Nicolas Monod — Curriculum Vitæ

I. Personal Data

Birth:	November 29, 1973; Switzerland
Citizenship:	Swiss

II. Positions Held

2008–	Full Professor, EPFL
2005–2008	Full Professor, University of Geneva
2004–2005	Assistant Professor, University of Chicago
2001–2004	L. E. Dickson Instructor, University of Chicago

III. Education

2001	PhD, ETH Zürich
1997	Diplôme, University of Lausanne
1996	Licence, University of Lausanne

IV. Awards and Honours

2006	ICM, Invited speaker
2005	AMS Central Section Meeting, Plenary speaker
2004	*Salomon Bochner Lectures in Mathematics*, Rice University
2001	ETH Medal and Prize for the doctoral dissertation

V. Editorial Boards

2005–	L'Enseignement Mathématique
2006–	Groups, Geometry and Dynamics
2008–	Journal of Topology and Analysis

VI. Ten Representative Publications

On the bounded cohomology of semi-simple groups, S-arithmetic groups and products
Crelle's Journal (J. R. Ang. Math.), to appear (33 pages, 2008).

Actions of product groups on manifolds (with A. Furman),
Duke Mathematical Journal 148 N° 1 (2009), 1–39.

Property (T) and rigidity for actions on Banach spaces (with U. Bader, A. Furman, T. Gelander),
Acta Mathematica 198 N° 1 (2007), 57–105.

Superrigidity for irreducible lattices and geometric splitting
Journal Amer. Math. Soc. 19 N° 4 (2006), 781–814.

Orbit equivalence rigidity and bounded cohomology (with Y. Shalom),
Annals of Mathematics 164 N° 3 (2006) 825–878.

Continuous bounded cohomology and applications to rigidity theory (with M. Burger),
GAFA 12 N° 2 (2002), 219–280.

Continuous bounded cohomology of locally compact groups
Lecture Notes in Mathematics vol. 1758, Springer (2001), 214+ix pages.

Isometry groups and lattices of non-positively curved spaces, (with P.-E. Caprace),
arxiv (82 pages, 2008).

A lattice in more than two Kac–Moody groups is arithmetic, (with P.-E. Caprace),
arxiv (19 pages, 2008).

Non-unitarisable representations and random forests, (with I. Epstein),
arxiv (12 pages, 2008).

VII. Publication List

[1] *On the bounded cohomology of semi-simple groups, S-arithmetic groups and products*
Crelle's Journal (J. R. Ang. Math.), in press (2009).
We prove vanishing results for Lie groups and algebraic groups (over any local field) in bounded cohomology. The main result is a vanishing below twice the rank for semi-simple groups. Related rigidity results are established for S-arithmetic groups and groups over global fields. We also establish vanishing and cohomological rigidity results for products of general locally compact groups and their lattices.

[2] *The Dixmier problem, lamplighters and Burnside groups*, (with N. Ozawa),
Journal of Functional Analysis, in press (2009).
J. Dixmier asked in 1950 whether every non-amenable group admits uniformly bounded representations that cannot be unitarised. We provide such representations upon passing to extensions by abelian groups. This gives a new characterisation of amenability. Furthermore, we deduce that certain Burnside groups are non-unitarisable, answering aquestion raised by G. Pisier.

[3] *Non-unitarisable representations and random forests*, (with I. Epstein),
IMRN, in press (2009).
We establish a connection between Dixmier's unitarisability problem and the expected degree of random forests on a group. As a consequence, a residually finite group is non-unitarisable if its first L^2-Betti number is non-zero or if it is finitely generated with non-trivial cost. Our criterion also applies to torsion groups constructed by D. Osin, thus providing the first examples of non-unitarisable groups not containing a non-Abelian free subgroup.

[4] *Isometry groups of non-positively curved spaces: structure theory*, (with P.-E. Caprace),
Journal of Topology, in press (2009).
We develop the structure theory of full isometry groups of locally compact non-positively curved metric spaces. Amongst the discussed themes are de Rham decompositions, normal subgroup structure and characterising properties of symmetric spaces and Bruhat–Tits buildings. Applications to discrete groups and further developments on non-positively curved lattices are exposed in a companion paper.

[5] *Isometry groups of non-positively curved spaces: discrete subgroups*, (with P.-E. Caprace),
Journal of Topology, in press (2009).
We study lattices in non-positively curved metric spaces. Borel density is established in that setting as well as a form of Mostow rigidity. A converse to the flat torus theorem is provided. Geometric arithmeticity results are obtained after a detour through superrigidity and arithmeticity of abstract lattices. Residual finiteness of lattices is also studied. Riemannian symmetric spaces are characterised amongst CAT(0) spaces admitting lattices in terms of the existence of parabolic isometries.

[6] *Actions of product groups on manifolds* (with A. Furman),
Duke Mathematical Journal 148 N° 1 (2009), 1–39.
We analyze volume-preserving actions of product groups on Riemannian manifolds. Under a natural spectral irreducibility assumption, we prove the following dichotomy: Either the action is measurably isometric (i.e. *compact*); or the action is infinitesimally linear, which means that the derivative cocycle arises from a linear representation of the acting groups.
As a first application, this provides lower bounds on the dimension of the manifold in terms of the number of factors in the acting group. Another application is a strong restriction for actions of non-linear groups. We prove our results by means of a new cocycle superrigidity theorem of independent interest, in analogy to Zimmer's programme.

[7] *A lattice in more than two Kac–Moody groups is arithmetic*, (with P.-E. Caprace),
arxiv 0812.1383 (2008), 18 pages.
Let $\Gamma < G_1 \times \cdots \times G_n$ be an irreducible lattice in a product of infinite irreducible complete Kac–Moody groups of simply laced type over finite fields. We show that if $n \geq 3$, then each G_i is a simple algebraic group over a local field and Γ is an arithmetic lattice. This relies on the following alternative which is satisfied by any irreducible lattice provided $n \geq 2$: either Γ is an S-arithmetic (hence linear) group, or Γ is not residually finite. In that case, it is even virtually simple when the ground field is large enough.
More general CAT(0) groups are also considered throughout.

[8] *Decomposing locally compact groups into simple pieces*, (with P.-E. Caprace),
arxiv 0811.4101 (2008), 19 pages.
We present a contribution to the structure theory of locally compact groups. The emphasis is put on compactly generated locally compact groups which admit no infinite discrete quotient. It is shown that such a group possesses a characteristic cocompact subgroup which is either connected or admits a non-compact non-discrete topologically simple quotient. We also provide a complete description of groups all of whose proper quotients are compact, of characteristically simple groups and of groups admitting a subnormal series with all subquotients compact, or compactly generated Abelian, or compactly generated and topologically simple.

[9] *Some properties of non-positively curved lattices*, (with P.-E. Caprace),
C. R. Acad. Sci. Paris, (Ser. I) 346 N° 15–16 (2008), 857–862.
We announce results on the structure of CAT(0) groups, CAT(0) lattices and of the underlying spaces. Our statements rely notably on a general study of the full isometry groups of proper CAT(0) spaces. Classical statements about Hadamard manifolds are established for singular spaces; new arithmeticity and rigidity statements are obtained.

[10] *Strong law of large numbers with concave moments*, (with A. Karlsson),
arxiv 0803.1856 (2008), 2 pages.
It is observed that a wellnigh trivial application of the ergodic theorem of Karlsson–Ledrappier yields a strong LLN for arbitrary concave moments.

[11] *Vanishing up to the rank in bounded cohomology*
Mathematical Research Letters 14 N° 4 (2007), 681–687.
Above degree two, the bounded cohomology of simple Lie groups or algebraic groups over

local fields is still mostly unknown; likewise for their lattices. We establish the vanishing for non-trivial unitary representations of the bounded cohomology of SL_d up to degree $d-1$. It holds more generally for uniformly bounded representations on superreflexive spaces. The same results are obtained for lattices. We also prove that the real bounded cohomology of any lattice is invariant in the same range.

[12] *Property (T) and rigidity for actions on Banach spaces* (with U. Bader, A. Furman, T. Gelander),
Acta Mathematica 198 N° 1 (2007), 57–105.
We study Kazhdan's property (T) and the fixed point property for actions on L^p and other Banach spaces. We show that property (T) holds when L^2 is replaced by L^p-type spaces, and that in fact it is independent of $1 \leq p < \infty$.
For simple Lie groups, algebraic groups and their lattices, we prove that the fixed point property for L^p holds for any $1 < p < \infty$ if and only if the rank is at least two. Finally, we obtain a superrigidity result for actions of irreducible lattices in products of general groups on superreflexive Banach spaces.

[13] *Superrigidity for irreducible lattices and geometric splitting*
Journal Amer. Math. Soc. 19 N° 4 (2006), 781–814.
We prove general superrigidity results for actions of irreducible lattices on CAT(0) spaces; first, in terms of the ideal boundary, and then for the intrinsic geometry (including for infinite-dimensional spaces). In particular, one obtains a new and self-contained proof of Margulis' superrigidity theorem for uniform irreducible lattices in non-simple groups.
The proofs rely on geometric arguments, including a splitting theorem which can be viewed as an infinite-dimensional (and singular) generalization of the Lawson–Yau/Gromoll–Wolf theorem. Appendix A gives a very elementary proof of commensurator superrigidity; Appendix B proves that all our results also hold for certain non-uniform lattices.

[14] *Orbit equivalence rigidity and bounded cohomology* (with Y. Shalom),
Annals of Mathematics 164 N° 3 (2006) 825–878.
We establish new results and introduce new methods in the theory of measurable orbit equivalence. Our rigidity statements hold for a wide (uncountable) class of groups defined geometrically.
Amongst our applications are (a) measurable Mostow-type rigidity theorems for products of negatively curved groups; (b) prime factorization results for measure equivalence; (c) superrigidity for orbit equivalence; (d) the first examples of continua of type II_1 equivalence relations with trivial outer automorphism group that are mutually not *stably* isomorphic.

[15] *An invitation to bounded cohomology*
Proceedings of the ICM 2006, Volume II, 1183–1211.
A selection of aspects of the theory of bounded cohomology is presented. The emphasis is on questions motivating the use of that theory as well as on some concrete issues sugested by its study. Specific topics include rigidity, bounds on characteristic classes, quasification, orbit equivalence, amenability.

[16] *Amenable actions, free products and a fixed point property* (with Y. Glasner), **Bull. London Math. Soc.** 39 N° 1 (2007), 138–150.
We investigate the class of groups admitting an action on a set with an invariant mean. It turns out that many free products admit interesting actions of that kind. A complete characterization of such free products is given in terms of a fixed point property.

[17] *Arithmeticity* vs. *non-linearity for irreducible lattices*
Geom. Ded. 112 N° 1 (2005) 225–237.
We establish an arithmeticity *vs.* non-linearity alternative for irreducible lattices in suitable product groups, such as for instance products of topologically simple groups. This applies notably to Kac–Moody groups. This alternative relies heavily on our superrigidity theorem 13, as we follow Margulis' reduction of arithmeticity to superrigidity.

[18] *Note: Superrigidity for irreducible lattices and geometric splitting*
C. R. Acad. Sci. Paris, (Ser. I) 340 N° 3 (2005), 185–190.
A presentation of a new approach to Margulis' superrigidity for irreducible lattices in products, unifying that problem with the classical splitting theorem in non-positive curvature.

[19] *Equivariant embeddings of trees in hyperbolic spaces* (with M. Burger and A. Iozzi), **IMRN** 2005:22 (2005) 1331–1369
We classify completely (and construct explicitly) all actions by isometries of automorphism groups of a regular locally finite tree upon the infinite dimensional hyperbolic space, *i.e.* their representation space associated to the group $\mathbf{O}(1, \infty)$.

[20] *Boundedly generated groups with pseudocharacter(s)* (with B. Rémy),
Journal London Math. Soc. 73 N° 1 (2006), 104–108 (Appendix to J.F. Manning).
A short note presenting the first examples of groups that are boundedly generated, have Kazhdan's property (T) and have a one-dimensional space of pseudocharacters.

[21] *Ideal bicombings for hyperbolic groups, and applications* (with I. Mineyev and Y. Shalom),
Topology 43 N° 6 (2004), 1319–1344.
The geodesic flow on negatively curved manifolds is generalized in homological terms to arbitrary Gromov-hyperbolic groups (and similar singular spaces). We then construct a cohomological invariant which implies that our Orbit Equivalence rigidity results established in [14] hold for all (non-elementary) hyperbolic groups, and more generally all their non-elementary subgroups. Further, we prove a general superrigidity result for actions of irreducible lattices on general hyperbolic metric spaces.

[22] *Cocycle super-rigidity and bounded cohomology for negatively curved spaces* (with Y. Shalom),
J. Differential Geometry 67 N° 3 (2004), 395–455.
We introduce new techniques to extend superrigidity theory beyond the scope of Lie or algebraic groups. We construct a cohomological invariant which accounts for, and generalizes, all known superrigidity results for actions on negatively curved spaces.

Together with a new vanishing result and the machinery of bounded cohomology , this enables us to prove a general superrigidity theorem for actions of irreducible lattices on spaces of negative curvature. We also prove a cocycle version à la Zimmer.

[23] *Negative curvature from a cohomological viewpoint and cocycle superrigidity* (with Y. Shalom),
C. R. Acad. Sci. Paris, Ser. I (337) N° 10 (2003), 635–638.
A note presenting the authors' aproach to rigidity in negative curvature through cohomological invariants. Proofs are given for illustrative "toy-cases".

[24] *On co-amenability for groups and von Neumann algebras* (with S. Popa),
C. R. Acad. Sci. Canada 25 N° 3 (2003), 82–87.
Answering a question asked by Eymard in 1972, we show that co-amenability does not pass to subgroups. We then address co-amenability for von Neumann algebras, we exhibit a similar phenomenon and we establish a relation of this with the former.

[25] *Stabilization of* SL_n *in bounded cohomology*,
Proceedings of the First JAMS Symposium (2002), Contemp. Math. 347 (2004) 191–202.
We prove that for all local fields SL_n is stable over n in terms of continuous bounded cohomology. We complement this by various computations in low degree, showing notably $\mathrm{H}^3_b(\mathrm{SL}_n(\mathbf{R})) = 0$ for all $n \in \mathbf{N}$. We link the corresponding vanishing for p-adic fields to a question on prime numbers.

[26] *On and around the bounded cohomology of* SL_2 (with M. Burger),
In: **Rigidity in dynamics and geometry**, Springer 2002 19–37.
We establish how the spectral decomposition for a Riemann surface determines the allocation of the bounded cohomology over the representations of $\mathrm{SL}_2(\mathbf{R})$. Then we explore the connections of the Dilogarithm with the continuous bounded cohomology of $\mathrm{SL}_2(\mathbf{R})$ and $\mathrm{SL}_2(\mathbf{C})$. In particular, it appears that Rogers' Dilogarithm is uniquely determined even measurably by the Spence-Abel functional equation.

[27] *Continuous bounded cohomology and applications to rigidity theory* (with M. Burger),
GAFA 12 N° 2 (2002), 219–280.
The central theme of this paper is a product formula for (continuous) bounded cohomology, and more specifically its applications to rigidity theory for lattices – both in Lie/algebraic groups and more general topological groups. A condensed exposition of the cohomological machinery is followed by finiteness results for lattices.

[28] *Continuous bounded cohomology of locally compact groups*
Lecture Notes in Mathematics vol. 1758, Springer (2001), 214+ix pages.
The purpose of this monograph is (a) to lay the foundations for a conceptual approach to bounded cohomology; (b) to harvest the resulting applications in rigidity theory. Of central importance is the new interplay between measure theory, amenability, Banach representations on one hand, with the homological apparatus on the other hand. The applications obtained in this text include rigidity for actions on Teichmüller spaces and homeomorphisms of the circle.

The main tools include Poisson boundaries for random walks, spectral sequences, Zimmer-amenability, cohomological induction.

[29] *Bounded cohomology of lattices in higher rank Lie groups* (with M. Burger),
J. Eur. Math. Soc. 1 N° 2 (1999) 199–235.
Let Γ be an irreducible uniform lattice in a higher semi-simple rank Lie group or algebraic group. We prove that any Γ-action on the circle by C^1 diffeomorphisms is finite. This is achieved by showing that natural map $\mathrm{H}_b^2(\Gamma) \to \mathrm{H}^2(\Gamma)$ from bounded to usual cohomology is injective. The latter holds also for nontrivial unitary coefficients, and implies more finiteness results for Γ; for instance the stable commutator length vanishes. We prove the same theorems for certain lattices in products of trees.

[30] *Éléments de géométrie grossière*,
Memoir of the University of Lausanne 1997 (83 pages).
With Gromov's celebrated Almost Nilpotent Groups theorem in mind, we establish the foundations of a functorial approach to "rough" geometry (geometry up to additive constants). The resulting machinery leads to a conceptual proof of Gromov's theorem under certain restrictions.