

# Jeffrey Galkowski

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## Research Interests

Scattering theory, microlocal analysis, quantum chaos, spectral theory, high energy eigenfunctions

## Employment

2019-present	Associate Professor	University College London
2018-2019	Assistant Professor	Northeastern University
2015-2018	NSF Postdoctoral Fellow	Stanford University
2015-2017	CRM-ISM Postdoctoral Fellow	McGill University

## Fellowships and Grants

EPSRC Early Career Fellow: EP/V001760/1	2021-2026
EPSRC Standard Grant: EP/V051636/1	2022-2026
NSF Research Grant DMS-1900434	2019
NSF Mathematical Sciences Postdoctoral Research Fellow	2015-2019
NSF Graduate Fellow	September 2010–2015

## Awards

2021	Adams Prize	University of Cambridge
2021	Faculty Education Award	University College London

## Education

2010-2015	Ph.D.	Mathematics, University of California, Berkeley Dissertation topic: Distribution of Resonances in Scattering by Thin Barriers Dissertation advisor: Maciej Zworski
2007-2010	BSE	Electrical Engineering, University of Rochester

## Research Papers

- [1] J. Galkowski, P. Marchand, and E. A. Spence. High-frequency estimates on boundary integral operators for the Helmholtz exterior Neumann problem. [arXiv:2109.06017](https://arxiv.org/abs/2109.06017), 2021.
- [2] J. Galkowski, D. Lafontaine, and E. A. Spence. Perfectly-matched-layer truncation is exponentially accurate at high frequency. [arXiv:2105.07737](https://arxiv.org/abs/2105.07737), 2021.
- [3] J. Galkowski, P. Marchand, A. Spence, and E. A. Spence. Applying GMRES to the Helmholtz equation with strong trapping: how does the number of iterations depend on the frequency? [arXiv:2102.05367](https://arxiv.org/abs/2102.05367), 2021.
- [4] J. Galkowski, P. Marchand, and E. A. Spence. Eigenvalues of the truncated helmholtz solution operator under strong trapping. [arXiv:2101.02116](https://arxiv.org/abs/2101.02116), to appear in *SIAM J. Math. Anal.*, 2021.
- [5] J. Galkowski, D. Lafontaine, and E. A. Spence. Local absorbing boundary conditions on fixed domains give order-one errors for high-frequency waves. [arXiv:2101.02154](https://arxiv.org/abs/2101.02154), 2021.
- [6] J. Galkowski. Complete asymptotic expansions of the spectral function for symbolic perturbations of almost periodic schrödinger operators in dimension one. [arXiv:2011.09245](https://arxiv.org/abs/2011.09245), to appear in *J. Spectr. Theory*, 2020.
- [7] Y. Canzani and J. Galkowski. Weyl remainders: an application of geodesic beams. [arXiv:2010.03969](https://arxiv.org/abs/2010.03969), 2020.
- [8] J. Galkowski and J. Shapiro. Semiclassical resolvent bounds for long range Lipschitz potentials. [arXiv:2010.01166](https://arxiv.org/abs/2010.01166), to appear *Int. Math. Res. Not. IMRN*, 2020.

- [9] J. Galkowski and M. Zworski. Outgoing solutions via Gevrey-2 properties. *arXiv:2004.07868* to appear in *Ann. PDE*, 2020.
- [10] J. Galkowski and M. Zworski. Analytic hypoellipticity of Keldysh operators. to appear in *Proc. Lond. Math. Soc. (3)* *arXiv:2003.08106*, 2020.
- [11] Y. Canzani and J. Galkowski. Growth of high  $L^p$  norms for eigenfunctions: an application of geodesic beams. *arXiv:2003.04597*, 2020.
- [12] J. Galkowski and J. Shapiro. Semiclassical resolvent bounds for weakly decaying potentials. *arXiv:2003.02525* to appear in *Math. Res. Lett.*, 2020.
- [13] J. Galkowski and S. Zelditch. Lower bounds for Cauchy data on curves in a negatively curved surface. *arXiv:2002.09456* to appear in *Israel J. Math.*, 2020.
- [14] J. Galkowski and M. Zworski. Viscosity limits for 0th order pseudodifferential operators. to appear in *Comm. Pure Appl. Math.*, *arXiv:1912.09840*, 2019.
- [15] J. Galkowski and M. Zworski. An introduction to complex microlocal deformations. *arXiv:1912.09845*, 2019.
- [16] O. P. Bruno and J. Galkowski. Domains without dense Steklov nodal sets. *J. Fourier Anal. Appl.*, 26(3):45, 2020.
- [17] Y. Canzani and J. Galkowski. Eigenfunction concentration via geodesic beams. *arXiv:1903.08461*, to appear in *J. Reine Angew. Math.*, 2019.
- [18] J. Galkowski, E. A. Spence, and J. Wunsch. Optimal constants in nontrapping resolvent estimates and applications in numerical analysis. *Pure Appl. Anal.*, 2(1):157–202, 2020.
- [19] J. Galkowski and J. A. Toth. Pointwise bounds for joint eigenfunctions of quantum completely integrable systems. *Comm. Math. Phys.*, 375(2):915–947, 2020.
- [20] Y. Canzani and J. Galkowski. Improvements for eigenfunction averages: An application of geodesic beams. *arXiv:1809.06296* to appear in *J. Differ. Geom.*, 2018.
- [21] J. Galkowski. A microlocal approach to eigenfunction concentration. *Journées équations aux dérivées partielles*, pages 1–14, 2018.
- [22] J. Galkowski and E. A. Spence. Wavenumber-explicit regularity estimates on the acoustic single- and double-layer operators. *Integral Equations Operator Theory*, 91(1):Art. 6, 35, 2019.
- [23] J. Galkowski and J. Wunsch. On non-diffractive cones. *arXiv:1807.05043*, to appear in *J. Differ. Geom.*, 2018.
- [24] J. Galkowski and M. Léautaud. Control from an interior hypersurface. *Trans. Amer. Math. Soc.*, 373(5):3177–3233, 2020.
- [25] Y. Canzani and J. Galkowski. On the growth of eigenfunction averages: Microlocalization and geometry. *Duke Math. J.*, 168(16):2991–3055, 2019.
- [26] Y. Canzani, J. Galkowski, and J. A. Toth. Averages of eigenfunctions over hypersurfaces. *Comm. Math. Phys.*, 360(2):619–637, 2018.
- [27] J. Galkowski. Defect measures of eigenfunctions with maximal  $L^\infty$  growth. *Ann. Inst. Fourier (Grenoble)*, 69(4):1757–1798, 2019.
- [28] J. Galkowski and J. A. Toth. Eigenfunction scarring and improvements in  $L^\infty$  bounds. *Anal. PDE*, 11(3):801–812, 2018.
- [29] S. Dyatlov and J. Galkowski. Fractal Weyl laws and wave decay for general trapping. *Nonlinearity*, 30(12):4301–4343, 2017.
- [30] J. Galkowski and J. A. Toth. Pointwise bounds for Steklov eigenfunctions. *J. Geom. Anal.*, 29(1):142–193, 2019.

- [31] J. Galkowski, E. H. Müller, and E. A. Spence. Wavenumber-explicit analysis for the Helmholtz  $h$ -BEM: error estimates and iteration counts for the Dirichlet problem. *Numer. Math.*, 142(2):329–357, 2019.
- [32] J. Galkowski. The  $L^2$  behavior of eigenfunctions near the glancing set. *Comm. Partial Differential Equations*, 41(10):1619–1648, 2016.
- [33] S. Chatterjee and J. Galkowski. Arbitrarily small perturbations of Dirichlet Laplacians are quantum unique ergodic. *J. Spectr. Theory*, 8(3):909–947, 2018.
- [34] J. Galkowski. A quantitative Vainberg method for black box scattering. *Comm. Math. Phys.*, 349(2):527–549, 2017.
- [35] J. Galkowski. The quantum Sabine law for resonances in transmission problems. *Pure Appl. Anal.*, 1(1):27–100, 2019.
- [36] J. Galkowski. Resonances for thin barriers on the circle. *J. Phys. A*, 49(12):125205, 22, 2016.
- [37] J. Galkowski. Distribution of resonances in scattering by thin barriers. *Mem. Amer. Math. Soc.*, 259(1248):ix+152, 2019.
- [38] J. Galkowski and H. F. Smith. Restriction bounds for the free resolvent and resonances in lossy scattering. *Int. Math. Res. Not. IMRN*, (16):7473–7509, 2015.
- [39] X. Han and M. Tacy. Semiclassical single and double layer potentials: boundedness and sharpness with an appendix by J. Galkowski. *J. Funct. Anal.*, 269:2890–2926, 2015.
- [40] J. Galkowski. Pseudospectra of semiclassical boundary value problems. *Journal of the Institute of Mathematics of Jussieu*, 14(2):405–449, August 2015.
- [41] J. Galkowski. Quantum ergodicity for a class of mixed systems. *J. Spectr. Theory*, 4(1):65–85, 2014.
- [42] J. Galkowski. Nonlinear instability in a semiclassical problem. *Comm. Math. Phys.*, 316(3):705–722, 2012.
- [43] D. Mott, J. Galkowski, L. Wang, J. Luo, and C. J. Zhong. Synthesis of size-controlled and shaped copper nanoparticles. *Langmuir*, 23:5740–5745, 2007.

## Editorial Work

Associate Editor, *Mathematika* 2021-present

## Professional Activities

Associate Member	EPSRC College	2021- present
Organizer	UCL Departmental Colloquium	09/2020-present
Organizer	London Analysis Seminar	12/2019-present
Presenter	STEM for Britain	03/2020
Organizer	Summer School on Semiclassical Analysis at Northwestern University	08/2019
Organizer	Research in Teams Program at Banff International Research Station	10/2017
Officer	Mathematics Graduate Student Association UC Berkeley	1/2011–1/2014

## Selected Research Talks

*Exponential accuracy for the method of perfectly matched layers*

- May 2021 UC Berkeley Analysis Seminar
- July 2021 Mini Conference in Loughborough

*Geodesic beams and Weyl remainders*

- March 2021 Spectral Theory and Mathematical Physics Seminar - Euler Institute
- May 2021 UCLA Analysis Seminar
- May 2021 Munich-Aarhus-Santiago Mathematical Physics Seminar
- July 2021 Spectral geometry session - -Mathematical Congress of the Americas

*Viscosity limits for 0<sup>th</sup> order operators*

June 2020 IHP mathematical physics seminar  
May 2020 Montreal Analysis Seminar - McGill University

*L<sup>p</sup> norms via geodesic beams*

May 2020 Spectral Theory and Dynamical Systems Seminar - Institut Mathématique de Jussieu

*On non-diffractive cones*

June 2020 Analysis Seminar - Cardiff University  
May 2020 Monza seminar - MIT

*Interior Behavior of Steklov Eigenfunctions*

November 2020 Spectral Geometry in the Clouds  
September 2020 Differential Geometry and Geometric Analysis Seminar - Princeton University  
April 2020 London Analysis and Probability Seminar - Kings College London  
November 2019 Analysis and Geometry Seminar - University of Bristol

*Concentration and growth of eigenfunctions*

December 2019 London Analysis Seminar  
November 2019 Analysis Seminar - University of Leeds  
October 2019 Recent Developments in Microlocal Analysis - MSRI  
October 2019 Analysis Seminar - University of Wisconsin, Madison  
January 2019 Analysis Seminar - Northwestern University  
January 2019 Analysis Seminar - UC San Diego  
February 2019 PDE Analysis Seminar - University of Massachusetts Amherst  
April 2019 Colloquium - University of New Mexico  
April 2019 Analysis and PDE Seminar - Brown University  
May 2019 Microlocal Methods in Analysis and Geometry - CIRM Luminy  
June 2019 Fudan Conference on Microlocal Analysis - Shanghai

*Optimal Constants in Non-trapping Resolvent Estimates*

December 2018 PDE Minischool - University of North Carolina Chapel Hill  
July 2019 PDE/Analysis seminar - Tsinghua University - Beijing

*A Novel Approach to Quantitative Improvements for Eigenfunction Averages*

July 2018 Around Quantum Chaos, Banff Research Station  
September 2018 Analysis and Geometry Seminar, Northeastern University  
November 2018 PDE Analysis Seminar, Massachusetts Institute of Technology

*Steklov Eigenfunctions and Nodal Geometry: a Semiclassical Approach*

May 2018 Workshop on Steklov Eigenproblems, American Institute of Mathematics

*Concentration of Eigenfunctions: Sup-norms and Averages*

January 2018 Analysis and PDE Seminar, UC Berkeley  
January 2018 Special Seminar, Northeastern University  
February 2018 Special Seminar, University of Cambridge  
February 2018 Analysis Seminar, McGill University  
March 2018 Workshop on Microlocal Analysis, Australian National University  
April 2018 Analysis and PDE Seminar, Stanford University  
May 2018 Mathematical Physics Seminar, UC Irvine  
June 2018 Journées Équations aux Dérivées Partielles, Obernai, France

*Fractal Weyl laws for general trapping*

July 2017 Third Symposium on Scattering and Spectral Theory, UFSC, Florianópolis, Brazil  
December 2017 Spectral Geometry, Graphs, and Semiclassical Analysis, Aussois, France  
February 2018 Spectral Geometry Seminar, Université de Montréal

*Defect Measures for Eigenfunctions with Maximal  $L^\infty$  Growth*

- March 2017 PDE/Analysis Seminar, Massachusetts Institute of Technology  
March 2017 Mathematical Physics and Harmonic Analysis Seminar, Texas A&M University  
April 2017 Analysis Seminar, Northwestern University

*Pointwise Bounds for Steklov eigenfunctions*

- December 2016 Spectral and Scattering Theory Seminar, Purdue University  
January 2017 Analysis Seminar, University of North Carolina, Chapel Hill  
February 2017 Bay Area Microlocal Analysis Seminar, UC Berkeley  
March 2017 Spectral Geometry Seminar, Université de Montreal  
April 2017 Analysis Seminar, Université Laval

*The  $L^2$  Behavior of Eigenfunctions Near the Glancing Set*

- October 2016 Analysis Seminar, University of Rochester

*Arbitrarily Small Perturbations of the Laplacian are QUE*

- April 2016 Student Harmonic Analysis and Differential Equations Seminar, UC Berkeley  
August 2016 Probabilistic Methods in Spectral Geometry and PDE, CRM Montreal

*Resonance Free Regions and Average Smoothing Times*

- December 2015 Partial Differential Equations/Analysis Seminar, UC Berkeley  
September 2016 Analysis/Spectral Theory Seminar, McGill University

*A Quantum Sabine Law for Transmission Problems*

- October 2015 Spectral and Scattering Theory Seminar, Purdue University  
February 2016 Bay Area Microlocal Analysis Seminar, Stanford University  
April 2016 Evolution Equations on Singular Spaces, CIRM  
June 2016 Dirichlet-to-Neumann Maps, Oaxaca Research Station

*Distribution of Resonances in Scattering by Thin Barriers*

- July 2015 Mathematics Colloquium, University of Reading  
November 2014 Geometric Scattering Theory and Applications, Banff International Research Station  
October 2014 Analysis and PDE Seminar, University of California Los Angeles  
October 2014 PDE Seminar, Brown University  
October 2014 PDE/Analysis Seminar, Massachusetts Institute of Technology  
June 2014 Séminaire Géométrie et Analyse, Université de Nice  
May 2014 Bay Area Microlocal Analysis Seminar, Stanford University  
April 2014 Partial Differential Equations Mini School, University of North Carolina, Chapel Hill  
October 2013 Student Harmonic Analysis and Differential Equations Seminar, UC Berkeley.

*Pseudospectra for Semiclassical Boundary Value Problems*

- February 2013 Student Harmonic Analysis and Differential Equations Seminar, UC Berkeley

*Quantum Ergodicity for a Class of Mixed Systems*

- October 2012 Student Harmonic Analysis and Differential Equations Seminar, UC Berkeley  
February 2013 Analysis, Dynamics, and Applications Seminar, University of Arizona

*Nonlinear Instability in a Semiclassical Problem*

- February 2012 Analysis, Dynamics, and Applications Seminar, University of Arizona  
August 2012 Partial Differential Equations/ Analysis Seminar, UC Berkeley  
November 2011 Student Harmonic Analysis and Differential Equations Seminar, UC Berkeley

## Teaching

2020,2021	Mathematical Analysis for Economists and Statisticians at University College London	instructor
Summer 2019	Eigenfunctions course at Summer School on Semiclassical Analysis at Northwestern University	instructor
Spring 2019	Math 7350: Pseudodifferential Equations, Northeastern University	instructor
Spring 2019	Math 5102: Analysis II, Northeastern University	instructor
Fall 2018	Math 1342: Calculus II for Scientists and Engineers, Northeastern University	instructor
March 2018	Minicourse on Microlocal Analysis, Australian National University	instructor
Fall 2017	Microlocal Analysis of Boundary Value Problems, Stanford University	instructor
Fall 2017	Elementary Functional Analysis, Stanford University	instructor
Winter 2017	Minicourse on Vasy's method, McGill University	instructor
Fall 2016	Advanced Real Analysis, McGill University	instructor
Winter 2016	Minicourse on Vasy's method, Stanford	instructor
Spring 2014	Math 1B (Calculus II), UC Berkeley	TA
Fall 2013	Math 16A (Calculus I), UC Berkeley	TA
Spring 2013	Math 16B (Calculus II), UC Berkeley	TA
Fall 2012	Math 55 (Discrete Math), UC Berkeley	TA
Spring 2011	Math 53 (Multivariable Calculus), UC Berkeley	TA
Fall 2010	Math 1A (Calculus I), UC Berkeley	TA