

CURRICULUM VITÆ

PERSONAL INFORMATION

Full name: David Edward Bruschi
Date & place of birth: 25 November 1982, Berkeley (California), United States of America
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RESEARCH INTERESTS

- Mathematical techniques underpinning the theory for relativistic and quantum technologies;
- Space-based relativistic and quantum science for future technologies;
- The role of quantum correlations in a theory of gravitating quantum matter.

CURRENT SCIENTIFIC POSITION

2020—current. *Wissenschaftler* (Senior Scientist)
Institute for Quantum Computing Analytics (PGI-12), Forschungszentrum Jülich, Germany.

PAST SCIENTIFIC POSITIONS

2019–2020. *Wissenschaftlicher Mitarbeiter* - Universität des Saarlandes, Germany.
2019. *Postdoctoral Researcher* - CEITEC, Brno University of Technology, Czech Republic.
2018–2019. *Visiting Researcher* - IQOQI Vienna, Austria.
2015–2017. *Research Fellow* - University of York, UK.
2013–2015. *Research Fellow* - Hebrew University of Jerusalem, Israel.
2012–2013. *Research Associate* - University of Leeds, UK.

PAST PROFESSIONAL POSITIONS

2017—2021. *Junior Editor* of the 'snapshots of modern mathematics' program,
Mathematisches Forschungsinstitut Oberwolfach (MFO), Germany.

PROFESSIONAL QUALIFICATIONS

2020–2029. Abilitazione Nazionale settore concorsuale 02A2, "Fisica Teorica delle Interazioni Fondamentali" — Italian habilitation for Associate Professor level.

EDUCATION

2012/Dec. PhD in Mathematics, University of Nottingham, UK. Supervisor: Dr. J. Louko.
2008/Mar. Master in Physics, University of Bologna, Italy. Grade: 110/110 summa cum laude.
2005/Oct. Bachelor in Physics, University of Bologna, Italy. Grade: 110/110 summa cum laude.

MAJOR GRANTS

2016–2018. "Quantum Observers in a Relativistic World" 84030 USD awarded by the FQXi;
2016–2018. "Leaps in cosmology: gravitational wave detection with quantum systems"
232691 EUR awarded by the John Templeton Foundation.

SMALL GRANTS

21 smaller grants for a total cumulative contribution of more than 19000 EUR.

FELLOWSHIPS AND AWARDS

2012/01. "Nottingham University Travel Prize" (University of Nottingham, UK).
2008/05-07. "Borsa di studio per periodi di ricerca all'estero" (Università degli Studi di Bologna, Italy).
2008/05-07. Three month "Research Fellowship" (BIGS Bonn, Germany).

COMMISSIONS OF TRUST

- Scientific evaluator for: NASA Postdoctoral Program (USA), COST (EU), EPSRC (UK).
- Referee for 50 journals (such as Phys. Rev. Lett., Nature Comm., Phys. Rev. D).

BIBLIOGRAPHY

47 manuscripts available online on the arXiv.
40 publications in international journals (4 *single author*).
1610 citations on [Google Scholar](#) [876 on Scopus, 975 on WoS].
h-index 22 on [Google Scholar](#) [18 on Scopus, 18 on WoS].

MEMBERSHIPS

2020—present: *Angehöriger* (Associate member), ML4Q Cluster of Excellence, Germany;
2019—present: Deutsche Physikalische Gesellschaft (DPG);
2012—present: European Physical Society (EPS);
2008—present: Società Italiana di Fisica (SIF).
Others: COST Actions CA16104, CA15220.

INVITED TALKS, LECTURES AND SEMINARS

16 Invited talks at scientific meetings;
26 Contributed talks at scientific meetings;
1 Invited lecture: Quantum Information;
34 Invited seminars at national and international institutes.

EXTENDED RESEARCH VISITS

June 2017—Aug 2018. *Visiting Scientist*, University of Vienna, Vienna, Austria
May—Aug 2008. *Visiting Scientist*, Hausdorff Institute for Mathematics, Bonn, Germany.

RESEARCH VISITS

68 national/international research visits (15 countries visited) starting from 2009:
Austria, Canada, China, Cuba, Czech Republic, Germany, Israel, Italy, Malta, Netherlands,
Poland, Spain, Sweden, Switzerland, UK.

SUPERVISION OF STUDENTS AND POSTDOCS

- Co-supervisor: 2 Postdocs (U. Nottingham, funded by FQXi and JTF grant).
- Co-supervisor: 3 PhD students (U. Vienna, U. Nottingham, UCL).
- Research supervisor: 1 PhD student during an academic exchange (U. Patras).
- Supervisor of 4 MSc students: C. Moore, B. Morris, M. Harris (graduated 2016&2017 at U. York), Y. Weber (U. Des Saarlandes).

TEACHING ACTIVITIES

- Physics laboratories teacher (2006-2008), Liceo Marconi High School, Parma, Italy;
- Nottingham: Undergraduate course assistant (2008-2012) for: Core Mathematics (Years 1 & 2); Calculus for engineering (Years 1 & 2); Core Physics (Years 1 & 2); Calculus (Year 1); Undergraduate homework/exam marker (2008-2012); Disability note taker (2011-2012); Small group tutor/private tutor (2008-2012); Tutor for students with Dyslexia (2008-2011);
- York: Undergraduate practical course lecturer (2015-2016). Electromagnetism and classical mechanics (Year 1); Elements of special relativity (Year 1).
- Saarbrücken (2019): Quantum optics and gravity (Seminar course); (2020) Quantum field theory (Graduate course); (2021): Mathematical Methods for Modern Physics (Graduate Course).

ORGANISATION OF SCIENTIFIC MEETINGS

2013/Jun. *RQI-N 2013* meeting. Nottingham, UK; 100 participants; Organiser.
2013/Apr. *Quantum Fields, Gravity & Information: joint efforts and new directions in mathematical physics* meeting, Nottingham, UK; 50 participants; Organiser.
2013/Feb. *Quantum technologies* meeting. Leeds, UK; 40 participants; Organiser.

BIBLIOGRAPHY

PUBLISHED

40. *A master-equation treatment of nonlinear optomechanical systems with optical loss*. S. Qvarfort, M. R. Vanner, P. F. Barker, **D. E. Bruschi**. arXiv:2009.02295 to appear Phys. Rev. A
39. *Optimal estimation of time-dependent gravitational fields with quantum optomechanical systems*. S. Qvarfort, A. Douglas K. Plato, **D. E. Bruschi**, F. Schneiter, D. Braun, A. Serafini, D. Rätzel. Phys. Rev. Research 3, 013159 (2021)
38. *General solution of the time evolution of two interacting harmonic oscillators*, **D. E. Bruschi**, G. S. Paroanu, Ivette Fuentes, Frank K. Wilhelm, Andreas W. Schell. Phys. Rev A 103:2, 023707 (2021)
37. *Thermodynamics of relativistic quantum fields confined in cavities*, **D. E. Bruschi**, B. Morris, I. Fuentes. Phys. Lett. A 384:25, 126601 (2020)
36. *Optimal estimation with quantum optomechanical systems in the nonlinear regime*, F. Schneiter, S. Qvarfort, A. Serafini, A. Xuereb, D. Braun, D. Rätzel, **D. E. Bruschi**. Phys. Rev. A 101, 033834 (2020)
35. *Time evolution of two harmonic oscillators with cross-Kerr interactions*. **D. E. Bruschi**. J. Math. Phys. 61, 032102 (2020)
34. *Time-evolution of nonlinear optomechanical systems: Interplay of mechanical squeezing and non-Gaussianity*. S. Qvarfort, A. Serafini, A. Xuereb, D. Braun, D. Rätzel, **D. E. Bruschi**. J. Phys. A: Math. Theor. 53, 075304 (2020)
33. *Time evolution of coupled multimode and multiresonator optomechanical systems*. **D. E. Bruschi**. J. Math. Phys 60, 062105 (2019)
32. *Enhanced nonlinearity through optomechanical modulation*. S. Qvarfort, A. Serafini, A. Xuereb, D. Rätzel, **D. E. Bruschi**. New J. Phys. 21, 055004 (2019)
31. *Quantum-metrology estimation of spacetime parameters of the Earth outperforming classical precision*. J. Kohlrus, D. E. Bruschi, I. Fuentes. Phys. Rev. A 99, 032350 (2019)
30. *“Mechano-optics”: An optomechanical quantum simulator*, **D. E. Bruschi**, A. Xuereb. New J. Phys. 20, 065004 (2018)
29. *Space QUEST: Experimentally testing decoherence due to gravity*, S. K. Joshi, et.al.. New J. Phys. 20, 063016 (2018)
28. *Work drives time evolution*, **D. E. Bruschi**. Annals of Physics 394, 155-161 (2018)
27. *Gravity in the Quantum Lab*, R. Howl, L. Hackermüller, **D. E. Bruschi**, I. Fuentes. Advances in Physics: X 3 (1), (2018)
26. *Entanglement and coherence in bi-squeezed tripartite Gaussian states*, **D. E. Bruschi**, C. Sabín, G. S. Paroanu. Phys. Rev. A 95, 062324 (2017)
25. *Quantum communications and quantum metrology in the spacetime of a rotating planet*, J. Kohlrus, **D. E. Bruschi**, J. Louko, I. Fuentes. EPJ Quantum Technology 4:7 (2017)
24. *Thermal noise in BEC-phononic gravitational wave detectors* C. Sabín, J. Kohlrus, **D. E. Bruschi**, I. Fuentes. EPJ Quantum Technology 3:8 (2016)
23. *Towards universal quantum computation through relativistic motion*, **D. E. Bruschi**, C. Sabín, P. Kok, G. Johansson, P. Delsing, I. Fuentes. Sci. Rep. 6, 18349 (2016)
22. *On the weight of entanglement*, **D. E. Bruschi**. Phys. Lett. B 754, 182-186 (2016)
21. *Quantum thermodynamics for a model of an expanding universe*, N. Liu, J. Goold, I. Fuentes, V. Vedral, K. Modi, **D. E. Bruschi**. Class. Quantum Grav. 33, 035003 (2016)
20. *Thermodynamics of creating correlations: limitations and optimal protocols*, **D. E. Bruschi**, M. Perarnau-Llobet, N. Friis, K. V. Hovhannisyan, M Huber. Phys. Rev. E 91, 032118 (2015)
19. *Quantum estimation of the Schwarzschild space-time parameters of the Earth*, **D. E. Bruschi**, A. Datta, R. Ursin, T. C. Ralph, I. Fuentes. Phys. Rev. D 90, 124001 (2014)
18. *Repeat-until-success quantum repeaters*, **D. E. Bruschi**, T. M. Barlow, M. Razavi, A. Beige. Phys. Rev. A 90, 032306 (2014)
17. *Spacetime effects on satellite-based quantum communications*, **D. E. Bruschi**, T. C. Ralph, I. Fuentes, T. Jennewein, M. Razavi. Phys. Rev. D 90, 045041 (2014)
16. *Phonon creation by gravitational waves*, C. Sabín, **D. E. Bruschi**, M. Ahmadi, I. Fuentes. New J.Phys. 16, 085003 (2014)
15. *Relativistic Quantum Metrology: Exploiting relativity to improve quantum measurement technologies*, M. Ahmadi, **D. E. Bruschi**, N. Friis, C. Sabín, G. Adesso, I. Fuentes. Sci. Rep. 4, 4996 (2014)
14. *Testing the effects of gravity and motion on quantum entanglement in space-based experiments*, **D. E. Bruschi**, C. Sabín, A. White, V. Baccetti, D. K. L. Oi, I. Fuentes. New J. Phys. 16, 053041 (2014)
13. *Quantum metrology for relativistic quantum fields*, M. Ahmadi, **D. E. Bruschi**, I. Fuentes. Phys. Rev. D 89, 065028 (2014)
12. *Localised projective measurement of a relativistic quantum field in non-inertial frames*, A. Dragan,

- J. Doukas, E. Martín-Martínez, **D. E. Bruschi**. *Class. Quantum Grav.* 30, 235006 (2013)
11. *On the robustness of entanglement in analogue gravity systems*, **D. E. Bruschi**, N. Friis, I. Fuentes, S. Weinfurter. *New J. Phys.* 15, 113016 (2013)
 10. *Relativistic motion generates quantum gates and entanglement resonances*, **D. E. Bruschi**, A. Dragan, A. Lee, J. Louko, I. Fuentes. *Phys. Rev. Lett.* 111, 090504 (2013)
 9. *Mode-mixing quantum gates and entanglement without particle creation in periodically accelerated cavities*, **D. E. Bruschi**, D. Faccio, I. Fuentes, J. Louko. *New J. Phys.* 15, 073052 (2013)
 8. *Time evolution techniques for detectors in relativistic quantum information*, **D. E. Bruschi**, A. R. Lee, I. Fuentes. *J. Phys. A: Math. Theor.* 46 165303 (2013)
 7. *Fermionic mode entanglement in quantum information*, N. Friis, A. R. Lee, **D. E. Bruschi**. *Phys. Rev. A* 87, 022338 (2013)
 6. *Quantum gates and multipartite entanglement resonances realized by motion*, N. Friis, M. Huber, I. Fuentes, **D. E. Bruschi**. *Phys. Rev. D* 86, 105003 (2012)
 5. *Particle and anti-particle bosonic entanglement in non-inertial frames*, **D. E. Bruschi**, I. Fuentes, J. Louko. *Phys. Rev. D* 86, 025026 (2012)
 4. *Motion generates entanglement*, N. Friis, **D. E. Bruschi**, J. Louko, I. Fuentes. *Phys. Rev. D* 85 (R), 081701 (2012)
 3. *Kinematic entanglement degradation of fermionic cavity modes*, N. Friis, A. Lee, **D. E. Bruschi**, J. Louko. *Phys. Rev. D* 85, 025012 (2012)
 2. *Voyage to Alpha Centauri: Entanglement degradation of cavity modes due to motion*, **D. E. Bruschi**, I. Fuentes, J. Louko. *Phys. Rev. D* 85 (R), 061701 (2012)
 1. *The Unruh effect in quantum information beyond the single-mode approximation*, **D. E. Bruschi**, J. Louko, E. Martín-Martínez, A. Dragan, I. Fuentes. *Phys. Rev. A* 82, 042332 (2010)

PREPRINTS

7. *Spacetime effects on wavepackets of coherent light*, **D. E. Bruschi**, S. Chatzinotas, F. K. Wilhelm, A. W. Schell. [arXiv:2106.12424](https://arxiv.org/abs/2106.12424)
6. *Factorizing time evolution into elementary steps*, D. E. Bruschi. [arXiv:2102.07018](https://arxiv.org/abs/2102.07018)
5. *Self gravity affects quantum states*, **D. E. Bruschi**, Frank K. Wilhelm. [arXiv:2006.11768](https://arxiv.org/abs/2006.11768)
4. *Wigner phase of photonic helicity states in the spacetime of the Earth*. J. Kohlrus, J. Louko, I. Fuentes, **D. E. Bruschi**. [arXiv:1810.10502](https://arxiv.org/abs/1810.10502)
3. *On the gravitational nature of energy*, **D. E. Bruschi**. [arXiv:1701.00699](https://arxiv.org/abs/1701.00699)
2. *Tuneable interacting bosons for relativistic and quantum information processing*, C. Moore, **D.E. Bruschi**. [arXiv:1601.01919](https://arxiv.org/abs/1601.01919)
1. *Ultimate precision: Gaussian parameter estimation in flat and curved spacetime*, D. Šafránek, J. Kohlrus, **D. E. Bruschi**, A. R. Lee, I. Fuentes. [arXiv:1511.03905](https://arxiv.org/abs/1511.03905)

CONFERENCE PROCEEDINGS

2. *Entanglement generation in relativistic cavity motion*, **D. E. Bruschi**, J. Louko, D. Faccio. *J. Phys. Conf. Ser.* 442 012024
1. *Charged Unruh effect on geon spacetimes*, **D. E. Bruschi**, J. Louko, *Proceedings of the Twelfth Marcel Grossman Meeting on General Relativity (Paris, France, 12–18 July 2009)* edited by T. Damour, R. Jantzen and R. Ruffini (World Scientific, Singapore, 2012), pp. 2359–2361. ([arXiv:1003.1297](https://arxiv.org/abs/1003.1297))