

Education

- 05/2015–12/2018 **PhD studies**, *Victoria University of Wellington*, Wellington
- 04/2006–05/2014 **Diplom in Mathematics**, *Rheinische Friedrich-Wilhelms-Universität*, Bonn,
Grade “Gut” (“Good”)
- 10/2005–06/2013 **Diplom in Physics**, *Rheinische Friedrich-Wilhelms-Universität*, Bonn,
Grade “Sehr Gut” (“Very Good”)

Theses

- PhD *Black Hole Evaporation: Sparsity in Analogue and General Relativistic Space-Times*,
Supervisor: Professor Matt Visser
- Diplom *Diskrete Geometrie im Raum elastischer Kurven*,
 (“Discrete Geometry in the space of elastic curves”),
Supervisor: Professor Martin Rumpf
- Diplom *Ein Ansatz zur Untersuchung der Quantengeometrodynamik im starken Kopplungslimes der Gravitation*,
 (“An ansatz for investigation of quantum geometrodynamics in the strong coupling limit of gravitation”),
Supervisor: Professor Claus Kiefer

Work Experience

- 02/2021–Present **Postdoctoral Researcher**, *Institute of Theoretical Physics*, Charles University Prague
Research; Co-Lecturer for NTMF091: Black Hole Thermodynamics; Offering Thesis Topics
- 09/2020–12/2020 **Research Assistant**, *School of Mathematics and Statistics*, Victoria University of Wellington
Research on Black Hole Physics
- 12/2019–08/2020 **Research Assistant; Senior Tutor**, *School of Chemical and Physical Sciences*, Victoria University of Wellington
Research in Electromagnetic Scattering; Lecturer for PHYS415: Electromagnetism
- 04/2019–12/2019 **Teaching Fellow**, *School of Mathematics and Statistics*, Victoria University of Wellington
Lecturer for Module of MATH321: Particle Physics and Aspects of Quantum Field Theory
- 07/2018–03/2019 **Research Assistant**, *School of Mathematics and Statistics*, Victoria University of Wellington
Research on Black Hole Physics
- 07/2015–11/2019 **Tutor & Marking**, *School of Mathematics and Statistics*, Victoria University of Wellington
Undergraduate courses: Differential Equations, Thermal Physics Laboratory,
“Introduction to Algebra, Analysis, and Topology”, Engineering Mathematics Foundations, Multi-
variable Calculus, “Introduction to Applied Physics for Designers”, “Solid State and Nuclear Physics”
Postgraduate courses: General Relativity, Differential Geometry
- 04/2008–03/2015 **Tutor & Marking**, *Physikalisches Institut*, Universität Bonn
Bachelor degree courses: Classical Mechanics, Classical Electrodynamics,
Quantum Mechanics, Thermodynamics and Statistical Mechanics,
Mathematics for Physicists;
Master degree courses: Advanced Quantum Mechanics, Quantum Field Theory, General Relativity
and Cosmology
- 09/2012–12/2013 **Welcoming Aide**, *BCGS*, Bonn
Providing assistance for incoming international students with settling in, bureaucracy, university life

Academic Experience

2019–Present **Taught Courses**

- 2021, 2023 — **NTMF091: Black hole thermodynamics: classical and quantum**, Charles University Prague, 4th year+ M.Sc. & PhD Course, taught together with Dr. Ana Alonso Serrano
- 2020 — **PHYS415: Electromagnetism**, Victoria University of Wellington, School of Chemical and Physical Sciences, 4th year Honours Course, second half taught by Prof. Eric Le Ru
- 2019 — **MATH321: Quantum Field Theory and Particle Physics**, Victoria University of Wellington, School of Mathematics and Statistics, 3rd year B.Sc. Course

2016–Present **Conference and School Organization**

- 2020 — **NZMRI Summer Workshop 2020** — Mathematical Aspects of General Relativity, Nelson (NZ)
- 2019 — **10th Australasian Conference on General Relativity and Gravitation**, Wellington (NZ)
- 2018 — **AotearoaFP18: Observer-dependent Entropy**, Wellington (NZ)
- 2017 — **NZMASP17 Conference**, Kaiteriteri (NZ)
- 2016 — **AotearoaFP16: QFT Summer School**, Wellington (NZ)

2015–Present **Talks or poster presentations**

- 2022/12/14 — SISSA, Trieste (IT): “*Distracted by Science-Fiction: The Physics of Reverse-Engineered Metrics*”;
- 2022/12/13 — Joint Theory Seminar (TU Wien & Universität Wien; AT): “*Distracted by Science-Fiction: The Physics of Reverse-Engineered Metrics*”;
- 2022/10/21 — Soutředění UTF v Ondřejově (“ITP’s lecture camp in Ondřejov”), Ondřejov (CZ): “*The Beauty and the Beast: Covariance and Electromagnetic Media*”;
- 2022/09/12 — 31st Texas Symposium on Relativistic Astrophysics, Prague (CZ): “*The Usefulness and Pitfalls of Reverse-Engineered Metrics*”, **contributed “highlight talk”**;
- 2022/04/06 — Karl-Ruprechts-Universität, Heidelberg (Germany): “*Of Computational Shortcuts, Questionable Physicality, and Arbitrarily Advanced Civilizations*”;
- 2022/03/28 — Albert-Einstein-Institut, Potsdam (Germany): “*Violations of Energy Conditions—and Why Should You Care?*”, **hybrid**;
- 2022/03/21 — DPG Spring Meeting, Heidelberg (Germany): “*Energy Conditions in Reverse-Engineered Metrics*”, **online**;
- 2022/01/11 — Relativistic Seminar, Prague (CZ): “*Energy Conditions, Physicality, and Reverse-Engineered Solutions*”, **hybrid**;
- 2021/12/21 — Universität zu Köln, Cologne (Germany): “*The Weird and the Not-So-Weird Reverse-Engineered Space-Times: Warp Drives and Tractor Beams*”, **online**;
- 2021/07/19 — Space Science @ Drop Tower Seminar, Bremen (Germany): “*Reverse Engineering the Solutions People Asked For: Wormholes, Warp Drives, Tractor Beams*”, **online, invited**;
- 2021/07/16 — Physikalisches Kolloquium, Bonn (Germany): “*Pushing the Limits of General Relativity: Curved Space-Time Quantum Field Theory, Analogues, and Exotica*”, **online, invited**;
- 2021/06/11 — Tartu Ülikool, Tartu (Estonia): “*Reverse Engineering the Solutions People Asked For: Wormholes, Warp Drives, Tractor Beams*”, **online, invited**;
- 2021/03/09 — Relativistic Seminar, Prague (CZ): “*Black Hole Physics, Analogue Space-Times, and Electromagnetism*”, **online**;
- 2020/06/19 — TeleGrav2020, Tartu (Estonia): “*A Simple Tool to Test Semi-Classical Theories of Gravity*”, **online**;
- 2019/12/11 — ACGRG10, Wellington (NZ): “*Sparsity – Quantifying the Difference Between Hawking Radiation and Black Body Radiation*”;
- 2019/07/12 — GR22/Amaldi13, Valencia (Spain): “*Subtleties Of Different Approaches To Electromagnetic Analogue Space-Times*”;
- 2019/06/17 — GeomGrav2019, Tartu (Estonia): “*Linear Electrodynamics as Analogue Space-Time for Modified Theories of Gravity*”;

- 2019/06/13 — Helsingin Yliopisto, Helsinki (Finland): “Sparsity — Quantifying the Difference Between Hawking Radiation and Black Body Radiation”;
- 2018/12/04 — NZMS 2018 Colloquium, Dunedin (NZ): “Analytic and Algebraic Analogue Space-Times from Electro-Magnetic Media”;
- 2018/11/18 — NZMASP18, Waikanae (NZ): “Space-Time Passes Everywhere”;
- 2018/10/11 — Albert-Einstein-Institut, Potsdam (Germany): “Analogue Space-Times: The Why and How”;
- 2018/09/18 — University of York, York (UK): “Analytic and Algebraic Analogue Space-Times from Electro-Magnetic Media”;
- 2018/09/11–12 — Gravity@Prague, Prague (CZ): “Analytic and Algebraic Analogue Space-Times from Electro-Magnetic Media”, **poster**;
- 2018/09/04 — EREP’18, Palencia (Spain): “Analytic and Algebraic Analogue Space-Times from Electro-Magnetic Media”;
- 2018/01/30 — ANZAMP18, Auckland (NZ): “Blueprint formulae for electromagnetic analogue space-times”;
- 2017/11/07 — NZMASP17, Kaiteriteri (NZ): “Quantizing Electro-Magnetic Fields in a Medium in a General Space-Time Background”;
- 2017/08/17 — Yukawa Institute, Kyōto (Japan): “Particle Sparsity in the Hawking Effect”;
- 2017/07/25 — Universität zu Köln, Cologne (Germany): “Effective metrics and a fully covariant description of constitutive tensors in electrodynamics”;
- 2017/07/17–21 — Between Geometry and Relativity, Vienna (Austria): “Fully covariant formulation of electrodynamics of continuous media on a general space-time”, **poster**;
- 2017/07/10–14 — Probing the spacetime fabric, Trieste (Italy): “Fully covariant formulation of electrodynamics of continuous media on a general space-time”, **poster**;
- 2017/07/06 — University of Glasgow, Glasgow (UK): “Analogue Space-Times: An Example from Macroscopic Electrodynamics”;
- 2016/11/21 — NZMASP16, Queenstown (NZ): “Imaginations from the Other Side: Analogue Gravity”;
- 2016/07/13 — GR21, New York (USA): “Sparsity of the Hawking Flux”;
- 2016/07/06 — Universitat de les Illes Balears, Palma de Mallorca (Spain): “The Sparsity of Hawking Radiation”;
- 2016/06/21 — Universität zu Köln, Cologne (Germany): “Particle Sparsity in the Hawking Effect”;
- 2015/12/03 — ACGRG8, Melbourne (Australia): “On the Sparsity of the Hawking Flux”;
- 2015/11/20 — NZMASP15, Taupo (NZ): “Particle Sparsity of Black Hole Evaporation”;

2011–Present **Attendances of International Conferences and Schools**

2022 — Gravity@Prague 2022, Prague (CZ); 2022 — Amplitudes 2022 Summer School, Prague (CZ); 2022 — Global Structure in Semi-Classical Gravity, Munich (DE); 2022 — The Quantum, the Thermal and the Gravitational Reconciled [. . .], Munich (DE), online; 2021 — Black Holes Inside and Out, online; 2021 — The Quantum and the Gravity 2021, online; 2018 — RQI-N 2018, Vienna (AT); 2018 — Energy conditions in quantum theory and gravity, York (UK); 2017 — Hawking75, Cambridge (UK); 2016 — Extrasolar Planets Summer School, Bad Honnef (DE); 2014 — GR@99, Summer School, Bad Honnef (DE); 2014 — Quantum Cosmology, 569. WE-Heraeus-Seminar, Bad Honnef (DE); 2013 — Equations of Motion in Relativistic Gravity, 524. WE-Heraeus-Seminar, Bad Honnef (DE); 2011 — Jürgen Ehlers spring school, Potsdam (DE)

2009–2010 **ERASMUS exchange program**, University of Helsinki

Voluntary Services

- 2021–Present **Guest Editor**, *Universe*
Special Issue on “[The Physics of Time Travel](#)”
- 2016–Present **Referee**, *General Relativity and Gravitation* (2016–), *Classical and Quantum Gravity* (2019–), *Canadian Journal of Physics* (2020–), *Physics Letters B* (2021–), *Nuclear Physics B* (2021–), *Materials Advances* (2022–), *Entropy* (2022–), *International Journal of Modern Physics A* (2022–)
- 2010–2015 **Student Body Physics/Astronomy**, Universität Bonn
2011–2012 Elected to the student body’s representative board; Member of two hiring committees for professor positions; Organization of physics and informational talks; Advertisement of student exchange programs; Presence services in student body’s office; Course evaluation
- 2006–2009 **Moderator, Assistant**, *Physikshow* (“*Physics Show*”), Universität Bonn

Awards, Scholarships, and Recognition

- 04/2022 **IOP Reviewer Award 2021**
Classical and Quantum Gravity
- 04/2021 **IOP Reviewer Award 2020**
Classical and Quantum Gravity
- 11/2020–Present **IOP trusted reviewer**
Awarded for submitting an outstanding review.
- 04/2018–06/2018 **Victoria Doctoral Submission Scholarship 2018**, 2 months of $\approx 2000\text{NZD}$, Total: $\approx 4000\text{NZD}$ (2430€), Funded by Victoria University of Wellington
- 05/2015–04/2018 **Victoria University of Wellington PhD scholarship**, 36 months of $\approx 2000\text{NZD}$, and three years of yearly fees of $\approx 8000\text{NZD}$, Total: $\approx 60\,000\text{NZD}$ (36\,466€), Funded by Victoria University of Wellington
- 09/2009–08/2010 **ERASMUS scholarship**
2005 **Finalist at the state competition of Northrhine-Westphalia in philosophy**
- 10/2002–09/2005 **FFF**, *Rheinische Friedrich-Wilhelms-Universität*, Bonn
Early enrolment of exceptional high school students to university

Computer Skills

LaTeX, SageMath, Python, Mathematica, Maple

Languages

German (Native), **English** (Fluent), **Finnish** (Basic), **Czech** (Basic), **Latin** ([Latinum](#))

Publications of Sebastian Schuster

1. S. Schuster, J. Santiago & M. Visser. ADM mass in warp drive spacetimes. *General Relativity and Gravitation* **55**, 14. doi:10.1007/s10714-022-03061-9. arXiv: 2205.15950 [gr-qc] (Jan. 2023).
2. J. Santiago, S. Schuster & M. Visser. *Tractor beams, pressor beams, and stressor beams within the context of general relativity* in *Proceedings of the 16th Marcel Grossmann Meeting* (2021). arXiv: 2110.14926 [gr-qc].
3. J. Santiago, S. Schuster & M. Visser. Tractor beams, pressor beams, and stressor beams in general relativity. *Universe* **7**, 271. doi:10.3390/universe7080271. arXiv: 2106.05002 [gr-qc] (July 2021). Invited for submission by *Universe*.
4. J. Santiago, S. Schuster & M. Visser. Generic warp drives violate the null energy condition. *Physical Review D* **105**, 064038. doi:10.1103/PhysRevD.105.064038. arXiv: 2105.03079 [gr-qc] (Mar. 2022).
5. C. Pfeifer & S. Schuster. Static Spherically Symmetric Black Holes in Weak $f(T)$ -Gravity. *Universe* **7**, 153. doi:10.3390/universe7050153. arXiv: 2104.00116 [gr-qc] (May 2021).
6. A. Fazel-Najafabadi, S. Schuster & B. Auguie. Orientation Averaging of Optical Chirality Near Nanoparticles and Aggregates. *Physical Review B* **103**, 115405. doi:10.1103/PhysRevB.103.115405. arXiv: 2012.10010 (Mar. 2021).
7. S. Schuster. Sparsity of Hawking Radiation in $D + 1$ Space-Time Dimensions for Massless and Massive Particles. *Classical and Quantum Gravity* **38**, 047002. doi:10.1088/1361-6382/abd144. arXiv: 1910.07256 [gr-qc] (Feb. 2021).
8. S. Schuster. *Black Hole Evaporation: Sparsity in Analogue and General Relativistic Space-Times* PhD thesis (Victoria University of Wellington, Dec. 2018). doi:10.26686/wgtn.17134433.v1. arXiv: 1901.05648.
9. S. Schuster & M. Visser. Electromagnetic analogue space-times, analytically and algebraically. *Classical and Quantum Gravity* **36**, 134004. doi:10.1088/1361-6382/ab2159. arXiv: 1808.07987 (June 2018). Focus Issue on Gravity in the Lab.
10. S. Schuster & M. Visser. Boyer–Lindquist space-times and beyond: Meta-material analogues. arXiv: 1802.09807 (2018).
11. S. Liberati, S. Schuster, G. Tricella & M. Visser. Vorticity in analogue spacetimes. *Physical Review D* **99**, 044025. doi:10.1103/PhysRevD.99.044025. arXiv: 1802.04785 (Feb. 2019).
12. S. Schuster & M. Visser. Bespoke analogue space-times: Meta-material mimics. *General Relativity and Gravitation* **50**, 55. doi:10.1007/s10714-018-2376-2. arXiv: 1801.05549 (May 2018).
13. S. Schuster & M. Visser. Effective metrics and a fully covariant description of constitutive tensors in electrodynamics. *Physical Review D* **96**, 124019. doi:10.1103/PhysRevD.96.124019. arXiv: 1706.06280 (Dec. 2017).
14. F. Gray, J. Santiago, S. Schuster & M. Visser. “Twisted” black holes are unphysical. *Modern Physics Letters A* **32**, 1771001. doi:10.1142/S0217732317710018. arXiv: 1610.06135 (June 2017).
15. F. Gray, S. Schuster, M. Visser & A. Van-Brunt. *Sparsity of the Hawking Flux* in *Proceedings, 14th Marcel Grossmann Meeting on Recent Developments in Theoretical and Experimental General Relativity, Astrophysics, and Relativistic Field Theories (MG14) (In 4 Volumes) : Rome, Italy, July 12-18, 2015* (eds M. Bianchi, R. T. Jantzen & R. Ruffini) (2015), 1724–1729. doi:10.1142/9789813226609_0175. arXiv: 1512.05809.
16. F. Gray, S. Schuster, A. Van-Brunt & M. Visser. The Hawking cascade from a black hole is extremely sparse. *Classical and Quantum Gravity* **33**, 115003. doi:10.1088/0264-9381/33/11/115003. arXiv: 1506.03975 [gr-qc] (Apr. 2016).

Media

- Interviewed for: Brad Bergan, [Exotic Forces: Do Tractor Beams Break the Laws of Physics?](#), *Interesting Engineering*, 10/01/2022
- Covered in: Brad Bergan, [Fact Check: Do Warp Drive Engines Violate the Laws of Physics?](#), *Interesting Engineering*, 26/08/2021