

## Petros Wallden - CV

### Personal Information

Citizenship: Greek

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### Current Position

- 2014 (September) - present **Research Associate** and **Lecturer** (fixed term) at **University of Edinburgh**, School of Informatics, Scotland, UK.

### Education

- **PhD**: 2003 - 2006 **Imperial College**, Theoretical Physics Group, UK  
Title: *Topics in the Decoherent Histories approach to Quantum Theory and Quantum Gravity*  
Supervisor: Prof. Jonathan J. Halliwell
- **Postgraduate**: 2002 - 2003 **University of Cambridge**, Department of Applied Mathematics and Theoretical Physics, UK  
**Master of Advanced Study in Mathematics**, Part III Mathematical Tripos, **Cambridge University**. Final grade: **Merit**
- **First Degree**: 1999 - 2002 **Imperial College**, Department of Physics, UK  
**Bsc. Physics with Theoretical Physics** Final grade: **First class honours 80.48%**  
Dissertation: *Quantifying entanglement* (grade 94%). Supervisor: Prof. Vlatko Vedral  
Associateship of the Royal College of Science, A.R.C.S. (2002)

### Professional History:

#### (a) Research Positions

- 2013-2014 **Research Associate** at **Heriot-Watt University**, Institute of Photonics and Quantum Sciences, Scotland, UK.
- 2009 - 2010 **Postdoctoral Fellow** at **University of Athens**, Physics Department, Nuclear and High Energy Physics Section, Greece.  
Fellowship of (Greek) State Scholarship Foundation (I.K.Y.)
- 2006 - 2008 **Postdoctoral Fellow** in Theoretical Physics, **Raman Research Institute**, Theoretical Physics Group, India

#### (b) Lecturing Positions

- 2009 - 2013 (February) **Adjunct Lecturer** at **Technological Educational Institute (TEI) of Chalkida**, Science Department, Greece.

#### (c) Visiting Positions

- 2014 (August) **Visiting Researcher** at **Institute for Quantum Computing**, University of Waterloo, Canada
- 2013 (May) **Visiting Researcher** at **Perimeter Institute for Theoretical Physics**, Canada
- 2013 (March - April) **Visiting Researcher** at **Imperial College, London**, Physics Department, Theoretical Physics Group, UK. STSM of COST Action MP1006

- 2008 (May) **Visiting Researcher** at **Imperial College, London**, Physics Department, Theoretical Physics Group, UK. Royal Society International Joint Project 2006-R2
- 2007 (November - December) **Visiting Researcher** at **Perimeter Institute for Theoretical Physics**, Canada
- 2007 (June - July) **Visiting Researcher** at **Imperial College, London**, Physics Department, Theoretical Physics Group, UK. Royal Society International Joint Project 2006-R2
- 2004 (November) **Visiting Researcher** at **Euler Mathematical Institute of the Russian Academy of Science**, St. Petersburg, Russia. “tete-a-tete in St. Petersburg”

#### (d) Other Positions

- 2008 - 2009 National military service in Greece (compulsory)

#### Organiser, Member & Referee

- *Management Committee Member* (Representative of Greece): European program: COST Action MP1006: Fundamental Problems in Quantum Physics (2012-2015).
- *Vice-Chair* of Working Group: “Quantum Theory meets Relativity” of COST Action MP1006 (2012-2015).
- *Organiser of workshop*: “Quantum Information in Scotland” QUISCO (6 speakers, 20 participants), School of Informatics, Edinburgh, December 2014.
- *Organiser of international workshop* “Foundations of Quantum Mechanics and Quantum Gravity” in the framework of COST Action MP1006 (15 speakers, 48 participants), Imperial College, London, April 2014.
- *Organiser of international workshop*: “Foundations of Quantum Mechanics and Relativistic Spacetime” in the framework of COST Action MP1006 (19 speakers, 47 participants), University of Athens, Athens, September 2012.
- *Organiser of workshop*: “Fundamental Problems in Quantum Physics” in the framework of COST Action MP1006 (13 speakers, 35 participants), N.C.S.R. “Demokritos”, Athens, March 2012.
- *Member*: Quantum Information in Scotland (QUISCO) network from 2013.
- *Member* (founding): Hellenic Society on Relativity, Gravitation & Cosmology (H.S.R.G.C.) 2008.
- *Member*: Association, Computability in Europe (CiE), from 2008.
- *Referee*: for journals “Phys. Rev. Lett.”, “Phys. Rev. A”, “Class. and Quant. Grav.”, “Jour. Math. Phys.”, “Quant. Inf. Proc.”, “Int. J. Quant. Inf.”, “Rep. Math. Phys.”, “Found. Phys.” & “Stud. Hist. Phil. M. S.”.
- *Program Committee*: 21st Australasian Conference on Information Security and Privacy 2016.

#### Academic Prizes & Scholarships

- Supported by **EPSRC grant No. EP/K022717/1**, “Practical quantum digital signatures” (2013 - 2014).
- **Short Term Scientific Mission** (STMS), of the COST Action MP1006 “Fundamental Problems in Quantum Physics”. Title of the STSM: “Non-separability and quantum measure”, in collaboration with: Prof. Fay Dowker, London, March - April 2013.
- **Fellowship for Postdoctoral Research** from the State Scholarship Foundation (I.K.Y.) of Greece, for the year 2009 - 2010.
- **Scholarship to carry out doctoral research** in Theoretical Physics from the “A.G. Leventis Foundation” 2003 - 2005.

- Participation in the “**Royal Society International Joint Project 2006-R2**” of British Royal Society, collaboration of Imperial College and Raman Research Institute. Visiting Researcher at Imperial College, June - July 2007 and May 2008.
- Participation in the program “**tete-a-tete in St. Petersburg**” of the Euler Mathematical Institute of the Russian Academy of Science (collaboration with Roman R. Zapatrin). Visiting Researcher at the Euler Mathematical Institute, November 2004.

## **Supervising**

Currently:

1. Alexandru Gheorghiu (PhD, co-supervising along with Elham Kashefi) started 2014
2. Daniel Mills (PhD, co-supervising along with Elham Kashefi) started 2015
3. Ryan Amiri (PhD, co-supervising along with Erika Andersson) started 2014
4. Jonathan Crickmore (PhD, co-supervising along with Erika Andersson) started 2015

Past:

1. Epistimi Epitidiou (MEng dissertation, NTUA, Greece 2014)

## **Teaching**

Currently:

1. Introduction to Quantum Computing, 4th year course, School of Informatics, University of Edinburgh. Main Lecturer

Past:

(a) Mathematics

1. Mathematics II (differential equations, multiple variables calculus), Department of Electrical Engineering, TEI Chalkidas, 2010-2011 summer semester. Main lecturer.
2. Mathematics I (Calculus, Linear Algebra), Department of Aircraft Technology, TEI Chalkidas, 2009-2010 (both semesters) and 2010-2011 (winter semester). Main lecturer.
3. Probabilities & Statistics, Department of Automation, TEI Chalkidas, 2010-2011 winter semester. Main lecturer.
4. Linear Algebra, Department of Automation, TEI Chalkidas, 2010-2011 winter semester. Main lecturer.
5. Mathematics II (differential equations, multiple variables calculus), Department of Mechanical Engineering, TEI Chalkidas, 2009-2010 both semesters. Main lecturer.
6. Mathematical Analysis (classworks), Department of Physics, Imperial College, 2004-2005 and 2005-2006. Teaching assistant under Prof. J.J. Halliwell.

(b) Physics

1. Physics I Experiments Department of Electrical Engineering and Department of Aircraft Technology, TEI Chalkidas, 2012-2013 winter semester. Main lecturer.
2. Physics I Experiments Department of Mechanical Engineering and Department of Aircraft Technology, TEI Chalkidas, 2011-2012 summer semester. Main lecturer.
3. Physics I Theory (Waves and Electromagnetism), Department of Mechanical Engineering, TEI Chalkidas, 2011-2012 winter semester. Main lecturer.

4. Physics I Experiments, Department of Mechanical Engineering and Department of Electrical Engineering and Department of Aircraft Technology, TEI Chalkidas, 2011-2012 winter semester. Main lecturer.
5. General Physics and Mathematics (classworks), Department of Physics, Imperial College, 2003-2004 and 2004-2005 and 2005-2006. Teaching assistant under Prof. P.Torok and Dr. T. Horbury.

(c) Computing

1. Computing Software “Mathematica” (lab), Department of Mechanical Engineering, TEI Chalkidas, 2010-2011 both semesters. Main lecturer.
2. Introduction to Computing (lab), Department of Electrical Engineering, TEI Chalkidas, 2009-2010 both semesters. Main lecturer.

**Invited Talks (11) & Talks at Conferences (30)**

**(a) Invited Talks**

11. Invited talk at York Centre for Quantum Technologies, University of York, November 2015.  
“*Quantum Digital Signatures*”
10. Invited talk at University of Oxford, Department of Computer Science, February 2015.  
“*Non-Locality and Quantum Non-Contextuality*”
9. Invited talk at University of Cambridge, Department of Applied Mathematics and Theoretical Physics, May 2014.  
“*Non-Locality and Quantum Non-Contextuality*”
8. Talk at Heinrich Heine University Düsseldorf, Institute for Theoretical Physics, Germany, February 2014.  
“*Quantum Digital Signatures without requiring quantum memory*”
7. Invited talk at University of California, San Diego (UCSD), Department of Mathematics, USA, May 2013.  
“*The coevents formulation: Kochen Specker theorem and the emergence of probabilities*”
6. Invited talk at University of California, San Diego (UCSD), Philosophy Department, USA, May 2013.  
“*Interpreting the path integral: The coevent formulation*”
5. Invited talk at Perimeter Institute for Theoretical Physics, Waterloo, Canada, January 2012.  
Talk delivered: “*The co-event formulation of Quantum Theory*”
4. Invited talk at the Academy of Athens, Research Center for Astronomy and Applied Mathematics (RCAAM), Athens, Greece, April 2009  
“*Towards a Quantum Theory of closed systems: The co-event interpretation*”
3. Invited talk at University of Athens, Physics Department, Athens, Greece, December 2007  
“*The Problem of Time in Quantum Gravity: The Decoherent Histories Approach*”
2. Invited talk at École Normale Supérieure, Paris, France, October 2007  
“*Discrete Quantum Gravity, the Cosmological Constant Problem and Black Hole Entropy*”
1. Invited talk at University of Athens, Faculty of the Philosophy and History of Science, Athens, Greece, October 2007  
“*Consistent Histories: Quantum Theory without External Observers*”

**(b) Talks at Conferences**

30. CryptoForma Workshop, University of Strathclyde, Glasgow, October 2015.  
Talk delivered: “*Verification of Quantum Computation*”
29. Workshop of the Networked Quantum Information Technologies (NQIT) Hub, Oxford, July 2015.  
Talk delivered: “*Verification of Quantum Computation*” (invited speaker)
28. Workshop on Physics and Information 2015, Paris, June 2015.  
Talk delivered: “*Quantum Measure Theory and Contextuality*” (invited speaker)
27. Workshop on Quantum Measure Theory, Raman Research Institute, Bangalore, India, January 2015.  
Talk delivered: “*Zero covers in coevents and consistent histories*” (invited speaker)
26. 21st Central European Workshop on Quantum Optics (CEWQO), Brussels, Belgium, June 2014.  
Talk delivered: “*Quantum digital signatures with quantum key distribution components*”
25. Is quantum theory exact?, Laboratori Nazionali di Frascati, Frascati, Italy, April 2014.  
Talk delivered: “*Quantum non-contextuality as a generalisation of quantum theory*”
24. Foundations of Quantum Mechanics and Quantum Gravity (organiser), Workshop in the framework of COST Action MP1006, Imperial College, London, UK, April 2014.  
Talk delivered: “*Characterising quantum non-locality and histories*”
23. QUISCO meeting, University of St. Andrews, UK, December 2013.  
Talk delivered: “*Quantum Digital Signatures without quantum memory*”
22. The Quantum Landscape, Perimeter Institute, Waterloo, Canada, May 2013.  
Talk delivered: “*Towards a realist’s interpretation of the path integral*” (invited speaker)
21. Second Panhellenic Conference in Philosophy of Science, Athens, Greece, November 2012.  
Talk delivered: “*Quantum measure theory and the meaning of probability in closed quantum systems*” (invited speaker)
20. Foundations of Quantum Mechanics and Relativistic Spacetime (organiser), Workshop in the framework of COST Action MP1006, Athens, Greece, September 2012.  
Talk delivered: “*Interpreting the quantum measure*”
19. 6th International Workshop on Decoherence, Information, Complexity and Entropy-DICE, Castiglione, Italy, September 2012  
Talk delivered: “*The co-event formulation of quantum theory and the distinction of pure initial states*”
18. NEB XV, 15th Conference: New Developments in Gravity, Chania, Greece, June 2012.  
Talk delivered: “*Causal Sets Dynamics: Progress and Outlook*”
17. Workshop: “Fundamental Problems in Quantum Physics” (organiser), in the framework of the COST Action MP1006, National Center for Scientific Research “Demokritos”, Athens, Greece, March 2012.  
Talks delivered: “*COST action MP1006: Fundamental Problems in Quantum Physics*”  
“*An introduction to the co-event formulation of Quantum Theory*”
16. Sixth Aegean Summer School: “Quantum Gravity and Quantum Cosmology” September 2011, Naxos, Greece.  
Talk delivered: “*Canonical Quantum Cosmology, The Problem of Time & Decoherent Histories*”
15. 5th International Workshop on Decoherence, Information, Complexity and Entropy-DICE, Castiglione, Italy, September 2010  
Talk delivered: “*Reasoning in Quantum Theory: Modus Ponens and the co-event interpretation*”

14. NEB XIV, 14th Conference: New Developments in Gravity, Ioannina, Greece, June 2010.  
Talk delivered: “*The Problem of Time in Quantum Cosmology: A Decoherent Histories View*”
13. Causets at DIAS II: “A workshop on recent progress in the Causal Set Approach to Quantum Gravity”, Dublin, Ireland, December 2009  
Talk delivered: “*Structure of Quantum Measure Theory*” (invited speaker)
12. First Mediterranean Conference on Classical and Quantum Gravity (MCCQG), Kolymbari, Greece, 2009.  
Talk delivered: “*Causal Sets: Quantum gravity from a fundamentally discrete spacetime*”
11. Forth International Workshop on Decoherence, Information, Complexity and Entropy, D.I.C.E., Castiglione della Pescaia, Italy, 2008: “*From Quantum Mechanics through Complexity to emergent dynamical structures*”  
Talk delivered: “*The Emergence of Probabilities in Anhomomorphic Logic*”
10. Second Annual Conference: “GRAVTUM II”, Amorgos, Greece, 2008.  
Talk delivered: “*An Introduction to Anhomomorphic Logic*”
9. Annual Conference: “Computability in Europe”, Athens, Greece, 2008: “*Logic and Theory of Algorithms*”  
Talk delivered: “*Anhomomorphic Logic: The Logic of Quantum Realism*”
8. NEB XIII, Thessaloniki, Greece, 2008: “*13th Conference New Developments in Gravity*”  
Talk delivered: “*Emergent Continuum Spacetime from a Random, Discrete, Partial Order*”
7. November - December 2007. Research visit at Perimeter Institute for Theoretical Physics, Waterloo, Canada.  
Talk delivered: “*Timeless Questions in the Decoherent Histories Approach to Quantum Theory*”
6. Fourth Aegean Summer School: “Black Holes” 2007, Mytilene, Greece.  
Talk delivered: “*Entropy Bounds in the Causal Sets Approach to Quantum Gravity*”
5. Causal Sets School, Imperial College, London, UK, 2006.
4. Third International Workshop on Decoherence, Information, Complexity and Entropy-DICE 2006, Piombino, Italy: “*Quantum Mechanics between Decoherence and Determinism: new aspects from particle physics to cosmology*”  
Talk delivered: “*The Quantum Zeno Effect in the Decoherent Histories*”
3. NEB XII, Nafplio, Greece, 2006: “*12th conference New Developments in Gravity*”  
Talk delivered: “*Effective Topology from Spacetime Tomography*”
2. ENRAGE (European Network on Random Geometry) Workshop, Utrecht University, Utrecht, Netherlands 2005.  
Talk delivered: “*The Decoherent Histories Analysis of Timeless Quantum Theories*”
1. November 2004, participated in the program ‘*tête-à-tête in St. Petersburg*’ supported by the Euler Mathematical Institute of the Russian Academy of Sciences, St. Petersburg, Russia.  
Talk delivered: “*A review of the Decoherent Histories approach to Quantum Theory*”

## **LIST OF PUBLICATIONS:**

Journal papers (16), book chapter (1), under review (4) & refereed conferences proceeding (12)

In all the papers, except papers [28,29,31,32] and [12-15], the authors are in alphabetical order. The total number of citations is 254, H-index 10 (Google Scholar November 2015).

### **Journals papers: refereed (in reverse chronological order)**

33. A. Gheorghiu, E. Kashefi and P. Wallden, Device independence and robustness of verifiable blind quantum computation, *New J. Phys.* **17**, 083040 (2015).
32. P. Wallden, V. Dunjko, A. Kent and E. Andersson, Quantum digital signatures with quantum key distribution components, *Phys. Rev. A* **91**, 042304 (2015).
31. R. J. Collins, R. J. Donaldson, V. Dunjko, P. Wallden, P. J. Clarke, E. Andersson, J. Jeffers, G. S. Buller, Realization of quantum digital signatures without the requirement of quantum memory, *Phys. Rev. Lett.* **113**, 040502 (2014). Featured in *Physics &* was selected as Editor's Suggestion
30. P. Wallden, Contrary Inferences in Consistent Histories and a Set Selection Criterion, *Found. Phys.* **44**, 1195 (2014).
29. V. Dunjko, P. Wallden and E. Andersson, Quantum Digital Signatures without quantum memory, *Phys. Rev. Lett.* **112**, 040502 (2014).
28. P. Wallden, V. Dunjko and E. Andersson, Minimum-cost quantum measurements for quantum information, *J. Phys A: Math. Theor.* **47** 125303 (2014).
27. F. Dowker, J. Henson and P. Wallden, A histories perspective on characterising quantum non-locality, *New J. Phys.* **16**, 033033 (2014).
26. P. Wallden, Distinguishing initial state-vectors from each other in histories formulations and the PBR argument, *Found. Phys.* **43**, 1502 (2013).
25. S. Surya and P. Wallden, Quantum Covers in Quantum Measure Theory, *Found. Phys.* **40**, 585 (2010).
24. Y. Ghazi-Tabatabai and P. Wallden, Dynamics and predictions in the co-event interpretation, *J. Phys. A: Math. Theor.* **42**, 235303, (2009).
23. D. Rideout and P. Wallden, Spacelike distance from discrete causal order, *Class. Quant. Grav.* **26**, 155013 (2009).
22. P. Wallden, Spacetime Coarse Grainings and the Problem of Time in the Decoherent Histories Approach to Quantum Theory, *Int. J. Theor. Phys.* **47**, 1512 (2008).
21. I. Raptis, P. Wallden and R.R. Zapatrin, Decomposition of pure states of quantum register, *Europ. Phys. Jour. D* **41**, 185 (2007).
20. J.J. Halliwell and P. Wallden, Invariant Class Operators in the Decoherent Histories Analysis of Timeless Quantum Theories, *Phys. Rev. D* **73**, 024011 (2006).
19. I. Raptis, P. Wallden and R.R. Zapatrin Spacetime, Topology from the tomographic histories approach: Case II, *Int. J. Theor. Phys.* **45**, 2350 (2006).
18. I. Raptis, P. Wallden and R.R. Zapatrin, Spacetime Topology from the tomographic histories approach I: Non-Relativistic Case, *Int. J. Theor. Phys.* **45**, 1589 (2006).

## **Papers appearing as Book Chapter**

17. K. Clements, F. Dowker and P. Wallden, Physical Logic, to appear in: “The Incomputable - Journeys Beyond the Turing Barrier” (editors S. Barry Cooper and Mariya Soskova), Springer book series “Theory and Applications of Computability” (earlier version preprint arXiv:1201.6266).

## **Journals Papers: Currently under review**

16. E. Kashefi and P. Wallden, Optimised resource construction for verifiable quantum computation, preprint 1510.07408 (2015).
15. R.J. Donaldson, R.J. Collins, K. Kleczkowska, R. Amiri, P. Wallden, V. Dunjko, J. Jeffers, E. Andersson, G.S. Buller, Experimental demonstration of kilometer-range quantum digital signatures, preprint 1509.07827 (2015).
14. R. Amiri, P. Wallden, A. Kent, E. Andersson, Secure Quantum Signatures Using Insecure Quantum Channels, preprint 1507.02975 (2015).
13. J.-M. Arrazola, P. Wallden, E. Andersson, Multiparty Quantum Signature Schemes, preprint 1505.07509 (2015).

## **Conference papers: refereed (in reverse chronological order)**

12. R. J. Collins, R. J. Donaldson, V. Dunjko, P. Wallden, P. J. Clarke, E. Andersson, J. Jeffers, G. S. Buller, An in fiber experimental approach to photonic quantum digital signatures that does not require quantum memory, Proc. SPIE, Emerging Technologies in Security and Defence II and Quantum-Physics-based Information Security III, 9254 (2014).
11. P. Wallden The coevents formulation of quantum theory, J. Phys.: Conf. Ser. **442**, 012044 (2013).
10. P. Wallden Causal Sets Dynamics: Review & Outlook, J. Phys.: Conf. Ser. **453**, 012023 (2013).
9. P. Wallden Reasoning in Quantum Theory: Modus Ponens and the co-event interpretation, J. Phys.: Conf. Ser. **306**, 012044 (2011).
8. T. Christodoulakis and P. Wallden The problem of time in quantum cosmology: a decoherent histories view, J. Phys.: Conf. Ser. **283**, 012041 (2011).
7. P. Wallden Causal Sets: Quantum gravity from a fundamentally discrete spacetime, J. Phys.: Conf. Ser. **222**, 012053 (2010).
6. D. Rideout and P. Wallden Emergence of spatial structure from causal sets, J. Phys.: Conf. Ser. **174**, 012017 (2009).
5. Y. Ghazi-Tabatabai and P. Wallden The Emergence of Probabilities in Anhomomorphic Logic, J. Phys.: Conf. Ser. **174**, 012054 (2009).
4. D. Rideout, P. Wallden Emergent Continuum Spacetime from a Random, Discrete, Partial Order, J. Phys.: Conf. Ser. **189**, 012045 (2009).
3. I. Raptis, P. Wallden and R.R. Zapatrin, Algebraic Approach to ‘Quantum Spacetime Geometry’, Proceedings of the Eleventh Marcel Grossmann Meeting on General Relativity, (ed.) H. Kleinert, R.T. Jantzen and R. Ruffini, World Scientific, p. 2806 (2008).
2. P. Wallden Quantum Zeno Effect in the Decoherent Histories, P. Wallden, J. Phys.: Conf. Ser. **67**, 012043 (2007).
1. P. Wallden Effective Topology from Spacetime Tomography, P. Wallden, J. Phys.: Conf. Ser. **68**, 012028 (2007).



## **Languages & Computer Skills**

- **Greek** (native language)
- **English** (I.E.L.T.S., first degree and postgraduate studies in England)
- **French** (D.E.L.F.)
- Programming: language C++
- Mathematica, MatLab
- Basic computer skills (Word, Excel, PowerPoint, Internet, LaTeX)

## **Non-Academic Activities**

- **Chess:** Since 2000, the title of **Candidate Master** (official title of Greek Chess Federation). My international rating (FIDE) is currently 2178 Elo. I am also qualified arbiter for chess, have been involved with teaching it and have been the president of Chess Club of Kaisariani (SMAOK) and member of the executive board of Chess Club of Pangrati. I have played for a number of teams in UK and Greece: Cambridge University Chess Club (won at Varsity 2003), Imperial College Chess Club, Edinburgh Chess Club (finalist at Richardson Cup 2015), Chess Club of Pangrati (twice finalist at Attica Cup), etc.
- **Music:** I have been taught violin and piano. I also play the guitar. Diploma of Music Theory (grade: very good) and Musical Harmony (grade:excellent).