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# Roland Steinbauer

*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 **Professor of Mathematical General Relativity**
*Department of Mathematics*, *University of Vienna*, Austria
2010-11 **parental leave**
2013-14 **parental leave**
2003–2025 **Associate Professor**, *Department of Mathematics*, University of Vienna, Austria
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 low regularity 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 $\Lambda$: The mathematical analysis. (with Clemens Sämann, Benedict Schinnerl, Robert Švarc) *Lett. Math. Phys.* to appear, 2024. `https://arxiv.org/abs/2312.01980`
2. 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`
3. The Hawking-Penrose singularity theorem for $C^1$-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 $\Lambda$: 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.), **Miguel Manzano** (ongoing).

Ph.D **E. Mayerhofer**[1] (2006), **C. Hanel** (2011), **B. Schinnerl** (2022), **T. Beran**[1] (May 2024), **A. Ohanyan** (ongoing, Nov. 2024), **M. Calisti** (ongoing), **C. Rossdeutscher**[1] (ongoing), **Luca Mrini**[1] (ongoing), **Marta Salamo Candal**[1] (ongoing), **Miguel Prados Abad**[1] (ongoing), **Sebastian Gieger**[1] (ongoing), **Ines Vega Gaonzalez**[1] (ongoing),

Master **M.Sc. Maths:** 14 (1 ongoing), **M.Sc. Physics:** 4 (1 ongoing), **M.Ed:** 14 (1 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.
3. **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
5. **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

[1] co-supervised

6. **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).
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.

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