

Marcelo Terra Cunha

Departamento de Matemática Aplicada

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IDENTIFICATION

Name: Marcelo de Oliveira Terra Cunha

Born: Rio de Janeiro, April 12, 1973.

Parents: José Luiz Terra Cunha e Maria Aparecida de Oliveira Terra Cunha

Married with Mirza Ferreira, father of Talita Ferreira Terra Cunha

EDUCATION

Ph.D. Physics from UFMG - Universidade Federal de Minas Gerais, 1997-2005

- Tesis: [Emaranhamento: caracterização, manipulação e conseqüências](#)

- Supervisor: Prof. Maria Carolina Nemes

M.Sc. Physics from Unicamp - Universidade Estadual de Campinas, 1994-1997

- Dissertation: [A geometria e os instantons da Teoria de Yang & Mills SU\(2\)](#)

- Supervisor: Dr. Marcio Antonio de Faria Rosa

B.Sc. Physics from Unicamp - Universidade Estadual de Campinas, 1991-1994

PROFESSIONAL HISTORY

Full Professor, Departamento de Matemática Aplicada, Universidade Estadual de Campinas, 2015-
Professor Associado, Departamento de Matemática, Universidade Federal de Minas Gerais,
2013-2015

Visiting Researcher (with a grant from Brazilian CNPq), University of Leeds, hosted by Prof. Vlatko
Vedral, 2006;

Professor Adjunto, Departamento de Matemática, Universidade Federal de Minas Gerais,
2005-2013

Professor Assistente, Departamento de Matemática, Universidade Federal de Minas Gerais,
1997-2005.

PRIZES AND DISTINCTIONS

Pesquisador CNPq, Level 1D, 2016-2020

Supervisor of a student awarded the "*Prêmio UFMG de Teses para Ciências Exatas*" (Bárbara Amaral), 2015

Regular Associate of International Centre for Theoretical Physics, 2011-2014

Pesquisador CNPq, Level 2, 2010-2013, 2013-2016

Affiliated Member of *Academia Brasileira de Ciências*, 2008-2013

Supervisor of a distinguished work at *Semana de Iniciação Científica, UFMG* (Marco Túlio Quintino), 2009

Supervisor of a distinguished work at *Semana de Iniciação Científica, UFMG* (Bárbara Amaral), 2007

Supervisor of a student distinguished with a Bronze Medal at *Jornadas de Iniciação Científica do IMPA* (Bárbara Amaral), 2006

SCHOLARSHIPS & GRANTS

(AS A DOCTOR)

Scholarship and Grant PQ-1D, CNPq, 2016-2020

Young Talent Scholarship for Dr. Matthias Kleinmann, CAPES/Science without Borders, 2014-2017

Grant to visit Oxford University, CNPq, 2014-2015 (awarded, but not used)

Young Talent Scholarship for Dr. Rafael Rabelo, CNPq/Science without Borders, 2013-2016

Pesquisador Mineiro, Fapemig, R\$ 48.000, 2013-2015

Scholarship PQ-2, CNPq, 2013-2016

Guest researcher for Prof. Andreas Winter as *Pesquisador Visitante Especial*, CAPES/Science without Borders, 2012-2015

Grant to visit *Universidad de Sevilla*, CAPES, 2012-2013 (awarded, but not used)
Pesquisador Mineiro, Fapemig, R\$ 48.000, 2011-2013
 Scholarship PQ-2, CNPq, 2010-2013
Pesquisador Mineiro, Fapemig, R\$ 48.000, 2009-2011
Universal, CNPq, R\$ 10.800, 2008-2009
Pesquisador Mineiro, Fapemig, R\$ 48.000, 2007-2009
 Grant to visit the University of Leeds, CNPq, 2006
 Grant for New Doctors, PRPq-UFMG, R\$ 11.600; 2006-2007
Universal, Fapemig, R\$ 19.443, 2006-2008

PARTICIPATION AT RESEARCH NETWORKS

Projeto Casadinho, Colaboration among UFU-USP-UFMG-IPEN: electronic structure, quantum information, and biomaterials characterization, 2012-2014
 Pronex “*Informação Quântica com Fótons Emaranhados*”, Fapemig, coordinated by Prof. Carlos Monken, 2009-2014
Instituto Nacional de Ciência e Tecnologia em Informação Quântica, INCT-IQ, CNPq/MCT, coordinated by Prof. Amir Caldeira, 2009-2014
II Instituto do Milênio em Informação Quântica, coordinated by Prof. Amir Caldeira, 2006-2008

PARTICIPATION IN SCIENCE MEETINGS

More than 60 participations in national and international meetings, including
 Quantum Correlations, Contextuality, and all that again, Natal, 2015
 5 Paraty Schools and Workshops on Quantum Information, Brazil, 2015, 2013, 2011, 2009, 2007
 10 *Colóquios Brasileiro de Matemática*, Rio de Janeiro, 2015, 2013, 2011, 2009, 2007, 2005, 2001, 1999, 1997, 1995
 6 Benasque Sessions on Quantum Information, Spain, 2015, 2013, 2011, 2009, 2007, 2003
 Quantum Optics VII, Argentina, 2014
 Many Faces of Distances, Campinas, 2014
Colóquio de Matemática da Região Norte, Manaus, 2014
 Quantum Applications, Spain, 2014
 DimWit Meeting, Poland, 2014
 Quantum [Un]Speakables, 50th years of Bell’s Theorem, Austria, 2014
Colóquio de Matemática da Região Sul, Florianópolis, 2014
 International Program on Quantum Information, India, 2014
 Quantum Correlations, Contextuality, and all that, Natal, 2013
II Encontro Nacional de Membros Afiliados da Academia Brasileira de Ciências, Petrópolis, 2013
 3 Central European Workshop on Quantum Optics, 2013, 2012, 2006
Semana Não-Local, Porto Alegre, 2013
Quo Vadis Quantum Physics?, Natal, 2013
 2 *Reunião Magna da Academia Brasileira de Ciências*, Rio de Janeiro 2012, 2010
 2 *Academia Brasileira de Ciências na UFMG*, Belo Horizonte, 2012, 2008
Encontro Temático do INCT - Correlações Quânticas, Brazil, 2011
 Quantum Information Processing, Singapore, 2011
Ciência, Tecnologia e Inovação: Visões da Jovem Academia, Rio de Janeiro, 2011
Avanços e Perspectivas da Ciência no Brasil, América Latina e Caribe, Rio de Janeiro 2009
 Entropy and the Quantum, EUA, 2009
 Foundations of Probability and Physics, Sweden, 2008
 Quantum Optics IV, Florianópolis, 2008
 SCALA Workshop on Quantum-Classical Transition and Quantum Information, Spain, 2006
 3 *Escolas Jorge André Swieca em Óptica Quântica e Óptica Não-Linear*, 2004, 2000, 1998
 IUPAP Conference on Quantum Entanglement, Complexity, and the Physical Basis for Quantum Computation, Rio de Janeiro, 2002
 International School on Quantum Computation and Information, Portugal, 2002
 PASI on Chaos, Decoherence, and Quantum Entanglement, Argentina, 2000
 International Conference on Squeezed States and Uncertainty Relations, Italy, 1999
 Escuela Latinoamericana de Física, Mexico, 1998
 Invited talks or shortcourses:
 Quantum Optics VII, Argentina, 2014
Colóquio de Matemática da Região Norte, Manaus, (october) 2014
 International Program on Quantum Information, India, 2014

Colóquio de Matemática da Região Sul, Florianópolis, 2014
 3 *Colóquio Brasileiro de Matemática*, IMPA, Rio de Janeiro, 2013, 2011, 2007
Oktobermat, PUC, Rio de Janeiro, 2010
 <WECIQ|2010>, LNCC, Petrópolis, 2010
Escola de Inverno em Física, UFMG, Belo Horizonte, 2010
 Bienal de Matemática da SBM, UFBA, Salvador, 2004

EVENTS ORGANIZATION

Quantum Correlations, Contextuality, and all that again, Natal, 2015
 Special session on Mathematics of Quantum Theory, *Colóquio Brasileiro de Matemática*, Rio de Janeiro, 2015
Ciência e Amizade, São Paulo/Campinas/Belo Horizonte, 2014
 Quantum Correlations, Contextuality, and all that, Natal, 2013
II Encontro Nacional de Membros Afiliados da Academia Brasileira de Ciências, Petrópolis, 2013
2 Verão em Matemática na UFMG, Belo Horizonte, 2012, 2010
III Encontro Temático do Instituto Nacional de Ciência e Tecnologia em Informação Quântica, Natal, 2011
 3 (first) Paraty School and Workshop on Quantum Information, Brazil, 2011, 2009, 2007
 Quantum Optics IV, Florianópolis, Brazil, 2008

TEACHING

Since 2005 I have taught the following courses for graduate students

Analysis in \mathbb{R}^n , Algebraic Topology, Quantum Theory of Information, Topics in Entanglement, Topics in Mathematical Physics, Functional Analysis

Since 1998 I have taught the following courses for undergraduate students

Calculus I, II e III, Differential Equations A and B, Analytic Geometry and Linear Algebra, Introduction to Mathematics, Problem Solving, Mathematics (for students from Accounting, Economical Sciences, and Public Administration), Algebra A (Number Theory), Analysis II, Topics in Differential Geometry and Relativity Theory, Topics in Quantum Information,

By invitation, I offered the following short courses

Probabilidades no Futebol, Juiz de Fora, 2010
 Noções de Informação Quântica, Porto Alegre, 2008

SUPERVISING

Two postdocs

Matthias Kleinmann, Capes/Science without Borders, 2014 - 2015
 Rafael Rabelo, CNPq/Science without Borders, 2013 -

Three PhD awarded

Gláucia Murta, Physics-UFMG, since 2016
 Bárbara Amaral, Mathematics-UFMG, 2014
 Raphael Campos Drumond, Physics-UFMG, 2011

One PhD awarded as co-supervisor

Carlos Felipe Lardizábal Rodrigues, Mathematics-UFRGS (supervisor: Artur Lopes), 2010

Six PhD students

Cristhiano Duarte, Mathematics-UFMG, since 2013
 José Roberto Pereira Jr, Physics-UFMG, since 2013
 Leonardo Guerini Mathematics-UFMG, since 2014
 Gabriel Fagundes, Physics-UFMG, since 2014
 Tassius Temistocles, Physics-UFMG, since 2014
 Natália S. Möller, Physics-UFMG, since 2014

Eight MSc awarded

Cristhiano Duarte, Mathematics-UFJF, 2013
 Marco Túlio Coelho Quintino, Physics-UFMG, 2012
 Mateus Araújo Santos, Physics-UFMG, 2012
 Gláucia Murta, Physics-UFMG, 2012
 Rafael L. Rabelo, Physics-UFMG, 2010
 Bárbara Lopes Amaral, Mathematics-UFMG, 2010
 Adriana Xavier Freitas, Mathematics-UFMG, 2010
 Daniel Cavalcanti, Physics-UFMG, 2006

Four MSc awarded as co-supervisor

- Eduardo Carlo Mascarenhas Moraes, Physics-UFMG (supervisor: Marcelo França Santos), 2010
- Manoel Pedro de Araújo, Physics-UFMG (supervisor: Maria Carolina Nemes), 2010
- Mariana Rodrigues Barros, Physics-UFMG (supervisor: Sebastião de Padua), 2010
- Juliana Gontijo Fonseca, Physics-UFMG (supervisor: Sebastião de Padua), 2009

Two MSc student

- Marcello Nery, Physics-UFMG, since 2014
- Jessica Bavaresco, Physics-UFMG, since 2014

ACADEMIC ADMINISTRATION

- Dean of Graduate Studies in Mathematics, UFMG, 2014-2015
- Member of *Conselho Universitário*, UFMG, 2012-2016
- Member of the selection committee for PhD students, Mathematics, UFMG, 2014
- Member of the selection committee for MSc students, Mathematics, UFMG, 2011-2013
- Deputy Dean of Undergrad Studies in Mathematics, UFMG, 2010-2012
- Member of *Comissão Permanente de Pessoal Docente*, UFMG, 2007-2010
- Member of many other committees

PUBLICATIONS

Papers in peer reviewed journals or conferences

1. Cristhiano Duarte, Raphael C. Drumond, and Marcelo Terra Cunha (2016), Self-catalytic conversion of pure quantum states, *J. Phys. A* **49**, 145303; arxiv:1504.06364.
2. Raphael C. Drumond, Cristhiano Duarte, Marcelo Terra Cunha, and M.C. Nomes (2016), Universality of finite time disentanglement, *Phys. Rev. A* **93**, 022313; arxiv:1510.06466.
3. Gláucia Murta, Ravishankar Ramanathan, Natália Möller, and Marcelo Terra Cunha (2016), Quantum bounds on multiplayer linear games and device-independent witness of genuine tripartite entanglement; *Phys. Rev. A* **93**, 022305; arXiv:1510.09210.
4. Barbara Amaral, Marcelo Terra Cunha, and Adán Cabello (2015), Quantum theory allows for absolute maximal contextuality, *Phys. Rev. A* **92**, 062125; arxiv:1507.03142.
5. Rafael Rabelo, Cristhiano Duarte, Antonio J. López-Tarrida, Marcelo Terra Cunha, and Adán Cabello (2014), Multigraph approach to quantum nonlocality, *J. Phys. A: Math. Theor.* **47**, 424021; arXiv:1407.5340.
6. Barbara Amaral, Marcelo Terra Cunha, and Adán Cabello (2014), Exclusivity principle forbids sets of correlations larger than the quantum set, *Phys. Rev. A* **89**, 030101; arxiv:1306.6289;
7. Adán Cabello, Piotr Badziąg, Marcelo Terra Cunha, and Mohamed Bourennane (2013), Simple Hardy-Like Proof of Quantum Contextuality, *Phys. Rev. Lett* **111**, 180404; arxiv:1310.8330;
8. Mateus Araújo, Marco Túlio Quintino, Costantino Budroni, Marcelo Terra Cunha, and Adán Cabello (2013), Complete characterization of the n-cycle noncontextual polytope, *Phys. Rev. A* **88**, 022118; arxiv:1206.3212;
9. Colin Teo, Mateus Araújo, Marco Túlio Quintino, Jiří Minář, Daniel Cavalcanti, Valerio Scarani, Marcelo Terra Cunha, and Marcelo França Santos (2013), Realistic loophole-free Bell test with atom-photon entanglement, *NATURE COMMUNICATIONS* **4**, 2104; arxiv:1206.0074;
10. Adán Cabello and Marcelo Terra Cunha (2013), State-independent contextuality with identical particles, *Phys. Rev. A* **87**, 022126; arXiv:1212.5501;
11. B. Marques, M.R. Barros, W.M. Pimenta, M.A.D. Carvalho, J. Ferraz, R.C. Drumond, M. Terra Cunha, and S. Pádua (2012), Double-slit implementation of the minimal Deutsch algorithm, *Phys. Rev. A* **86**, 032306;
12. Mateus Araújo, Marco Túlio Quintino, Daniel Cavalcanti, Marcelo França Santos, Adán Cabello, and Marcelo Terra Cunha (2012), Tests of Bell inequality with arbitrarily low photodetection efficiency and homodyne measurements, *Phys. Rev. A* **86**, 030101(R); arXiv:1112.1719;
13. M.T. Quintino, M. Araújo, D. Cavalcanti, M. França Santos, and M. Terra Cunha, *Maximal violations and efficiency requirements for Bell tests with photodetection and homodyne measurements*, *J. Phys. A: Math. Theor.* **45**, 215308; [arXiv:1106.2486](https://arxiv.org/abs/1106.2486);
14. Marcelo F. Santos, Marcelo Terra Cunha, Rafael Chaves, and André R.R. Carvalho (2012), *Quantum computing with incoherent resources and quantum jumps*, *Phys. Rev. Lett* **108**, 170501; [arXiv:1111.1319](https://arxiv.org/abs/1111.1319);
15. C. Vitelli, M. Terra Cunha, N. Spagnolo, F. De Martini, and F. Sciarrino (2012), *Continuous-variable nonlocality test performed over a multiphoton quantum state*, *Phys. Rev. A* **85**, 012104;
16. A. Cabello and M. Terra Cunha (2011), *Proposal of a two-qutrit contextuality test free of the finite precision and compatibility loopholes*, *Phys. Rev. Lett.* **106**, 190401; [arXiv:1009.2330](https://arxiv.org/abs/1009.2330);

17. A. Baraviera, C.F. Lardizabal, A.O. Lopes, and M. Terra Cunha (2011), *Quantum Stochastic Processes, Quantum Iterated Function Systems and Entropy*, São Paulo Journal of Mathematical Sciences **5**, 51; [arxiv:0911.0182](#);
18. W. M. Pimenta, B. Marques, M. A. Carvalho, M. R. Barros, J. G. Fonseca, J. Ferraz, M. Terra Cunha, and S. Pádua (2010), *Minimal state tomography of spatial qubits using a spatial light modulator*, *Opt. Express* **18**, 24423-24433;
19. R.C. Drumond, L.A.M. Souza, and M. Terra Cunha (2010), *Asymptotic Entanglement Dynamics Phase Diagrams for Two Electromagnetic Field Modes in a Cavity*, *Phys. Rev. A* **82**, 042302; [arxiv:0909.4023](#);
20. E. Mascarenhas, B. Marques, M. Terra Cunha, and M. França Santos (2010), *Continuous Quantum Error Correction through local operations*, *Phys. Rev. A* **82**, 032327;
21. A. Baraviera, C.F. Lardizabal, A.O. Lopes, and M. Terra Cunha (2010), *A Thermodynamic Formalism for density matrices in Quantum Information*, *Appl Math Res Express* **2010** (1): 63-118; [arxiv:0911.0179](#);
22. E. Mascarenhas, B. Marques, D. Cavalcanti, M. Terra Cunha, and M. França Santos (2010), *Protection of quantum information and optimal singlet conversion through higher dimensional quantum systems and environment monitoring*, *Phys. Rev. A* **81**, 032310; [arxiv:1002.0436](#);
23. Ariel Bendersky, Juan Pablo Paz, and Marcelo Terra Cunha (2009), *General theory of measurement with two copies of a quantum state*, *Phys. Rev. Lett.* **103**, 040404; [arxiv:0904.3576](#);
24. R.C. Drumond and M. Terra Cunha (2009), *Asymptotic entanglement dynamics and geometry of quantum states* *J. Phys. A* **42**, 285308; [arxiv:0809.4445](#);
25. R.C. Drumond and M.O. Terra Cunha (2009), *Geometry of Entanglement Sudden Death: Explicit Examples* *AIP Conf. Proc.* **1101**, 386; [arxiv:0811.3344](#);
26. D. Cavalcanti, P.L. Saldanha, O. Cosme, F.G.S.L. Brandão, C.H. Monken, S. Pádua, M. França Santos, M.O. Terra Cunha (2008), *Geometrically induced singular behavior of entanglement*, *Phys. Rev. A* **78**, 012318; [arxiv:0709.0301](#);
27. D. Cavalcanti, M. O. Terra Cunha, and A. Acin (2007), *Multipartite entanglement of superpositions*, *Phys. Rev. A* **76**, 042329; [arxiv:0705.2521](#);
28. Daniel Cavalcanti, L. M. Moreira, Franklin Matinaga, Marcelo O. Terra Cunha, and Marcelo França Santos (2007), *Useful entanglement from the Pauli principle*, *Phys. Rev. B* **76**, 113304; [arxiv:quant-ph/0608141](#);
29. Marcelo O. Terra Cunha (2007), *The Geometry of Entanglement Sudden Death*, *New Journal of Physics* **9**, 237; [arxiv:quant-ph/0703121](#);
30. M. O. Terra Cunha, J. A. Dunningham, and V. Vedral (2007), *Entanglement in single particle systems*, *Proc. Roy. Soc. A* **463**, 2277; [arxiv:quant-ph/0606149](#);
31. Marcelo O. Terra Cunha and Vlatko Vedral (2006), *How to Extract Entanglement from a Piece of Solid or a Bunch of Neutrons*, *Acta Physica Hungarica B* **26**, 261-268; [arxiv:quant-ph/0607224](#);
32. D. Cavalcanti, F.G.S.L. Brandão, and M.O. Terra Cunha (2006), *Entanglement quantifiers, entanglement crossover, and phase transitions*, *New J. Phys.* **8**, 260; [arxiv:quant-ph/0510132](#);
33. Daniel Cavalcanti, J. G. Oliveira Jr, J. G. Peixoto de Faria, Marcelo O. Terra Cunha, and Marcelo França Santos (2006), *Entanglement versus energy in the entanglement transfer problem*, *Phys. Rev. A* **74**, 042328; [arxiv:quant-ph/0608139](#);
34. Daniel Cavalcanti, Marcelo O. Terra Cunha (2006), *Estimating entanglement of unknown states*, *Appl. Phys. Lett.* **89**, 084102. [Arxiv:quant-ph/0605155](#);
35. D. Cavalcanti, M.F. Santos, M.O. Terra Cunha, C. Lunken, V. Vedral (2005), *increasing identical particle entanglement by fuzzy measurements*, *Phys. Rev. A* **72**, 062307. [Arxiv:quant-ph/0505029](#);
36. D. Cavalcanti, F.G.S.L. Brandão, M.O. Terra Cunha (2005), *Are all maximally entangled states pure?* *Phys. Rev. A* **72**, 040303. [Arxiv:quant-ph/0505121](#);
37. Mauricio Reis, M.O. Terra Cunha, Adelcio C. Oliveira, M.C. Nemes (2005), *Relation between quantum phase transitions and classical instability points in the pairing model*, *Phys. Lett. A* **344**, 164;
38. D. Cavalcanti, L. Cioletti, and M.O. Terra Cunha (2005), *Tomographic characterization of three qubits pure states with only two qubits detectors*, *Phys. Rev. A* **71**, 014301. [Arxiv:quant-ph/0408022](#);
39. M.O. Terra Cunha and M.C. Nemes (2004), *Towards an understanding of decoherence on ions traps*, *Phys. Lett. A* **329**, 409-413. [Arxiv:quant-ph/0401117](#);
40. A.R. Bosco de Magalhães, S.G. Mokarzel, M.C. Nemes, and M.O. Terra Cunha (2004), *Decay rate and decoherence control in coupled dissipative cavities*, *Physica A* **341**, 234-250. [Arxiv:quant-ph/0405022](#);
41. M.O. Terra Cunha and M. C. Nemes (2002), *Analysing a complementarity experiment on the quantum-classical boundary*, *Phys. Lett. A* **305**(6), 313-321.
42. S.P. Walborn, M.O. Terra Cunha, S. Pádua, and C.H. Monken (2002), *A Double-Slit Quantum Eraser*, *Phys. Rev. A* **65** 033818.

43. M.O. Terra Cunha, V.i. Man'ko, and M.O. Scully (2001), *Quasiprobability and Probability Distributions for Spin-1/2 States*, *Found. Phys. Lett.* **14**(2), 103-117.

Outreach Articles

1. S.P. Walborn, M.O. Terra Cunha, S. Padua, and C.H. Monken (2003), *Quantum Erasure*, *American Scientist* **91**, 336. ([pdf file](#)). Submitted text: *Getting to the heart of quantum mechanics*, ([html file](#), [rtf file](#)). Spanish translation: *Borrado Cuántico*, *investigación y Ciencia* **329**, 59 (Febrero 2004) e *Scientific American Latinoamérica* **19**, pp (Febrero 2004); German translation: *Quantenradierer*, *Spektrum der Wissenschaft* **2**, 32 (Februar 2004).
2. B.N.B. de Lima, G.N. Costa, M.O.T. Cunha, F. Brochero e R.V. Martins (2008), *Futebol: uma caixinha de ... sorteios*, *Ciência Hoje* **254**, 24-29.

Books

1. Bárbara Amaral, Alexandre Tavares Baraviera, and Marcelo O. Terra Cunha, *Mecânica Quântica para Matemáticos em Formação*, IMPA-SBM, ISBN 9788524403279 (2011);
2. M. Terra Cunha, *Noções de Informação Quântica*, IMPA-SBM, ISBN 9788524402593 (2007).

Book chapters

1. A. Baraviera, C.F. Lardizabal, A.O. Lopes, and M. Terra Cunha (2011), *A dynamical point of view of quantum information: entropy and pressure*, in: M.M. Peixoto, A.A. Pinto, and D.A. Rand, *Dynamics, Games and Science I*, Springer, pp 81-122.
2. A. Baraviera, C.F. Lardizabal, A.O. Lopes, and M. Terra Cunha (2011), *A dynamical point of view of quantum information: discrete Wigner measures*, in: M.M. Peixoto, A.A. Pinto, and D.A. Rand, *Dynamics, Games and Science II*, Springer, pp 161-186.