abstract. I will discuss the deep connection between the structure of the equations of certain algebraic varieties and Alexander invariants of groups. This has led to a universal bound on the nilpoteny index of the fundamental group of non-fibred compact Kähler manifolds, or of the Torelli group. Joint work with Aprodu, Papadima, Raicu and Weyman.

Olivier de Gaay Fortman: Hyperbolic uniformization of complex and real moduli spaces.

Abstract. A classical theorem describes the moduli space of complex elliptic curves as the quotient of the hyperbolic plane by SL2(Z), the special linear group of two-by-two matrices with integral coefficients. I will first recall some known generalizations of this theorem to other moduli spaces of complex varieties: sometimes, such a moduli space arises as the quotient of complex hyperbolic space by an arithmetic group. Then I will explain what happens in the real case. Some moduli spaces of real varieties can be presented as real hyperbolic space modulo a non-arithmetic group. The real moduli space is obtained by glueing together arithmetic hyperbolic pieces, in the spirit of the construction of Gromov and Piatetski–Shapiro. I will provide a general construction of glueing hyperbolic quotient spaces, generalizing work of Allcock–Carlson–Toledo.

Cécile Gachet: Finite quotients of abelian varieties, étale in codimension 2, with a Calabi-Yau resolution.

Abstract. Let A be an abelian variety, and let G be a finite group acting freely in codimension 2 on A. It is quite natural to ask whether the quotient A/G has a crepant resolution. If it does, this crepant resolution can also be characterized among K-trivial varieties by a vanishing of its second Chern class. In the 90ies, Oguiso classified such quotients and such K-trivial varieties in dimension 3: there are exactly two of them. In this talk, we classify these objects in dimension 4 and 5. For that purpose, we use some computational group theory (implemented in GAP), as well as a correspondence between the Hodge numbers of a crepant resolution and the orbifold Hodge numbers of the quotient that is being resolved, due to Batyrev and Dais.

Dieter Kotschick: Sasaki versus Kähler groups.

Abstract: I will discuss fundamental groups of compact Sasaki manifolds, and compare them to those of compact Kähler manifolds. While Sasaki groups share many of the properties of Kähler groups, they actually behave quite differently under certain natural constructions. I will highlight these differences. The talk is based on joint work with G. Placini.

Vincent Koziarz: Volumes of moduli spaces of flat surfaces of genus 0 with conical singularities.

Abstract. Since the seminal works by Thurston and Veech, it is known that the moduli spaces of flat surfaces with prescribed cone angles at the singularities carry some natural volume forms. The values of these volumes have meaningful interpretations in many cases. The goal of this talk is to explain how tools from complex analytic and algebraic geometry can be used to compute such values in the case of genus 0. This is a joint work with Duc-Manh Nguyen.

Anne Lonjou: Action of the Cremona group on a CAT(0) cube complex.

Abstract. The Cremona group is the group of birational transformations of the projective plane. Even if this group comes from algebraic geometry, tools from geometric group theory have been powerful to study it. In this talk, based on a joint work with Christian Urech, we will build a natural action of the Cremona group on a CAT(0) cube complex. We will then explain how we can obtain new and old group theoretical and dynamical results on the Cremona group.

Matthew Stover: Residually finite central extensions of lattices.

Abstract. For $n \geq 2$, Deligne famously proved using the congruence subgroup property that the central extension of $\mathrm{Sp}(2n, \mathbb{Z})$ by $\mathbb{Z}$ determined by its preimage in the universal cover of $\mathrm{Sp}(2n, \mathbb{R})$ is not residually finite. On the other hand, the preimage of $\mathrm{PSL}(2, \mathbb{Z})$ in any connected cover of $\mathrm{SL}(2, \mathbb{R})$ is residually finite, and one can prove this very explicitly using nilpotent quotients. These quotients have many interpretations that manifest the modular group's special place at the intersection of low-dimensional topology, geometric group theory, number theory, and complex analysis. I will describe joint work with Domingo Toledo that develops methods, generalizing one interpretation of the argument for $\mathrm{PSL}(2, \mathbb{Z})$, to prove residual finiteness (in fact, linearity) of cyclic central extensions of fundamental groups of aspherical manifolds with residually finite fundamental group. I will then describe how this generalization applies to prove residual finiteness of cyclic central extensions of certain arithmetic lattices in $\mathrm{PU}(n, 1)$ and raise some open questions.

Konstantinos Tsouvalas: Fiber products and non quasi-isometric embeddings into linear groups

Abstract. Several important classes of groups are known to admit discrete and faithful linear representations which are quasi-isometric embeddings. These include Anosov hyperbolic groups and more generally convex cocompact groups in $\mathrm{PSL}(d, \mathbb{R})$. In this talk, we will be interested in groups with the opposite behaviour. We are going to exhibit some classes of finitely generated (and presented) subgroups P of direct products of linear hyperbolic groups with the property that every linear representation of P over a local field fails to be a quasi-isometric embedding.

Stefano Vidussi: Finiteness properties of algebraic fibers of group extensions.

Abstract. I will discuss some results about the existence and properties of algebraic fibrations of group extensions, with particular regards for those that arise as fundamental groups of Kaheler manifolds, such as (iterated) Kodaira fibrations.