Program

Yves Benoist (Université Paris-Sud) *Recurrence on homogeneous spaces*

Abstract. I will present a joint work with Jean-Francois Quint, extending previous results by A. Eskin and G. Margulis, and answering their conjectures: A random walk on a finite volume homogeneous space is always recurrent as soon as the transition probability has finite exponential moments and its support generates a subgroup whose Zariski closure is semisimple.

Robert Bieri (University of Frankfurt) *Horospherical limit sets of modules over* CAT(0)*-groups*

Abstract. The topic of this lecture has its root in a little workshop on finite presentability organized by Herbert Abels in the late 70s. Ralph Strebel and I came to Bielefeld with a new tool in commutative algebra which allowed us to prove that *if a soluble group G is finitely presented then so are its metabelian quotients G/N ...* obviously, as we felt, the first step towards a positive answer to Philip Hall's 1954-question whether, in fact, *all quotients of G are finitely presented.* It turned out that this was more likely the last step in that direction, for Herbert had exactly the right counter example in his drawer to show that we could not do any better. Our then new tool was the Geometric Invariant $\Sigma(\Gamma; A)$, a subset of the sphere at infinity of the Euclidean Γ-space $\Gamma \otimes \mathbb{R}$, which is associated to every finitely generated module A over a finitely generated Abelian group Γ. Twenty years later $\Sigma(\Gamma; A)$ became a "prehistoric" item of modern Tropical Geometry: the integral version of the tropicalization of the annihilator ideal of the module A in the group ring $\mathbb{Z}\Gamma$.

I will talk about the geometric Invariant $\Sigma(M; A) \subseteq \partial M$ as we (this is joint work with Ross Geoghegan) see it today: A subset of the boundary at infinity of a proper CAT(0) space M on which an arbitrary finitely generated group Γ acts by isometries, defined for every finitely generated Γ-module A. Somewhat surprisingly all general properties of $\Sigma(\Gamma; A)$ carry over to this level of generality. The obvious and interesting task now is to examine other special cases of M, like hyperbolic space $M = \mathbf{H}^n$ acted upon by a group Γ of Moebius transformations or the symmetric space $M = \mathrm{SL}(n, \mathbb{R})/\mathrm{SO}(n)$ acted upon by $\Gamma = \mathrm{SL}(n, \mathbb{Z})$. We find that $\Sigma(M; A)$ links Tropical Geometry with Poincaré's limit sets on $\partial\mathbf{H}^n$ and the spherical buildings of $\mathrm{SL}(n, \mathbb{Q})$.

Yves de Cornulier (Université Paris-Sud) *Compact presentability of p-adic groups (after Abels)*

Abstract. In the 80s, Abels characterized algebraic p-adic groups that are compactly presented. The characterization involves the geometry of weights, and central extensions. I will explain this result and give an outline of the mains ideas of proof.

Alex Eskin (University of Chicago) *Rational billiards and the* $\mathrm{SL}(2,\mathbb{R})$ *action on moduli space*

Abstract. I will discuss ergodic theory over the moduli space of compact Riemann surfaces and its applications to the study of polygonal billiard tables. There is an analogy between this subject and the theory of flows on homogeneous spaces; I will talk about some successes and limitations of this viewpoint. This is joint work with Maryam Mirzakhani.

Tsachik Gelander (the Hebrew University of Jerusalem) *On the growth of Betti numbers of arithmetic groups*

Abstract. We study the asymptotic behaviour of the Betti numbers of higher rank locally symmetric manifolds as their volumes tend to infinity. Our main theorem is a uniform version of the Luck Approximation Theorem, which is much stronger than the linear upper bounds on Betti numbers proved by Gromov. The basic idea is to adapt the theory of local convergence, originally introduced for sequences of graphs of bounded degree by Benjamimi and Schramm, to sequences of Riemannian manifolds. Using rigidity theory we are able to show that when the volume tends to infinity, the manifolds locally converge to the universal cover in a sufficiently strong manner that allows us to derive the convergence of the normalized Betti numbers. Joint work with M. Abert, N. Bergeron, I. Biringer, N. Nikolov, J. Raimbault and I. Samet.

William Goldman (University of Maryland) *Proper affine actions and the Auslander-Milnor Conjecture*

Abstract. In the early 1960's Louis Auslander erroneously claimed to have proved a basic structure theorem for compact complete affine manifolds. Whether his optimistic picture holds remains an open question. By the late 1970's, when the flaws were recognized, Milnor asked whether a nonabelian free group could act properly by affine transformations. Shortly thereafter Margulis showed free groups can act properly and affinely even on 3-space. In 1990 Drumm constructed fundamental domains for these surprising actions. This talk will describe a few recent developments in this theory.

Ralf Gramlich (University of Gießen) *Finiteness properties of* S*-arithmetic subgroups of almost simple algebraic groups over global function fields*

Abstract. A group is of type F_m if it admits a classifying space with finite m-skeleton; F_1 is equivalent to being finitely generated, F_2 to being finitely presented.

By Borel-Serre an S-arithmetic subgroup of an almost simple algebraic group over a number field is of type F_m for each $m \in \mathbb{N}$. By an observation of Nagao's this is different in the function field case; Serre and Stuhler proved at the end of the 1970's how Behr-Harder reduction theory can be used in order to determine the finiteness properties of S-arithmetic groups that act on (products) of trees. Later these finiteness properties were established by Bux and Wortman for S-arithmetic groups of global rank 1; furthermore, they gave a general upper bound for the

finiteness properties, which depends on the euclidean rank of the underlying product of affine buildings.

In my talk I would like to discuss the general situation and discuss the result proved by Bux, Witzel and myself that in the function field case such S-arithmetic groups are of type F_{l-1}, but not of type F_l, where l is the euclidean dimension of the product of affine buildings on which the S-arithmetic groups acts as an irreducible lattice. The upper bound determined by Bux and Wortman is therefore sharp.

Gregory Margulis (Yale University) *On some topics related to collaboration with Herbert Abels*

Abstract. I will briefly discuss two topics: (1) Metrics on semisimple groups and arithmetic quotients:; (2) Discrete groups of affine transformations.

Shahar Mozes (the Hebrew University of Jerusalem) *Simple groups without lattices*

Abstract. In a joint work with Uri Bader, Pierre-Emmanuel Caprace and Tsachik Gelander we consider the group of almost tree automorphisms and show that admits no lattices.

Bernhard Mühlherr (University of Gießen) *Polar regions in spherical buildings*

Abstract. A fundamental result of Tits asserts that an irreducible spherical building of rank at least 3 is Moufang. Hence, its automorphism group contains 'all' root groups. We define for each root its polar region. It turns out that the geometry of polar regions in Moufang building has very nice properties and provides a useful tool for investigating spherical buildings of higher rank. It can be used to give an alternative approach of the center conjecture. The known proof of this conjecture relies on a case-by-case analysis for each type, which becomes rather involved for the exceptional cases. Our new approach provides a considerably shorter proof which almost works uniformly for all types. This is joint work with R. Weiss.

Bertrand Rémy (University of Lyon) *Quasi-isometry classes of twin building lattices*

Abstract. We will explain that some well-chosen lattices in products of buildings provide in finitely many quasi-isometry classes of finitely presented simple groups. This is a consequence of a non-distorsion result. This is joint work with Pierre-Emmanuel Caprace.

Mark Sapir (Vanderbilt University) *Aspherical groups and manifolds with extreme properties*

Abstract. We prove that every aspherical recursively presented group embeds into a group with finite aspherical presentation complex. By results of Gromov and

Davis, this implies that there exists a closed aspherical manifold of any dimension > 3 (smooth in dimension > 4) with universal cover of infinite asymptotic dimension, and which is a counterexample to the Baum-Connes conjecture with coefficients.

Ernest Vinberg (Moscow State University) *On algebras of automorphic forms on multidimensional symmetric domains of type IV*

Abstract. Contrary to dimensions 1 and 2, almost nothing is known about the structure of algebras of automorphic forms on multidimensional symmetric domains of type IV. The only such result was obtained by J. Igusa (1962), who proved that some algebra of automorphic forms on the 3-dimensional symmetric domain of type IV is free, and found the degrees of its generators. The speaker has managed to obtain analogous results in dimensions 4,5,6,7, making use of the interpretation of the projective spectra of the considered algebras of automorphic forms as the moduli varieties of some classes of quartic surfaces. These results imply that the corresponding arithmetic groups are generated by (complex) reflections. On the other hand, one can prove that the algebras of automorphic forms cannot be free, if the dimension is too big.

Richard Weiss (Tufts University) *The local structure of a Bruhat-Tits building*

Abstract. Like Coxeter groups, spherical buildings are uniquely determined by their rank 2 residues. This is not at all true of affine buildings. In the theory of affine buildings, it is instead the building at infinity and valuations that take center stage. Nevertheless, the residues of an affine building are an important structural feature. Determining their structure involves the investigation of various kinds of “ramified” and “unramified” algebraic structures defined over a local field. The case that the building at infinity is an exceptional Moufang quadrangle is particularly interesting. This is joint work with Bernhard Mühlherr and Holger Petersson.

Kevin Wortman (University of Utah) *Filling coarse manifolds in arithmetic groups*

Abstract. A theorem of Lubotzky-Mozes-Raghunathan states that the word metric of any irreducible lattice L in a higher rank semisimple group G is quasi-isometric to the metric on L obtained by restricting the metric on G. In other words, given any two points x and y in L, there is a quasi-path in L that joins x to y and whose length is roughly the length of the shortest path between x and y in G.

In this talk I'll explain a conjectural generalization of Lubotzky-Mozes-Raghunathan due to Bux-Wortman on the existence of metrically efficient “coarse” $n+1$ manifolds in L whose boundaries realize given n manifolds in L as long as the rank of G is at least $n + 2$. I'll explain recent progress toward proving this conjecture, and how the conjecture implies some known finiteness properties of latices and some mostly unknown isoperimetric inequalities for lattices. This is joint work with Mladen Bestvina and Alex Eskin.