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William A. Coish

Date of birth: 12 May 1978
Place of birth: Winnipeg, Manitoba, Canada
Citizenship: Canadian

Employment/Education

Mar. 2009 – Present **CIFAR Junior Fellow**
with R. Laflamme
Institute for Quantum Computing, University of Waterloo

Sept. 2007 – Feb. 2009 **Ontario Postdoctoral Fellow**
with F. K. Wilhelm and J. Baugh
Institute for Quantum Computing, University of Waterloo

Dec. 2006 – Aug. 2007 **Postdoctoral Researcher**
Group of Daniel Loss,
Department of Physics, University of Basel

Sept. 2002 – Nov. 2006 **Ph. D. in Theoretical Physics**
Dept. of Physics, University of Basel,
Basel, Switzerland (Ph.D. Thesis .pdf)
Advisor: Prof. Daniel Loss

Sept. 2000 – Aug. 2002 **M. Sc. in Physics**
Dept. of Physics and Astronomy, McMaster University,
Hamilton, Ontario, Canada
Advisors: Profs. A. J. Berlinsky and C. Kallin

Sept. 1996 – Apr. 2000 **B. Sc. (hons.) in Physics**
Dept. of Physics and Astronomy, University of Manitoba,
Winnipeg, Manitoba, Canada

Research Interests

- Spintronics
- Decoherence
- Nanoscale nuclear magnetism
- Quantum computation/quantum information
- Electron transport in nanostructures
- Quantum measurement theory
- Optical properties of semiconductors

Awards

2009–2010	CIFAR Junior Fellowship (CDN $50 000+/yr.)
2007–2009	Ontario Postdoctoral Fellowship (CDN $50 000+/yr.)
2002–2004	NSERC PGS B Scholarship (with tenure abroad, CDN $42 000)
2001–2002	Ontario Graduate Scholarship (CDN $15 000)
2000–2001	Richard Fuller Memorial Scholarship (CDN $11 000)
2000	McMaster Univ. Entrance Scholarship (CDN $2 000)
2000	McMaster Univ. Graduate Scholarship (CDN $2 000)
2000	Univ. Manitoba Faculty of Science Undergrad. Research Award (CDN $4 000+)
1999	NSERC Undergrad. Research Award (CDN $4 000+)
1996	Univ. Manitoba International Baccalaureate Entrance Scholarship (CDN $1 000)

Publications

In preparation

[1] F. Qassemi, W. A. Coish, J. Bergli, and F. K. Wilhelm
Finite-frequency shot noise as a spin-relaxation probe in quantum dots

Preprints

[1] W. A. Coish, J. Fischer, and D. Loss
Free-induction decay and envelope modulations in a narrowed nuclear-spin bath
arXiv:0911.4149.

2009

[1] W. A. Coish and J. M. Gambetta
Entangled photons on demand: Erasing which-path information with sidebands
Phys. Rev. B **80**, 241303(R) (2009); arXiv:0907.0437.

[2] W. A. Coish
Quantum dots: Through locks to narrows
Nature Physics **5**, 710 (2009); A news and views article on two exciting new experiments, featured on the cover of the October issue.

[3] W. A. Coish and J. Baugh
Nuclear spins in nanostructures
Physica Status Solidi B **246**, 2203 (2009), (**invited article**, featured on the cover.)

[4] J. Fischer, M. Trif, W. A. Coish, and Daniel Loss
Spin interactions, relaxation and decoherence in quantum dots
Solid State Communications **149**, 1443 (2009).

[5] F. Qassemi, W. A. Coish, and F. K. Wilhelm
Stationary and transient leakage current in the Pauli spin blockade
Phys. Rev. Lett. **102**, 176806 (2009).

2008

[1] J. Fischer, W. A. Coish, and Daniel Loss
Spin decoherence of a heavy hole coupled to nuclear spins in a quantum dot
Phys. Rev. B **78**, 155329 (2008).

[2] D. Klauser, D. V. Bulaev, W. A. Coish, and Daniel Loss
Electron and hole spin dynamics and decoherence in quantum dots
Chapter in "Semiconductor Quantum Bits", eds. O. Benson and F. Henneberger, Pan Stanford Publishing, ISBN 978-9814241052; arXiv:0706.1514.

[3] D. Klauser, W. A. Coish, and Daniel Loss
Nuclear spin dynamics and Zeno effect in quantum dots and defect centers
Phys. Rev. B **78**, 205301 (2008).

[4] W. A. Coish
How to build a better iPod: Spintronics holds the key
Phys 13, Winter (2008) (featured on the cover).

[5] W. A. Coish, Jan Fischer, and Daniel Loss
Exponential decay in a spin bath
Phys. Rev. B **77**, 125329 (2008).

[6] D. Klauser, W. A. Coish, and Daniel Loss
Quantum-dot spin qubit and hyperfine interaction
Adv. Sol. State Phys. **46**, 17 (2008).

2007

[1] F. H. L. Koppens, D. Klauser, W. A. Coish, K. C. Nowack, L. P. Kouwenhoven, D. Loss, and L. M. K. Vandersypen
Universal phase shift and non-exponential decay of driven single-spin oscillations
Phys. Rev. Lett. **99**, 106803 (2007).

[2] W. A. Coish, E. A. Yuzbashyan, B. L. Altshuler, and Daniel Loss
Quantum vs. classical hyperfine-induced dynamics in a quantum dot
J. Appl. Phys. **101**, 081715 (2007).

[3] W. A. Coish and Daniel Loss
Quantum computing with spins in solids
Chapter in vol. 5 of the Handbook of Magnetism and Advanced Magnetic Materials, Eds. H. Kronmler and S. Parkin, Wiley, Sept. 2007, ISBN 978-0-470-02217-7; cond-mat/0606550.

[4] W. A. Coish and Daniel Loss
Exchange-controlled single-electron-spin rotations in quantum dots
Phys. Rev. B **75**, 161302(R) (2007).

2006

[1] W. A. Coish, Vitaly N. Golovach, J. Carlos Egues, and Daniel Loss
Measurement, control, and decay of quantum-dot spins
Physica Status Solidi (b) **243**, 3658 (2006).

[2] M. R. Gräber, W. A. Coish, C. Hoffmann, M. Weiss, J. Furer, S. Oberholzer, D. Loss, and C. Schoenenberger
Molecular states in carbon nanotube double quantum dots
Phys. Rev. B **74**, 075427 (2006).

[3] D. Klauser, W. A. Coish, and Daniel Loss
Nuclear spin state narrowing via gate–controlled Rabi oscillations in a double quantum dot
Phys. Rev. B **73**, 205302 (2006).

***2005* and earlier**

[1] W. A. Coish and Daniel Loss
Singlet-triplet decoherence due to nuclear spins in a double quantum dot
Phys. Rev. B **72**, 125337 (2005).

[2] Veronica Cerletti, W. A. Coish, Oliver Gywat, and Daniel Loss
Recipes for spin-based quantum computing
Nanotechnology **16**, R27 (2005).

[3] W. A. Coish and Daniel Loss
Non-Markovian dynamics of a localized electron spin due to the hyperfine interaction
Hyperfine Interactions **158**, 235 (2005) (Proceedings of HFI2004, Bonn, Germany).

[4] W. A. Coish and Daniel Loss
Hyperfine interaction in a quantum dot: Non-Markovian electron spin dynamics
Phys. Rev. B **70**, 195340 (2004).

[5] J. M. Vail, W. A. Coish, H. He, and A. Yang
F center in BaF_2: Diffuse excited state
Phys. Rev. B **66**, 014109 (2002).

Invited Talks

	Nuclear-spin state narrowing in quantum dots
18 Dec. 2009	Tarucha group Seminar, Univ. of Tokyo, Japan
14 Dec. 2009	JST-ICORP group Seminar, NTT Atsugi, Japan
3 Dec. 2009	**Spin-bath decoherence: Old results and new surprises** KITP, UC Santa Barbara (Quantum Information Science program)
9 Nov. 2009	**How can quantum physics transform information technology?** Public lecture at the CIFAR Lunar Circle Dinner
30 Oct. 2009	**Physical flying qubits** CIFAR Quantum Information Processing meeting, Banff, AB, Canada
23 Oct. 2009	**From electron spins to photons:** **Physical quantum information processing** Physics Colloquium, University of Manitoba, Winnipeg, MB, Canada
2 Sept. 2009	**The power of spin: Manipulation, decoherence, and coupling to light** seminar at Université de Sherbrooke, Sherbrooke, QC, Canada
15 Apr. 2009	**The future of quantum hardware** CIFAR Junior Fellow Meeting, Toronto, ON, Canada
16 Mar. 2009	**Decoherence mechanisms for electron and hole spins in quantum dots** APS March Meeting, Pittsburgh, PA, USA
2 Feb. 2009	**Spins in semiconductors: Qubits or new bits?** McGill University Colloquium, Montréal, QC, Canada
1 Dec. 2008	**Hyperfine coupling and entanglement generation** NRC Condensed matter seminar, National Research Council, Ottawa, ON, Canada
1 June 2008	**Decoherence of a heavy hole coupled to nuclear spins in a quantum dot** Group of M. Bayer, Universität Dortmund, Germany
11 Jan. 2008	**Nuclear spin diffusion in nanodevices** Coherent Spintronics workshop, IQC, Waterloo, ON, Canada
7 Jan. 2008	**Electron spin dynamics and decoherence in a spin bath** NSEC Frontiers in Nanoscale Science and Technology Workshop, Basel, Switzerland
15 Nov. 2007	**Exponential decay in a spin bath** NRC Condensed matter seminar, National Research Council, Ottawa, ON, Canada
10 Sept. 2007	**Electron spins as qubits: Coherence in a hostile environment** IQC Colloquium, Institute for Quantum Computing, Waterloo, ON, Canada
25 Apr. 2007	**Exchange-controlled single-electron-spin rotations in quantum dots** NCCR Site Visit Simposium, University of Basel, Basel, Switzerland
	Fine-tuning the dynamics of electron spins in quantum dots
2 Apr. 2007	Tarucha group seminar University of Tokyo, Tokyo, Japan
16 Mar. 2007	Department of Physics Seminar, University of Iceland, Reykjavik, Iceland
27 Feb. 2007	Cory group seminar, MIT, Cambridge, MA, USA
26 Feb. 2007	Condensed Matter Theory Seminar, Harvard University, Cambridge, MA, USA
26 Jan. 2007	Condensed Matter Theory Seminar, UBC, Vancouver, BC, Canada
25 Jan. 2007	IQC Theory Seminar, IQC, Waterloo, ON, Canada
23 Jan. 2007	Condensed Matter Theory Seminar, Yale University, New Haven, CT, USA
19 Jan. 2007	Condensed Matter Theory Seminar, Instituut-Lorentz, Leiden, The Netherlands

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14 Aug. 2006	**Hyperfine interaction in quantum dots: Non-Markovian evolution and the quantum/classical distinction** Frontiers of Decoherence Workshop Fields Institute, University of Toronto, Toronto, Ontario, Canada
9 Aug. 2005	**Hyperfine interaction in a two-electron double quantum dot: Revealing the Overhauser field through transport** Conference on Strongly Interacting Systems at the Nanoscale ICTP Trieste, Italy
	Spin dynamics and hyperfine interaction in quantum dots
7 Jan. 2005	Group seminar, Group of Prof. Peter Zoller, IQOQI, Innsbruck, Austria
8 Dec. 2004	Group seminar, Group of Prof. Ignacio Cirac, MPQ, Garching, Germany
5 Oct. 2004	**Hyperfine interaction in a GaAs quantum dot: Non-Markovian electron spin dynamics** QSIT Meeting, Villa Garbald, Castasegna, Switzerland
26 Aug. 2004	**Hyperfine interaction and spin qubits in quantum dots** 13^{th} International conference on Hyperfine Interactions (HFI2004) University of Bonn, Bonn, Germany

Contributed Talks

7 Jul. 2009	**Three mysteries of the Pauli spin blockade** Spintech V, Kraków Poland
19 Mar. 2009	**Stationary and transient leakage current in the Pauli spin blockade** APS March Meeting, Pittsburgh, PA, USA
3 March 2007	**Exchange-controlled single-electron spin rotations** APS March Meeting, Denver, CO, USA
10 Aug. 2006	**Hyperfine interaction in quantum dots: Controlling the environment through measurement** CQIQC-II, Fields Institute, University of Toronto, Toronto, ON, Canada
31 July 2006	**Hyperfine interaction in quantum dots: Coherence, decoherence, and control** ICN+T2006, Congress Centre Basel, Basel, Switzerland
21 March 2003	**Lattice Landau theory for two-dimensional superconductors** Meeting of the Swiss Physical Society, University of Basel, Basel, Switzerland

Posters

	Sideband eraser of 'which-path' information for entangled photons on demand
Aug. 2009	Mathematics in Experimental Quantum Information, Waterloo, ON, Canada
June 2009	International Conference on Quantum Engineering, Monte Verità, Switzerland
Oct. 2008	**Using quantum mechanics to find "practical" improvements to computing and communication** Ontario PDF Networking Event, MaRS, Toronto, ON, Canada
Aug. 2008	**Spin decoherence of a heavy hole coupled to nuclei in a quantum dot** PASPS V, Iguassu Falls, Brazil
Feb. 2007	**Decoherence and dynamics in a spin bath** Ultracold NanoMatter, Toronto, ON, Canada

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Sept. 2007	**Solid-state quantum computing: Benchmarking and control** QuantumWorks Second Annual General Meeting, Delta Calgary Airport Hotel, Calgary, AB, Canada
Mar. 2007	**Exchange-controlled single-spin rotations in quantum dots** NSEC Frontiers of Nanoscience and Technology conference, Tokyo, Japan
June 2006	**Decoherence and nuclear-spin state narrowing in a double quantum dot** Spin and Charge Effects at the Nanoscale (SCEN06), Pisa, Italy
Jan. 2006	**Singlet-triplet decoherence due to nuclear spins in a double quantum dot** Frontiers in Nanoscience and Technology Workshop, San Francisco, CA, USA
Dec. 2005	**Decoherence and state narrowing in a double quantum dot** GDEST Workshop on quantum information and quantum coherence Max Planck Society Headquarters, Munich, Germany
Jul. 2005	**Singlet-triplet decoherence due to nuclear spins in a double quantum dot** Conference on Control and Manipulation of Quantum Systems Monte Verità, Ascona, Switzerland **Hyperfine interaction in a quantum dot: Non-Markovian electron spin dynamics**
Mar. 2005	ESF-JSPS Conference on Quantum Information and Quantum Physics Shonan Village Center, Kanagawa, Japan
Oct. 2004	Frontiers in Nanoscience and Nanotechnology Workshop Harvard University, Cambridge, Massachusetts, USA
Sept. 2004	Summer school on Quantum Dots Monte Verità, Ascona, Switzerland

Scientific Visits

13-18 Dec. 2009	**Groups of Y. Tokura and S. Tarucha** NTT Atsugi and University of Tokyo, Japan
Sep.–Dec. 2009	**Kavli Institute for Theoretical Physics** **Program on Quantum Information Science** UCSB, Santa Barbara, CA, USA
Aug./Sept. 2009	**Groups of Profs. M. Pioro-Ladrière and A. Blais**, Université de Sherbrooke, Sherbrooke, QC, Canada
Apr. 2007	**Group of Prof. Seigo Tarucha**, University of Tokyo, Tokyo, Japan and NTT laboratories, Atsugi, Japan
Mar. 2007	**Dr. S.I. Erlingsson**, University of Iceland, Reykjavik, Iceland
Jan. 2005	**Group of Prof. Peter Zoller**, IQOQI, Innsbruck, Austria
Dec. 2004	**Group of Prof. Ignacio Cirac**, MPQ Garching, Germany
Nov. 2004	**Group of Prof. Atac Imamoglu**, ETH Zurich, Switzerland
Oct. 2004	**Prof. Emil Yuzbashyan**, Rutgers University, Piscataway, NJ, USA

Teaching/Supervision

Students co-supervised:

J. Mracek	(B.Eng., Jan.-Sep. 2009 (co-op) with J. Baugh, Waterloo Engineering)
F. Qassemi	(Ph.D., 2008-present with F.K. Wilhelm, Waterloo Physics, in progress)
E. Platt	(M.Math., 2007-2009 with F.K. Wilhelm and J. Paldus, Waterloo Mathematics, completed)
J. Fischer	(Ph. D., 2006-present with D. Loss, Basel Physics, in progress)
D. Klauser	(Ph. D., 2005-2008 with D. Loss, Basel Physics, completed)

2008-2009	**Replacement lecturer for F. Wilhelm (nanophysics)** University of Waterloo
Sept. 2002 – Aug. 2007	**Teaching Assistant/System Administrator** Dept. of Physics, University of Basel
Sept. 2000 – 2002	**Teaching Assistant** Dept. of Physics and Astronomy, McMaster University
Sept. 1997 – 2000	**Teaching Assistant** Dept. of Mathematics and Statistics, University of Manitoba

Service

Referee for: Nature Physics,
Physical Review Letters,
Europhysics Letters,
Physics Letters A,
Physical Review B,
Physical Review A,
Canadian Journal of Physics,
Quantum Information and Computation

Other service:

- Co-organizing (with J. Gambetta) international workshop on solid-state quantum information processing (to be held in spring, 2010 in Waterloo).
- Co-organizer for IQC Colloquia (since Jan. 2009)
- 20 Feb. 2009: Presentation about the IQC for visiting high-school students
- 28 Oct. 2008: "Phys10" presentation on Spintronics for undergraduates at Waterloo
- Summer 2008: 5 Presentations about the IQC for high-school students, teachers, and Perimeter Institute International Summer School attendees.

Languages

- English: spoken (native), written (native)
- German: spoken (fluent), written (fair)
- French: spoken (fluent), written (fair)

References

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University of Waterloo,
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Prof. Daniel Loss
Department of Physics,
University of Basel,
Klingelbergstrasse 82,
4056 Basel,
Switzerland

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Prof. Lieven Vandersypen
Kavli Institute of NanoScience,
Delft University of Technology,
Lorentzweg 1,
2628 CJ Delft,
the Netherlands

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