

Robert W. Spekkens

Curriculum Vitae

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Personal Details

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E-mail	r.w.spekkens@damtp.cam.ac.uk
Citizenship	Canadian
Date of Birth	28/08/1972

Education

9/1995 – 9/2001 Awarded 11/2001	Ph.D. Physics	University of Toronto , Toronto, Canada Thesis: Aspects of entanglement Supervisor: Professor John E. Sipe
9/1994 – 9/1995 Awarded 11/1995	M.Sc. Physics	University of Toronto , Toronto, Canada
9/1989 – 9/1994 Awarded 11/1994	B.Sc. Joint Honours Physics and Philosophy	McGill University , Montreal, Canada

Academic Positions

1/2006 – present	Royal Society USA/Canada research fellow at University of Cambridge, Cambridge, United Kingdom
10/2005 – 1/2006	Affiliate of the Institute for Quantum Computing, Waterloo, Canada
1/2003 – 1/2006	Postdoctoral fellow at the Perimeter Institute for Theoretical Physics, Waterloo, Canada
9/2001 – 12/2002	Postdoctoral fellow in the group of John Sipe, Department of Physics, University of Toronto, Toronto, Canada
7/2002 – 12/2002	Affiliate of the Perimeter Institute for Theoretical Physics, Waterloo, Canada

Fellowships, Scholarships and Awards

2006 – 2009	Royal Society USA/Canada Research Fellowship
2002 – 2004	NSERC Postdoctoral Fellowship
1998 – 2000	Ontario Graduate Scholarship
1996 – 1998	NSERC Postgraduate Scholarship B
1997 – 1999	Walter C. Sumner Memorial Fellowship
1997 – 1998	E. F. Burton Fellowship
1995 – 1996	University of Toronto Special Open Doctoral Fellowship
1995	Edward Christie Stevens Award
1994 – 1995	University of Toronto Open Master's Fellowship
1994	NSERC Undergraduate Student Research Award
1989 – 1992	Canada Scholarship
1989	Irving Levitt Family Foundation Scholarship
1989	McGill University McConnell Entrance Award

Competitive Research Grants

Year	Project Title	Grant	Role	Value
2007	Operational Probabilistic Theories as Foils to Quantum Theory	FQXI award Foundational Questions Institute, www.fqxi.org	Principal Investigator (with Jonathan Barrett and Tony Short)	46,000 USD
2004-2006	Relative Quantum Information theory	Australian Research Council International Linkage Grant LX0455561	Principal Investigator (with Stephen Bartlett and Danny Terno)	30,500 AUD over 2 years
2003-2004	Optimizing quantum cryptographic protocols for two-party tasks	Natural Sciences and Engineering Research Council of Canada Postdoctoral fellowship	Sole Principal Investigator	80,000 CAD over 2 years

Citations

Three most cited publications

From Science Citation index. On-line citations from <http://citebase.eprints.org>.

42 citations (58 on-line citations)

S. D. Bartlett, T. Rudolph and R. W. Spekkens, "Classical and quantum communication without a shared reference frame", *Phys. Rev. Lett.* **91**, 027901 (2003).

40 citations (30 on-line citations)

R. W. Spekkens and J. E. Sipe, "Spatial fragmentation of a Bose-Einstein Condensate in a double-well potential," *Phys. Rev. A* **59**, 3868 (1999).

27 citations (13 on-line citations)

J.-C. Boileau, D. Gottesman, R. Laflamme, D. Poulin, and R. W. Spekkens, "Robust polarization-based quantum key distribution over a collective-noise channel", *Phys. Rev. Lett.* **92**, 017901 (2004).

Citations in non-specialist journals

- 2004 Eugenie Reich, "Which way is up?" *New Scientist* Oct. 2, 2004
This is a feature article inspired by the Workshop on Reference Frames and Superselection Rules in Quantum Information Theory that I co-organized in July, 2004. I was the primary consultant on its content.
- 2002 "Foiling quantum cheats", *Nature research highlights* Nov. 2002
This is a 1-page review of R. W. Spekkens and T. Rudolph, *Quantum protocol for cheat-sensitive weak coin flipping*, *Phys. Rev. Lett.* **89**, 227901 (2002).

Publications

Published articles

Letters

1. M. S. Leifer and R. W. Spekkens, "Pre- and Post-selection paradoxes and contextuality in quantum mechanics", *Phys. Rev. Lett.* **95**, 200405 (2005).
2. J.-C. Boileau, D. Gottesman, R. Laflamme, D. Poulin, and R. W. Spekkens, "Robust polarization-based quantum key distribution over a collective-noise channel", *Phys. Rev. Lett.* **92**, 017901 (2004).
3. S. D. Bartlett, T. Rudolph, and R. W. Spekkens, "Classical and quantum communication without a shared reference frame", *Phys. Rev. Lett.* **91**, 027901 (2003).
4. R.W. Spekkens and T. Rudolph, "Quantum protocol for cheat-sensitive weak coin flipping", *Phys. Rev. Lett.* **89**, 227901 (2002).

Rapid Communications

5. T. Rudolph, R. W. Spekkens, and P. S. Turner, "Unambiguous discrimination of mixed states", *Phys. Rev. A* **68**, 010301(R) (2003).

Regular articles

6. M. R. Dowling, S. D. Bartlett, T. Rudolph, R. W. Spekkens, "Observing a coherent superposition of an atom and a molecule", *Phys. Rev. A* **74**, 052113 (2006).

7. D. W. Kribs and R. W. Spekkens, "Quantum Error Correcting Subsystems as Unitarily Recoverable Subsystems", *Phys. Rev. A* **74**, 042329 (2006)
8. G. Gour and R. W. Spekkens, "Entanglement of Assistance is not an entanglement monotone", *Phys. Rev. A* **73**, 062331 (2006).
9. S. D. Bartlett, T. Rudolph, R. W. Spekkens, and P. S. Turner, "Degradation of a quantum reference frame", *New J. Phys.* **8**, 58 (2006).
10. S. D. Bartlett, T. Rudolph and R. W. Spekkens, "Dialogue Concerning Two Views on Quantum Coherence: Factist and Fictionist", *Int. J. Quantum Inf.* **4**, 17 (2006), issue dedicated to the memory of Asher Peres; www.arxiv.org/quant-ph/0507214.
11. S. D. Bartlett, A. C. Doherty, R. W. Spekkens, and H. M. Wiseman, "Entanglement under restricted operations: an analogy to mixed state entanglement", *Phys. Rev. A* **73**, 022311 (2006).
12. S. D. Bartlett, P. Hayden and R. W. Spekkens, "Random subspaces for encryption based on a private shared Cartesian frame", *Phys. Rev. A* **72**, 052329 (2005).
13. R. W. Spekkens, "Contextuality for preparations, transformations and unsharp measurements," *Phys. Rev. A* **71**, 052108 (2005).
14. T. Rudolph and R. W. Spekkens, "Quantum state targeting", *Phys. Rev. A* **70**, 052306 (2004).
15. S. D. Bartlett, T. Rudolph, R. W. Spekkens, "Optimal measurements for relative quantum information", *Phys. Rev. A* **70**, 032321 (2004).
16. S. D. Bartlett, T. Rudolph, R. W. Spekkens, "Decoherence-full subsystems and the cryptographic power of a private shared reference frame," *Phys. Rev. A* **70**, 032307 (2004).
17. R. W. Spekkens and T. Rudolph, "Optimization of coherent attacks in Generalizations of the BB84 quantum bit commitment protocol," *Quant. Inform. Compu.* **2**, 66 (2002).
18. R. W. Spekkens and T. Rudolph, "Degrees of concealment and bindingness in quantum bit commitment protocols," *Phys. Rev. A* **65**, 012310 (2001).
19. R. W. Spekkens and J. E. Sipe, "Non-orthogonal core projectors for modal interpretations of quantum mechanics," *Found. Phys.* **31**, 1403 (2001).
20. R. W. Spekkens and J. E. Sipe, "A modal interpretation of quantum mechanics based on a principle of entropy minimization," *Found. Phys.* **31**, 1431 (2001).
21. R. W. Spekkens and J. E. Sipe, "Spatial fragmentation of a Bose-Einstein Condensate in a double-well potential," *Phys. Rev. A* **59**, 3868 (1999).

Conference Proceedings

22. M. S. Leifer and R. W. Spekkens, "Logical pre- and post-selection paradoxes, measurement-disturbance and contextuality," www.arxiv.org/quant-ph/0412179, to appear in the proceedings of the Biennial Meeting of the International Quantum Structures Association, 2004.
23. S. D. Bartlett, A. C. Doherty, R. W. Spekkens, and H. M. Wiseman, "Mixed-State Entanglement in the Light of Pure-State Entanglement Constrained by Superselection Rules," Proceedings of the 1st Asia-Pacific Conference on Quantum Information Science, National Cheng Kung University, Taiwan 10 - 13 December 2004

24. R. W. Spekkens and J. E. Sipe, "On the Detection of Single Mode Quantum Coherence at Optical Frequencies," in *Coherence and Quantum Optics VIII*, eds. N. Bigelow et al. (Kluwer Academic, New York, 2003) p. 465.
25. R. W. Spekkens and J. E. Sipe, "Some remarks on fragmentation in Bose Condensates," *Progress in Physics* **46**, 873 (1998).

Submitted articles

26. S. D. Bartlett, T. Rudolph and R. W. Spekkens, "Reference frames, superselection rules and quantum information". To be published in *Rev. Mod. Phys.*
27. J. Oppenheim, R. W. Spekkens and A. Winter, "A classical analogue of negative information", www.arxiv.org/quant-ph/0511247, accepted for publication in *Phys. Rev. Lett.*
28. R. W. Spekkens, "In defense of the epistemic view of quantum states: a toy theory" www.arxiv.org/quant-ph/0401052, To be published in *Phys. Rev. A*

Articles in progress

29. S. D. Bartlett, T. Rudolph and R. W. Spekkens, "Classical Liouville mechanics with an epistemic restriction"

Book in Progress

J. E. Sipe and R. W. Spekkens, "The quantum puzzle", Oxford University Press
This is a graduate level textbook on the foundations of quantum mechanics. The aim of the textbook is to provide an unbiased survey, analysis, and comparison of the various approaches to the interpretation of quantum theory.

Table of contents:

1. Introduction
2. The nature of scientific theories
3. Operational quantum mechanics
4. Realist talk
5. Hidden variable theories: possibilities and constraints
6. Two Orthodoxies
7. The Copenhagen interpretation
8. Decoherence theory
9. The deBroglie-Bohm interpretation
10. Quantum logic
11. Consistent histories
12. Many worlds
13. Modal interpretations
14. Collapse theories
15. Outlook

Draft chapters are available upon request.

Scholarly contributions

Advisory roles

Member of the advisory board for the topical group on quantum information, concepts and computation of the American Physical Society.

Refereeing for international journals

American Journal of Physics
Canadian Journal of Physics
Europhysics Letters
Fluctuation and Noise Letters
Foundations of Physics
Journal of Mathematical Physics
Journal of Physics A and B
New Journal of Physics
Philosophy of Science
Physics Letters A
Physical Review A
Physical Review Letters
Physica Scripta
Quantum Information and Computation
Studies in History and Philosophy of Modern Physics

External Examination for higher degrees

2003 Ph.D. thesis of Jay Gambetta, Griffith University, Brisbane, Australia

Workshops organized

To occur in	Principle organizer (with Jonathan Barrett and Tony Short)
2007	Workshop entitled <i>Operational Probabilistic Theories as Foils to</i>
(2 weeks)	<i>Quantum Theory</i> , DAMTP, University of Cambridge, July 2-13, 2007
2004	Co-organizer (with Stephen Bartlett)
(5 days)	Workshop entitled <i>Reference Frames and Superselection Rules in</i>
	<i>Quantum Information Theory</i> , Perimeter Institute, July 12-16, 2004
	Website: http://www.perimeterinstitute.ca/activities/scientific/cws/PI-WORK-1/index.php
1997 and	Founder and organizer
1998	<i>Quantum optics and condensed matter physics student retreat,</i>
(2 days)	Department of Physics, University of Toronto

Invited talks

- 11/2006 The Eighth International Conference on Quantum Communication, Measurement and Computing, Tsukuba, Japan (talk delivered by Stephen Bartlett)
- 6/2006 Workshop on Quantum-Classical Transition and Quantum Information, Benasque, Spain
- 8/2005 Being Bayesian in a Quantum World workshop, Konstanz, Germany
- 7/2005 Quantum information, computation and logic workshop, Perimeter Institute, Waterloo, Canada
- 5/2005 “What’s quantum in quantum computing?” workshop, Konstanz, Germany
- 2/2005 Tutorial at the meeting of the South-West Quantum Information Network, Tucson, USA
- 7/2004 The Seventh International Conference on Quantum Communication, Measurement and Computing, University of Strathclyde, Glasgow, UK
- 5/2004 Symposium on quantum information geometry and quantum computing, Fields Institute, Toronto, Canada
- 5/2004 University of Western Ontario symposium on the foundations of physics, London, Canada
- 2/2004 Workshop on Quantum computing, quantum information and quantum gravity, Perimeter Institute, Waterloo, Canada
- 6/2003 International Conference In Quantum Theory: Reconsideration of Foundations-2, Växjö, Sweden
- 5/2003 New Directions in the Foundations of Physics Conference, Washington D.C., USA
- 10/2002 Quantum Foundations in the Light of Quantum Information Workshop, Montreal, Canada

Contributed talks

- 7/2006 Kets, Cats and Cloisters conference, Oxford, UK
- 3/2006 APS March meeting, Baltimore, USA
- 7/2003 Workshop on Quantum Measurements and Quantum Stochastics, Aarhus, Denmark
- 9/ 2002 The Eleventh UK Conference in Foundations of Physics, Oxford University, UK
- 7/2000 Canadian Association of Physicists Congress, York University, Toronto, Canada
- 7/1998 Canadian Association of Physicists Congress, Waterloo University, Waterloo, Canada

Poster presentations

- 1/2004 The Seventh Workshop on Quantum Information Processing, Waterloo, Canada
- 7/2002 The Sixth International Conference on Quantum Communication,

- 5/2001 Measurement and Computing, MIT, Boston, U.S.A.
The Eighth Rochester Conference on Coherence and Quantum Optics, Rochester, U.S.A.
- 5/2001 International Conference on Quantum Information, Rochester, U.S.A.
- 8/1999 Fundamental Problems in Quantum Theory workshop, University of Maryland Baltimore County, Baltimore, U.S.A.
- 8/1998 The Fourth International Conference on Quantum Communication, Measurement and Computing, Evanston, Illinois, U.S.A.
- 5/1998 International Conference on Atomic Physics XVI, Windsor, Canada
- 8/1997 Fundamental Problems in Quantum Theory workshop, University of Maryland Baltimore County, Baltimore, U.S.A.

Other talks

- 12/2006 Imperial College London, gravity group lunch
- 11/2006 University of Leeds, Physics seminar
- 11/2006 University of Leeds, History and Philosophy of Science seminar
- 10/2006 Oxford University, philosophy seminar
- 5/2006 Griffith University, Brisbane, Centre for Quantum Dynamics seminar
- 4/2006 University of Sydney, Sydney, Conceptual and Historical Issues in Modern Physics seminar
- 3/2006 Perimeter Institute, Piquidos seminar
- 12/2005 Institute for Quantum Computing, University of Waterloo, seminar
- 12/2005 Mathematics department, University of Guelph, seminar
- 11/2005 Institute for Quantum Information Science, University of Calgary, seminar
- 5/2005 Bell labs, Lucent Technologies, seminar
- 4/2005 University of Sydney, Sydney, Conceptual and Historical Issues in Modern Physics seminar
- 4/2005 Griffith University, Brisbane, Centre for Quantum Dynamics seminar
- 12/2004 Newton Institute, Cambridge University, seminar
- 11/2004 Center for Quantum Computation, Oxford University, seminar
- 11/2004 Philosophy department, Oxford University, seminar
- 11/2004 Imperial college, London, Knight group talk
- 11/2004 Perimeter Institute, Piquidos seminar
- 7/2004 Perimeter Institute, Workshop on Reference Frames and Superselection rules in Quantum Information Theory
- 5/2004 University of Montreal, seminar
- 4/2004 Queensland university, Brisbane, Australian Institute of Physics seminar series
- 4/2004 Griffith University, Centre for Quantum Dynamics, seminar
- 3/2004 University of Guelph, Mathematics department, seminar
- 10/2003 Los Alamos National Laboratories, Quantum lunch
- 10/2003 University of New Mexico, seminar
- 10/2003 Jet Propulsion Laboratory, NASA, seminar
- 10/2003 Institute for Quantum Information, Caltech, seminar
- 05/2003 Perimeter Institute, Piquidos seminar

03/2003	Perimeter Institute quantum information mini-workshop
02/2003	Queensland university, Brisbane, seminar
02/2003	Griffith university, Brisbane, seminar
01/2003	Macquarie university, Sydney, seminar
12/2002	University of Toronto, quantum information seminar series
5/2002	Bell labs, Lucent Technologies, seminar
3/2002	University of Toronto quantum information seminar
3/2002	University of Waterloo, Institute for quantum information seminar
10/2001	University of Vienna, Austria, Zeilinger group talk
11/1998	University of Toronto quantum optics and condensed matter physics seminar series

Committee work

2003 – 2004	Member of the postdoctoral fellow selection committee, Perimeter Institute
2003 –2004	Member of the quantum foundations search committee, Perimeter Institute
2001	Active in development of new joint undergraduate program in physics and philosophy at the University of Toronto
1995 – 2001	Student member of the graduate curriculum committee, Department of Physics, University of Toronto. Consulted with faculty and students to develop the syllabus for a new quantum optics graduate course

Teaching

Teaching experience

1998-2001 (4 terms)	Grader and guest lecturer	Current Interpretations of Quantum Mechanics Graduate-level physics course, also open to senior undergraduates
2000-2001 (2 terms)	Grader and guest lecturer	Philosophy of Physics Third year philosophy course.
1997-1998 (1 term)	Tutorial leader and grader	Quantum Physics for engineering scientists Introductory course in quantum mechanics for second year engineering science students
1996-1997 (1 term)	Grader	Quantum Physics II Third year quantum physics course for physics majors
1995-1996 (1 term)	Tutorial leader and grader	The Magic of Physics Course offered by the physics department for Arts students, requiring no physics or mathematics background
1994-1995	Demonstrator	First year physics laboratory

comprehension of the material.

Engaging students. To this end, I believe that it is important to use a dynamic presentation style: switching media, having demonstrations where possible, initiating class discussion, and so forth. Encouraging students to ask questions and asking questions *of* the students are also effective tools. Having and expressing enthusiasm for the subject matter is critical.

Referees

Christopher A. Fuchs
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Murray Hill, New Jersey 07974 USA
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Waterloo, Ontario N2L 2Y5 Canada
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