

Information Physics Group, Center for Advanced Studies  
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## Education

### California Institute of Technology

Ph.D. in Physics, 2002.  
 M.S. in Physics, 2000.  
 Ph.D. Thesis: *Controlling quantum information.*  
 Thesis advisor: Prof. John Preskill.

### Virginia Polytechnic Institute and State University

B.S. in Physics, *Summa cum laude, in Honors*, 1996.  
 B.S. in Mathematics, *Summa cum laude*, 1996.  
 Honors Thesis: *Solving a two-person perfect information game with a quantum computer.*  
 Thesis advisor: Prof. Lay-Nam Chang.

## Academic/Research Positions

2005–present	Research Assistant Professor Department of Physics and Astronomy, University of New Mexico
2002–2005	Hewlett-Packard/MIT Postdoctoral Fellow Center for Theoretical Physics, Massachusetts Institute of Technology
1996–2002	Graduate Research Assistant Department of Physics, California Institute of Technology
1994	NSF Research Experience for Undergraduates Researcher Department of Physics, University of Illinois
1992–1994	Systems Engineering Researcher Hughes Aircraft Company, Herndon, VA

## Research Interests

Quantum information and quantum computation. Primarily algorithms, error-correction, fault-tolerance, control theory, and computer architecture.

## Grants

2007–2010	\$300,000. NSF PIF: <i>Quantum-classical tradeoffs for information-processing tasks.</i> Award #0653596. PIs: Carlton Caves, Andrew Landahl.
2006–2009	\$199,026. NSF PIF: <i>High fidelity gates and qubit addressing in an optical lattice quantum processor.</i> Award #0555573. PIs: Ivan Deutsch, Andrew Landahl.
1994	\$2,000. Society of Physics Students Undergraduate Research Award: <i>Nonlinear optical limiting in Buckminsterfullerene.</i> Advisor: Prof. Randy Heflin.

**Teaching Experience****Classroom teaching**

- Fall 2007      Instructor, University of New Mexico  
Physics 452/581: Introduction to Quantum Information
- Fall 2007      Instructor, University of New Mexico  
Physics 501: Information Physics Seminar
- Fall 2006      Instructor, University of New Mexico  
Physics 262: General Physics III, Optics, Relativity, Quantum Mechanics
- Fall 2006      Instructor, University of New Mexico  
Physics 501: Information Physics Seminar
- Fall 2005      Guest lecturer (Quantum algorithms), Sandia National Laboratories  
Short course on quantum information, Prof. Ivan Deutsch
- Fall 2005      Lecturer, Southwest Quantum Information and Technology Summer School  
Quantum Error Correction
- Fall 2002      Guest lecturer (Quantum algorithms), Harvard University  
Physics 287: Topics in Physics of quantum information, Prof. Mikhail Lukin
- 1996–2002    Graduate Teaching Assistant, California Institute of Technology  
Head TA, Physics 229: Quantum Information and Quantum Computation  
Head TA, Physics 135: Quantum Optics  
Recitation Leader, Physics 12: Waves, Quantum Mechanics, Statistical Physics.  
Recitation Leader, Math 1: Calculus and Probability

**Ph.D. Advisor**

Brad Chase, 2006–present

**Masters Advisor**

Devon Hjelm, 2007–present

**Undergraduate Mentor**

Nathan Wozny, “Error tolerance in quantum storage of information,” Summer 2001

Eric Dennis, “Fault tolerant recovery of toric codes,” Summer 1999

**High School Mentor**

Alexei Dunaway, “Implementing the Solovay-Kitaev algorithm,” Summer 2006.

Brian Jacokes, “An improved quantum algorithm for searching an ordered list,” Summer 2003.  
(Siemens-Westinghouse \$1,000 regional prize winner.)

### Professional Service and Outreach

2006–2009	Chair, Local Organizing Committee for International QIP 2009 Conference
2008–present	Member, Program Committee for International QIP 2009 Conference
2007	Grand Awards Judge, Intel International Science and Engineering Fair
2006	Creator/developer, <a href="http://info.phys.unm.edu">info.phys.unm.edu</a> (UNM Information Physics Group website)
2006–present	Member, UNM Center for Advanced Studies Seminar Series Committee
2004–2005	Co-leader, MIT Quantum Reading Group
2003–2004	Mentor, Siemens Westinghouse Competition (Brian Jacokes)
2002–2005	Member, MIT Quantum Information Processing Seminar Committee
2002	Creator/developer, <a href="http://qis.mit.edu">qis.mit.edu</a> (MIT Quantum Information Science website)
2000	Creator/developer, <a href="http://www.iqi.caltech.edu">www.iqi.caltech.edu</a> (Caltech Institute for Quantum Information website)
1999	Physics demonstrator, Rolling Valley Elementary, Alexandria, VA
1998–2002	Judge, Caltech Summer Undergraduate Research Fellowship Speaking Competition
1997–2002	Member, Caltech Physics Graduate Students Issues Committee
1992–1996	Physics demonstrator, Blacksburg Middle School, Blacksburg, VA
Journal/Grant Referee	<i>IEEE Transactions on Computers, International Journal of Quantum Information, Journal of Mathematical Physics, Journal of Physics B, NSF Division of Mathematical Sciences, Physical Review A, Physical Review Letters, Quantum Information and Computation, Quantum Information Processing</i>

### Prizes and Awards

Barry M. Goldwater Scholar, 1995–1996  
 Rhodes Scholarship Nominee, Virginia, 1996  
 Phi Beta Kappa Scholar, 1995–1996  
 Society of Physics Students Scholar, 1995–1996  
 Phi Kappa Phi Scholar, 1995–1996  
 Leinhardt Scholarship for Departmental Service (Virginia Tech), 1994  
 Hatcher Scholarship in Mathematics (Virginia Tech), 1994–1995  
 Mortar Board National Honor Society, 1994–1995 (Fundraising Chair)  
 Hamilton Prize in Physics (Virginia Tech), 1994  
 Sigma Pi Sigma National Physics Honor Society, 1994  
 Pi Mu Epsilon National Mathematics Honor Society, 1994  
 Gamma Beta Phi National Honor Society, 1993–1994  
 Virginia Scholar, 1992–1996  
 National Merit Scholar, 1992–1996

## Preprints/In Press

- [1] B. A. Chase and A. J. Landahl, *Universal quantum walks and adiabatic algorithms by 1D Hamiltonians*. arXiv:0802.1207 (2008).

## Publications

### I. Book-length publications

#### A. Ph.D. thesis

*Controlling quantum information*, California Institute of Technology (2002).

### II. Technical articles

#### A. Technical articles in refereed journals (Citations from Web of Science 3/2008)

- [8] **(0 citations)** B. A. Chase, A. J. Landahl, and JM Geremia, *Efficient feedback controllers for continuous-time quantum error correction*, arXiv:0711.0689, Phys. Rev. A **77**, 032304 (2008).
- [7] **(0 citations)** A. M. Childs, A. J. Landahl, and P. A. Parrilo, *Quantum algorithms for the ordered search problem via semidefinite programming*, quant-ph/0608161, Phys. Rev. A **75**, 032335 (2007).
- [6] **(57 citations)** M. Christandl, N. Datta, T. C. Dorlas, A. Ekert, A. Kay, and A. J. Landahl, *Perfect transfer of arbitrary states in quantum spin networks*, quant-ph/0411020, Phys. Rev. A **71**, 032312 (2005).
- [5] **(138 citations)** M. Christandl, N. Datta, A. Ekert, and A. J. Landahl, *Perfect state transfer in quantum spin networks*, quant-ph/0309131, Phys. Rev. Lett. **92**, 187902 (2004).
- [4] **(7 citations)** S. Lloyd, A. J. Landahl, and J.-J. E. Slotine, *Universal quantum interfaces*, quant-ph/0303048, Phys. Rev. A **69**, 012305 (2004).
- [3] **(8 citations)** A. M. Childs, E. Deotto, E. Farhi, J. Goldstone, S. Gutmann, and A. J. Landahl, *Quantum search by measurement*, quant-ph/0204013, Phys. Rev. A **66**, 032314 (2002).
- [2] **(25 citations)** C. Ahn, A. C. Doherty, and A. J. Landahl, *Continuous quantum error correction via quantum feedback control*, quant-ph/0110111, Phys. Rev. A **65**, 042301 (2002).
- [1] **(52 citations)** E. Dennis, A. Kitaev, A. Landahl, J. Preskill, *Topological quantum memory*, quant-ph/0110143, J. Math. Phys. **43**, 4452–4505 (2002).

#### B. Other technical articles

- [6] A. J. Landahl, M. Christandl, N. Datta, and A. Ekert, *Information processing in quantum spin systems*, in Proceedings of the 7th International Conference on Quantum Communication, Measurement and Computing, S. M. Barnett, E. Anderson, J. Jeffers, P. Öhberg, and O. Hirota, Eds., (AIP Press, 2004), pp. 215–218.

- [5] S. Lloyd, A. J. Landahl, and J.-J. E. Slotine, *Universal single-qubit quantum controller-observers*, in Proceedings of the 2003 International Conference on Physics and Control, A.L. Fradkov and A.N. Churilov, Eds., (IEEE Press, St. Petersburg, Russia, 2003), pp 829–833.
- [4] A. M. Childs, E. Deotto, E. Farhi, J. Goldstone, S. Gutmann, and A. J. Landahl, *Highlights of quantum search by measurement*, in Proceedings of the 6th International Conference on Quantum Communication, Measurement, and Computing, J. Shapiro and O. Hirota, Eds., (Rinton Press, Princeton, 2003), pp. 426–429.
- [3] A. J. Landahl, *Solving a two-person perfect information game with a quantum computer*, Honors Thesis, Virginia Tech (1996).
- [2] A. J. Landahl, *Determining global asymptotic behavior of differential equations from renormalization group theoretic structural stability analysis*, National Science Foundation Research Experience for Undergraduates Research Reports (1995).
- [1] A. J. Landahl, *Transformation of a graphics demonstration into a networked parallel processing visual system*, George Washington University Science and Engineering Research Reports (1992).

### III. Other publications

#### A. Book reviews

- [1] A. J. Landahl, *Breaking barriers to quantum computing*, Science **300**, 1509 (2003).

#### Unpublished Manuscripts

- [1] M. B. Jacones, A. J. Landahl, and E. Brookes, *An improved quantum algorithm for searching an ordered list*. [Superseded by improved results in II.A.[7].] (2004).

#### Conferences and Invited/Contributed Presentations (Asterisk \* denotes talk or poster presented.)

Mar.	2008*	American Physical Society March Meeting, New Orleans, LA
Feb.	2008*	Tenth Annual Southwest Quantum Information and Technology Workshop, Santa Fe, NM
Dec.	2007	First International Conference on Quantum Error Correction (QEC), Los Angeles, CA
Dec.	2007	Quantum Institute Workshop, Los Alamos, NM
Jul.	2007*	Quantum Enabled Science and Technology (QUEST) Workshop, Santa Fe, NM
May	2007*	Los Alamos Workshop on Quantum Computational Methods for Differential Equations and Physics Problems, Los Alamos, NM
Mar.	2007	American Physical Society March Meeting, Denver, CO
Feb.	2007*	Ninth Annual Southwest Quantum Information and Technology Workshop, Pasadena, CA
May	2006*	KITP Workshop on Topological Phases and Quantum Computation, Santa Barbara, CA
Feb.	2006*	Eighth Annual Southwest Quantum Information and Technology Workshop, Albuquerque, NM

- Jan. 2006 Eighth Annual Workshop on Quantum Information Processing (QIP 2006), Paris, FR
- Dec. 2005 Quantum Institute Workshop, Los Alamos National Laboratories, Los Alamos, NM
- Jul. 2005\* Fourth Annual Southwest Quantum Information and Technology Student Summer School and Retreat, Los Angeles, CA
- Jan. 2005 Seventh Annual Workshop on Quantum Information Processing (QIP 2005), Cambridge, MA
- Aug. 2004 Newton Institute Workshop on Quantum Information Theory, Cambridge, UK
- Jul. 2004\* Quantum Information and Quantum Control Conference (QIQC 2004), Toronto, ON
- Jul. 2004\* Seventh International Conference on Quantum Communication, Measurement, and Computing (QCMC 2004), Glasgow, UK
- Jan. 2004\* Sixth Annual Workshop on Quantum Information Processing (QIP 2004), Waterloo, Canada
- Oct. 2003 Foundations of Computer Science Conference (FOCS 2003), Cambridge, MA
- Oct. 2003 Cambridge-MIT Institute Workshop, Cambridge, MA
- Aug. 2003\* HP/MIT Workshop, Corvallis, OR
- Aug. 2003\* International Conference on Physics and Control (PhysCon 2003), St. Petersburg, Russia
- Jun. 2003 Cambridge-MIT Institute Workshop, Cambridge, UK
- May 2003\* Simons Conference on Quantum and Reversible Computation, Stony Brook, NY
- Oct. 2002\* Eastern Section Meeting of the American Mathematical Society, Cambridge, MA
- Jul. 2002 HP/MIT Quantum Information Summer School, Palo Alto, CA
- Jul. 2002\* Sixth International Conference on Quantum Communication, Measurement, and Computing (QCMC 2002), Cambridge, MA
- Mar. 2002\* Fourth Annual Meeting of the Southwestern Quantum Information Network (SQuInT 2002), Boulder, CO
- Jan. 2002 Cambridge-MIT Institute Workshop, Cambridge, MA
- Jan. 2002\* Fifth Annual Workshop on Quantum Information Processing (QIP 2002), Yorktown Heights, NY
- Dec. 2001\* Institute of Theoretical Physics (ITP) Conference on Quantum Information: Entanglement, Decoherence, and Chaos, Santa Barbara, CA
- Aug. 2001\* Quantum Enabled Science and Technology (QUEST) Workshop, Santa Fe, NM
- Jun. 2001\* International Conference on Quantum Information (ICQI), Rochester, NY
- Apr. 2001 Quantum Electromechanics Workshop, Pasadena, CA
- Mar. 2001 Third Annual Meeting of the Southwestern Quantum Information Network (SQuInT), Pasadena, CA
- Jul. 1998 Workshop on Quantum Computation, Torino, Italy
- Feb. 1998 First NASA International Conference on Quantum Computing and Quantum Communications (QCQC 1998), Palm Springs, CA
- Jul. 1997 Workshop on Quantum Computation, Torino, Italy
- Dec. 1996 Institute for Theoretical Physics (ITP) Conference on Quantum Coherence and Decoherence, Santa Barbara, CA
- Nov. 1996 Quantum Information and Computation (QUIC) Workshop, Pasadena, CA

**Presentations**

- One-dimensional nearest-neighbor time-independent Hamiltonians are universal for quantum computation, T-Division Quantum Lunch Seminar, Los Alamos National Laboratories, 16 August 2007
- Quantum walks and quantum computing, UNM-UAZ Hannigan Meadows Research Retreat and Workshop, Hannigan Meadows, AZ, 9 August 2007
- Implementing quantum circuits without using dynamical control fields, Quantum Enabled Science and Technology (QUEST) Workshop, Santa Fe, 27 July 2007
- So you've got a quantum computer, *Now what?*, Computer Science Research Institute Seminar, Sandia National Laboratories, 6 June 2007
- Ballistic quantum computation: Improving the Feynman computer, Workshop on Quantum Computational Methods for Differential Equations and Physics Problems, Los Alamos National Laboratories, 24 May 2007
- Printed quantum circuits, Southwest Quantum Information Network (SQuInT) Annual Meeting, Caltech, 18 February 2007
- Untitled blackboard seminar on quantum control and quantum computing, KITP Blackboard Seminar, Program on Topological Phases and Quantum Computation, University of California at Santa Barbara, 21 March 2006
- An improved algorithm for the ordered search problem, Southwest Quantum Information Network (SQuInT) Annual Meeting, University of New Mexico, 18 February 2006
- Quantum wires made out of quantum spins, Quantum Institute Workshop, Los Alamos National Laboratories, 7 December 2005
- Blueprints from a quantum information mechanic: Designs for wires, codes, and algorithms, Center for Advanced Studies Seminar, University of New Mexico, 13 July 2005
- How to build a fault-tolerant quantum computer, Physics & Astronomy Department General Seminar, Louisiana State University, 7 April 2005
- How to "print" a quantum computer out of spin chains, Atomic, Molecular, and Optical Physics Seminar, Georgia Tech, 5 November 2004
- How to build a quantum computer out of spin chains, Quantum Information Processing Seminar, Massachusetts Institute of Technology, 1 November 2004
- How to build a quantum computer out of spin chains and spin networks, Quantum/Nanophysics Seminar, Dartmouth, 14 October 2004

- Quantum computing with spin networks,  
Quantum Communication, Measurement, and Computation (QCMC) Conference, University of Strathclyde, Glasgow, 27 July 2004
- Quantum computing with spin networks,  
Quantum Information and Quantum Control Conference (QIQC), University of Toronto, 19 July 2004
- The quantum information revolution,  
Keynote Awards Day Lecture, Virginia Tech, 22 April 2004
- Why fundamental physics needs quantum information,  
Center for Theoretical Physics Seminar, Massachusetts Institute of Technology, 20 February 2004
- Why fundamental physics needs quantum information,  
Particle and Nuclear Physics Theory Seminar, University of New Hampshire, 18 February 2004
- Quantum adiabatic algorithms,  
Center for Bits and Atoms Seminar, Massachusetts Institute of Technology, 28 October 2003
- Quantum information science: putting quantum weirdness to work,  
Sidney-Pacific Seminar, Massachusetts Institute of Technology, 8 October 2003
- Quantum communication in spin networks,  
MIT Quantum reading group, Massachusetts Institute of Technology, 1 October 2003
- Quantum fault tolerance,  
Center for Bits and Atoms Seminar, Massachusetts Institute of Technology, 29 September 2003
- Computer games for quantum computers: Are they harder or easier?,  
HP Labs Seminar, HP Labs, Palo Alto, 22 September 2003
- Universal quantum interfaces,  
International Conference on Physics and Control, St. Petersburg, Russia, 21 August 2003
- Universal quantum interfaces and quantum recursive algorithms,  
HP/MIT Workshop, Hewlett-Packard, Corvallis, OR, 13 August 2003
- Universal quantum interfaces or the power of one (qubit),  
Simons Conference on Quantum and Reversible Computation, SUNY, Stony Brook, 28 May 2003
- Quantum sparse graph codes,  
MIT Quantum reading group, Massachusetts Institute of Technology, 12 May 2003
- Ordered search,  
MIT Quantum reading group, Massachusetts Institute of Technology, 24 March 2003
- Lower bounds by polynomials,  
MIT Quantum reading group, Massachusetts Institute of Technology, 6 November 2003

- Quantum information science: algorithms, error-correction, and control, Center for Bits and Atoms Seminar, Massachusetts Institute of Technology, 28 October 2002
- Continuous-time quantum error correction, Quantum Feedback Control Workshop, Massachusetts Institute of Technology, 17 October 2002
- Continuous-time quantum error correction, American Mathematical Society Fall Eastern Section Meeting, Northeastern University, 5 October 2002
- Quantum search by measurement, Quantum Communication, Measurement, and Computation (QCMC) Conference, Massachusetts Institute of Technology, 24 July 2002
- Quantum search by measurement, Institute for Quantum Information Seminar, California Institute of Technology, 9 April 2002
- Continuous-time quantum error correction, Southwest Quantum Information Network (SQuInT) Annual Meeting, National Institutes of Standards and Technology, Boulder, CO, 9 March 2002
- Continuous-time quantum error correction, T-8 Division Seminar, Los Alamos National Laboratories, 22 February 2002
- Continuous-time quantum error correction, Quantum Computing Seminar, University of California at Berkeley, 14 February 2002
- Continuous quantum error correction via quantum feedback control, Information Science Seminar, Bell Laboratories, 30 January 2002
- Continuous quantum error correction via quantum feedback control, Quantum Information Processing Seminar, Massachusetts Institute of Technology, 22 January 2002
- Quantum control: continuous QEC via QFC, Quantum Enabled Science and Technology (QUEST) Workshop, St. John's College, Santa Fe, NM, 8 August 2001
- Quantum error correction from the ground up: From quantum bits to stabilizer codes with nontrivial homologies, Mathematics Graduate Student Seminar, California Institute of Technology, 1996