Curriculum Vitae

Gustav Holzegel

Contact Information

Mathematisches Institut
Universität Münster
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Department of Mathematics
South Kensington Campus
Imperial College
London, SW7 2AZ
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Research Interests

General Relativity, Partial Differential Equations

Professional History

Instructor, Princeton University; September 2008-June 2011
Assistant Professor, Princeton University; September 2011-August 2012
Lecturer, Imperial College, London; September 2011-July 2014
Reader, Imperial College, London; August 2014-August 2018
Professor, Imperial College, London; from September 2018
Humboldt-Professor, University of Münster; from November 2020

Education

University of Cambridge (UK)

Ph.D. (June 2008) Relativity and Gravitation group of the Department of Applied Mathematics and Theoretical Physics (DAMTP)
Supervisors: Prof. G. W. Gibbons, Prof. M. Dafermos

Part III Mathematics 2002-2003, with distinction

University of Kaiserslautern (GER)

German Diploma (Physics) 2000-2005, with distinction
exchange student at *ETH Zurich*, 2003-2004
exchange student at *University of Freiburg*, 2004-2005

Honours and Awards

Humboldt Professorship (November 2020)

Blavatnik Award (January 2019)

Adams Prize (May 2018)

Whitehead Prize (July 2016)

ERC Consolidator Grant (2018-2023)

ERC Starting Grant (2013-2018)

NSF grant 1161607 (awarded July 2012)

Member of Studienstiftung des deutschen Volkes (German Merit Foundation)

PUBLICATIONS

G. Holzegel and C. Kauffman, "A note on the wave equation on black hole spacetimes with small non-decaying first order terms", *JHDE* **20**(4) (2023), 825-834

G. Holzegel and A. Shao, "The bulk-boundary correspondence for the Einstein equations in asymptotically anti-de Sitter spacetimes", *Arch. Ration. Mech. Anal.* **247** (2023), doi:10.1007/s00205-023-01890-9

O. Graf and G. Holzegel, "Mode stability results for the Teukolsky equations on Kerr–anti-de Sitter spacetimes", *Class. Quant. Grav.* **374** (2023), doi:10.1088/1361-6382/acb0ac

G. Holzegel, J. Luk, J. Smulevici, C. Warnick, "Asymptotic properties of linear field equations in anti-de Sitter space", *Comm. Math.Phys.* **374** (2020), 1125–1178, [arXiv:1502.04965]

M. Dafermos, G. Holzegel and I. Rodnianski, "Boundedness and decay for the Teukolsky equation on Kerr spacetimes I: the case $|a| \ll M$" *Ann. PDE* **5**(2) (2019), 1–118, [arXiv:1711.07944]

M. Dafermos, G. Holzegel and I. Rodnianski, "The linear stability of the Schwarzschild solution to gravitational perturbations", *Acta Mathematica* **222**(1) (2019), 1–214, [arXiv:1601.06467]

G. Holzegel and A. Shao, "Unique continuation from infinity in asymptotically Anti-de Sitter spacetimes II: Non-static boundaries", *Comm. Partial Differential Equations* **42**(12) (2017), 1871–1922, [arXiv:1608.07521]

G. Holzegel, "Conservation laws and flux bounds for gravitational perturbations of the Schwarzschild metric", *Class. Quant. Grav.* **30** (22) (2016), [arXiv:1602.04524]

G. Holzegel, J. Luk, J. Speck, W. Wong, "Stable shock formation for nearly plane symmetric waves", *Annals of PDE* **2**(10) (2016), 1–198, [arXiv:1601.01303]

G. Holzegel and A. Shao, "Unique continuation from infinity in asymptotically Anti-de Sitter spacetimes", [arXiv:1508.03820], *Comm. Math. Phys.* 347:723 (2016). doi:10.1007/s00220-016-2576-0

G. Holzegel, S. Klainerman, J. Speck, W. Wong, "Shock Formation in Small-Data Solutions to 3D Quasilinear Wave Equations: An Overview", JHDE **13 (1)** (2016) 1-105, [arXiv:1407.6276]

M. Dafermos, G. Holzegel and I. Rodnianski, "A scattering theory construction of dynamical vacuum black holes", to appear in *Journal of Differential Geometry*, [arXiv:1306.5364]

G. Holzegel and C. Warnick, "The Einstein-Klein-Gordon-AdS system for general boundary conditions", JHDE **12 (2)** (2015) 293-342

G. Holzegel and J. Smulevici, "Quasimodes and a Lower Bound on the Uniform Energy Decay Rate for Kerr-AdS Spacetimes", Analysis & PDE **7** (2014), No. 5, 1057–1090

G. Holzegel and C. Warnick, "Boundedness and growth for the massive wave equation on asymptotically anti-de Sitter black holes", J. Funct. Anal. **266 (4)** (2014) 2436-2485

G. Holzegel and J. Smulevici, "Decay Properties of Klein-Gordon fields on Kerr-AdS spacetimes", Comm. Pure Appl. Math. **66 (11)** (2013) 1751-1802

G. Holzegel and J. Smulevici, "Stability of Schwarzschild-AdS for the spherically symmetric Einstein-Klein-Gordon system", Comm. Math.Phys. **317 (1)** (2013) 205-251

G. Holzegel and J. Smulevici, "Self-gravitating Klein-Gordon fields in asymptotically Anti-de-Sitter spacetimes", Annales Henri Poincaré **13 (4)** (2012) 991-1038

G. Holzegel, "Well-posedness for the massive wave equation on asymptotically anti-de Sitter spacetimes", JHDE **9 (2)** (2012) 239-261

G. Holzegel, "The massive wave equation on slowly rotating Kerr-AdS spacetimes", Comm. Math. Phys. **294** (2010) 169-197

G. Holzegel, "Asymptotic stability of the five-dimensional Schwarzschild metric under biaxial perturbations", Adv. Theor. Math. Phys. **14 (5)** (2010) 1245-1372

G. Holzegel, T. Schmelzer and C. M. Warnick, "Ricci Flow of Biaxial Bianchi IX Metrics", Class. Quant. Grav. **24** (2007) 6201-6217

M. Dafermos and G. Holzegel, "On the nonlinear stability of higher-dimensional triaxial Bianchi IX black holes", Adv. Theor. Math. Phys. **10** (2006) 503-523

G. W. Gibbons and G. Holzegel, "The positive mass and isoperimetric inequalities for axisymmetric black holes in four and five dimensions", Class. Quant. Grav. **23** (2006) 6459

G. Holzegel, "A note on the instability of Lorentzian Taub-NUT space", Class. Quant. Grav. **23** (2006) 3951

PREPRINTS

G. Holzegel, G. Mavrogiannis, R. Velozo Ruiz, "A note on integrated local energy decay estimates for spherically symmetric black hole spacetimes", 14 pages, [arXiv:2403.02533]

S. Collingbourne and G. Holzegel, "Uniform Boundedness for Solutions to the Teukolsky Equation on Schwarzschild from Conservation Laws of Linearised Gravity", 40 pages, accepted by *Comm. Math. Phys.* [arXiv:2307.05458]

G. Holzegel and C. Kauffman, "The wave equation on subextremal Kerr spacetimes with small non-decaying first order terms", 75 pages, [arXiv:2302.06387]

M. Dafermos, G. Holzegel, I. Rodnianski, M. Taylor, "Quasilinear wave equations on asymptotically flat spacetimes with applications to Kerr black holes", 98 pages, [arXiv:2212.14093]

M. Dafermos, G. Holzegel, I. Rodnianski, M. Taylor, "The non-linear stability of the Schwarzschild family of black holes", 513 pages, [arXiv:2104.08222]

Invited Talks (past 5 years)

Analysis Seminar, Princeton University, 4 March, 2024

Mathematical Relativity: Past, Present, Future (Workshop in honour of Y. Choquet-Bruhat's 100th birthday), 4–7 Dec, 2023

Singularities and patterns in evolution equations, 4–8 September 2023, University of Bath (minicourse, 3 lectures)

Workshop on Singularities and Curvature in General Relativity, Radboud University Nijmegen, 19–23 June, 2023

String Theory Seminar, University of Southampton, 15 March, 2023

Geometric Analysis Seminar, University of Warwick, 14 March, 2023

Felix-Hausdorff-Lecture: Analysis and Geometry of Black Holes, Alfried Krupp Wissenschaftskolleg Greifswald, 30 January, 2023

Mathematical Colloquium, University of Bayreuth, 19 January, 2023

2022 International Conference on Geometric Analysis and Hyperbolic Equations (online), Guangxi Center for Mathematical Research, 12 December, 2022

Clay Research Conference, University of Oxford, 26–30 September, 2022

Bad Honnef Physics School: Black Holes, 4–6 September, 2022

ICM 2022, University of Copenhagen, 10 July, 2022

EWM-EMS Summer School: The Cauchy Problem in General Relativity (3 lectures of 90 minutes), Institut Mittag-Leffler, 13–17 June, 2022

ZMP Colloquium, University of Hamburg, 2 June, 2022

General Physical Colloquium, University of Münster, 5 May, 2022

Research Seminar Differential Geometry, University of Münster, 31 January, 2022

Research Seminar Topology, University of Münster, 26 January, 2022

Mathematical Aspects of General Relativity, Oberwolfach Research Institute for Mathematics, 30 August-3 September 2021

General Relativity and Geometric Analysis Seminar, University of Vienna, 24 June, 2021 (online)

Geometric Analysis Seminar, Harvard University, 19 March, 2021 (online)

Analysis Seminar, University of Kentucky, 16 March, 2021 (online)

Developments in the Mathematical Sciences 2020, MPI Leipzig, 11-13 January, 2021 (online)

Bridging the Gap Analysis Seminar, University of Münster, 18 November, 2020 (online)

One World PDE Seminar, University of Bath, 30 June, 2020 (online)

Geometry and Analysis Seminar, University of Oxford, 1 June, 2020 (online)

Mini Workshop on Wave Equations, Queen Mary University London, 28-29 January, 2020

Dynamics, Equations and Applications, Krakow, 16-20 September, 2019

MINI Course (4 lectures), Max Planck Institute for Gravitational Physics, 22-23 July, 2019

Colloquium Theoretical Physics, Imperial College, 25 June, 2019

Analysis Seminar Birmingham, 23 October, 2018

NEB 2018: "Recent Developments in Gravity and Relativity", Rhodes (Greece), 20-23 September, 2018

International Conference on Mathematical General Relativity, Institut Henri Poincaré, Paris, 30 May-1 June, 2018

Felix Klein Kolloquium, University of Leipzig, 11 April, 2018

Field Equations on Lorentzian Spacetimes, University of Hamburg, 19-23 March, 2018

Conference Organization

Workshop "Taking it to the extreme: Symmetries and dynamics of extremal black holes", 6-8 March, 2024 (joint with Gabriele Benomio, Delia Gates and Hengrui Zhu)

Conference "New Trends in Geometric PDEs" at the University of Münster, 1-5 November, 2022 (joint with Christopher Böhm, Christian Seis and Burkhard Wilking)

Session on "General Relativity" at the ICMP 2021, Geneva, 2-7 August, 2021 (joint with Gerhard Huisken)

Conference "Recent trends in PDE" at King's College London, 8-11 January, 2018 (joint with Mahir Hadzic and Alexander Pushnitski)

Workshop on "General Relativity and the AdS-CFT correspondence", Fields Institute, Toronto, 23-27 October, 2017 (joint with Spyros Alexakis and Toby Wiseman)

Workshop on "Geometric Hyperbolic PDE", Imperial College London, 30 Sep-2 Oct, 2015 (joint with Arick Shao and Claude Warnick)

Focus Week (8-12 June, 2015) on "Black Hole Stability" during the Focus Program

on on 100 Years of General Relativity, Fields Institute, Toronto, May-June, 2015 (joint with Steven Liebling)

Teaching and Supervision

Recent Courses taught:
Functional Analysis (Imperial, Spring 2016)
Measure and Integration (Imperial, Autumn 2016)
Analytic Methods in PDE (Imperial, Spring 2018)
Non-Linear Wave Equations (Münster, Spring 2021 and Autumn 2022)
General Relativity and the Analysis of Black Hole Spacetimes (Münster, Autumn 2021 and 2023)

Supervision of PhD students:
Dominic Dold (2013-2018); co-supervised with M. Dafermos
Thomas Johnson (2014-2018)
Gabriele Benomio (2016-2020); co-supervised with C. Warnick
Georgios Chalivopoulos (2016-2020)
Adam Almakroudi (started in 2018)
Max Weissenbacher (2020–2023); co-supervised with M. Taylor
Gemma Hood (started in October 2020); co-supervised with M. Taylor
Alessandra Tullini (started in October 2022)
Milos Provci (started in October 2023)

Supervision of Postdocs:
Dr. Arick Shao (8/2014-8/2016; now a senior lecturer at Queen Mary Univ. of London)
Dr. Martin Taylor (1/2016-9/2018; now a lecturer at Imperial College London)
Dr. Olivier Graf (11/2020-8/2022; now a lecturer at the Institute Fourier in Grenoble)
Dr. Christopher Kauffman (from 1/2019; from Johns Hopkins University)
Dr. Athanasios Chatzikaleas (from 9/2021; from Sorbonne Université Paris)
Dr. Marios Apetroaie (from 10/2023; from University of Toronto)
Dr. Allen Fang (from 10/2023; from Princeton University)

Departmental Responsibilities

Coordinator Undergraduate Prizes (Imperial, 2013-2020)
Member of the Research Committee (Imperial, 2016-2020)
Member of Connecting Mathematical Fields Committee (Münster, since 2021)

Münster, March 2024