Rodolfo Reis Soldati

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My homepage

Education

2019 – 2023 **Ph.D. – Advisors: Prof. Eric Lutz, Prof. Gabriel Landi**, *Joint Ph.D.* (*cotutelle*), University of Stuttgart and University of São Paulo
Thesis. **Quantum cooling: thermodynamics and information**.

2017 – 2018 **M.Sc. Physics – Advisor: Prof. Nelson Yokomizo**, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil
Dissertation. **Entanglement entropy in quantum field theory**.

2014 – 2015 **Visiting student, Theoretical Physics**, Durham University, Durham, UK
Project. **Monte-Carlo N-Particle transport simulation of radiation dosimetry.**

2013 – 2016 **B.Sc. Physics**, Universidade Federal de Minas Gerais, ICEx, Belo Horizonte, MG, Brazil

Scholarships

Ph.D. Brazil–Germany National Council for Scientific and Technological Development and German Academic Exchange Service (CNPq-DAAD) fellowship.

MSc. CAPES Foundation scholarship.

BSc. Science Without Borders (CAPES) international exchange scholarship.

Academic appointments

2025 – Present **Postdoctoral Fellow**, *Group of Prof. Eduardo Martín-Martínez*, Institute for Quantum Computing, University of Waterloo, Waterloo, ON, Canada.

2023 – 2025 **Postdoctoral Fellow**, *Group of Prof. Raymond Laflamme*, Institute for Quantum Computing, University of Waterloo, Waterloo, ON, Canada.

Teaching and Mentorship

2025 – Present Co-advising of Master's student on error models for algorithmic cooling and LOCC activation of local passive states.

2024 Mentorship of undergraduate student in a 6 months co-op project at the University of Waterloo. Topic: efficient methods for algorithmic cooling.

2024 Fall Guest Lecturer under Prof. Ray Laflamme for Implementations of Quantum Computers (PHYS468), University of Waterloo.

Lecture topics: introduction to quantum theory, and theory for quantum computing with ion traps (quantum mechanics, electrodynamics, and atomic physics).

2023 Summer Teaching Assistant for Classical Mechanics, at the University of Stuttgart.

2022/23 Winter — Teaching Assistant for Mathematical Methods of Physics 1, at the University of Stuttgart.

2022 Summer — Teaching Assistant for Electrodynamics, at the University of Stuttgart.

2021/22 Winter — Teaching Assistant for Mathematical Methods of Physics 1, at the University of Stuttgart.

Teaching assistantship consisting of tutorials based on assignment sheets, and grading.

2021 Summer — Teaching Assistant on Reading Course.

Supervised Master's students on a one-term research project in quantum theory topics.

1st semester, 2020 — Teaching Assistant on Physics 1: Classical Mechanics, at the University of São Paulo.

Teaching assistantship consisting of tutorials based on assignment sheets, and grading.

Other teaching and outreach experiences

Board member at QBrasil — I am a board member of QBrasil, the volunteer Brazilian branch of **QWorld**, an international non-profit organization aiming at popularizing and democratizing education in quantum technologies and quantum information science. Some examples of activities of this organization are:

QBronze148 (see link above). I tutored to an introductory lecture course on quantum computing with certification issued at the undergraduate level.

Translation of quantum information material to Portuguese.

Virtual round table with specialists in topics of quantum information, from technical to societal aspects.

In preparation — I will be giving a talk to a high school science club in Waterloo on Quantum Teleportation: From Fiction to Reality.

Actor in Quantum of Hope. A physicist-written play about quantum science and technologies and their impacts on society.

Publications

In preparation — Tutorial: Lean for Quantum Information

2025 — Meiburg A., Lessa L. A., **Soldati, R. R.** A Formalization of the Generalized Quantum Stein's Lemma in Lean. [arXiv:2510.08672]

2025 — Chakraborty R., Mendonça B. S., Driscoll K., **Soldati, R. R.**, Laflamme R. Exploring Quantum Responsible Innovation efforts in Canada and the world. [arXiv:2507.05192]. **Physics in Canada, Vol. 81, No. 2 (2025)**.

2024 — **Soldati, R. R.**, Quantum cooling: thermodynamics and information (Doctoral dissertation, Stuttgart, Universität Stuttgart, 2023). DOI: [10.18419/opus-13701]

2023 — **Soldati, R. R.**, Dasari, D. B., Wrachtrup, J., & Lutz, E. (2024). Cooling Limits of Coherent Refrigerators, [arXiv:2410.18201].

2022 **Soldati, R. R.**, Dasari, D. B., Wrachtrup, J., & Lutz, E. (2022). Thermodynamics of a minimal algorithmic cooling refrigerator. **Physical Review Letters, 129(3), 030601.** [arXiv:2109.14056].

2021 **Soldati, R. R.**, Menicucci, L. S., & Yokomizo, N. (2021). Universal terms of the entanglement entropy in a static closed universe. **Physical Review D, 104(12), 125016.** [arXiv:2106.06803].

2021 **Soldati, R. R.**, Mitchison, M. T., & Landi, G. T. (2021). Multipartite quantum correlations in a two-mode Dicke model. **Physical Review A, 104(5), 052423.** [arXiv:2105.09260].

2016 da Paz, I. G., **Soldati, R.**, Cabral, L. A., de Oliveira Jr, J. G. G., & Sampaio, M. (2016). Poisson's spot and Gouy phase. **Physical Review A, 94(6), 063609.** [arXiv:1609.09023].

Events and presentations

March 2026	QI Seminar, Perimeter Institute	Waterloo, CA	A Formalization of the Generalized Quantum Stein's Lemma in Lean. doi:10.48660/26030069.
February 2025	Quantum Days 2025	Toronto, CA	Participant.
August 2024	RQI North 2024	Prague, Czechia	Poster on "Trajectory superpositions in signalling with quantum fields."
July 2023	Quantum Thermodynamics Conference 2023	Vienna, Austria	Poster on "Cooling advantage of coherent virtual qubits."
Sep 2022	Qalypso Summer School on Quantum Computation & Open Quantum Systems	Gozo, Malta	Poster and short talk on "Thermodynamics of a minimal algorithmic cooling refrigerator."
Jul 2022	Entropy and the Second Law of Thermodynamics	WE-Heraeus-Seminar 761	Poster on "Thermodynamics of a minimal algorithmic cooling refrigerator."
Jun 2022	Quantum Thermodynamics Conference 2022	QUB/Online	Poster on "Thermodynamics of a minimal algorithmic cooling refrigerator."
Aug 2021	Quantum Thermodynamics Summer School	SwissMap	Poster on "Multipartite quantum correlations in a two-mode Dicke model."
Sep/Oct 2019	Predoc School on Interaction of Light with Cold Atoms	Les Houches	Poster on "Symmetry Breaking in a U(1) Dicke model."
Nov 2018	Workshop Physics in the Department	UFMG, Brazil	Talk delivered on "Universal terms of the entanglement entropy in Einstein space."
Nov 2017	Workshop Physics in the Department	UFMG, Brazil	Talk delivered on "Quantum correlations for scalar field in closed spacetime."
Mar 2016	II Workshop on Quantum Field Theory and Quantum Optics	UESC, Brazil	Talk delivered on "Poisson spot with matter waves."

Professional development

Aug 2021 **Quantum Thermodynamics Summer School**, *SwissMap Research Station, Les Diablerets. Organized by ETH Zurich and Squid*

Nov/Dec 2020 **A mini-course on Quantum-Information Thermodynamics**, *Online, hosted by USP*

Aug 2020 **Online School on Ultra Quantum Matter**, *Perimeter Institute*

Sep/Oct 2019 **Predoc School on Interaction of Light with Cold Atoms**, *Les Houches*

Sep 2019 **School on Interaction of Light with Cold Atoms**, *ICTP-SAIFR*

Jul 2019 **XXI Giambiagi Winter School — Quantum simulations and quantum metrology with cold trapped ions**, *University of Buenos Aires*

Apr 2019 **Minicourse on Quantum Gravity from the QFT perspective**, *ICTP-SAIFR*

Jun 2018 **1st Joint ICTP-Trieste/ICTP-SAIFR School on Particle Physics**, *ICTP-SAIFR*

Jan/Feb 2018 **Mathematics Summer Programme**, *UFMG*

Aug 2017 **XVI Brazilian School on Cosmology and Gravitation**, *CBPF*

Jul 2016 **IFT-Perimeter-SAIFR Journeys into Theoretical Physics**, *ICTP-SAIFR*

Research experience

2019 – present **Ph.D. in a double-degree programme (CNPq and DAAD fellowships)**, *Cotutelle by Prof. Gabriel Landi and Prof. Eric Lutz*, USP, University of Stuttgart

I am currently working on the theory and applications of information theory in the thermodynamics of quantum refrigerators. We investigate different platforms and their correlation profiles to characterize the advantages and overall differences on the operation of refrigerators in a genuine quantum regime.

2017 – 2018 **Master's degree research project (CNPq scholarship)**, *advised by Prof. Nelson Yokomizo*, UFMG

My master's degree research project is on the behaviour of universal contributions to entanglement entropy in field theory. It is known that the area law for entropy gets corrections due to curvature of spacetime, and we are looking for them using numerical methods and lattice regularisation for the fixed background of the Einstein universe.

2016 **Undergraduate research project (CNPq scholarship)**, *advised by Prof. Marcos Sampaio*, UFMG

Study of the Poisson spot with matter waves using path integral formulation and including effects of decoherence. We also noticed how the Poisson spot intensity is augmented when the Gouy phase shift is taken into account, leading to better fit of experimental data for interferometry of deuterium molecules.

Summer 2015 **Final project for Science Without Borders scholarship programme**, *advised by Prof. Ian Terry*, Centre for Materials Physics, Durham University

Simulations with the software MCNP6 of the response of transistors to irradiation from the beta decay of Sr^{90} and Y^{90} and the characteristic X-ray spectrum of a Ag target.

July 2013 – June 2014 **Institutional Program to aid the Research of Newly Licensed Doctors (PRPq scholarship)**, *advised by Prof. Ethan Cotterill*, Department of Mathematics, UFMG

Gonality of tree-decomposed graphs: study of algorithms for the identification of tree-decomposition of metric graphs *chip-firing algorithm*, and for the embedding of graphs on a Riemann sphere (*cut-and-join* algorithm).

Other projects

Lecture recording — I was part of the team managing the recording and live stream of lectures during the academic years of 2021 and 2022 at the University of Stuttgart. I have been particularly responsible for the two lecture courses: (1) Mathematical Methods of Physics; (2) Electrodynamics.

Academic service

Institute seminar — In 2019 I assisted the organization of the Quantum Discussions seminar series at USP, with Prof. Gabriel Landi, with the aim to bring closer together research at the interface between quantum information, condensed matter and high-energy physics.

Group seminar — I have been responsible from the second half of 2017 to 2018 for managing the weekly meetings of the Group for Fundamental Theory at UFMG, which include a seminar given by one of our members or invited speakers, and the "PI session", when we gather to watch the latest research seminars provided by the Perimeter Institute at PIRSA. I have also worked on setting up the group's webpage, at GFT.

Languages

Portuguese	Native
Spanish	Basic
English	Fluent