

Curriculum Vitae - Matthias Keller

Contact information

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Personal information

Date of birth: December 31, 1980
Country of Citizenship: Germany
Marital Status: married, four children

Education

Habilitation in Mathematics (May 2015)

Friedrich Schiller University Jena, Germany,
On the analysis and geometry of graphs,
Reviewer: Jürgen Jost, Alexander Grigor'yan, Daniel Lenz, Karl-Theodor Sturm.

Ph.D. in Mathematics (December 2010)

Friedrich Schiller University Jena, Germany,
On the spectral theory of operators on trees,
Reviewer: Daniel Lenz, Simone Warzel and Richard Froese.

Diploma in Mathematics (June 2006)

Chemnitz University of Technology, Germany,
Produkte zufälliger Matrizen und der Lyapunov-Exponent,
Reviewer: Peter Stollmann and Daniel Lenz.

Academic activity

Professor (W2), University of Potsdam, since October 2015.

Fellow, Israel Institute of Advanced Studies, Jerusalem, September 2025 until June 2026.

Visiting Associate Professor, Technion Haifa, March until July 2019 and February until August 2023.

Research and teaching assistant, Friedrich Schiller University Jena, with Daniel Lenz, October 2008 until September 2015 (in between on leave for stay in Jerusalem and Haifa).

Visiting Assistant Professor, Technion Haifa, on an invitation of Yehuda Pinchover, February until March 2015.

Postdoctoral Fellow, Hebrew University Jerusalem, with Jonathan Breuer and Dan Mangoubi, February until June 2011 and October 2012 until September 2013.

Visiting Student Research Collaborator, Princeton University, with Michael Aizenman and Simone Warzel, October 2007 until May 2008.

Klaus Murmann Fellow as PhD student, Klaus Murmann Fellowship (SDW), July 2007 until June 2010.

Research associate, Chemnitz University of Technology, with Daniel Lenz and Peter Stollmann, July 2006 until June 2007.

Student assistant, Chemnitz University of Technology and Fraunhofer Institute Chemnitz, 2001 until 2006.

Grants

German Science Foundation Research Grant, *Discrete Hardy inequalities and related problems*, Middle Eastern Collaboration, (joint with Prof. Y. Pinchover and Prof. F. Pogorzelski) since October 2025.

German Science Foundation Research Grant, *Ricci Flow on Discrete Structures*, (joint with Dr. F. Münch) since October 2024.

Grant within the priority program of the German Science Foundation, *Boundaries and harmonic functions of simplicial complexes and Dirichlet spaces*, (joint with Prof. Dr. D. Lenz and Dr. M. Schmidt) since May 2020.

German Science Foundation Research Grant, *Hardy inequalities on graphs and Dirichlet spaces*, Middle Eastern Collaboration, (joint with Prof. Y. Pinchover and JProf. F. Pogorzelski) since May 2019.

German Science Foundation Research Grant, *Boundaries, Greens formulae and harmonic functions for graphs and Dirichlet spaces - follow up*, (joint with Prof. Dr. D. Lenz and Dr. M. Schmidt) since February 2018.

Grant within the priority program of the German Science Foundation, *Boundaries, Greens formulae and harmonic functions for graphs and Dirichlet spaces*, (joint with Prof. Dr. D. Lenz) since June 2017.

German Science Foundation Research Grant, *Geometry of discrete spaces and spectral theory of non-local operators*, (joint with Prof. Dr. D. Lenz) since June 2012.

Programme to support junior researchers in obtaining third-party funding Programme, Line A (Advanced), Friedrich Schiller University, *Geometry and Analysis of Graphs*, traveling grant, September 2014 until September 2016.

Short visiting grant of the European Science Foundation for stay at Technical University of Graz, July 2012.

Fellowships

Fellow and Co-organizer for a research group at the Israel Institute of Advanced Studies, Jerusalem, September 2025 until June 2026.

Swiss Professorship for a stay at the Technion Haifa, February until August 2023.

Golda Meir Fellowship, for a stay at Hebrew University Jerusalem, October 2012 until September 2013 (additional scholarship

by the Hebrew University).

Post-Doctoral Fellowship by the Hebrew University, Jerusalem, February until June 2011.

PhD Fellowship, Klaus Murmann Fellowship Programme (SDW), July 2007 until June 2010.

Research interests

Dirichlet forms and Markov processes

Functional inequalities for Schrödinger operators on graphs

Curvature and spectrum of graphs

Spectral theory of random operators

Publications and Preprints

Books

1. Graphs and Discrete Dirichlet Spaces, (with Daniel Lenz, Radoslaw Wojciechowski), Springer, Grundlehren der mathematischen Wissenschaften, 358, 2021.
2. Analysis and Geometry on Graphs and Manifolds, (co-edited with Daniel Lenz, Radoslaw Wojciechowski), London Mathematical Society Lecture Note Series, 461, 2020.

Articles and Book Chapters

3. On Landis' conjecture for positive Schrödinger operators on graphs (with Ujjal Das, Yehuda Pinchover) International Mathematics Research Notices 2025, no. 12, Paper No. rnaf151, 20 pp.
4. The space of Hardy-weights for quasilinear operators on discrete graphs (with Ujjal Das, Yehuda Pinchover), Journal of Differential Equations, 457 (2026), Paper No. 114057, 28 pp.
5. Boundary representations of intermediate forms between a regular Dirichlet form and its active main part, (with Daniel Lenz, Marcel Schmidt,

Michael Schwarz, Melchior Wirth), *Potential Analysis*, 64 (2026), no. 1, Paper No. 6, 23 pp.

6. Recurrence and transience for non-Archimedean and directed graphs (with Anna Muranova), *Mathematische Nachrichten*, 298 (2025), no. 10, 3307–3330.
7. Gaussian upper bounds, volume doubling and Sobolev inequalities on graphs (with Christian Rose), *Journal de l'École polytechnique. Mathématiques*, 13 (2026), 965–1005.
8. Gaussian upper bounds for heat kernels on graphs with unbounded geometry (with Christian Rose), *Journal of Spectral Theory*, 16 (2026), no. 2, 709–750.
9. Eigenvalue asymptotics and unique continuation of eigenfunctions on planar graphs (with Michel Bonnefont, Sylvain Golénia), *Annales de l'Institut Fourier*, 75 (2025), no. 4, 1753–1795.
10. Agmon estimates for Schrödinger operators on graphs, (with Felix Pogorzelski), *Journal d'Analyse Mathématique*, 157 (2025), no. 1, 171–209.
11. Neumann semigroup, subgraph convergence, form uniqueness, stochastic completeness and the Feller property (with Florentin Münch, Radosław K. Wojciechowski) *Journal of Geometric Analysis*, 35 (2025), no. 1, Paper No. 14.
12. Gradient estimates, Bakry-Emery Ricci curvature and ellipticity for unbounded graph Laplacians (with Florentin Münch), *Communications in Analysis and Geometry*, 32 (2024), no. 2, 343–364.
13. Capacity of infinite graphs over non-Archimedean ordered fields (with Florian Fischer, Anna Muranova, Noema Nicolussi), *Journal of Mathematical Analysis and Applications*, 543, Issue 2, Part 2, 128943.
14. Anchored heat kernel upper bounds on graphs with unbounded geometry and anti-trees (with Christian Rose), *Calculus of Variations and Partial Differential Equations* 63 (2024), no. 1, Paper No. 20, 18 pp.

15. Sobolev-Type Inequalities and Eigenvalue Growth on Graphs with Finite Measure (with Bobo Hua, Michael Schwarz, Melchior Wirth), *Proceedings of the American Mathematical Society*, 151 (2023), no. 8, 3401–3414.
16. On optimal Hardy weights for the Euclidean lattice, (with Marius Lemm), *Transactions of the American Mathematical Society*, 376 (2023), no. 9, 6033–6062.
17. Optimal Hardy Inequality for Fractional Laplacians on the Integers (with Marius Nietschmann), *Ann. Henri Poincaré* 24 (2023), no. 8, 2729–2741.
18. An Improved Discrete p -Hardy Inequality, (with Florian Fischer, Felix Pogorzelski), *Integral Equations Operator Theory* 95 (2023), no. 4, Paper No. 24, 17 pp.
19. On L^p Liouville theorems for Dirichlet forms, (with Bobo Hua, Daniel Lenz, Marcel Schmidt), in: Chen, ZQ., Takeda, M., Uemura, T. (eds) *Dirichlet Forms and Related Topics. IWDFRT 2022. Springer Proceedings in Mathematics & Statistics*, vol 394.
20. A note on eigenvalue bounds for non-compact manifolds (with Shihong Liu, Norbert Peyerimhoff), *Mathematische Nachrichten*, 294, no. 6 (2021).
21. Riesz Decompositions for Schrödinger Operators on Graphs (with Florian Fischer), *Journal of Mathematical Analysis and Applications*, 495 (2021), no. 1, 22 pp.
22. From Hardy to Rellich inequalities on graphs, (with Yehuda Pinchover, Felix Pogorzelski), *Proceedings of the London Mathematical Society*, 122 (2021), no. 3, 458–477.
23. On the uniqueness class, stochastic completeness and volume growth for graphs (with Xueping Huang, Marcel Schmidt), *Transactions of the American Mathematical Society*, 373 (2020), no. 12, 8861–8884.
24. Feynman path integrals for magnetic Schrödinger operators on infinite weighted graphs (with Batu Güneysu), *Journal d'Analyse Mathématique*, 141, pages 751–770 (2020).

25. Critical Hardy Inequalities on Manifolds and Graphs, book chapter, (with Yehuda Pinchover, Felix Pogorzelski), in *Analysis and Geometry on Graphs and Manifolds* 461, (2020) 172–202.
26. Magnetic sparseness and Schrödinger operators on graphs (with Michel Bonnefont, Sylvain Golénia, Shiping Liu, Florentin Münch), *Annales Henri Poincaré* 21 (2020), no. 5, 1489–1516.
27. Courant’s Nodal Domain Theorem for Positivity Preserving Forms (with Michael Schwarz), *Journal of Spectral Theory*, 10 (2020), no. 1, 271–309.
28. Criticality theory for Schrödinger operators on graphs (with Yehuda Pinchover, Felix Pogorzelski), *Journal of Spectral Theory*, 10 (2020), no. 1, 73–114.
29. A new discrete Hopf-Rinow theorem, (with Florentin Münch), *Discrete Mathematics*, 342 (2019), no. 9, 2751–2757.
30. Boundary representation of Dirichlet forms on discrete spaces (with Daniel Lenz, Marcel Schmidt, Michael Schwarz), *Journal de Mathématique Pure et Appliquée*, 126 (2019), 109–143.
31. Scattering the geometry of weighted graphs (with Batu Güneysu), *Mathematical Physics Analysis and Geometry*, 21, (2019) p. 21-28.
32. The Kazdan-Warner equation on canonically compactifiable graphs (with Michael Schwarz), *Calculus of Variations and Partial Differential Equations* 57 (2018), no. 2, Art. 70, 18 pp.
33. Optimal Hardy inequalities for Schrödinger operators on graphs (with Yehuda Pinchover, Felix Pogorzelski), *Communications in Mathematical Physics* 358 (2018), no. 2, 767–790.
34. An improved discrete Hardy inequality (with Yehuda Pinchover, Felix Pogorzelski) *American Mathematics Monthly*, 125 (2018), no. 4, 347–350.
35. Global properties of Dirichlet forms in terms of Green’s formula (with Sebastian Haeseler, Daniel Lenz, Jun Masamune, Marcel Schmidt), *Calc. Var. Partial Differential Equations* 56 (2017), no. 5, 56–124.

36. Geometric and spectral consequences of curvature bounds on tessellations, book chapter in *Modern Approaches to Discrete Curvature, Lecture Notes in Mathematics*, 2184, 2017.
37. Sectional curvature of polygonal complexes with planar substructures (with Norbert Peyerimhoff, Felix Pogorzelski), *Advances in Mathematics*, 307 (2017), 1070–1107.
38. General Cheeger inequalities for p -Laplacians on graphs (with Delio Mugnolo), *Nonlinear Anal.* 147 (2016), 80–95.
39. Note on uniformly transient graphs (with Daniel Lenz, Marcel Schmidt, Radosław K. Wojciechowski), *Revista Matemática Iberoamericana*, 33 (2017), no. 3, 831–860.
40. Note on short time behavior of semigroups associated to selfadjoint operators (with Daniel Lenz, Florentin Münch, Marcel Schmidt, Andras Telcs), *Bull. Lond. Math. Soc.* 48 (2016), no. 6, 935–944.
41. Geometry and spectrum of rapidly branching graphs, (with Florentin Münch, Felix Pogorzelski), *Math. Nachr.* 289 (2016), no. 13, 1636–1647.
42. A Feynman-Kac-Itô formula for magnetic Schrödinger operators on graphs (joint with Batu Güneysu, Marcel Schmidt), *Probability Theory and Related Fields* 165 (2016), no. 1-2, 365–399.
43. An overview of curvature bounds and spectral theory of planar tessellations, *Proceedings of the CIRM Meeting*, 3 nr. 1, Discrete Curvature; theory and applications (2013).
44. Eigenvalue asymptotics for Schrödinger operators on sparse graphs (with Michel Bonnefont, Sylvain Golénia), *Annales de l'Institut Fourier*, Volume 65 no. 5 (2015), 1969–1998.
45. Graphs of finite measure (with Agelos Georgakopoulos, Sebastian Haelser, Daniel Lenz, Radosław Wojciechowski), *Journal Mathématiques Pures Appliquées*, Volume 103 (2015), no. 5, 1093–1131.
46. Intrinsic metrics on graphs: A survey, *Mathematical technology of networks*, 81–119, *Springer Proceedings in Mathematics and Statistics*, Volume 128, Springer, Cham, 2015.

47. Diffusion determines the recurrent graph (joint with Daniel Lenz, Marcel Schmidt, Melchior Wirth), *Advances in Mathematics*, Volume 269, (2015), 364–398.
48. An invitation to trees of finite cone type: random and deterministic operators, (joint with Daniel Lenz and Simone Warzel), *Markov Processes and Related Fields* 21 (2015), no. 3, part 1, 557–574.
49. Cheeger inequalities for unbounded graph Laplacians (joint with Frank Bauer, Radosław Wojciechowski), *Journal of the European Mathematical Society (JEMS)*, Volume 17 (2015), no. 2, 259–271.
50. Harmonic functions of general graph Laplacians (joint with Bobo Hua), *Calculus of Variations and Partial Differential Equations*, 51 (2014), no. 1–2, 343–362.
51. On the l^p spectrum of Laplacians on graphs (joint with Frank Bauer, Bobo Hua), *Advances in Mathematics*, Volume 248, Issue 25 (2013), 717–735.
52. Note on basic features of large time behaviour of heat kernels (mit Daniel Lenz, Hendrik Vogt, Radosław Wojciechowski), *Journal für die reine und angewandte Mathematik (Crelle's Journal)*, Volume 708 (2015), 73–95.
53. A note on self-adjoint extensions of the Laplacian on weighted graphs (joint with Xueping Huang, Jun Masamune, Radosław Wojciechowski), *Journal of Functional Analysis*, Volume 265, Issue 8 (2013), 1556–1578.
54. Volume growth and bounds for the essential spectrum for Dirichlet forms (joint with Sebastian Haeseler, Radosław Wojciechowski), *Journal of the London Mathematical Society*, Volume 88, Issue 3 (2013), 883–898.
55. Volume growth, spectrum and stochastic completeness of infinite graphs (joint with Daniel Lenz, Radosław Wojciechowski), *Mathematische Zeitschrift*, Volume 274, Issue 3 (2013), 905–932.
56. Spectral analysis of certain spherically homogeneous graphs (joint with Jonathan Breuer), *Operators and Matrices*, Volume 7, Number 4 (2013), 825–847.

57. Laplacians on infinite graphs: Dirichlet and Neumann boundary conditions (joint with Sebastian Haeseler, Daniel Lenz, Radosław Wojciechowski), *Journal of Spectral Theory*, Volume 2, Issue 4, (2012) 397-432.
58. Absolutely continuous spectrum for multi-type Galton Watson trees, *Annales Henri Poincaré*, Volume 13, Issue 8 (2012), 1745-1766.
59. Absolutely continuous spectrum for random operators on trees of finite cone type (joint with Daniel Lenz and Simone Warzel), *Journal d'Analyse Mathématique* Volume 118, Issue 1, 2012 363-396.
60. On the spectral theory of trees with finite cone type (joint with Daniel Lenz and Simone Warzel), *Israel Journal of Mathematics*, Volume 194, Issue 1, (2013), 107–135.
61. Dirichlet forms and stochastic completeness of graphs and subgraphs (joint with Daniel Lenz), *Journal für die reine und angewandte Mathematik (Crelle's Journal)*, Volume 2012, Issue 666, 189-223.
62. Curvature, geometry and spectral properties of planar graphs, *Discrete & Computational Geometry*, 46, Issue 3 (2011), 500-525.
63. Generalized solutions and spectrum for Dirichlet forms on graphs (joint with Sebastian Haeseler), *Random Walks, Boundaries and Spectra, Progress in Probability*, 2011 Birkhäuser, 181-201.
64. Cheeger constants, growth and spectrum of locally tessellating planar graphs (joint with Norbert Peyerimhoff), *Mathematische Zeitschrift*, 268, Issue 3-4 (2011), 871-886.
65. Unbounded Laplacians on Graphs: Basic Spectral Properties and the Heat Equation (joint with Daniel Lenz), *Mathematical modeling of natural phenomena: Spectral Problems*, 5, No. 4 (2010), 198-224.
66. The essential spectrum of the Laplacian on rapidly branching tessellations, *Mathematische Annalen*, 346, Issue 1 (2010), 51-66.

Preprints

- 67. Eigenvalue growth of the discrete Hodge Laplacian across dimensions, (with Philipp Bartmann), preprint arXiv:2608.11170.
- 68. Optimal Hardy Inequalities for Random Walks on $\mathbb{Z}^2$, (with Philipp Hake, Felix Pogorzelski), preprint arXiv:2608.24213.
- 69. A Liouville Theorem for Domains in Graphs, (with Philipp Hake, Felix Pogorzelski, Marcel Schmidt), preprint arXiv:2607.17814.
- 70. The complex property of the boundary operator on simplicial complexes, (with Philipp Bartmann), preprint arXiv:2605.21069.
- 71. Positive Criticality and Optimal Hardy Inequality for Fractional Laplacians, (with Philipp Hake, Felix Pogorzelski), preprint arXiv:2605.19423.
- 72. Coupling of the continuum and semiclassical limit. Part I: convergence of eigenvalues, (with Lorenzo Pettinari, Christiaan van de Ven), preprint arXiv:2602.23156.
- 73. Optimal Hardy Inequality for Fractional Laplacians on the Lattice, (with Philipp Hake, Felix Pogorzelski), preprint arXiv:2601.00902.
- 74. The heat equation and independence of the spectrum of the Hodge Laplacian on ℓ^p , (with Philipp Bartmann), preprint arXiv:2602.18597.
- 75. Large deviations in mean-field quantum spin systems (with Christiaan van de Ven), arXiv:2410.08538.
- 76. On Hodge Laplacians on General Simplicial Complexes (with Philipp Bartmann), arXiv:2508.07761.
- 77. On the accretivity and m-accretivity of porous medium-type operators on graphs (with Davide Bianchi, Alberto G. Setti, Radoslaw K. Wojciechowski), preprint.
- 78. Graphs at infinity: Liouville theorems, Recurrence and Characterisation of Dirichlet forms (mit Daniel Lenz, Marcel Schmidt), preprint.

Reviewer for scientific organizations

Alexander von Humboldt-Foundation

United States-Israel Binational Science Foundation (BSF)

German Academic Exchange Service (DAAD)

German Science Foundation (DFG)

European Research Council (ERC)

Czech Science Foundation (GACR)

German Israeli Foundation for Scientific Research and Development (GIF)

SPI-Fondecyt-Chile

Reviewer for journals and book series

Acta Scientiarum Mathematicarum

Advances in Mathematics

AMS, University Lecture Notes series

Analysis and Geometry in Metric Spaces

Analysis, Mathematical Physics and Geometry

Annales Henri Poincaré

Archiv der Mathematik

Birkhäuser Operator Theory

Bulletin of the Australian Mathematical Society

Bulletin of the London Mathematical Society

Calculus of Variations and Partial Differential Equations

Cambridge University Press

Combinatorica

Communications in Analysis and Geometry

Communications in Mathematical Physics

Complex Analysis and Operator Theory

Computers in Biology and Medicine

CRC Press, Mathematics, Physics, and Life Sciences
Discrete & Computational Geometry
Discrete Mathematics
Documenta Mathematica
Electronical Journal of Probability
European Journal of Combinatorics
Filomat
Groups, Geometry, and Dynamics
Hokkaido Mathematical Journal
Integral Equations and Operator Theory
International Journal of Mathematics
Israel Journal of Mathematics
Journal for Analysis and Applications
Journal of Differential Equations
Journal of Combinatorial Theory, Series A
Journal of Differential Equations
Journal of Differential Geometry
Journal of the European Mathematical Society
Journal of Fourier Analysis and Applications
Journal of Fractional Geometry
Journal of Functional Analysis
Journal of the London Mathematical Society
Journal of Mathematical Analysis and Applications
Journal of Mathematical Physics
Journal de Mathématiques Pures et Appliquées
Journal of Physics A
Journal für die Reine und Angewandte Mathematik
Journal of Spectral Theory

Journal of Statistical Physics
 Letters in Mathematical Physics
 Linear Algebra and Its Applications
 Mathematical Physics, Analysis and Geometry
 Mathematische Annalen
 Modern Physics Letters B
 New York Journal of Mathematics
 Nonlinear Analysis: Theory, Methods & Applications
 Nonlinearity
 Operators and Matrices
 Pacific Journal of Mathematics
 Physica A
 Potential Analysis
 Proceedings of the Royal Society of Edinburgh
 Revista Matemática Iberoamericana
 Science China Mathematics
 SIAM Journal on Discrete Mathematics
 Springer Briefs
 Springer Ergebnisse der Mathematik und ihrer Grenzgebiete
 The Journal of Geometric Analysis
 Transactions of the American Mathematical Society
 Vietnam Journal of Mathematics

Organization of scientific meetings

Conference *Geometric and analytic functional inequalities on discrete spaces* at TSIMF Sanya, China, (joint with Florian Fischer, Shubham Gupta, Bobo Hua) September 2026.

Workshop Jena-Leipzig-Potsdam-Haifa *Dynamical systems, Operator theory, Graphs and Spectral theory* in Jena , (with Ram

Band, Siegfried Beckus, Daniel Lenz, Felix Pogorzelski, Marcel Schmidt), March 2025.

Oberwolfach Mini-Workshop *Hardy Inequalities in Discrete and Continuum Settings*, (joint with Elvise Berchio, Yehuda Pinchover, Luz Roncal), March 2024.

Summer school in Potsdam *Spectral theory and geometry of ergodic Schrödinger operators* (joint with Ram Band, Siegfried Beckus), July 2023.

ISEM 26, Internet seminar *Graphs and Discrete Dirichlet Spaces*, (joint with Daniel Lenz, Marcel Schmidt, Christian Seifert), 2022–2023.

Workshop on *Functional Analysis, Operator Theory and Dynamical Systems* in Potsdam (joint Siegfried Beckus, Felix Pogorzelski, Marcel Schmidt, Ram Band), September 2022

Oberwolfach Mini-Workshop *Variable Curvature Bounds, Analysis and Topology on Dirichlet Spaces*, (joint with Gilles Carron, Batu Güneysu, Kazuhiro Kuwae), December 2021.

Oberwolfach Workshop *Geometry, Dynamics and Spectrum of Operators on Discrete Spaces*, (joint with David Damanik, Tatiana Nagnibeda and Felix Pogorzelski as well as Siegfried Beckus and Marcel Schmidt), January 2021.

Two Day Workshop, *Dirichlet forms on graphs*, Friedrich Schiller University Jena, October 2020.

Oberwolfach Mini-Workshop *Recent Progress in Path Integration on Graphs and Manifolds*, (joint with Batu Güneysu, Kazumasa Kuwada, Anton Thalmeier), April 2019.

Two Day Workshop, *Dirichlet forms on graphs*, Friedrich Schiller University Jena, June 2018.

Conference *Analysis and Geometry on Graphs and Manifolds*, Potsdam University 2017.

Workshop on *Discrete Analysis*, Fudan University Shanghai, August 2016.

Workshop on *Spectral Geometry*, University of Potsdam, January 2016.

One Day Workshop, *New directions in mathematical physics and beyond*, Friedrich Schiller University Jena, January 2014.

International Conference *Fractal Geometry and Stochastics V*, in Tabarz, local organizing committee, March 2014.

Workshop *Geometric aspects of probability and geometry*, Friedrich Schiller University Jena, September 2013.

One-Day-Workshop *Schrödinger operators*, Friedrich Schiller University Jena, December 2011.

Graduate student symposium within the Summer school on 'Graphs and spectra' at Chemnitz University of Technology, July 2011.

Graduate student symposium with the Walkshop 2010 at Friedrich Schiller University Jena, September 2010.

Short research stays

Technion Haifa, Yehuda Pinchover, March/April 2024.

Graduate Center CUNY, New York City, Radoslaw Wojciechowski, February 2024.

University of Tübingen, Marius Lemm, December 2022.

Graduate Center CUNY, New York City, Radoslaw Wojciechowski, October 2022.

University of Insubria, Como, Alberto Setti, July 2022.

Graduate Center CUNY, New York City, Radoslaw Wojciechowski, January 2020.

Technion Haifa, Yehuda Pinchover, Research Semester March-July 2020.

Technion Haifa, Yehuda Pinchover, March/April 2018.

Technion Haifa, Yehuda Pinchover and Felix Pogorzelski, April 2017.

Remnin University Beijing, Yong Lin, August 2016.

Fudan University, Bobo Hua, August 2016.

Graduate Center CUNY, New York City, Radoslaw Wojciechowski, May 2016.

Technion Haifa, Yehuda Pinchover, March 2016.

Tohoku University, Sendai, Japan, Jun Masamune, April 2015.

Université de Carthage, Bizerte Tunisia, Nabila Torki-Hamza, March 2014.

University of Toronto, Balint Virag, March 2013.

Harvard University, group of Shing-Tung Yau, March 2013.

University of Connecticut, group of Alexander Teplayev, February 2013.

Graduate Center CUNY, New York City, Jozef Dodziuk and Radoslaw Wojciechowski, February 2013.

Max-Planck-Institut Leipzig, group of Jürgen Jost, August 2012.

Chemnitz University of Technology, groups of Peter Stollmann and Ivan Veselic, July 2012.

Graz University of Technology, group of Wolfgang Woess, July 2012.

Université Bordeaux 1, Sylvain Golénia, May 2012.

Max-Planck-Institut Leipzig, group of Jürgen Jost, May 2012.

Hebrew University Jerusalem, Jonathan Breuer and Dan Mangoubi, December 2011.

Bielefeld University, group of Alexander Grigor'yan, November 2011.

Munich University of Technology, group of Simone Warzel, July 2011.

Universität Bielefeld, group of Alexander Grigor'yan, Dezember 2010.

Humboldt University Berlin, group of Jochen Brüning, December 2010.

University of Lisbon, Group of Mathematical Physics Jean-Claude Zambrini, November 2009.

Bielefeld University, group of Michael Baake, December 2008.

Graz University of Technology, group of Wolfgang Woess, November 2008.

Graduate Center New York City University, group of Jozef Dodziuk, May 2008.

Munich University of Technology, Simone Warzel, October 2008.

Durham University, Norbert Peyerimhoff, September 2007.

Invitations to conferences

September 2026, Workshop at BIRS Banff, *Nonlinear Diffusion and related PDEs in (non) Euclidean Settings, Optimal Hardy inequalities for the fractional Laplacian.*

August 2026, International Congress of Basic Science, Beijing, *Optimal Hardy inequalities for the fractional Laplacian.*

June 2025, Conference in Cornell *Fractals 8th, Gaussian upper heat kernel bounds and Sobolev inequalities on graphs.*

September 2024, Conference in Olsztyn, *10th Congressio-Mathematica, On Landis Conjecture on Graphs.*

June 2024, Conference at Institut Mittag-Leffler, *Quantum Dynamics and Spectral Theory, On Landis Conjecture on Graphs.*

May 2024, Workshop at BCAM Bilbao, *Factional Calculus, Probability and Non-local Operators, Optimal Hardy inequality for the factional Laplacian and beyond.*

July 2023, International Congress of Basic Science, Beijing, *From Hardy to Rellich inequalities on graphs.*

February 2023, Spring School at Braude College, Israel, *Geometric Methods for Data Analysis, Dirichlet forms on graphs, intrinsic metrics and the heat equation.*

November 2022, Conference at ESI Vienna, *Spectral Theory of Differential Operators in Quantum Theory, From Hardy to Rellich inequalities and Agmon estimates on graphs.*

May 2021, Conference *Probability and Analysis 2021, From Hardy to Rellich inequalities and Agmon estimates on graphs.*

February 2021, Online Workshop Hagen, *Variational methods on graphs and networks, From Hardy to Rellich inequalities and Agmon estimates on graphs.*

October 2019, Oberwolfach Mini-Workshop *Self-adjoint Extensions in New Settings, Dirichlet forms and boundaries of graphs II.*

September 2019, 6th Najman Conference on Spectral Theory and Differential Equations, Sveti Martin na Muri, *Optimal Hardy inequalities on graphs.*

June 2019, Conference Technion Haifa, *Geometric aspects of harmonic analysis and spectral theory, Discrete spectrum for graphs.*

January 2019, Mittag-Leffler-Institute, Stockholm, *Spectral Methods in Mathematical Physics, On optimal Hardy inequalities on graphs.*

September 2018, Summer school *Generalized Curvatures Gen-Curv2018*, EPFL Lausanne, *Upper curvature bounds and spectral theory.*

January 2018, Dodziuk Fest, CUNY, *On Cheeger inequality for graphs.*

November 2017, ZiF Bielefeld, *Workshop – Discrete and continuous models in the theory of networks, Optimal Hardy inequalities on graphs.*

October 2017, Bordeaux *Journées du GDR AFHP, Optimal Hardy inequalities on graphs.*

March 2017, TSIMF Sanya China *Curvatures of Graphs, Simplicial Complexes and Metric Spaces Workshop,, Sectional curvature of polygonal complexes with planar substructures.*

February 2017, Bielefeld University, *IRTG Workshop, Optimal Hardy inequalities on graphs.*

August 2016, Fudan University Shanghai, *Discrete Analysis, On compactifications of graphs.*

August 2016, Euler Institute St. Petersburg, *OTAMP 2016, Optimal Hardy inequalities on graphs.*

July 2016, University of Bielefeld, *Heat kernels and analysis on manifolds and fractals, On compactifications of graphs.*

January 2016, CIRM Luminy, *Spectrum of Random Graphs, Does diffusion determine the geometry of a graph?.*

June 2015, BIRS Banff, *Groups, Graphs and Stochastic Processes, On the compactification of graphs ... the Royden compactification revisited.*

February 2015, Oberwolfach Workshop *Discrete p -Laplacians: Spectral Theory and Variational Methods in Mathematics and Computer Science, On Cheeger's inequality for graphs.*

January 2015, Oberwolfach Workshop *Spectral Theory and Weyl Functions, Cheeger inequalities for unbounded graph Laplacians.*

October 2014, Conference Bordeaux *Spectral Theory and Its Applications, Intrinsic metrics on graphs.*

September 2014, Meeting *Mathematical Physics in Jena, Absolutely continuous spectrum of Galton-Watson trees.*

March 2014, Conference *Fractal Geometry and Stochastics V* in Tabarz, *Cheeger's inequality for unbounded graph Laplacians.*

March 2014, Cours pour Doctorants, Université de Carthage, Bizerte Tunisia, *L^p Spectrum of Graphs.*

March 2014, Journée-Workshop *Géométrie et Analyse sur les Graphes*, Université de Carthage, Bizerte Tunisia, *Curvature and Spectrum on Tessellating Graphs.*

December 2013, Conference on *Mathematical Technology of Networks - QGraphs 2013*, ZiF Bielefeld, *Intrinsic metrics on graphs.*

November 2013, *A colloquium on discrete curvature*, C.I.R.M. Luminy, *On the spectral theory of negatively curved planar graphs.*

September 2013, Fall school *Dirichlet forms, operator theory and mathematical physics* Chemnitz, Minicourse *Dirichlet forms on graphs.*

July 2013, LMS Symposium, *Graph Theory and Interactions*, Durham, *On negative curvature and spectrum of graph Laplacians.*

September 2012, *Workshop on Probability*, Kansai University Osaka, *Large time behavior of heat kernels*.

September 2012, Conference *Stochastic Analysis and Applications*, Okayama, *Essential spectra and volume growth of regular Dirichlet forms*.

August 2012, Conference *Spectral Theory and Differential Operators*, Graz, *Volume growth and spectra of Dirichlet forms*.

January 2012, Oberwolfach Mini-Workshop *Boundary Value Problems and Spectral Geometry*, *Curvature and spectrum on graphs*.

October 2011, Oberwolfach Workshop *Correlations and Interactions for Random Quantum Systems*, *Absolutely continuous spectrum on trees*.

September 2011, BMS Summer School *Random motion and random graphs*, Berlin, *Absolutely continuous spectrum for multi-type Galton Watson trees*.

September 2010, Walkshop and PhD Symposium, Jena, *On the spectral theory of trees and tessellations*.

September 2010, *QMath 11*, Hradec Kralove, *Absolutely continuous spectrum for substitution trees*.

July 2010, Workshop *Analysis on Graphs and its Applications*, Isaac Newton Institute for Mathematical Sciences Cambridge, *Absolutely continuous spectrum for trees of finite forward cone type*.

June 2010, Workshop *Random Schrödinger operators*, Lausanne CIB, *Stability of ac spectrum: Contraction properties of the recursion relation*.

May 2010, AIMS Conference *Dynamical Systems, Differential Equations and Applications*, Dresden, *Stability of ac spectrum under random perturbations on trees*.

September 2009, *Walkshop*, Chemnitz, *Dirichlet forms on discrete sets and absence of essential spectrum*.

July 2009, Workshop *Structure and Dynamics of Networks*, Blaubeuren, *Heat transport to the boundary on discrete graphs*.

July 2009, *Alp-Workshop*, St. Kathrein, *Random trees and absolutely continuous spectrum*.

June 2009, Workshop *Boundaries*, Graz, *Heat transport to the boundary*.

November 2008, Workshop *Structural Probability*, Erwin-Schrödinger-Institut Wien, *The Laplacian (plus potential) on trees and rapidly branching graphs*.

Seminars and Colloquia

December 2025, Technion Haifa Kolloquium, *Optimal Hardy inequalities on the Euclidean lattice*.

May 2025, Friedrich-Alexander Universität Erlangen-Nürnberg, Seminar Mathematical Physics, *On Landis Conjecture for Positive Schrödinger Operators on Graphs*.

December 2024, Bielefeld, Seminar Geometric Analysis, *Gaussian upper heat kernel bounds and Sobolev inequalities on graphs*

April 2024, Technion Haifa, PDE Seminar *On Landis Conjecture on Graphs*.

May 2023, Technion Haifa, PDE Seminar *On Gaussian Heat Kernel Bounds on Graphs with Unbounded Geometry*.

April 2023, Hebrew University Jerusalem, Analysis Seminar, *On Gaussian Heat Kernel Bounds on Graphs with Unbounded Geometry*.

November 2021, Tübingen, Seminar Mathematical Physics, *Agmon Estimates on Graphs*.

November 2021, Dortmund, Oberseminar Mathematical Physics, *Agmon Estimates on Graphs*.

October 2021, Leipzig, *Graphs and discrete Dirichlet spaces - an introduction*.

June 2021, Regensburg, Oberseminar Global Analysis and Geometry, *Graphs and discrete Dirichlet spaces - an introduction*.

July 2019, Brauder College, *Improving Hardy's inequality*.

June 2019, Technion Haifa, Colloquium, *Stochastic completeness, uniqueness class and volume growth of graphs*.

May 2019, Hebrew University Jerusalem, PDE Seminar, *Path integral representations for magnetic Schrödinger operators on graphs*.

April, 2019, Technion Haifa, PDE and Applied Mathematics Seminar, *Path integral representations for magnetic Schrödinger operators on graphs*.

December 2018, University Leipzig, Functional Analysis Seminar, *Stochastic completeness, uniqueness class and volume growth of graphs*.

May 2018, University of Potsdam, GAMS Seminar, *Hardy inequalities on graphs*.

April 2018, Technion Haifa, PDE Seminar, *On Courant's nodal domain theorem for positivity preserving forms*.

July 2017, Universität Greifswald, Colloquium, *Curvature on graphs*.

April 2017, Technion Haifa, PDE Seminar, *Schrödinger operators on sparse graphs*.

March 2016, Technion Haifa, PDE Seminar, *Compactifications of graphs and the Dirichlet problem*.

November 2015, Potsdam University Differential Geometry Seminar, *Intrinsic metrics on graphs*.

June 2015, Bonn University Probability Seminar, *Intrinsic metrics on graphs*.

May 2015, Tohoku University Sendai, Geometry and Analysis Seminar, *Intrinsic metrics on graphs*.

April 2015, FSU Jena, Habilitation Defense, *Über die Geometrie und Analysis auf Graphen*.

March 2015, Technion Haifa, PDE and Applied Mathematics Seminar, *Does diffusion determine the geometry of a graph?*

March 2015, Hebrew University Jerusalem, PDE Seminar, *Compactifications of uniformly transient graphs*.

December 2014, Seminar Hagen University, *Schrödinger operators on sparse graphs*.

November 2014, Seminar Bielefeld University, *On the analysis and geometry on graphs*.

May 2014, Seminar Jena University, *Intrinsic metrics on graphs*.

May 2014, Seminar Ulm University, *Analysis and geometry on graphs*.

May 2013, Friedrich Schiller University Jena, PhD Seminar, *Negative curvature and spectrum of graphs*.

March 2013, University of Toronto, Special lecture, *Isoperimetric inequalities on graphs*

March 2013, University of Toronto, Toronto Probability Geometry Seminar, *Absolutely continuous spectrum of Galton-Watson trees*

March 2013, Harvard University, Differential Geometry Seminar, *Intrinsic metrics for Laplacians on graphs*

February 2013, University of Connecticut, Analysis and Probability Seminar, *Graphs of unbounded geometry and intrinsic metrics*

February 2013, Graduate Center CUNY, NY, Differential Geometry Seminar, *Spectral consequences of upper curvature bounds on planar graphs*

January 2013, PDE and Applied Mathematics Seminar, Technion Haifa, *Isoperimetric inequalities and volume growth estimates for unbounded graph Laplacians*

December 2012, Colloquium, University of Haifa, *Periodic and random Schrödinger operators on trees*

November 2012, PDE Seminar Jerusalem, *Cheeger inequalities and volume growth for unbounded graph Laplacians*

August 2012, Max Planck Institute Leipzig, Special Seminar, *Geometric and spectral consequences of upper curvature bounds on planar graphs*.

July 2012, Chemnitz University of Technology, Research seminar Analysis, Stochastik und Mathematische Physik, *Anti-trees - the perfect (counter)example*.

July 2012, Friedrich Alexander University Erlangen, *Negative curvature and discrete spectrum for graphs*.

July 2012, Graz University of Technology, Seminar Mathematische Strukturtheorie, *Stability of spectral types for Galton Watson trees*.

May 2012, Université Bordeaux 1, Séminaire Analyse, *On the spectral theory of operators on trees*.

May 2012, Max Planck Institute Leipzig, Special Seminar, *Negative curvature and spectrum of graph Laplacians*.

December 2011, Hebrew University Jerusalem, PDE Seminar, *Absolutely continuous spectrum for Galton Watson trees*.

November 2011, Clausthal University of Technology, Oberseminar Analysis und Spektraltheorie, *Dirichlet forms on graphs*.

May 2011, Technion Haifa, PDE and Applied Mathematics Seminar, *On the long time behavior of heat kernels*.

April 2011, Weizmann Institute Rehovot, Geometric Functional Analysis & Probability Seminar, *Absolutely continuous spectrum for trees*.

March 2011, Hebrew University Jerusalem, PDE Seminar, *Curvature and spectrum for graphs*.

December 2010, Friedrich Alexander University Erlangen, *Absolutely continuous spectrum for trees*.

December 2010, Bielefeld University, Seminar Geometric Analysis, *Curvature and spectrum for graphs*.

November 2010, Friedrich Schiller University Jena, Seminar Analysis, Geometrie und Stochastik, *Planar graphs of non-positive curvature*.

June 2010, Humboldt University Berlin, Seminar Geometrische Analysis und Spektraltheorie, *Cheeger constants, exponential growth and spectrum of planar graphs*.

June 2010, Chemnitz University of Technology, Research seminar Analysis, Stochastik und Mathematische Physik, *Cheeger constants, exponential growth and spectrum of planar graphs*.

May 2010, Friedrich Schiller University Jena, Seminar Analysis, Geometrie und Stochastik, *Discrete Spectrum for Schrödinger operators on graphs*.

January 2010, Friedrich Schiller University Jena, Seminar Analysis, *Cheegerkonstanten, exponentielles Wachstum und Spektrum von planaren Graphen*.

November 2009, University of Lisbon, Seminar of Mathematical Physics, *Cheeger constants, exponential growth and spectrum of planar graphs*.

October 2009, Hebrew University Jerusalem, PDE Seminar, *Trees of finite vertex type and absolutely continuous spectrum*.

December 2008, Bielefeld University, Seminar Mathematik in den Naturwissenschaften, *The Laplacian on rapidly branching graphs*.

November 2008, Graz University of Technology, Seminar Mathematische Strukturtheorie, *The Laplacian on rapidly branching graphs*.

November 2008, Wien University, Seminar Analysis, *The Laplacian on rapidly branching graphs*.

October 2008, Ludwig Maximilian University Munich, Seminar Analysis und Zufall, *The Laplacian on rapidly branching graphs*.

April 2008, Houston Rice University, Geometry-Analysis Seminar, *The Laplacian on rapidly branching graphs*.

February 2008, Graduate Center CUNY, NY, Differential Geometry Seminar, *The Laplacian on rapidly branching graphs*.

September 2007, Durham University, Geometry Seminar, *Spectral properties of rapidly branching graphs*.

Supervision and Co-supervision

Siegfried Beckus, 2018-2020 (University teaching position, tenured since 2020).

Christian Rose, since 2021 (DFG).

Noema Nicolussi, 2020, 2022 (Marietta Blau and Erwin Schrödinger scholarship).

Moritz Gerlach, 2015-2017 (University teaching position).

PhD

Xinrong Zhao, *Topic on Discrete Ricci Flow*, PhD ongoing, visiting as a CRC student.

Yannik Thomas, *Topic in Spectral Theory and Dynamical Systems*, PhD ongoing.

Matti Richter, *Topic on Asymptotic Formulas of the Heat Kernel*, PhD ongoing.

Philipp Bartmann, *Topic on the Riesz Transform and Simplicial Complexes*, PhD ongoing.

Florian Fischer, *Topic on discrete Hardy inequalities*, PhD 2023.

Florentin Münch, *Discrete Ricci curvature, diameter bounds and rigidity*, PhD, 2019 (Michelson Prize for best dissertation).

Michael Schwarz, *Nodal Domains and Boundary Representation for Dirichlet Forms*, PhD, 2020.

Master

Matti Richter, *Positive Generalised Eigenfunctions and the Heat Equation on Graphs with Nilpotent Group Actions*, Master 2023.

Florian Fischer, *Riesz Decompositions and Martin Compactification Theory for Schrödinger Operators on Graphs*, Master 2018 (Prize at DMV Students' Conference).

Christian Scholz, *Boundary conditions and resolvent limits of graphs*, Master 2017.

Florentin Münch, *Li-Yau inequalities on graphs*, Master 2014 (Exam's Prize at the FSU, Main Prize at DMV Students' Conference).

Bachelor

Tilmann Beyer *Topic on the Wave Equation on Graphs*, since 2025.

Jakob Heidrich *Topic on One Dimensional Hardy Inequalities*, Bachelor 2026.

Robert Müller, *Topic on Gromov hyperbolicity*, Bachelor 2023.

Matthias Böhl, *On Upper Bounds for the First Eigenvalue on Surfaces and Planar Graphs*, Bachelor 2022.

Marius Nietschman, *Hardy Inequality for Fractional Laplacians on the Integers*, Bachelor 2022 (BMG Prize).

Wiebke Hanl, *Graphs, Markov Processes and Markov Semigroups*, Bachelor 2021.

Matti Richter, *Harmonic functions on graphs with a group action*, Bachelor 2020 (Leopold-von-Buch-Prize for best Bachelor thesis).

Jonas Grünberg, *Mean field equations on canonically compactifiable graphs*, Bachelor 2019.

Sarah Burchert, *The Puisseux expansion*, Bachelor 2017 (BMG Prize).

Katja Ohde, *Geometry of rapidly growing graphs*, Bachelor 2016.

Melchior Wirth, *Does diffusion determine the graph structure?*, Bachelor 2013.

Oliver Siebert, *Spectra of lamplighter random walks associated with percolation*, Bachelor 2013.

Florentin Münch, *Ultra metric Cantor sets and boundaries of trees*, Bachelor 2012.

Teaching experience

Lecture *Analysis I*, winter semester 2026/27.

Lecture *Analysis on Graphs*, winter semester 2026/27.

Seminar *Operator Semigroups*, winter semester 2026/27.

Lecture *Functional Analysis II*, summer semester 2025.

Seminar *Schrödinger Operators and Eigenvalues*, summer semester 2025.

Lecture *Functional Analysis*, winter semester 2024/25.

Lecture *C*-Algebras*, winter semester 2024/25.
 Seminar *Spectral Graph Theory*, summer semester 2024.
 Lecture *Analysis IV*, summer semester 2024.
 Lecture *Analysis III*, winter semester 2023/24.
 Lecture *Analysis on Graphs*, winter semester 2023/24.
 Lecture *Partial Differential Equations I*, winter semester 2022/23.
 Lecture *Analysis on graphs II*, winter semester 2022/23.
 Lecture *Simplicial Complexes*, summer semester 2022.
 Seminar *Random operators*, winter semester 2021/22.
 Lecture *Analysis on graphs*, winter semester 2021/22.
 Seminar *Dirichlet forms on discrete spaces*, winter semester 2021/22.
 Lecture *Functional Analysis II*, summer semester 2021.
 Seminar *Hardy inequalities*, summer semester 2021.
 Lecture *Functional Analysis*, winter semester 2020/21.
 Seminar *Analysis on graphs*, winter semester 2020/21.
 Lecture *C*-algebras*, summer semester 2020.
 Lecture *Analysis IV for mathematicians*, summer semester 2019/20.
 Lecture *Analysis III for mathematicians*, winter semester 2019/20.
 Lecture *Mathematics for computer scientists in economics*, winter semester 2019/20.
 Seminar *From functional inequalities to heat kernels* winter semester 2019/20.
 Lecture *Analysis on graphs*, winter semester 2018/19.
 Lecture *Mathematics for computer scientists*, winter semester 2018/19.
 Lecture *Analysis III for mathematicians*, winter semester 2017/18.
 Seminar *Choquet theory* winter semester 2017/18.
 Lecture *Mathematics for computer scientists*, winter semester 2017/18.
 Lecture *Analysis II for mathematicians*, summer semester 2017.
 Seminar *Heat kernels on graphs* summer semester 2017.

Lecture *Analysis I for mathematicians*, winter semester 2016/17.

Lecture *C*-algebras*, winter semester 2016/17.

Lecture *Simplicial complexes*, summer semester 2016.

Lecture *Analysis on graphs*, winter semester 2015/16.

Lecture *Mathematics for computer scientists in economics*, winter semester 2015/16.

Lecture *Analysis I for physicists*, summer semester 2015.

Lecture *Analysis II for mathematicians and physicists*, winter semester 2014/15.

Tutorial *Analysis II for mathematicians and physicists*, summer semester 2014.

Lecture *Topics in operator theory* (2 hours per week), winter semester 2013/14.

Tutorial *Analysis I for mathematicians*, winter semester 2013/14.

Lecture *Applications of operator theory* (4 hours per week), summer semester 2012.

Tutorial *Analysis III for mathematicians*, Tutorial *Analysis III for physicists*, winter semester 2011/12.

Tutorial *Analysis I for mathematicians*, winter semester 2010/11.

Tutorial *Analysis III for physicists*, winter semester 2009/10.

Tutorial *Analysis II for physicists*, Seminar *Random Schrödinger Operators*, summer semester 2009.