Roland Steinbauer

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Curriculum Vitæ

Education

- 2003 Habilitation, University of Vienna, Austria
- 2001 Ph.D, Mathematics, summa cum laude, University of Vienna, Austria
- 1996 M.Sc, Theoretical Physics, with distinction, University of Vienna, Austria

Employment

- current Associate Professor, Department of Mathematics, University of Vienna, Austria
- 2010-11 parental leave
- 2013-14 parental leave
- 2001–2003 Assistant Professor, ibid
 - 2001 Visiting Scientist, Department of Mathematics, University of Southampton, U.K
- 1999-2000 Teaching position, Department of Mathematics, University of Vienna, Austria
- 1998–99 Scientific Coworker, FWF research grant P12023MAT
- 1996–98 Ph.D. scholar, Austrian Academy of Science
- 1993–98 Several Teaching Positions, Dep. of Mathematics & Inst. for Theoretical Physics, University of Vienna, Austria

Main areas of research and selected results

Mathematical General Relativity: Proof of singularity theorems in C^{1} - and $C^{1,1}$ -spacetimes, Extension of Lorentzian causality theory to weak regularity, Lorentzian length spaces, null distance

Exact solutions in General Relativity: Completeness results for impulsive gravitational waves with distributional and cut-and-paste method, study of gyratons & the gravitational wave memory effect.

Non-linear generalised functions: Construction of the first diffeomorphism invariant algebra of generalised functions, applications in mathematical physics and PDE.

Differential Geometry: Construction of a non-linear distributional geometry & a low regularity pseudo-Riemannian geometry, new comparison methods.

Partial Differential Equations: Existence theory for kinetic (Vlasov) equations and highly singular PDEs using non-linear generalised functions.

Mathematics Education Research: Professional knowledge of school-teachers and teacher trainees.

10 Most Important Publications

1. Cut-and-paste for impulsive gravitational waves with Λ : The mathematical analysis. (with Clemens Sämann, Benedict Schinnerl, Robert Švarc) *Lett. Math. Phys.* to appear, 2024.

https://arxiv.org/abs/2312.01980

- Null distance and convergence of Lorentzian length spaces. (with Michael Kunzinger) Ann. Henri Poincare 23, 4319–4342, 2022. https://doi.org/10.1007/s00023-022-01198-6
- The Hawking-Penrose singularity theorem for C¹-Lorentzian metrics. (with Michael Kunzinger, Argam Ohanyan, Benedict Schinnerl) Commun. Math. Phys. 391, 1143–1179, 2022

https://doi.org/10.1007/s00220-022-04335-8 4. Cut-and-paste for impulsive gravitational waves with Λ : The geometric picture. (with Jiří Podolský, Clemens Sämann, Robert Švarc) Phys. Rev. D 100(2), 024040, 2019.

- https://doi.org/10.1103/PhysRevD.100.024040 5. The Hawking-Penrose singularity theorem for $C^{1,1}$ -Lorentzian metrics. (with Melanie Graf, James Grant, Michael Kunzinger) Commun. Math. Phys. 360(3), 1009–1042, 2018.
- https://doi.org/10.1007/s00220-017-3047-y 6. Hawking's singularity theorem for $C^{1,1}$ -metrics. (with Michael Kunzinger, Milena Stojković, James A. Vickers) *Classical Quantum Gravity*, 32(7):075012, 19, 2015. (Featured as a highlight 2015 in CQG.) https://doi.org/10.1088/0264-9381/32/7/075012
- 7. The wave equation on singular space-times. (with James D.E. Grant, Eberhard Mayerhofer) Commun. Math. Phys., 285(2):399-420, 2009. https://doi.org/10.1007/s00220-008-0549-7
- 8. The use of generalized functions and distributions in general relativity (with James Vickers) *Classical Quantum Gravity* 23(10), R91-R114, 2006. (Featured as a highlight 2007 in CQG.)
 - https://doi.org/10.1088/0264-9381/23/10/R01
- 9. Global weak solutions of the relativistic Vlasov-Klein-Gordon system (with Michael Kunzinger, Gerhard Rein, Gerald Teschl) *Commun. Math. Phys.*, 238, 367-378, 2003.
- https://doi.org/10.1007/s00220-003-0861-1 10. A global theory of algebras of generalized functions (with Michael Grosser, Michael Kunzinger, James Vickers) Adv. Math., 166, 50-72, 2002. https://doi.org/10.1006/aima.2001.2018

All publications: http://www.mat.univie.ac.at/~stein/research/publications.html

Mentoring and supervision experience

- PostDocs **Darko Mitrovic** (now University of Vienna), **Robert Švarc** (now Charles University Prague), **James D.E. Grant** (now University of Surrey, U.K.)
 - Ph.D E. Mayerhofer¹ (2006), C. Hanel (2011), B. Schinnerl (2022), T. Beran¹ (May 2024),
 A. Ohanyan (ongoing, Nov. 2024), M. Calisti (ongoing), C. Rossdeutscher¹ (ongoing).
 - Master M.Sc. Maths: 12 (3 ongoing), M.Sc. Physics: 4 (1 ongoing), M.Ed: 12 (2 ongoing)

10 Additional research achievements

- 1. **Project-cooordinator** of the newly approved Austian Science Fund's Emerging Field "A new geometry for Einsteins theory of relativity and beyond" with funding volume of 7M. EUR.
- 2. **Highly visible and award winning publications:** 4 HIGHLIGHTS in Classical and Quantum Gravity, 2 FEATURED REVIEWS by the Amercan Mathematical Society, 1 EDITOR'S PICK in Jour. Math. Phys.
- Competitive research funding: author, (co-)applicant, and (co-)head of third-party-funded research projects amounting to approx. 12M. EUR. FWF-Projects EF-N6, P35078, P33594, P28770, P25326, P23714, P20525, Y237, P16742; OeAD WTZ-Projects HR04/2022, CZ12/2018, CZ15/2013; 2 IK-Doctoral Colleges of Vienna University.
- 4. **Invited/main lecturer (selection):** Charles University Prague (regularly); GF2014 (International Conference on Generalized Functions, 2014), Southampton; Winter- and Summerschools on PDE and GFSE2010 (all Novi Sad, Serbia); University of Osaka, Japan, 2008; Imperial College, U.K., 2008
- Co-Organiser (selection): GF2009 (International Conference on Generalized Functions, 2009); SCRI21 (Singularity theorems, causality, and all that. A tribute to Roger Penrose); GF2022 (International Conference on Generalized Functions, 2022); ESI-Workshop "Non-regular Spacetime Geometry", 2023
- Memberships (selection): IAGF (The International Association for Generalized Functions, Treasurer,), ISAAC (The International Society for Analysis, its Applications & Computation), GDM (German Society for Didactics of Mathematics), Scientific Committee GeLo-series (International Meeting on Lorentzian Geometry, Córdoba, Spain, 2020, Merida, Mexico 2024).

¹co-supervised

- 7. **Promotio sub auspiciis praesidentis rei publicae**² and Honorary prize (Würdigungspreis), Austrian Ministry of Science, 2001, habilitation suceeding within 2 years.
- 8. **Teaching Awards:**, UNIVIE-Teaching Award (University of Vienna, 2013), Ars Docendi, Austrian National Award in University Teaching, 2016, Hans-Christian Reichel-Prize (Faculty of Mathematics, University of Vienna, 2022).
- 9. **Mathematics education research:** Theoretical and empirical studies concerning the professional knowledge of (pre-service) teachers, publications and conference contributions.
- 10. Knowledge transfers, science communication, dissemination: regular talks in high-schools, community colleges, the Vienna Planetarium, cooperation with media-artist Tomas Eller.

²The Austrian equivalent of a summa cum laude Ph.D. graduation, also requiring top marks throughout high-school.