Christopher H. Cashen

Faculty of Mathematics – University of Vienna
Oskar-Morgenstern-Platz 1, 1090 Vienna, Austria
christopher.cashen@univie.ac.at • orcid: 0000-0002-6340-469X

Nationality: USA
Research interests: Geometric Group Theory, Algebra, Low dimensional Geometry/Topology

Positions

University of Vienna — **Vienna, Austria**
Privatdozent/Project Leader — *2021–present*
Senior Postdoctoral Fellow/Project Leader — *2014–2020*
Postdoctoral Fellow — *2012–2014*

University of Arkansas — **Fayetteville, USA**
Visiting Assistant Professor — *2020–2021*

Université de Caen Normandie — **Caen, France**
Postdoctoral Fellow — *2011–2012*

University of Utah — **Salt Lake City, USA**
Postdoctoral Fellow — *2008–2011*

Mathematical Sciences Research Institute — **Berkeley, USA**
Postdoctoral Fellow — *Fall 2007*

Education

University of Vienna — **Vienna, Austria**
Habilitation, Mathematics — *2020*
"Formal determination of outstanding scientific and didactic qualification."
License to teach independently and to supervise doctoral students.

University of Illinois at Chicago — **Chicago, USA**
PhD, Mathematics — *2007*
Supervisor: Kevin Whyte

Loyola University — **Chicago, USA**
BS, Mathematics — *2000*
Magna Cum Laude, Alpha Sigma Nu honor society

Grants

Erwin Schrödinger Institute Workshop Grant — **€20,000**
GAGTA 2023: Groups & Dynamics — *2023*

Erwin Schrödinger Institute Research in Teams Project — **~€7,000**
Rigidity in Coxeter groups — *2023*

Austrian Science Fund (FWF): P 34214-N — **~€400,000**
Project Leader *Hierarchies and graph products of elementary groups* — *2021–2024*

Austrian Science Fund (FWF): P 30487-N35 — **~€240,000**
Project Leader *Generalizations of Hyperbolic Boundaries* — *2017–2020*

Austrian Science Fund (FWF): M 1717-N25 — **~€140,000**
Project Leader *Geometric and Analytic Aspects of Free Group Automorphisms* — *2014–2016*
Lise Meitner Fellowship

Supervision

Alexandra Edletzberger, Master Thesis — Vienna, 2019
Residual finiteness in hyperbolic groups

Charlotte Hoffman, Master Thesis — Vienna, 2020
Generalisations of Small Cancellation: The RSym Algorithm On Hyperbolic One-Relator Groups

Valentina Marie Dolin, Master Thesis — Vienna, 2023
Hyperbolicity or non-hyperbolicity of certain one-relator groups

Alexandra Edletzberger, PhD — Vienna, exp. 2024
Quasi-Isometies for two-dimensional Right-Angled Coxeter Groups

Lena Birschitzky, Master Thesis — Vienna, exp. 2024

Teaching Experience

University	Semester	Course	Level	Enrollment
Illinois	2006 Spring	Calculus III	U	20
Illinois	2006 Fall	Exercise ODEs	U	20
Illinois	2007 Spring	Exercise ODEs	U	22
Utah	2008 Spring	Calculus II	U	46
Utah	2008 Fall	Trigonometry	U	95
Utah	2009 Spring	Real Analysis II	U	26
Utah	2009 Fall	PDEs for Engineers	U	26
Utah	2010 Spring	Riemannian Geometry	G	8
Utah	2010 Fall	Linear Algebra	U	42
Utah	2011 Spring	Calculus I	U	120
Vienna	2019 Spring	Exercise Prob. and Statistics	U	20
Arkansas	2020 Fall	Advanced Calculus	U	15
Arkansas	2021 Spring	Algebraic Topology	G	16
Arkansas	2021 Spring	Topics in Algebra: Coxeter Groups	G	6
Vienna	2022 Spring	Topics in Algebra: Coxeter Groups	G	15
Vienna	2023 Spring	Topics in Algebra: Random Walks in Groups	G	6
Vienna	2024 Spring	Topics in Algebra: Computational Group Theory	G	17

Level: U=Undergraduate/Bachelor, G=Graduate/Master&PhD

Invited Research Visits

Rigidity in Coxeter Groups — Schrödinger Inst., Austria, 07.2023
Non-Positive Curvature, Group Actions, and Cohomology — Newton Institute, UK, 03.2017
Measured Group Theory — Schrödinger Inst., Austria, 02.2016
Low-dimensional Topology, Geometry, and Dynamics — ICERM, USA, 10.2013
The Geometry of Outer Space — Aix-Marseille U., France, 07.2013
Automorphisms of Free Groups — CRM, Spain, 11.2012
Geometric Group Theory — MSRI, USA, Fall 2007

Professional Activities

Member: American, Austrian, European Math. Societies, Association for Women in Math.
Organizer: 'Max Dehn Seminar', Utah, 2008-2011
Organizer: 'Geometry and Analysis on Groups Seminar', Vienna, 2014-2020, 2021-
Organizer: conference GAGTA 2023: Groups and Dynamics, Schrödinger Inst., Austria

Invited Conference Talks

Dubrovnik X, Topology & Dynamical Systems — IUC Dubrovnik, Croatia, 06.2024
RAAGedy RACGs

Rigidity properties of free-by-cyclic groups — AIM, USA, 10.2023
PG-rated free-by-cyclic groups

A week at infinity — U. Toronto, Canada, 03.2022
Variations on the Morse property

Of coarse! Quasi-isometries and groups — Ventotene, Italy, 09.2019
The current state of the quasiisometry classification of RAAGs and RACGs

Groups with hyperbolic features — ETH Zürich, Switzerland, 08.2019
Group actions with strongly contracting elements

Dubrovnik IX, Topology & Dynamical Systems — IUC Dubrovnik, Croatia, 06.2019
Group actions with a strongly contracting element

Non-positive Curvature in Action — Newton Institute, UK, 01.2017
The topology of the contracting boundary of a group

Dubrovnik VIII, Geometric Topology, Geometric Group Theory & Dynamical Systems — IUC Dubrovnik, Croatia, 06.2015
Contracting elements in infinitely presented small cancellation groups

Geometry of Computation in Groups — Schrödinger Inst., Austria, 03.2014
Growth tight actions

Groups and Geometry in the South East — U. Southampton, UK, 12.2012
Quasi-isometries of groups admitting certain cyclic JSJ decompositions

Automorphisms of Free Groups — CRM, Spain, 11.2012
Mapping Tori of Polynomially Growing Free Group Automorphisms

Journées sur $\mathrm{Out}(F_n)$ — U. Paris-Sud, France, 08.2011
Quasi-Isometries of Mapping Tori of Free Group Automorphisms

AMS Sectional Meeting — UNLV, USA, 04.2011
Virtually Geometric Multiwords

Spring Topology and Dynamics Conference — U. Texas at Tyler, USA, 03.2011
Virtually Geometric Multiwords

Wasatch Topology Conference — Park City, USA, 12.2010
Virtually Geometric Multiwords

Quasi-isometric Rigidity in Low Dimensional Topology — BIRS, Canada, 03.2010
Line Patterns in Free Groups

AMS Sectional Meeting — FAU, USA, 11.2009
Line Patterns in Free Groups and Quasi-isometries of Mapping Tori of Linearly Growing Free Group Automorphisms

AMS Sectional Meeting — LSU, USA, 03.2008
Quasi-isometries Between Tubular Groups

Publications

Peer-reviewed

1. *Quasi-isometries between tubular groups*, Groups, Geometry and Dynamics **4** (2010), no. 3, 473–516.
2. *Line patterns in free groups*, w/Macura, Geometry & Topology **15** (2011), no. 3, 1419–1475.
3. *Growth tight actions*, w/Arzhantseva and Tao, Pacific Journal of Mathematics **278** (2015), no. 1, 1–49.
4. *Virtual geometricity is rare*, w/Manning, LMS Journal of Computation and Mathematics **18** (2015), no. 1, 444–455.
5. *Quasi-isometries need not induce homeomorphisms of contracting boundaries with the Gromov product topology*, Analysis and Geometry in Metric Spaces **4** (2016), no. 1, 278–281.
6. *Splitting line patterns in free groups*, Algebraic & Geometric Topology **16** (2016), no. 2, 621–673.
7. *Mapping tori of free group automorphisms, and the Bieri-Neumann-Strebel invariant of graphs of groups*, w/Levitt, Journal of Group Theory **19** (2016), no. 2, 191–216.
8. *Growth tight actions of product groups*, w/Tao, Groups, Geometry and Dynamics **10** (2016), no. 2, 753–770.
9. *A geometric proof of the structure theorem for cyclic splittings of free groups*, Topology Proceedings **50** (2017), 335–349.
10. *Characterizations of Morse geodesics via superlinear divergence and sublinear contraction*, w/Arzhantseva, Gruber, and Hume, Documenta Mathematica **22** (2017), 1193–1224.
11. *Quasi-isometry classification for* [*right-angled Coxeter groups defined by suitable subdivisions of*] *complete graphs*, w/Dani and Thomas, Journal of Topology **10** (2017), no. 4, 1066–1106, appendix to *Bowditch's JSJ tree and the quasi-isometry classification of certain Coxeter groups* by Dani and Thomas.
12. *Quasi-isometries between groups with two-ended splittings*, w/Martin, Mathematical Proceedings of the Cambridge Philosopical Society **162** (2017), no. 2, 249–291.
13. *Negative curvature in graphical small cancellation groups*, w/Arzhantseva, Gruber, and Hume, Groups, Geometry and Dynamics **13** (2019), no. 2, 579–632.
14. *A metrizable topology on the contracting boundary of a group*, w/Mackay, Transactions of the American Mathematical Society **372** (2019), no. 3, 1555–1600.
15. *Morse subsets of CAT(0) spaces are strongly contracting*, Geometriae Dedicata **204** (2020), no. 1, 311–314.
16. *Cogrowth for group actions with strongly contracting elements*, w/Arzhantseva, Ergodic Theory and Dynamical Systems **40** (2020), no. 7, 1738–1754.
17. *Short, highly imprimitive words yield hyperbolic one-relator groups*, w/Hoffmann, Experimental Mathematics **32** (2023), no. 4, 631–640.
18. *Asymptotic cones of snowflake groups and the strong shortcut property*, w/Hoda and Woodhouse, Algebraic & Geometric Topology (in press).

Preprints

19. *Visual right-angled Artin subgroups of two-dimensional right-angled Coxeter groups*, w/Edletzberger, preprint (2024), `arXiv:2405.04817`.

Theses

20. *Quasi-isometries among tubular groups*, Ph.D. thesis, University of Illinois at Chicago, (2007).
21. *Morse, contracting, and strongly contracting sets with applications to boundaries and growth of groups*, Habilitationsschrift, University of Vienna, (2019).

Software

22. *virtuallygeometric*, w/Manning, (2014), python scripts for working with multiwords in free groups, including relative JSJ decompositions, Whitehead reduction, Stallings folding, checking virtual geometricity, `github.com/cashenchris/virtuallygeometric`.
23. *orgcensus*, (2020), census of all 1-relator groups of rank ≤ 4 and relator length ≤ 16 and accompanying python scripts, `https://www.mat.univie.ac.at/~cashen/orgcensus/`.
24. *CFS graphs*, (2024), Enumeration of isomorphism types of triangle-free CFS graphs with up to 12 vertices. Python scripts implementing results of papers of Davis-Januszkiewicz, Nguyen-Tran, Dani-Levcovitz, Edletzberger for right-angled Coxeter groups defined by CFS graphs., `https://www.mat.univie.ac.at/~cashen/CFS/`.