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# Bernhard Krön

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DOB 31 January 1972, Salzburg  
Citizenship: Austria (EU)

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## Positions held

- Ass. Prof. (“Universitätsassistent”), Univ. of Vienna, Faculty of Mathematics, since 2007/10.
- Visiting Professor at the City College of New York, City University of NY, 2009/01-2009/06.
- Marie Curie fellowship (IEF) of the European Union, Universität Hamburg (Germany) in cooperation with R. Diestel, 2006/02–2007/10.
- Erwin Schrödinger fellowship, Univ. of Sydney (Australia), in cooperation with D.I. Cartwright, 2004/03–2006/02.
- Researcher at the Medical University Innsbruck, Radiology II, 2003/03-2004/02.
- Postdoctoral research fellow of K.Schmidt in 2003/03-2004/02 and 2001/10-2002/09, C.Krattenthaler 2003/01-2003/02, both University of Vienna; H.Fleischner, Austrian Academy of Science, Vienna 2002/10–2002/12.
- Vertragsassistent (Lecturer, substitute) at Graz University of Technology 1999/10–2001/01, Tutor 2001/03–2001/07.
- Research fellow, P.J.Grabner, Graz University of Technology, 1999/06–2001/10.

## Degrees, awards

- Christian Doppler prize, the Salzburg State (Land Salzburg) science award 2006.
- PhD study in Mathematics at Graz University of Technology, thesis supervised by P.J.Grabner and W.Woess. Final examination passed with distinction (“mit Auszeichnung bestanden”); degree Dr.techn., 1999–2001.
- Study of Mathematics at the University of Salzburg; final examination passed with distinction; degree Mag.rer.nat. 1990–1998. Master’s thesis supervised by W.Woess, Università di Milano (Italy), 1996/10–1997/07.

Memberships: Austrian Math. Soc. (ÖMG); Mathematisches Seminar der Universität Hamburg.

## Fields of Research

Group actions on infinite graphs, geometric group theory and related fields in group theory, graph theory, topology and random walks. Keywords: ends of graphs (end compactifications) and groups, boundaries of graphs and groups, splitting of groups, structure tree theory, groups acting on graphs, Cayley graphs, random walks, self-similar (“fractal-like”) graphs, non-locally finite graphs, quasi-isometries and totally disconnected topological groups.

## Pre-prints

- M.J. Dunwoody, B. Krön. Vertex cuts. Available at <http://www.personal.soton.ac.uk/mjd7/Pub.html>
- B. Krön, Infinite faces and ends of almost transitive graphs, submitted. Available at <http://homepage.univie.ac.at/bernhard.kroen/>

## Articles in refereed journals

- B. Krön, R.G. Möller. Quasi-isometries between graphs and trees, *J. Combin. Theory Ser. B*, **98**, 994–1013 (2008)
- B. Krön, R.G. Möller. Free groups and ends of graphs, to appear in *Abh. Math. Sem. Univ. Hamburg*.
- B. Krön, R.G. Möller. Metric ends, fibers and automorphisms of graphs, *Math. Nachr.* **281**, no. 1 (2008), 62–74.
- B. Krön, R.G. Möller, Analogues of Cayley graphs for totally disconnected topological groups, *Math. Z.*, **258**, no. 3 (2008), 637–675.
- D.I. Cartwright, B. Krön. On Stallings’s unique factorization groups, *Bull. of the Austral. Math. Soc.* **73** (2006), no. 1, 27–36.
- B. Krön, E. Teufl. Asymptotics of the transition probabilities of the simple random walk on self-similar graphs, *Trans. Amer. Math. Soc.*, **356** (2004), 393–414.
- B. Krön. Growth of self-similar graphs, *Journal of Graph Theory*, **45**, no. 3 (2004), 224–239.
- B. Krön. Green functions on self-similar graphs and bounds for the spectrum of the Laplacian, *Ann. Inst. Fourier (Grenoble)* **52**, no. 6 (2002), 1875–1900.
- B. Krön. End compactifications in non-locally-finite graphs. *Math. Proc. Cambridge Philos. Soc.* **131** (2001), 427–443.
- B. Krön. Quasi-isometries between non-locally-finite graphs and structure trees, *Abh. Math. Sem. Univ. Hamburg* **71** (2001), 161–180.

## Theses

- B. Krön. Structural and Spectral Theory of Infinite Graphs, PhD thesis at Graz University of Technology, (2001).
- B. Krön. Topologische Strukturtheorie nicht lokalendlicher Graphen, diploma thesis, University of Salzburg, (1998).

## Work in progress

- B. Krön, N. Seifert, E. Teufl. The linear boundary of nilpotent groups.
- B. Krön, E. Teufl. A theorem of Halin for path connected Hausdorff space.
- B. Krön, J. Lehnert, M. Stein. Remarks on the linear boundary of finitely generated groups.

Longer academic stays (more than two weeks, except for conference or workshop participations and stays in Austria)

- Visting Professor position at CCNY/CUNY, spring term 2009, 2009/01–2009/06.
- Univ. of Hamburg, Marie Curie fellowship, in cooperation R. Diestel, since 2006/02.
- University of Iceland, three times visiting R.G. Möller in Reykjavik, 2006/08–2006/06, 01/2003–03/2003, 07/2001.
- University of Sydney (Australia), Erwin Schrödinger overseas fellowship, in cooperation with D.I. Cartwright, 2004/03–2006/01.
- Università di Milano (Italy), 1996/10–1997/07, Master’s Thesis under supervision of W. Woess, supported by the Italian Ministry of Foreign Affairs.

## Teaching

- University of Vienna: exercise class<sup>1</sup> on Analysis 1, two exercise classes on “Discrete Mathematics”, summer term 2009; lecture “Graphs and Groups” winter term 2008/09; lecture “Combinatorics”, summer term 2008, exercise class on “Analysis 1”, two exercise classes on “Discrete Mathematics”, winter term 07/08. Scheduled for 2009/10: lecture “Graph Theory”. Scheduled for 2010: lecture “Combinatorics”.
- CCNY/CUNY, Math 37500: Elements of Probability Theory; Math 39200: Linear Algebra and Vector Analysis for Engineers, spring term 2009.
- University of Hamburg, seminar series on “Infinite graphs and and groups”, 2006.
- Graz University of Technology (GUT): exercise cases<sup>1</sup> on “Analysis I” (one semester, 2000), “Mathematics II for Electronic Engineers” (4 semesters, 1999–2001).
- University of Salzburg, tutorials<sup>2</sup> (8 courses, each 2 hours a week) in real analysis, linear algebra, discrete mathematics and probability calculus, 8 semesters, 1995–1999.

## Conference participations and talks

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|------------------------|---|
| 2009/12/14...          | Talk at Graz University of Technology “Tree decompositions”.  |
| 2009/12/09...          | Talk at the University of Ljubljana (Slovenia) “Tree decompositions”.   |
| 2009/06/29-07/04 ..... | Alp-Workshop on “Spectral and probabilistic properties of random walks on random graphs”, St. Kathrein am Offenegg, Austria.  |
| 2009/06/30...          | Talk at the conference “Boundaries” on “Vertex cuts, ends and group splittings”.  |
| 2009/02/2....          | Talk at the NY Group Theory Seminar, “Vertex cuts”.   |
| 2008/09/15...          | Invited talk at the University of Iceland, “Vertex cuts”.   |
| 2008/08/25-27          | Groups and Infinite Graphs at the Erwin Schrödinger International Institute, Vienna, organiser.   |
| 2008/01/08...          | ARGE Discrete Mathematics, Vienna University of Technology, invited seminar talk “Vertex cuts”.   |
| 2007/12/18             | Minisymposion “Infinite graphs” Graz Univ. of Techn., invited talk “Vertex cuts”.   |
| 2007/10/14-19          | Workshop “Infinite Graphs”, Banff International Research Station, invited talk “Infinite faces and ends of almost transitive graphs”, organizing mini-workshop on “Ends and automorphisms”, Banff (Canada).                   |
| 2007/09 .....          | Joint Congress of the Slovak Union of Mathematicians and Physicists (JSMF) and the Austrian Mathematical Society (ÖMG), invited talk “Ends and automorphisms - from graph theory to topology and back”, Podbanske (Slovakia). |

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<sup>1</sup>“Übung” or “Proseminar” = Mandatory problem class, usually combined with written examinations. It is a course on its own, marks are awarded independendly of the lecture. The “Übung” is the practical part of a subject, the theoretical part is taught in a corresponding lecture.

<sup>2</sup>“Tutorium” = Non-mandatory course without marks where the instructor repeats selected parts of the lecture or explains examples.

- 2007/08 . . . . . Conference “Combinatorial group theory with applications”, talk “Infinite faces and ends of almost transitive graphs”, University of Dortmund (Germany).
- 2007/07 . . . . . Special semester, “Amenability”, part 3 “Geometric and probabilistic aspects of amenability” Erwin Schrödinger Institute (ESI), Vienna (Austria).
- 2007/06 . . . . . Special semester, “Amenability”, part 2 “Algebraic aspects of amenability” Erwin Schrödinger Institute (ESI), Vienna (Austria).
- 2007/06 . . . . . talk at the University of Southampton (UK), “Infinite faces and ends of almost transitive graphs”.
- 2007/05 . . . . . Conference “Totally disconnected Groups, Graphs and Geometry”, Heinrich-Fabrit-Institut Blaubeuren, (Germany).
- 2007/04 . . . . . Seminar at the Univ. of Hamburg (Germany), “Strukturbäume” (“structure trees”).
- 2007/03 . . . . . Special semester, “Amenability”, part 1 “Amenability beyond groups” Erwin Schrödinger Institute (ESI), talk “Analogous of Cayley graphs for topological groups”, Vienna, (Austria).
- 2007/02-03 . . . . . Workshop “Groups 007” (4 weeks), Centre International de Rencontres Mathématiques (CIRM), Luminy, Marseille (France).
- 2007/01 . . . . . Talk at Graz University of Technology (Austria) “Enden und unendliche Flächen von planaren Graphen” (“Ends and infinite faces of plane graphs”).
- 2007/01 . . . . . Talk at the University of Leoben (Austria) “Enden und unendliche Flächen von planaren Graphen”.
- 2006/12 . . . . . Talk at Vienna University of Technology (Austria), AG Diskrete Mathematik “Enden und unendliche Flächen von planaren Graphen”.
- 2006/11 . . . . . Seminar at the Univ. of Hamburg, “Ends of graphs with weak symmetry conditions and fibers”.
- 2006/11 . . . . . Talk at the University of Bielefeld (Germany), “Richtungen von Automorphismen, Freie Gruppen und Enden von Graphen” (“Directions of automorphisms, free groups and ends of graphs”).
- 2006/09 . . . . . Talk at the University of Iceland, “Infinite faces and ends of plane graphs”.
- 2006/06 . . . . . Talk at the University of Salzburg (Austria) “Enden und Flächen von unendlichen planaren Graphen”.
- 2006/05 . . . . . Seminar series at the University of Hamburg (Germany), “Unendliche Graphen und Gruppen” (“Infinite graphs and groups”).
- 2006/02 . . . . . Workshop “Infinite graphs”, University of Auckland (New Zealand), talk on “Metric ends of graphs”.
- 2005/10 . . . . . Colloquium of the Mathematical Science Institute (MSI) of the Australian National University (ANU), Canberra (Australia), “Ends of graphs”.
- 2005/09 . . . . . 49th Meeting of the Austral. Math. Soc., Univ. of Western Australia (UWA), Perth, “Different ways of going towards infinity in infinite graphs”.
- 2005/04 . . . . . Two talks at the University of Sydney (Australia), “Ends of Graphs I+II”.
- 2005/03 . . . . . Talk at the Erwin Schrödinger Institute (ESI), Vienna (Austria), “Groups acting on ends of graphs”.
- 2004/09-10 . . . . . 48th Annual Meeting of the Australian Mathematical Society in Melbourne (RMIT, Australia), talk “Free subgroups of groups acting graphs”.
- 2004/09 . . . . . Talk at the University of New South Wales (Australia), “Group actions on non-locally finite graphs”.
- 2004/08 . . . . . Talk at the University of Newcastle (Australia), School of Mathematical and Physical Sciences, “An example of a non-locally finite graph”.
- 2004/08 . . . . . Talk at the University of Sydney, School of Mathematics and Statistics, “Random walks on self-similar graphs”.
- 2003/11-12 . . . . . Two seminars at the University of Vienna (Austria), “Freie Untergruppen von Gruppen, die auf Graphen agieren II” (“Free subgroups of groups acting on graphs I+II”).
- 2003/09 . . . . . 8th meeting of the ÖMG in Bolzano (Italy) together with the SIMAI and the UMI, talk “Free subgroups of groups acting on graphs”.
- 2003/02-03 . . . . . Three talks at the University of Iceland on “Random walks on self-similar graphs”.
- 2003/01 . . . . . Talk at Vienna Univ. of Technology (Austria) “Quasiisometrien und Strukturbäume auf unendlichen Graphen” (“Quasi-isometries and structure trees on infinite graphs”).
- 2002/06 . . . . . Talk at Vienna University of Technology in the lecture series “Wissenswertes aus der Mathematik” on “Graphen als topologische Räume” (“Graphs as topological spaces”).

- 2002/05 . . . . . “Finite Markov Chains” workshop with J. Fill and L. Saloff-Coste, Math. Forschungsinstitut Oberwolfach (Germany), talk “Characteristic parameters of the simple random walk on self-similar graphs”.
- 2002/05 . . . . . Talk at the ESI Vienna (Austria), “Quasi-isometries and metric ends of graphs”.
- 2002/04 . . . . . 19th Leoben-Ljubljana Seminar on Graph Theory, Austrian Academy of Science (Vienna), talk “Quasi-isometries and metric ends”.
- 2002/03 . . . . . Talk at the University of Vienna, Department of Mathematics, “Periodische Geraden von nicht elliptischen Automorphismen auf Graphen” (“Periodic lines of non-elliptic automorphisms on graphs”).
- 2001/12 . . . . . Seminars at the University of Vienna, Department of Mathematics, “Random walks on self-similar graphs” part 1 and 2.
- 2001/12 . . . . . Talk at the University of Leoben, Department of Mathematics and Statistics, “Ends of non-locally-finite graphs”.
- 2001/11 . . . . . Defense and presentation of the PhD thesis at the GUT, talk “Ends and self-similar graphs” (“Enden und selbstähnliche Graphen”).
- 2001/11 . . . . . Talk at the ESI Vienna, “End compactifications in non-locally-finite graphs”.
- 2001/09 . . . . . 15th Congress of the Ö and the DMV in Vienna. Talk “Measuring instead of counting—metric ends in non-locally-finite graphs” (“Messen statt zählen—metrische Enden in nicht lokalendlichen Graphen”).
- 2001/06-07 . . . . . Random Walks 2001, ESI Vienna, Part 2: Random Walks and Geometry, talk “Decomposition and analytic continuation of Green functions and asymptotic transition probabilities on self-similar graphs”.
- 2001/06 . . . . . Fractals 2001, GUT, talk “Self-similar graphs and their spectrum”.
- 2001/02-03 . . . . . Random Walks 2001, ESI Vienna, Part 1: Random Walks and Statistical Physics.
- 2001/01-02 . . . . . Dynamical Systems, the dynamic odyssey, CIRM (Centre International de Rencontres Mathématiques), Marseille, talk “Julia-sets of rational functions and the spectrum of self-similar graphs”.
- 2000/09 . . . . . Congress of the DMV in Dresden, talk “The spectrum of self-similar graphs” (“Das Spektrum selbstähnlicher Graphen”).
- 2000/06 . . . . . Third European Congress of Mathematics in Barcelona.
- 2000/05 . . . . . Talk at the GUT, on “The Dirichlet problem at the boundary of the free group”.
- 1999/09 . . . . . 7th meeting of the ÖMG in Graz.
- 1998/10 . . . . . Talk at the Graz University of Technology (GUT), on “End compactifications in non-locally-finite graphs”.
- 1998/03 . . . . . Talks at the University of Salzburg, Department of Mathematics; Part 1 “End compactifications in non-locally-finite graphs”; Part 2 “Metric compactifications in non-locally-finite graphs and connected metric spaces”.
- 1997/12 . . . . . Talk at the Institute of applied Informatics at the University of Salzburg on “Methods of describing structures in non-locally-finite graphs” (“Methoden der Strukturbeschreibung in nicht lokalendlichen Graphen”).
- 1997/09 . . . . . 14th Congress of the ÖMG and the German Mathematical Society (DMV) in Salzburg.
- 1995/09 . . . . . 6th meeting of the Austrian Mathematical Society (ÖMG) in Leoben.

## Vistors in Vienna

- Piotr Przytycki, Polish Akademy of Science, ESI Junior Fellow, 2010/01/10-2010/02/28
- Martin J. Dunwoody, University of Southampton, UK, 2008/08/21-2008/08/28
- Norbert Seifter, Montanistic University of Leoben, Austria, 2008/08/05
- Maya J. Stein, Universidade de São Paulo, Brazil, 2008/07/01-2008/08/31
- Elmar Teufel Universität Bielefeld, Germany, 2007/10/01-2007/10/12
- Elmar Teufel Universität Bielefeld, Germany, 2007/12/13-2007/12/22

## Refereeing

- Journal of Combinatorial Theory, Series B
- Discrete Applied Mathematics
- Discrete Mathematics
- Monatshefte für Mathematik (book review)
- Internationale Mathematische Nachrichten, IMN (book review)
- Hacettepe Journal of Mathematics and Statistics
- Proceedings of the 32nd International Workshop on Graph-Theoretic Concepts in Computer Science (WG 2006)
- Proceedings of the Intern. Symposium on Symbolic and Algebraic Computation 2008 (ISSAC)
- M. Drmota, P. Flajolet, D. Gardy, B. Gittenberger, (editors). Mathematics and computer science III. Algorithms, trees, combinatorics and probabilities. Proceedings (Vienna 2004), Trends in Mathematics. Birkhäuser, 2004.
- P.M. Grabner, W. Woess (editors). Fractals in Graz 2001: Analysis, Dynamics, Geometry, Stochastics. Proceedings (Graz 2001), Birkhäuser, 2003.

## External funding

- Austrian academic exchange service (ÖAD), Slovenian - Austrian Co-operation, travel expenses for researchers and students, Project SI-20/2009
- Marie Curie Fellowship (Hamburg, Germany), European Union, 108.774 EUR
- Erwin Schrödinger Fellowship (Sydney, Australia), Austrian Science Fund (FWF), ca. 58.000 EUR
- Christian Doppler Prize (Salzburg State), 2.180,00 EUR
- Submitted research proposal (FWF) for one PosDoc and one PhD student (decision ca. in October '08).

## Organisation of conferences

- Organisation of the conference “Groups and Infinite Graphs” at the Erwin Schrödinger Institute (ESI), August 2008, Vienna, Austria. Information can be found at [http://homepage.univie.ac.at/bernhard.kroen/groups\\_graphs/index.html](http://homepage.univie.ac.at/bernhard.kroen/groups_graphs/index.html)
- Organisation assistance: ÖMG congress 1997 in Salzburg, ÖMG conference 1999 in Graz, “Fractals 2001” in Graz.

## Applied Mathematics and other sciences

Statistical texture analysis (using the computer programs Mazda and SPSS) for ultrasonic medical images at the University of Innsbruck, Faculty of Medicine, (2003/03–2004/02).

Study of Psychology, Philosophy and Mathematics (education) at the University of Vienna (2003/10–2004/02). Within the study of Psychology: planning, realization and statistical evaluation of an opinion poll on smoking in University buildings.

## Some other qualifications and activities

Languages: German (mother tongue), English (fluent), Italian (intermediate)

Running (2 marathons), gym, scuba diving, skiing/snowboarding, swimming and other sports.

Diploma of the First Austrian Barkeeper School. Organisation of cocktail caterings.

From 1999 to 2001, a series of articles in the Salzburg street newspaper “Asfalter” as honorary journalist and columnist.

Since 1989 drummer in several Pop- and Rock-bands (with longer breaks). Organising 3 CD-productions several and concerts, including sponsoring and advertising.

## References

1. W. Woess, Graz University of Technology, Institut für Mathematik (C), Steyrergasse 30, 8010 Graz, Austria, email: woess@weyl.math.tu-graz.ac.at
2. C. Krattenthaler, University of Vienna, Faculty of Mathematics, Nodbergstr. 15, 1090 Vienna, Austria, email: christian.krattenthaler@univie.ac.at
3. M. J. Dunwoody, Faculty of Mathematical Studies, University of Southampton, Southampton, England, SO17 1BJ, email: M.J.Dunwoody@soton.ac.uk
4. R. G. Möller, University of Iceland, Science Institute, Department of Mathematics, Dunhaga 3, IS-107 Reykjavik, Iceland, email: roggi@raunvis.hi.is

