

Curriculum Vitae

Ernesto Fagundes Galvão



International Iberian Nanotechnology Laboratory
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Nationality: Brazilian
Date of birth: December 5th, 1973

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Appointments

2019-present International Iberian Nanotechnology Laboratory (INL, Braga, Portugal)

Staff researcher (group leader) – Quantum and Linear-Optical Computation group

2014-present Universidade Federal Fluminense (UFF, Niterói, Brazil)
Associate Professor (“*Professor Associado*”), Instituto de Física

2006-2014 Universidade Federal Fluminense (UFF, Niterói, Brazil)
Assistant Professor (“*Professor Adjunto*”), Instituto de Física

2005-2006 Universidade Federal Fluminense
Postdoctoral Fellow

2002-2005 Perimeter Institute for Theoretical Physics
Postdoctoral Fellow

Education

1998-2002 University of Oxford
D. Phil. (Ph.D) in Physics.
Thesis: [Foundations of quantum mechanics and quantum information applications](#).
Supervisor: Lucien Hardy

1996-1998 Universidade Federal do Rio de Janeiro (UFRJ)
Master’s degree in Physics.
Dissertation: Efeito Casimir dinâmico com espelhos parcialmente refletivos.

Supervisor: Paulo Américo Maia Neto

1992-1996 Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio)
Bachelor's degree in Physics (with full tuition scholarship)

Awards, grants and scholarships

- 2016-2022 Productivity in Research Grant, level 2 - Brazilian funding agency *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq).
- 2006-2015 Coordinator of 2 FAPERJ grants APQ1 for research projects.
- 2007, 2011 Coordinator of 2 APQ2/FAPERJ grants as co-organizer of the [I and III Quantum Information School and Workshop](#)- Paraty.
- 2006 Brazilian funding agency *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES) PRODOC post-doctoral scholarship.
- 2006- Participant of several projects coordinated by others: PRONEX funded by state agency FAPERJ (coordinated by Luiz Davidovich, 2006-2013); Instituto Nacional de Ciência e Tecnologia de Informação Quântica (INCT-IQ) (2009-2014), funded by CNPq (coord. Amir Caldeira); INCT-IQ (2017-2022), funded by CNPq (coord. Belita Koiler).
- 2005-2006 Junior postdoctoral scholarship by Brazilian funding agency CNPq.
- 2002-2005 Postdoctoral Fellowship at the Perimeter Institute for Theoretical Physics.
- 1999-2001 Overseas Research Students (ORS) Award from Universities UK, a tuition waiver for study at the University of Oxford, value roughly £12000.
- 1998-2002 Brazilian funding agency CAPES Ph.D. scholarship for study abroad (tuition, stipend).
- 1996-1998 CAPES Master's degree scholarship.
- 1992-1995 Full tuition Academic Performance Scholarship, Pontifical Catholic University of Rio (PUC-Rio).

Presentations

Invited Conference Talks

- 2018 XXXVIII Congresso Nacional de Matemática Aplicada e Computacional (CNMAC), invited talk in Mini-symposium "[Mathematics of Quantum Mechanics](#)" (Sept. 17-21).

- 2017 Workshop “[Quantum correlations, contextuality and all that, again and again](#)”, International Institute of Physics (IIP), Natal, Brazil (Nov. 20-24).
- 2016 XXXIX Encontro Nacional de Física da Matéria Condensada (largest condensed matter meeting in Brazil).
- 2015 XXXVIII Encontro Nacional de Física da Matéria Condensada (largest condensed matter meeting in Brazil).
- 2015 PICQUE Scientific School in integrated quantum photonics applications: from simulation to sensing (Rome, Italy).
- 2015 V Workshop em Comunicação e Informação Quântica (Campina Grande, Paraíba, março de 2015).
- 2015 Workshop “[Quantum correlations, contextuality and all that, again](#)”, International Institute of Physics (IIP), Natal, Brazil.
- 2014 One-day symposium “[O Pote de Ouro de Bell - 50 anos das desigualdades de Bell](#)”, Centro Brasileiro de Pesquisas Físicas (CBPF), Rio de Janeiro, Brazil.
- 2013 Workshop “[Quantum information seen through closed timelike curves](#)”, Fondation des Treilles, Tourtour, France.
- 2010 I Workshop de Física Teórica do CBPF, Rio de Janeiro, Brazil.
- 2009 Keynote speaker at SEMISH 2009, XXIX Congresso da Sociedade Brasileira de Computação (Congress of the Brazilian Computation Society), Bento Gonçalves, Brazil.

Invited mini-courses

- 2018 Short course "[Introduction to quantum computation and simulability](#)" at ICTP-SAIFR/IFT-UNESP (São Paulo), jointly with Daniel Brod and Leandro Aolita. Total of 22h30m of classes (7h30m each), October 2018.
- Short course “[Ingredients for universal quantum computation](#)”, Universidad Autonoma de Mexico (UNAM), October 2017.
- Short course “[Ingredients for universal quantum computation](#)”, [Concepción Summer Physics School - Concepción](#), Chile, January 2016.
- V Paraty Quantum Information School. “[Ingredients for universal quantum computation](#)“, 6h of lectures (2015).
- I Semana da Física do Instituto de Física de São Carlos (USP). Mini-course “Introdução à Informação Quântica”. 3h30m of lectures (2011) .

- XII Escola de Verão Jorge André Swieca de Ótica Quântica e Ótica Não Linear . “Introdução à Informação Quântica”, 4h30m of lectures. UFF (2010).

Research seminars

- Various invited research seminars in the University of Oxford, Cambridge University, Université de Montréal, University of Edinburgh, Universidad de Buenos Aires, Perimeter Institute, International Iberian Nanotechnology Laboratory, Pontifícia Universidade Católica do Rio Grande do Sul, Universidade Federal de Minas Gerais, Universidade Federal de Uberlândia, Universidade Federal do Rio de Janeiro, , Universidade do Estado do Rio de Janeiro, Centro Brasileiro de Pesquisas Físicas, Universidade Federal de Santa Catarina.

Professional service

Reviewing and refereeing

- Reviewer for research projects submitted to: European Research Council (ERC), Brazilian federal funding agency CNPq, state-wide funding agencies FAPESP, FACEPE.
- Referee for journals Physical Review Letters, Physical Review A, Journal of Modern Optics, Journal of Physics A, New Journal of Physics, Physics Letters A, Quantum Information and Computation.

Conference and workshop organization

- Program committee: [Theory of Quantum Computation, Communication and Cryptography \(TQC\) 2019](#) (Maryland, U.S.A., June 3-5, 2019).
- Program committee: [Q-turn quantum information workshop](#). 26-30th November, 2018 (Florianópolis, Brazil).
- Co-organizer of the series of 3 Quantum Rio Workshops, each a 2-day event in the Brazilian Center for Physical Research (CBPF), in November 2018, November 2017 and November 2016.
- Invited sub-reviewer by the program committee of conferences Quantum Information Processing (QIP) 2014 (Benasque, Spain) and QIP 2015 (Sydney, Australia).
- Program committee: V Workshop-Escola de Computação e Informação Quânticas (WECIQ), Campina Grande, Brazil, 2015.
- Sub-coordinator for events of the CNPq project *Instituto Nacional de Ciência e Tecnologia de Informação Quântica* (INCT-IQ), a nation-wide project with around 70 researchers in Brazil. From 2010 to 2014.
- Co-organizer of workshop “[Quo Vadis, quantum physics](#)’ at the International Institute of Physics (Natal, Brazil), 2013.
- Program committee: [First Workshop on Parallel Quantum Computing \(ParQ 2013\)](#), Edinburgh, 2013.

- Co-organizer of the III Quantum Information School and Workshop (Paraty, Brazil), 2011. Two-week event with around 100 participants.
- Co-organizer of the meeting of the INCT-IQ project, CBPF, Rio de Janeiro, Brazil, 2010.
- Co-organizer of the VII CBPF Winter School, Rio de Janeiro, Brazil, 2008.
- Co-organizer of the I Quantum Information School and Workshop (Paraty, Brazil), 2007. Two-week event with around 100 participants.
- Co-organizer of the first Perimeter Institute Quantum information workshop, 2003.

Outreach

- My book “[O que é computação quântica?](#)” (Ed. Vieira&Lent, 2007) and two articles for “Ciência Hoje” magazine were written with the general public in mind.
- Participation in the 30-minute TV program “[Universidade - Física Quântica](#)” (Canal Saúde – Fiocruz, Brazil), theme: quantum mechanics (2018).
- Participation in a “Pint of Science” popular science event in Rio de Janeiro (2018), on quantum information.
- Recorded [11 short physics video-classes for the “Sei Mais Física” outreach project](#) at UFF in 2008. They have had over 1.3 million visualizations on YouTube.
- In 2004/2005 I recorded nine short (5-min long) radio columns on science for Radio Centre-Ville (Montreal), broadcasting in Portuguese.
- Participation in the 30-minute CKCO-TV (Ontario) program “The big questions“, explaining relativity and quantum theory to school students. First broadcast on Dec 1st, 2002.

Other

- President of the Maths, Chemistry and Physics student society at PUC-Rio (1994-1995).

Publications

Book

- E. F. Galvão. O que é computação quântica? (in Portuguese). Editora Vieira&Lent (2007).

Popularization of science

- E. F. Galvão. A mecânica quântica das viagens no tempo. Revista Ciência Hoje (março 2012), p. 20-25.
- E. F. Galvão. Admirável mundo quântico. Revista Ciência Hoje, (junho 2009), p. 76-77.

Refereed journal articles

1. Allan D. C. Tosta, Daniel J. Brod, Ernesto F. Galvão. [Quantum computation from fermionic anyons on a 1D lattice](#). *Phys. Rev. A* **99**, 062335 (2019).
2. D. J. Brod, E. F. Galvão, A. Crespi, R. Osellame, N. Spagnolo, F. Sciarrino. [Photonic implementation of boson sampling: a review](#). *Advanced Photonics* **1** (3), 034001 (2019).
3. B. Pinheiro da Silva, D. S. Tasca, E. F. Galvão, A. Z. Khoury. [Astigmatic tomography of orbital angular momentum superpositions](#). *Phys. Rev. A* **99**, 043820 (2019).
4. D. J. Brod, E. F. Galvão, N. Viggianiello, F. Flamini, N. Spagnolo, F. Sciarrino. [Witnessing genuine multiphoton indistinguishability](#). *Phys. Rev. Lett.* **122**, 063602 (2019).
5. [N. Viggianiello, F. Flamini, M. Bentivegna, N. Spagnolo, A. Crespi, D. J. Brod, E. F. Galvão, R. Osellame, F. Sciarrino. Optimal photonic indistinguishability tests in multimode networks. *Science Bulletin* **63** \(22\), 1470 \(2018\).](#)
6. [Niko Viggianiello, Fulvio Flamini, Luca Innocenti, Daniele Cozzolino, Marco Bentivegna, Nicolò Spagnolo, Andrea Crespi, Daniel J. Brod, Ernesto F. Galvão, Roberto Osellame, Fabio Sciarrino. Experimental generalized quantum suppression law in Sylvester interferometers. *New Journal of Physics* **20**, 033017 \(2018\).](#)
7. [André L. Oestereich and E. F. Galvão, Reliable computation from contextual correlations. *Phys. Rev. A* **96**, 062305 \(2017\).](#)
8. [W. F. Balthazar, C. E. R. Souza, D. P. Caetano, E. F. Galvão, J. A. O. Huguenin, A. Z. Khoury. Tripartite non-separability in classical optics. *Optics Letters* **41** \(24\), pp. 5797-5800 \(2016\).](#)
9. [B. Pinheiro da Silva, M. Astigarreta Leal, C. E. R. Souza, E. F. Galvão, A. Z. Khoury. Laser beam mode transfer via a classical analogue of quantum teleportation. *J. Phys. B: At. Mol. Opt. Phys.* **49** 055501 \(2016\).](#)
10. [Marco Bentivegna, Nicolò Spagnolo, Chiara Vitelli, Fulvio Flamini, Niko Viggianiello, Ludovico Latmiral, Paolo Mataloni, Daniel J. Brod, Ernesto F. Galvão, Andrea Crespi, Roberta Ramponi, Roberto Osellame, Fabio Sciarrino. Experimental scattershot boson sampling. *Science Advances* **1** \(3\), e1400255 \(2015\).](#)
11. [M. Bentivegna, N. Spagnolo, C. Vitelli, D. J. Brod, A. Crespi, F. Flamini, R. Ramponi, P. Mataloni, R. Osellame, E. F. Galvão, F. Sciarrino. Bayesian approach to Boson Sampling validation. *Int. J. Quantum Inform.* **12**, 1560028 \(2014\).](#)
12. [N. Spagnolo, C. Vitelli, M. Bentivegna, D. J. Brod, A. Crespi, F. Flamini, S. Giacomini, G. Milani, R. Ramponi, P. Mataloni, R. Osellame, E. F. Galvão, F. Sciarrino. Experimental validation of photonic boson sampling. *Nature Photonics* **8**, 615–620 \(2014\).](#)

13. [N. Spagnolo, C. Vitelli, L. Sansoni, E. Maiorino, P. Mataloni, F. Sciarrino, D. J. Brod, E. F. Galvao, A. Crespi, R. Ramponi, R. Osellame. General Rules for Bosonic Bunching in Multimode Interferometers. *Phys. Rev. Lett.* **111**, 130503 \(2013\).](#)
14. [Dias da Silva R., Galvão E. F., Compact quantum circuits from one-way quantum computation. *Phys. Rev. A* **88**, 012319 \(2013\).](#)
15. [A. Crespi, R. Osellame, R. Ramponi, D. J. Brod, E. F. Galvao, N. Spagnolo, C. Vitelli, E. Maiorino, P. Mataloni, F. Sciarrino. Integrated multimode interferometers with arbitrary designs for photonic boson sampling. *Nature Photonics* **7**, 545–549 \(2013\).](#)
16. [Brod D. J., Galvão E. F., Geometries for universal quantum computation with matchgates. *Phys. Rev. A* **86**, 052307 \(2012\).](#)
17. [Brod, D. J., Galvão E. F., Extending matchgates into universal quantum computation. *Phys. Rev. A* **84**, 022310 \(2011\).](#)
18. [Dias da Silva R., Galvão E. F., Kashefi E. Closed timelike curves in measurement-based quantum computation. *Phys. Rev. A* **83**, 012316 \(2011\).](#)
19. [Galvão E. F. Economical ontological models for discrete quantum systems. *Phys. Rev. A* **80**, 022106 \(2009\).](#)
20. [A. Casaccino, E. F. Galvão, S. Severini, Extrema of discrete Wigner functions and applications, *Phys. Rev. A* **78**, 022310 \(2008\).](#)
21. [Cormick C., Galvão E. F., Gottesman D., Paz J. P., and Pittenger A. O. Classicality in discrete Wigner functions. *Phys. Rev. A* **73**, 012301 \(2006\).](#)
22. [Galvão E. F. Discrete Wigner functions and quantum computational speedup. *Phys. Rev. A* **71**, 042302 \(2005\).](#)
23. [Galvão E. F., and Hardy, L. Substituting a qubit for an arbitrarily large number of classical bits. *Phys. Rev. Lett.* **90**, 087902 \(2003\).](#)
24. [Galvão E.F. Feasible quantum communication complexity protocol. *Phys. Rev. A* **65**, 012318 \(2002\).](#)
25. [Galvão E. F., Plenio M. B. and Virmani S. Tripartite entanglement and quantum relative entropy. *J. Phys. A* **33**, 8809 \(2000\).](#)
26. [Galvão E. F., and Hardy, L. Cloning and quantum computation. *Phys. Rev. A* **62**, 022301 \(2000\).](#)
27. [Galvão, E. F., and Hardy, L. Building multiparticle states with teleportation. *Phys. Rev. A* **62**, 012309 \(2000\).](#)

Preprints

- T. Giordani, D. J. Brod, C. Esposito, N. Viggianiello, M. Romano, F. Flamini, G. Carvacho, N. Spagnolo, E. F. Galvão, F. Sciarrino. [Experimental quantification of genuine four-photon indistinguishability](#). Arxiv:1907.01325.
- E. F. Galvão, D. J. Brod. [Quantum and classical bounds for unknown two-state overlaps](#). ArXiv:1902.11039 [quant-ph].

Teaching and academic supervision

- I have supervised 2 completed PhDs – [Daniel Jost Brod](#) (currently associate professor at Universidade Federal Fluminense) and Raphael Dias da Silva (currently a tech entrepreneur), with CNPq scholarships. I currently supervise PhD student [Allan D. C. Tosta](#).
- My former PhD student Daniel J. Brod was awarded [honourific mention at José Leite Lopes Prize](#) for best PhD thesis in physics awarded in 2014 (Brazilian Physics Society).
- I have supervised 4 undergraduate research projects funded by agencies CNPq and FAPERJ. I have supervised undergraduate research projects of Hilary Greaves (jointly with Lucien Hardy, Univ. of Oxford) and Aissa Stein (jointly with Lee Smolin, Perimeter Institute).
- Undergraduate teaching at UFF, since 2005: Quantum Mechanics I (2 semesters) and II (3 semesters), Classical Mechanics I (two semesters), Electromagnetism I and II (4 semesters each), Basic Physics II and III, Experimental Physics II and III.
- Teacher Homage recipient at the 1st and 2nd semester graduating classes in Physics at Instituto de Física, UFF (2011).
- Graduate teaching at UFF, since 2007: Quantum Mechanics I (six semesters), Quantum Information and Computation I (one semester).
- Tutor in two one-week long physics courses for gifted A-level (secondary) students. [Villiers Park Educational Trust](#), U.K. (2000 and 2001).

Languages

- Native Portuguese speaker, fluent English. Basic French and Spanish.