Eduardo Hafemann

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Education

PhD in Mathematics **10/2023 – 09/2026**
Universität Hamburg (UHH)
Supervisor: Prof. Dr. Melanie Graf.
Co-supervisor: Prof. Dr. Eleni-Alexandra Kontou (King's College London)
Thesis Project: Non-smooth Techniques in Mathematical Relativity.
Funding: Cluster of Excellence Quantum Universe at Universität Hamburg and DESY.

Msc Mathematics **08/2021 – 08/2023**
Federal University of Santa Catarina - Florianópolis (UFSC)
Supervisor: Prof. Dr. Ivan Pontual Costa e Silva.
Dissertation Title: Geometry and Topology of Black Hole Horizons (RI UFSC).

Bsc Chemical Engineering **08/2016 – 08/2021**
Federal University of Santa Catarina - Florianópolis (UFSC)
Award: Highest GPA in Chemical Engineering, Graduating Class of August 2021.

Work Experience

Chemical Engineering Internship & Consultant **08/2020 – 12/2022**
Tubanharon Process Engineering.
Supervisor: Dr. Luismar Marques Porto
Activities: Mathematical modeling for soybean oil extractor and web development.

Department of Mathematics Research Internship **08/2019 – 08/2021**
Supervisor: Prof. Dr. Fábio Junior Margotti.
Theme: Inverse problems and Electrical Impedance Tomography (EIT).
Published Work: Articles [4, 5, 6] and book [12]

Department of Physics Research Internship (Volunteer) **08/2019 - 08/2020**
Supervisor : Prof. Dr. Débora Peres Menezes.
Theme: Quark stars and thermodynamic consistent models.
Published Work: Article [7]

Department of Chem. Eng. Research Internship **08/2016 - 08/2019**
Supervisor : Prof. Dr. Ricardo Antônio Francisco Machado.
Theme : Biomass valorization and RNA sequential analysis.
Published Work: Articles [8, 9, 10, 11]

Articles

In preparation:
[1] E. Hafemann, "A low-regularity Riemannian positive mass theorem for non-spin manifolds with distributional curvature", In preparation, 2025

Published:
[2] E. Hafemann and E.-A. Kontou, "Penrose inequality for integral energy conditions", Classical and Quantum Gravity **42**, 195016 (2025)

[3] M. Calisti, M. Graf, E. Hafemann, M. Kunzinger, and R. Steinbauer, "Hawking's singularity theorem for Lipschitz Lorentzian metrics", Commun. Math. Phys. **406**, 207 (2025)

Articles in Applied Fields

Inverse Problems
[4] A. De Cezaro, E. Hafemann, A. Leitão, and A. Osses, "A regularization method based on level-sets for the problem of crack detection from electrical measurements", Inverse Problems **39**, 035009 (2023)

[5] R. Filippozzi, E. Hafemann, J. C. Rabelo, F. Margotti, and A. Leitão, "A range-relaxed criteria for choosing the Lagrange multipliers in the Levenberg–Marquardt–Kaczmarz method for solving systems of non-linear ill-posed equations: Application to EIT-CEM with real data", Journal of Inverse and Ill-posed Problems **31**, 267–292 (2023)

[6] F. Margotti and E. Hafemann, "Range-relaxed strategy applied to the Levenberg–Marquardt method with uniformly convex penalization term in Banach spaces", Inverse Problems **38**, 095001 (2022)

Particle Physics
[7] B. C. Backes, E. Hafemann, I. Marzola, and D. P. Menezes, "Density-dependent quark mass model revisited: thermodynamic consistency, stability windows and stellar properties", Journal of Physics G: Nuclear and Particle Physics **48**, 055104 (2021)

Chemical Engineering
[8] T. Neitzel, C. S. Lima, E. Hafemann, D. A. A. Paixão, J. M. Junior, G. F. Persinoti, L. V. dos Santos, and J. L. Ienczak, "RNA-seq based transcriptomic analysis of the non-conventional yeast Spathaspora passalidarum during Melle-boinot cell recycle in xylose-glucose mixtures", Renewable Energy **201**, 486–498 (2022)

[9] E. Hafemann, R. Battisti, D. Bresolin, C. Marangoni, and R. A. F. Machado, "Enhancing chlorine-free purification routes of rice husk biomass waste to obtain cellulose nanocrystals", Waste and Biomass Valorization **11**, 6595–6611 (2020)

[10] E. Hafemann, R. Battisti, C. Marangoni, and R. A. Machado, "Valorization of royal palm tree agroindustrial waste by isolating cellulose nanocrystals", Carbohydrate Polymers **218**, 188–198 (2019)

[11] R. Battisti, E. Hafemann, C. A. Claumann, R. A. F. Machado, and C. Marangoni, "Synthesis and characterization of cellulose acetate from royal palm tree agroindustrial waste", Polymer Engineering and Science **59**, 891–898 (2018)

Books

Inverse Problems:
[12] F. Margotti, E. Hafemann, and L. M. Santana, *Implementação computacional da tomografia por impedância elétrica (Computational implementation of electrical impedance tomography)*, ISBN 978-85-244-0535-8 (Editora do IMPA, 2023)

Training & Research Stay

Workshop, Masterclass and Meeting
Masterclass, *Geometrical Aspects of Mathematical Relativity*, University of Copenhagen, 16–20 June 2025.

Workshop, *Introductory Workshop – New Frontiers in Curvature*, SLMath, Berkeley, CA, 26–30 August 2024 (Travel support of $1,000 provided by the event.)

Meeting, *14th Central European Relativity Seminar*, University of Tübingen, 14–16 February 2024.

Research Stay
King's College London with Prof. Eleni-Alexandra Kontou, 29 April – 3 May 2024 and 1–5 December 2025.

Universität Wien with Profs. Michael Kunzinger and Roland Steinbauer, 11–15 December 2023.

Talks & Presentations

Talk at Gravity Journal Club, *King's College London*, , 1 December 2025 [2].

Poster presentation at Quantum Universe Day, *DESY*, 16 February 2025 [2].

Talk at 15th Central European Relativity Seminar, *Radboud University Nijmegen*, 22–24 January 2025 [1].

Talk at *Mathematical Relativity Seminar*, *Universität Hamburg*, 14 December 2024 and 30 April 2025 [1, 2].

Presenter at the *34th Brazilian Mathematics Colloquium* (CBM): Advanced Course on Electrical Impedance Tomography (EIT), with collaborator Fábio Margotti. *Instituto Nacional de Matemática Pura e Aplicada* (IMPA), 24–28 July 2023 [12].

Teaching Experience

Differential Geometry Teaching Assistant **08/2022 – 12/2022**
Assisted undergraduate mathematics students with homework and review sessions.

Theory of Distributions Teaching Assistant **10/2024 – 03/2025**
Responsible for creating exercise sheets and exercise classes.

Language & Skills

Languages
Brazilian-Portuguese (Native), English (Fluent), German (A1).

Computer Skills
Python, R, MATLAB, Linux, Docker, Git, Django, HTML, CSS, JavaScript, Bootstrap, FEniCS project.

Piano
I studied piano seriously for five years starting at age 14, and the creativity and discipline of music continue to inspire my research today.

References

Prof. Dr. Melanie Graf
Professor in Geometry and Analysis, Universität Hamburg.
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melanie.graf@uni-hamburg.de

Prof. Dr. Eleni-Alexandra Kontou
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