Peter Hintz

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Research interests

Partial Differential Equations, General Relativity, Microlocal Analysis, Scattering Theory.

Employment

Associate Professor of Mathematics and Physics (with tenure), ETH Zürich	07/2021-
Associate Professor (without tenure), Massachusetts Institute of Technology	07/2021 - 01/2022
Assistant Professor, Massachusetts Institute of Technology	01/2019-06/2021
Clay Research Fellow, Clay Mathematics Institute	08/2017 - 08/2020
Miller Research Fellow, University of California, Berkeley	10/2015 - 07/2017

Education

Ph.D. in Mathematics, Stanford University	09/2011-09/2015
Thesis advisor: András Vasy	
Thesis title: Global analysis of linear and nonlinear wave equations	
$on\ cosmological\ spacetimes$	
B.Sc. in Mathematics, University of Göttingen, Germany	10/2009-03/2011
B.Sc. in Physics, University of Göttingen, Germany	10/2008 – 04/2011

Awards, grants, and honors

2025 - 2030
07/2024
07/2023
2022
07/2022
08/2021
2020 - 2022
2020 - 2023
2017 - 2020
2015 - 2018
2011 - 2015
2009 - 2013
2011

Publications and Preprints

- [44] "Gluing small black holes along timelike geodesics III: construction of true solutions and extreme mass ratio mergers". Preprint, 2024. arXiv:2408.06715.
- [43] "Gluing small black holes along timelike geodesics II: uniform analysis on glued spacetimes". Preprint, 2024. arXiv:2408.06712.
- [42] "Pseudodifferential operators on manifolds with scaled bounded geometry". Preprint, 2024. arXiv:2408.06651.

- [41] "Local theory of wave equations with timelike curves of conic singularities". Preprint, 2024. arXiv:2405.10669.
- [40] "Asymptotically de Sitter metrics from scattering data in all dimensions". Philosophical Transactions of the Royal Society A, 382 20230037, 2024.
- [39] "Universality of the quantum energy flux at the inner horizon of asymptotically de Sitter black holes", with Christiane Klein. *Classical and Quantum Gravity*, **41** 075006, 2024.
- [38] "Gluing small black holes along timelike geodesics I: formal solution". Preprint, 2023. arXiv:2306.07409.
- [37] "The linearized Einstein equations with sources". Letters in Mathematical Physics, 114(4):94, 2024.
- [36] "Linear waves on asymptotically flat spacetimes. I". Preprint, 2023. arXiv:2302.14647.
- [35] "Exterior stability of Minkowski space in generalized harmonic gauge". Archive for Rational Mechanics and Analysis, 247:99, 2023.
- [34] "Microlocal analysis near null infinity in asymptotically flat spacetimes", with András Vasy. Preprint, 2023. arXiv:2302.14613.
- [33] "Microlocal analysis of operators with asymptotic translation- and dilation-invariances". Preprint, 2023. arXiv:2302.13803.
- [32] "Underdetermined elliptic PDE on asymptotically Euclidean manifolds, and generalizations". Preprint, 2023. arXiv:2302.12904.
- [31] "Gluing small black holes into initial data sets". Communications in Mathematical Physics, 405:114, 2024.
- [30] "Mode stability and shallow quasinormal modes of Kerr-de Sitter black holes away from extremality". Accepted for publication in *Journal of the European Mathematical Society*.
- [29] "Elliptic parametrices in the 0-calculus of Mazzeo and Melrose". Pure and Applied Analysis, 5(3), 729–766, 2023.
- [28] "Quasinormal modes of small Schwarzschild-de Sitter black holes", with YuQing Xie. Journal of Mathematical Physics, 63:011509, 2022.
- [27] "Quasinormal modes and dual resonant states on de Sitter space", with YuQing Xie. Physical Review D, 104(6), 064037, 2021.
- [26] "The Dirichlet-to-Neumann map for a semilinear wave equation on Lorentzian manifolds", with Gunther Uhlmann and Jian Zhai. Communications in Partial Differential Equations, 47(12):2363–2400, 2022.
- [25] "Semiclassical propagation through cone points". Accepted for publication in Analysis&PDE.
- [24] "Resolvents and complex powers of semiclassical cone operators". *Mathematische Nachrichten*, 295(10), 2022.
- [23] "An inverse boundary value problem for a semilinear wave equation on Lorentzian manifolds", with Gunther Uhlmann and Jian Zhai. International Mathematics Research Notices, rnab088.
- [22] "A sharp version of Price's law for wave decay on asymptotically flat spacetimes". Communications in Mathematical Physics, 389:491–542, 2022.
- [21] "Black hole gluing in de Sitter space". Communications in Partial Differential Equations, 46(7):1280–1318, 2021.
- [20] "Linear stability of slowly rotating Kerr black holes", with Dietrich Häfner and András Vasy. Inventiones mathematicae 223:1227–1406, 2021.

- [19] "Normally hyperbolic trapping on asymptotically stationary spacetimes". Probability and Mathematical Physics, 2(1):71–126, 2021.
- [18] "Strong cosmic censorship in charged black-hole spacetimes: still subtle", with Vitor Cardoso, João Costa, Kyriakos Destounis, and Aron Jansen. Phys. Rev. D, 98(10), 104007, 2018.
- [17] "Quasinormal modes and Strong Cosmic Censorship", with Vitor Cardoso, João Costa, Kyriakos Destounis, and Aron Jansen. Phys. Rev. Lett., 120(3), 031103, 2018.
- [16] "Stability of Minkowski space and polyhomogeneity of the metric", with András Vasy. Annals of PDE, 6(2), 2020.
- [15] "Reconstruction of Lorentzian manifolds from boundary light observation sets", with Gunther Uhlmann. International Mathematics Research Notices, rnx320, 2018.
- [14] "Wave decay for star-shaped obstacles in ℝ³: papers of Morawetz and Ralston revisited", with Maciej Zworski. Mathematical Proceedings of the Royal Irish Academy, 117A(2):47–62, 2017.
- [13] "Resonances for obstacles in hyperbolic space", with Maciej Zworski. Communications in Mathematical Physics, 359(2):699–731, 2018.
- [12] "Uniqueness of Kerr-Newman-de Sitter black holes with small angular momenta". Annales Henri Poincaré, 19(2):607–617, 2018.
- [11] "Non-linear stability of the Kerr-Newman-de Sitter family of charged black holes". Annals of PDE, 4(1):11, Apr 2018.
- [10] "The global non-linear stability of the Kerr-de Sitter family of black holes", with András Vasy. Acta mathematica, 220:1–206, 2018.
- [9] "Analysis of linear waves near the Cauchy horizon of cosmological black holes", with András Vasy. Journal of Mathematical Physics, 58(8):081509, 2017.
- [8] "Boundedness and decay of scalar waves at the Cauchy horizon of the Kerr spacetime". Commentarii Mathematici Helvetici, 92(4):801–837, 2017.
- [7] "Resonance expansions for tensor-valued waves on asymptotically Kerr-de Sitter spaces". Journal of Spectral Theory, 7:519–557, 2017.
- [6] "Asymptotics for the wave equation on differential forms on Kerr-de Sitter space", with András Vasy. Journal of Differential Geometry, 110(2):221–279, 2018.
- [5] "Quasilinear waves and trapping: Kerr-de Sitter space", with András Vasy. Journées équations aux dérivées partielles, 21(6):1–15, 2014.
- [4] "Global analysis of quasilinear wave equations on asymptotically Kerr-de Sitter spaces", with András Vasy. International Mathematics Research Notices, 2016(17):5355-5426, 2016.
- [3] "Global analysis of quasilinear wave equations on asymptotically de Sitter spaces". Annales de l'Institut Fourier, 66(4):1285–1408, 2016.
- [2] "Non-trapping estimates at normally hyperbolic trapping", with András Vasy. Math. Res. Lett., 21(6):1277–1304, 2014.
- "Semilinear wave equations on asymptotically de Sitter, Kerr-de Sitter and Minkowski spacetimes", with András Vasy. Analysis&PDE, 8(8):1807–1890, 2015.

Seminar and workshop organization

06/2024
05/2024
11/2023
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06/2023 - 07/2023
09/2021-
09/2018-06/2021
Spring 2019
06/2018
06/2017
10/2015 - 07/2018

Teaching

Spring 2024
Fall 2023
Spring 2023
Fall 2022
Spring 2022
Fall 2021
Spring 2021
Spring 2020
Spring 2019
Summer 2014
Spring 2014
Spring 2013
Spring 2011

Research talks and minicourses

Stability of Kerr-de Sitter spacetimes IAMP Early Career Award lecture, ICMP 2024, Strasbourg	06/2024
Minicourse (5 lectures) on <i>Linear waves and spectral theory</i> Thematic Program "Quantum and classical fields interacting with geometry", Institut Henri Poincaré, Paris	03/2024
Minicourse (4 lectures) on <i>Quasinormal modes in General Relativity</i> Oberwolfach Seminar "Scattering Resonances in Quantum Mechanics, General Relativity and Hyperbolic Dynamics"	11/2023
Gluing small black holes along timelike geodesics Conference "Mathematical Aspects of General Relativity", Oberwolfach Colloquium , University College London Keynote lecture at the 14th Central European Relativity Seminar, Tübingen Conference "Mathematical Relativity: Past, Present, Future", ESI, Vienna Conference "Nonlinear Aspects of General Relativity", PCTS (Princeton)	08/2024 03/2024 02/2024 12/2023 10/2023
Perturbations and weak interactions of black holes Center for Mathematical Physics Colloquium, Leipzig Zürich Colloquium in Mathematics	06/2024 10/2023

06/2023 05/2023
03/2023
03/2023 02/2023 01/2023 12/2022
07/2022
06/2023 11/2022 05/2022 04/2022 03/2022 02/2022
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05/2024 11/2021 10/2021 04/2021 02/2021 12/2020 12/2020 06/2020 04/2020
02/2020
09/2019
08/2019
11/2020

North British Mathematical Physics Seminar General Relativity Seminar, Harvard University Conference "Microlocal analysis and spectral theory", Berkeley Conference "Microlocal analysis and applications", Fudan, Shanghai Conference "Fredholm theory of non-elliptic operators", Leeds Conference "Inverse Problems, Imaging and PDE", Hong Kong Conference "Microlocal Methods in Analysis and Geometry", Luminy	$\begin{array}{c} 07/2020\\ 11/2019\\ 10/2019\\ 06/2019\\ 06/2019\\ 05/2019\\ 05/2019\\ \end{array}$
 Stability of Minkowski space and polyhomogeneity of the metric Colloque des sciences mathématiques du Québec, Montreal Geometric Analysis Seminar, McGill University Conference "Geometric Singular Analysis and Mathematical Physics", Oldenburg PDE/Analysis Seminar, MIT Conference "Mathematical Aspects of General Relativity", Oberwolfach Conference "Mathematical General Relativity", IHP Analysis Seminar, University College, London Conference "Quantum Fields, scattering and spacetime horizons", Les Houches Analysis Seminar, UC San Diego AMS Special Session on General Relativity and Geometric Analysis Analysis Seminar, Purdue University CAAM Special Lecture Series, Rice University Conference "Frontiers of Theory and Applications of Nonlinear PDE", Hong Kong 	12/2018 12/2018 09/2018 09/2018 08/2018 05/2018 05/2018 05/2018 05/2018 05/2018 04/2018 02/2018 11/2017 12/2017
Trapping in perturbations of Kerr spacetimes Research Seminar, MSRI, Berkeley Bay Area Microlocal Analysis Seminar, Stanford	12/2019 10/2018
Stability problems in General Relativity Workshop on microlocal analysis, Murramarang, Australia	03/2018
Nonlinear stability via global analysis Black Hole Initiative Colloquium, Harvard University	02/2018
Reconstruction of Lorentzian metrics from boundary light observation sets Conference "Applied Inverse Problems", Grenoble MATH+X Symposium, Rice University Geometry & Analysis Seminar, University of California, Santa Cruz	07/2019 01/2018 05/2017
Resonances for obstacles in hyperbolic space Conference "Waves, Spectral Theory and Applications", UNC Chapel Hill Bay Area Microlocal Analysis Seminar, Stanford University	10/2017 05/2017
Minicourse (5 lectures) on <i>Black hole stability</i> Tokyo–Berkeley Workshop "PDE and Mathematical Physics", Tokyo	01/2017
 Nonlinear stability of Kerr-de Sitter black holes Prize lecture, Frontiers of Science Award, BIMSA, China Analysis Seminar, Shanghai Jiao Tong University Department Colloquium, Cardiff University AMS Special Session on Mathematics of Gravitational Wave Science, San Diego Analysis Seminar, Johns Hopkins University Geometry and Analysis Seminar, Columbia University Analysis Seminar, University of Washington Department Colloquium, Northwestern University Department Colloquium, Stanford University Analysis and PDE Seminar, University of Kentucky AMS Sectional Meeting, Pullman, Washington 	07/2023 08/2019 09/2018 01/2018 10/2017 05/2017 05/2017 05/2017 04/2017 04/2017 04/2017

Department Colloquium , University of California, Berkeley	04/2017
Analysis Seminar, University of Melbourne	04/2017
Analysis Seminar, Texas A&M	03/2017
Analysis Seminar, MIT	03/2017
Conference "Resonances: Geometric Scattering and Dynamics", Luminy	03/2017
Oberseminar Analysis, Universität Regensburg	03/2017
Analysis Seminar, Instituto Técnico Superior, Lisbon	03/2017
Conference "Geometric and Spectral Methods in PDE", Oaxaca	12/2016
HKUST IAS Workshop on Inverse Problems, Imaging and PDE, Hong Kong	12/2016
AMS Sectional Meeting, Raleigh, North Carolina	11/2016
Analysis Seminar, Princeton University	11/2016
Analysis Seminar, Brown University	11/2016
Bay Area Microlocal Analysis Seminar, UC Berkeley	10/2016
Analysis Seminar, University of Cambridge	10/2016
Mathematical General Relativity Seminar, Université Pierre et Marie Curie, Paris	10/2016
Conference "Asymptotic Analysis in General Relativity", Roscoff	10/2016
Geometry Seminar, University College, London	07/2016
Finite codimension solvability of quasilinear wave equations	
Analysis Seminar, Université Joseph Fourier, Grenoble	05/2016
Analysis Seminar, UC Berkeley	04/2016
Analysis Seminar, UNC Chapel Hill	03/2016
Analysis Seminar, MIT	03/2016
Popularity of ways at the Cauchy horizon of black hole expectimes	/
Conference "Evolution equations on singular spaces" Luminy	04/2016
Department Collecuium, Hong Kong University of Science and Technology	19/2010
Paris /Borkolov /Bonn /Zürich Analysis Sominar	$\frac{12}{2015}$ $\frac{11}{2015}$
Tans/Derkeley/Donn/Zurien Anarysis Seminar	11/2010
Asymptotics for Maxwell's equations on Kerr-de Sitter space	00/001
Analysis Seminar, MIT	03/2015
Conference "Geometric and analytic aspects of resonances", Luminy	03/2015
Analysis Seminar, University of Washington	02/2015
Quasilinear wave equations on asymptotically Kerr-de Sitter spacetimes	
Conference "Modern theory of wave equations", ESI, Vienna	08/2015
Conference "Mathematical Aspects of General Relativity", Oberwolfach	07/2015
May Midwestern Microlocal Meeting, Northwestern University	05/2015
Analysis Seminar, Johns Hopkins University	03/2015
Analysis Seminar, Princeton University	11/2014
Geometry Seminar, Stanford University	05/2014
Analysis Seminar, Purdue University	04/2014
Semilinear wave equations on asymptotically de Sitter spacetimes	
Bay Area Microlocal Analysis Seminar, UC Berkeley	11/2013
AMS Sectional Meeting, Temple University	$10^{\prime}/2013$
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Mentoring

Ph.D. students	
Pieter-Bart Peters (ETH)	2022 -
Thomas Stucker (ETH)	2022 -
Ethan Sussman (MIT)	2018 - 2023

Last updated: August 17, 2024