

# Stefan Steinerberger

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CONTACT INFORMATION DL 456, Department of Mathematics  
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RESEARCH INTERESTS I am interested in Mathematical Analysis and Applications (broadly interpreted).

EMPLOYMENT **7/2017** – : Tenure-Track Assistant Professor, Yale University  
**7/2014 - 6/2017**: Gibbs Assistant Professor, Yale University  
**12/2013 - 06/2014**: Postdoc, Mathematical Institute, Universität Bonn

EDUCATION **10/2010 -11/2013**: Ph.D., Mathematical Institute, Universität Bonn  
*Geometric Structures arising in Partial Differential Equations* with Herbert Koch  
**2009 - 2010**: M.Sc., Johannes Kepler Universität Linz, Austria  
Thesis in Number Theory with Friedrich Pillichshammer  
**2006 - 2009**: B.Sc., Johannes Kepler Universität Linz, Austria

## AWARDS AND GRANTS

- Alfred P. Sloan Fellow (2018)
- (2018 – 2021): Standard NSF Grant DMS-1763179 [\$207.742]
- US Junior Oberwolfach Fellow 2017
- Grant, Institute of New Economic Thinking, joint with Jakob Kapeller (JKU Linz) and Carlo d’Ippoliti (Sapienza Rome), 2015–2017 [\$145.000]
- AMS Travel Grant 2015–2017
- 2015 Young Scientist Award, Governor of Upper Austria
- US Junior Oberwolfach Fellow 2015
- 2014 Distinguished Paper Award, *Annales Henri Poincaré*
- Oberwolfach Leibniz Graduate Student (twice in 2013, once in 2014)
- Kapp Prize, European Association for Evolutionary Political Economy 2013
- Felix Hausdorff Doctoral Scholarship (Bonn Intl. Graduate School), 2010–2013
- Award of Excellence (awarded annually to 50 graduates of all Universities and Technical Colleges), Austrian Ministry of Science, 2010

## PUBLICATIONS

1. A forgotten Theorem of Schönberg on one-sided integral averages, arXiv:1901.04953
2. Poissonian Pair Correlation in Higher Dimensions, arXiv:1812.10458
3. (with Jianfeng Lu and Chris Sogge) Approximating Pointwise Products of Laplacian Eigenfunctions, arXiv:1811.10447
4. A Nonlocal Transport Equation Describing Roots of Polynomials Under Differentiation, arXiv:1811.04844
5. Quantitative Homogenization and Convergence of Moving Averages, arXiv:1810.13190
6. (with Raphy Coifman), A Remark on the Arcsine Distribution and the Hilbert transform, arXiv:1810.10128
7. (with Trevor Richards) Leaky Roots and Stable Gauss-Lucas Theorems, arXiv:1810.03050
8. (with Peter W. Jones) Localization of Neumann eigenfunctions near irregular boundaries, *Nonlinearity*, accepted.

9. A metric Sturm-Liouville theory in two dimensions, arXiv:1809.01044
10. The Hermite-Hadamard inequality in higher dimensions, arXiv:1808.07794
11. (with Hau-tieng Wu) On Zeroes of Random Polynomials and Applications to Unwinding, arXiv:1807.05587
12. (with Eric Chi) Recovering Trees with Convex Clustering, arXiv:1806.11096
13. A Stability Version of the Gauss-Lucas Theorem and Applications, *J. Aust. Math. Soc.*, accepted.
14. A Compactness Principle for Maximizing Smooth Functions over Toroidal Geodesics, *Bull. Aust. Math. Soc.*, accepted.
15. (with Jakob Kapeller and Matthias Aistleitner) Citation Patterns in Economics and Beyond: Assessing the Peculiarities of Economics from Two Scientometric Perspectives, *Science in Context*, accepted.
16. (with Alex Cloninger) On the Dual Geometry of Laplacian Eigenfunctions, *Experimental Mathematics*, accepted.
17. Electrostatic Interpretation of Zeros of Orthogonal Polynomials, *Proc. Amer. Math. Soc.*, accepted.
18. An Endpoint Alexandrov Bakelman Pucci Estimate in the Plane, *Canad. Math. Bull.*, accepted.
19. Quantitative Projections in the Sturm Oscillation Theorem, arXiv:1804.05779
20. (with Jianfeng Lu and Matthias Sachs) Quadrature Points via Heat Kernel Repulsion, arXiv:1804.02327
21. Wasserstein Distance, Fourier Series and Applications, arXiv:1803.08011
22. (with George Linderman) Numerical Integration on Graphs: where to sample and how to weigh, arXiv:1803.06989
23. Generalized Designs on Graphs: Sampling, Spectra, Symmetries, arXiv:1803.02235
24. (with Dmitriy Bilyk and Feng Dai), General and Refined Montgomery Lemmata, *Math. Ann.*, accepted
25. A Sharp Estimate for Probability Distributions, arXiv: 1801.00663
26. (with G. Linderman, M. Rachh, J. Hoskins, Y. Kluger), Efficient Algorithms for t-distributed Stochastic Neighborhood Embedding, *Nature Methods*, accepted.
27. On the Spectral Resolution of Products of Laplacian Eigenfunctions, *Journal of Spectral Theory*, accepted.
28. (with S. Johnson), The Universal Aesthetics of Mathematics, *Math. Intelligencer* and COGSCI 2018
29. (with J. Lierl) A Local Faber-Krahn inequality and Applications to Schrödinger's Equation, *Comm. PDE*, accepted.
30. Varadhan Asymptotics for the Heat Kernel on Finite Graphs, arXiv:1801.02183
31. (with G. Linderman, G. Mishne, Y. Kluger), Randomized Near Neighbor Graphs, Giant Components, and Applications in Data Science, arXiv:1711.04712
32. Poissonian Pair Correlation and Discrepancy, *Indag. Math.*, accepted.
33. (with Jianfeng Lu), Detecting localized eigenstates of linear operators, *Res. Math. Sci.*, accepted.
34. Spectral Limitations of Quadrature Rules and Generalized Spherical Designs, arXiv:1708.08736
35. Oscillatory functions vanish on a large set, arXiv:1708.05373

36. Exponential Sums and Riesz Energies, *Journal of Number Theory*, accepted.
37. (with Jakob Kapeller) Stability, Fairness and Random Walks in the Bargaining Problem, *Physica A*, accepted.
38. (with Nick Marshall) Triangles capturing many lattice points, *Mathematika*, accepted.
39. (with George Linderman) Clustering with t-SNE, provably, arXiv:1706.02582
40. (with SMALL 2016), On algorithms to calculate integer complexity, *Integers*, accepted.
41. (with Florian Pausinger) Heating a Room with Number Theory, to appear in *Mathematics Magazine*
42. (with Jakob Kapeller and Matthias Aistleitner) The Power of Scientometrics and the Development of Economics, *Journal of Economics Issues*, accepted.
43. (with Xiuyuan Cheng and Gal Mishne) The Geometry of Nodal Sets and Outlier Detection, *Journal of Number Theory*, accepted.
44. Topological Bounds for Fourier coefficients and Applications to Torsion, *Journal of Functional Analysis*, accepted.
45. (with Noah Kravitz) Ulam Sequences and Ulam Sets, *Integers*, accepted.
46. (with Florian Pausinger and Manas Rachh) Optimal Jittered Sampling for two points in the unit square, *Stat.Prob. Lett.*, accepted.
47. (with Uri Shaham) Stochastic Neighbor Embedding separates well-separated clusters, arXiv:1702.02670
48. (with Bogdan Georgiev and Mayukh Mukherjee), The van den Berg conjecture in two dimensions, *Potential Analysis*, accepted.
49. (with Jianfeng Lu), A Variation on the Donsker-Varadhan Inequality for the Principal Eigenvalue, *Proceedings of the Royal Society A*, accepted.
50. (with Xiuyuan Cheng and Manas Rachh), On the Diffusion Geometry of Graph Laplacians and Applications, *Applied and Computational Harmonic Analysis*, accepted.
51. Well-distributed great circles on  $\mathbb{S}^2$ , *Discrete & Computational Geometry*, accepted.
52. Fast Escape in Incompressible Vector Fields, *Monatshefte Math.*, accepted.
53. Localized Quantitative Criteria for Equidistribution, *Acta Arithmetica*, accepted.
54. An amusing sequence of functions, *Mathematics Magazine*, accepted.
55. (with Raphy Coifman and Hau-tieng Wu), Carrier frequencies, holomorphy and unwinding, *SIAM J. Math. Anal.*, accepted.
56. (with Roy Lederman) Stability Estimates for Truncated Fourier and Laplace Transforms *Integral Equations and Operator Theory*, accepted.
57. (with Alex Cloninger) On Suprema of Autoconvolutions with an Application to Sidon sets, *Proc. Amer Math. Soc.*, accepted.
58. (with Alex Cloninger), Spectral Echolocation via the Wave Embedding, *Applied and Computational Harmonic Analysis*, accepted.
59. Refined Heinz-Kato-Löwner inequalities, *Journal of Spectral Theory*, accepted.
60. (with Yuke Li, Tianhao Wu and Nicholas Marshall) Extracting Geography from Trade Data, *Physica A*, accepted.

61. (with Diogo Oliveira e Silva) Hermite polynomials, linear flows on the torus, and an uncertainty principle for roots, *Journal of Mathematical Analysis and Applications*, accepted.
62. (with Manas Rachh), On the location of maxima of solutions of Schrödinger's equation, *Comm. Pure Appl. Math.*, accepted
63. (with Jakob Kapeller) Emergent phenomena in scientific publishing: a simulation exercise, *Research Policy*, accepted.
64. (with Markus Faulhuber) Optimal Gabor frame bounds for separable lattices and estimates for Jacobi theta functions, *Journal of Mathematical Analysis and Applications*, accepted.
65. Localization of Quantum States and Landscape Functions, *Proceeding of the American Mathematical Society*, accepted.
66. (with Raphy Coifman), Nonlinear phase unwinding of functions, *Journal of Fourier Analysis and Applications*, accepted.
67. A Hidden Signal in the Ulam Sequence, *Experimental Mathematics*, accepted.
68. (with Alberto Enciso and Daniel Peralta-Salas) Prescribing the nodal set of the first eigenfunction in each conformal class, *IMRN*, accepted.
69. Directional Poincaré inequalities along mixing flows, *Arkiv foer Matematik*, accepted.
70. A Rigidity Phenomenon for the Hardy-Littlewood maximal function, *Studia Mathematica*, accepted.
71. A Filtering Technique for Markov Chains with Applications to Spectral Embedding, *Applied and Computational Harmonic Analysis* **40** (2016), 575-587.
72. (with Florian Pausinger) On the Discrepancy of Jittered Sampling, *Journal of Complexity* **33** (2016), 199-216.
73. (with Rima Al-Aifari and Lillian Pierce) Lower bounds for the truncated Hilbert transform, *Revista Matemática Iberoamericana*, **32** (2016), 23-56.
74. An Uncertainty Principle on Compact Manifolds, *The Journal of Fourier Analysis and Applications*, **21** (2015), 575-599.
75. (with Herbert Koch) Convolution Estimates for Singular Measures and some Global Nonlinear Brascamp-Lieb inequalities, *Proceedings of the Royal Society of Edinburgh*, **145** (2015), 1223-123..
76. Sharp  $L^1$ -Poincaré inequalities correspond to optimal hypersurface cuts, *Archiv der Mathematik* **105** (2015), 179-188.
77. (with Florian Pausinger) Local Extrema in Quantum Chaos, *Physics Letters A* **379** (2015), 535-541.
78. On the number of legal positions in chess without promotion, *International Journal of Game Theory* **44**, 761-767.
79. New Bounds for the Traveling Salesman Constant, *Advances in Applied Probability*, **47** (2015).
80. A Remark on Disk Packings and Numerical Integration of Harmonic Functions, *Journal of Complexity* **31** (2015), 486-493.
81. A Short Note on Integer Complexity, *Contributions to Discrete Mathematics* **9** (2014), 63-69.
82. Lower bounds on nodal sets of eigenfunctions via the heat flow, *Communications in Partial Differential Equations*, **39** (2014).

83. A Geometric Uncertainty Principle with an Application to Pleijel's Estimate, *Annales Henri Poincaré*, **15** (2014), 2299-2319.
84. Dispersion dynamics for the generalized Korteweg-de Vries equation, *Proceedings of the AMS*, **143** (2015), 486-493..
85. (with Michaela A. C. Nieuwenhuis and James C. Robinson), Minimal Periods for Ordinary Differential Equations in Strictly Convex Banach Spaces and Explicit Bounds for some  $L^p$ -Spaces, *Journal of Differential Equations*, **256** (2014), 2846 - 2857.
86. (with Jakob Kapeller) Modeling the evolution of preferences: an answer to Schubert and Cordes, *Journal of Institutional Economics*, **10** (2014), 337-347.
87. (with Jakob Kapeller) How Formalism shapes Perception: An Experiment on Mathematics as a Language, *International Journal of Pluralism and Economics Education* **4** (2013): 138–156.
88. (with Jakob Kapeller and B. Schuetz) The Impossibility of Rational Consumer Choice—A Problem and its Solution. *Journal of Evolutionary Economics* **23** (2013): 29–60.
89. Random restricted matching and lower bounds for combinatorial optimization. *Journal of Combinatorial Optimization* **24** (2012), no. 3, 280–298.
90. A note on implicitly defined sets in uniform distribution theory. *Uniform Distribution Theory* **6** (2011), no. 2, 85–94.
91. On the optimal interpoint distance sum inequality. *Archiv der Mathematik* **97** (2011), 289–298.
92. (with Erhard Aichinger) A proof of a Theorem by Fried and MacRae and applications to the composition of polynomial functions, *Archiv der Mathematik* **97** (2011), 115–124.
93. Extremal uniform distribution and random chord lengths. *Acta Mathematica Hungarica* **130** (2011), 321–339.
94. The asymptotic behavior of the average  $L^1$ -discrepancies and a randomized discrepancy, *The Electronic Journal of Combinatorics*, **17** (2010), R106
95. A New Lower Bound for the Geometric Traveling Salesman Problem in Terms of Discrepancy, *Operations Research Letters*, **38** (2010), 318–319.
96. A Note on the number of different inner products generated by a finite set of vectors, *Discrete Mathematics* **310** (2010), 1112–1117.
97. Uniform distribution preserving mappings and variational problems. *Uniform Distribution Theory* **4** (2009), 117–145.
98. (with Fritz Pillichshammer) Average distance between consecutive points of uniformly distributed sequences, *Uniform Distribution Theory* **4** (2009), 51–67.

#### INVITED TALKS

- 2019  
University of Rochester (Colloquium + Seminar)
- 2018  
Western Washington University, CUNY, University of Maryland College Park, Park City Mathematical Institute, Harmonic Analysis and Applications (Strobl, Austria, Plenary Speaker), NTNU Trondheim, U Oregon (Seminar + Colloquium), UC San Diego, Yale, Memorial Conference in Honor of Alan McIntosh (ANU), Meeting in Harmonic Analysis (Basque Center of Applied Mathematics), Bristol

- 2017  
JKU Linz, Conference on Monte Carlo Methods (samsi), Special Session on Graph Laplacians (SIAM PDE 2017), Discrepancy Theory and Applications (Erwin Schrodinger Institute), Oberwolfach: Real and Harmonic Analysis; Analysis, Geometry and Probability: Conference in Honor of Peter W. Jones (KIAS, Seoul), AMS Sectional Meeting at Indiana University: Special Session on Laplacian Eigenfunctions, Stanford (Seminar + Colloquium)
- 2016  
JKU Linz, Stony Brook (Colloquium), USC (Colloquium), Institute for Mathematics and Applications Minneapolis, U Minnesota, Princeton, Toronto, Waterloo (Colloquium), Cornell, University of Wisconsin-Madison (Colloquium), Conference on Discrepancy Theory (Varenna, Italy), Conference on Modern Topics in Time-Frequency Analysis (Strobl, Austria), University of Vienna, Harmonic Analysis Conference in Honor of Michael Christ's 60th birthday (University of Wisconsin-Madison), Duke, Brown, TU Munich, Indiana University, UIUC (Colloquium), Princeton
- 2015  
JKU Linz, New Trends in Elliptic and Partial Differential Equations (SIAM PDE 2015), Williams College, U Virginia (Colloquium), Yale Economics Micro Theory Lunch Seminar, Oberwolfach Workshop: Applied Harmonic Analysis and Sparse Representations, Bonn, Oxford, AMS Sectional Meeting in Porto, NYU, Rutgers, Yale
- 2014  
Yale, ICERM Workshop on Discrepancy Theory, AMS Fall Western Sectional Meeting in San Francisco, Brown, 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications (2 talks, Madrid), Workshop: Harmonic Analysis Methods in Dispersive PDEs, ICMAT Madrid
- 2013  
U Cologne, U Basel, Oberwolfach Workshop: Uniform Distribution Theory and Applications, Rome 3 (Tor Vergata), IST Austria, Meeting on Spectral Theory of Laplace and Schroedinger Operators (Banff), Workshop on Nonlinear Waves (Bielefeld)

## TEACHING

1. Supervision of M.Sc. Theses
  - Sina Koohbour: 'Spectral gaps on Graphs'  
Mr. Koohbour studied spectral properties of the Graph Laplacian and how they pertain to the geometry of the graph. Material covered included Cheeger's inequality, expander graphs and the connection between fast mixing of Markov chains, bottlenecks and the first eigenvalue.
  - Kathrin Heim: 'Computer-aided investigations of solitons in Boson stars'  
The Boson star equation is a dispersive equation describing the stellar evolution of a Boson star – it is a dispersive PDE and is known to have soliton solutions. The propagator of the free evolution is a pseudodifferential operator and no explicit closed-form expression of the soliton is known; numerical methods were used to numerically approximate them.
2. Supervision of Undergraduate Research and Honor Theses
  - Chris Shriver: Fractional Number Systems and Integer Complexity (2015)
  - Youkow Homma; Topological pre-processing for spectral partitioning (2016)
  - Tianjia Chen (M.Sc. Stats): Analysis of scientometric data (INET) (2016)
  - Tianhao Wu (M.Sc. Stats): Analysis of scientometric data (INET) (2016)

- Chenglin Lu (M.Sc. Biostats): Scientometric Analysis (INET project) (2017)
  - Noah Kravitz: Additive Combinatorics (arXiv:1705.01883, *Integers*) (2017)
  - Noah Kravitz: Fourier Analysis (arXiv:1712.01206 *J. Fourier Anal.*) (2017)
  - Borys Kuca: Additive Combinatorics (arXiv:1804.09594, *Acta Arithm.*) (2018)
  - Elaine Hou: The Brun Sieve (Senior Honor Thesis) (2018)
  - Luke Peilen: Riesz Energy (Senior Honor Thesis) (2018)
  - M. Lukianchikov, V. Nazarchuk and C. Xue: Iterative Variable-Blaschke Factorization, arXiv:1810.01458, REU Project Summer 2018
3. Fall 2009/2010: Functional Analysis: taught supp. lecture at JKU
  4. Spring term 2013/2014: Seminar (The Foundations of Game Theory)
  5. Fall term 2014/2015: Math 246a (Ordinary Differential Equations)
  6. Fall term 2014/2015: Math 320a/520a (Measure Theory & Integration)
  7. Spring 2014/2015: Math 305 (Real Analysis)
  8. Fall term 2015/2016: Math 120 (Multivariable Calculus)
  9. Fall term 2015/2016: Math 260 (Basic Analysis in Function Spaces)
  10. Spring 2015/2016: Math 300 (Topics in Analysis)
  11. Fall 2016/2017: Math 230 (Linear Algebra and Introductory Analysis)
  12. Spring 2016/2017: Math 231 (Linear Algebra and Introductory Analysis II)
  13. Spring 2016/2017: Applied Math 160 (The Structure of Networks)
  14. Fall 2017/2018: Math 310 (Introduction to Complex Analysis)
  15. Fall 2017/2018: Graduate Class: Advanced Topics in Real and Harmonic Analysis
  16. Spring 2017/2018: Math 247 (Partial Differential Equations)
  17. Fall 2018/2019: Math 250 (Multivariable Calculus)
  18. Spring 2019: Math 724 (The Heat Kernel)

COMMUNITY AND  
OUTREACH

1. Member of the American Mathematical Society
2. Reviewer for mathscinet (60+ reviews)
3. Referee for *Acta Arithmetica*, *Advances in Mathematics*, *AMS Mathematical Surveys and Monographs* book series, *Analysis & PDE*, *Annales Henri Poincare*, *Applied and Computational Harmonic Analysis*, *Communications in Mathematical Physics*, *Complex Analysis and Operator Theory*, *Complexity*, *Constructive Approximation*, *Differential and Integral Equations*, *Experimental Mathematics*, *Expert Systems with Applications*, *IEEE Transactions on Computational Intelligence and AI in Games*, *IEEE Transactions on Signal Processing*, *International Mathematics Research Notices*, *Involve*, *Journal of Approximation Theory*, *Journal of Artificial Intelligence Research*, *Journal of Combinatorial Optimization*, *Journal of Complexity*, *Journal of Fourier Analysis and Applications*, *Journal of Fractal Geometry*, *Journal of Infometrics*, *Journal of Inequalities and Applications*, *Journal of the International Computer Games Association*, *Journal of Number Theory*, *Mathematical Physics, Analysis and Geometry*, *Mathematics Magazine*, *Mathematische Annalen*, *Monatshefte für Mathematik*, *Neural Computation*, *Potential Analysis*, *Proceedings of the AMS*, *Revista Matemática Iberoamericana*, *SIAM Journal of Computing*, *The Journal of Analysis*, *Transactions of the AMS*

4. *Getting the most out of circles*, Math Morning Lecture at Yale [public outreach program for elementary school students], 10/11/2015
5. *Surprising Applications of Fourier Series*, talk at the Yale Undergraduate Math Society, 2/25/2016
6. Co-organized (with Eyvindur Palsson and Steven Miller) research group at the SMALL REU at Williams College (Summer 2016)
7. *The mysterious solitary wave*, Yale Undergraduate Math Society, 11/3/2016
8. *Bilateral Bargaining: History, Morality, Fairness and the Heat equation*, Yale Undergraduate Math Society, 10/12/2017
9. Co-organized (with Arseniy Sheydvasser) research group at the SUMRY REU, Yale (Summer 2017)
10. Organizer, SUMRY (Yale REU), Summer 2018