Ivan H. Deutsch, Professor, Regents' Professor
CURRICULUM VITAE, February 2020

Dept. of Physics and Astronomy, University of New Mexico, Albuquerque, NM 87131
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Educational History:

Degree: S. B., Physics (June, 1987)
Massachusetts Institute of Technology, Cambridge MA
Thesis: *Free-Electron Laser Radiation Induced by Stimulated Transition Scattering*
Advisors: Prof. G. Bekefi and Dr. J. S. Wurtele
Degree: Ph. D., Physics (December, 1992)
University of California, Berkeley CA
Thesis: *The Quantum Theory of Paraxial Optical Fields, and Two-Photon Bound-States in a Self-Focusing Kerr Medium*
Advisors: Prof. R. Y. Chiao and Dr. J. C. Garrison

Employment History:

Present Position:

- Director, Center for Quantum Information and Control (CQuIC)
- Regents' Professor of Physics and Astronomy, University of New Mexico

Previous Positions:

8/10 - 8/16	Associate Chair for Graduate Studies, Dept. of Physics and Astronomy, UNM
8/05 - 8/09	Director of the Center for Advanced Studies, University of New Mexico
6/01 - 6/05	Associate Professor of Physics and Astronomy, University of New Mexico
8/95 - 5/01	Assistant Professor of Physics and Astronomy, University of New Mexico
9/93 - 7/95	National Research Council Postdoctoral Fellow, National Institute of Standards and Technology, Gaithersburg MD
1/93 - 8/93	Postdoctoral Research, France Telecom, Centre National d'Etude des Télécommunications
1/89 - 12/92	Research Assistant, University of California, Berkeley

Honors and Awards:

• APS 5-Sigma Award for Science Policy Advocacy	2019
• Regents' Professor, University of New Mexico	2015
• UNM 59th Annual Research Lecturer Award	2014
• Fulbright Senior Scholar, Barcelona Spain	2010
• Fellow, American Physical Society	2006
• Regents Lecturer, University of New Mexico	2003
• Excellence in Teaching Award, 4 time recipient, P&A UNM.	1997, 2001, 03, 04
• Sigma Xi Young Investigator Award	2000
• Miller Research Professor Award, Berkeley California	1999
• National Research Council Fellow	1993
• Fellowship for Cooperation in Science and Education	1992
• Department of Education Fellowship	1990
• Phi Beta Kappa Scholarship for Academic Distinction	1990
• Outstanding Graduate Instructor Award	1989
• Phi Beta Kappa	1987

Fields of Research Specialization

- Quantum information theory
- Atomic-Molecular-Optical (AMO) Physics
- Quantum Optics

Research

Publications:

Articles in refereed journals:

1. G. Bekefi, J. S. Wurtele, and I. H. Deutsch, "Free-electron laser radiation induced by a periodic dielectric medium", *Physical Review A* **34**, 1228 (1986).
2. I. H. Deutsch and J. C. Garrison, "Paraxial quantum propagation", Physical Review A **43**, 2498 (1991).
3. I. H. Deutsch, J. C. Garrison, and E. M. Wright, "Excess noise in gain-guided amplifiers", *Journal of the Optical Society of America B* **8**, 1244 (1991).
4. R. Y. Chiao, I. H. Deutsch, and J. C. Garrison, "Two-photon bound state in self-focusing media", *Physical Review Letters* **67**, 1399 (1991).
5. I. H. Deutsch, "A basis independent approach to quantum optics", *American Journal of Physics* **59**, 834 (1991).
6 I. H. Deutsch and J. C. Garrison, "Quantum spatial propagation of squeezed light in a degenerate parametric amplifier", *Optics Communications* **86**, 311 (1991).
7. I. H. Deutsch, R. Y. Chiao, and J. C. Garrison,"Diphotons in a nonlinear Fabry-Pérot resonator: Bound states of interacting photons in an optical 'quantum wire' ", *Physical Review Letters* **69**, 3627 (1992).
8. I. H. Deutsch, R. Y. Chiao, and J. C. Garrison, "Two-photon bound states: The diphoton bullet in dispersive self-focusing media", *Physical Review A* **47**, 3330 (1993).
9. I. H. Deutsch and I. Abram, "Reduction of quantum noise in soliton propagation by phase-sensitive amplification", *Journal of the Optical Society of America B* **11**, 2303 (1994).
10. I. H. Deutsch, R. J. C. Spreeuw, S. L. Rolston, and W. D. Phillips, "Photonic bandgaps in optical lattices", *Physical Review A* **52**, 1394 (1995).
11. G. Birkl, M. Gatzke, I. H. Deutsch, S. L. Rolston, and W. D. Phillips, "Bragg scattering from atoms in optical lattices", *Physical Review Letters* **75**, 2823 (1995).
12. P.S. Jessen and I. H. Deutsch, "Optical Lattices", *Advances in Atomic, Molecular, and Optical Physics* **37**, p. 95-136, B. Bederson and H. Walther eds., (Academic Press, San Diego, 1996).
13. I. H. Deutsch, J. Grondalski, and P. M. Alsing, "Local dynamics of laser cooling in optical lattices", *Physical Review A (Rapid Communication)* **56**, R1705 (1997).
14. I. H. Deutsch and P. S. Jessen; "Quantum state control in optical lattices", *Physical Review A* **57**, 1972 (1998).
15. S. E. Hamann, D. L. Haycock, P. H. Pax, I. H. Deutsch, and P. S. Jessen, "Resolved Raman-sideband cooling in an optical lattice", *Physical Review Letters* **80**, 4149 (1998).
16. G. K. Brennen, C. M. Caves, P. S. Jessen, and I. H. Deutsch, "Quantum logic gates in optical lattices", *Physical Review Letters* **82**, 1060 (1999).
17. J. Grondalski, I. H. Deutsch, and P. M. Alsing, "Spatial correlation diagnostics for atoms in optical lattices", *Optics Express* **5**, 249-261 (1999).
18. G. K. Brennen, I. H. Deutsch, and P. S. Jessen, "Entangling dipole-dipole interactions and quantum logic in optical lattices", *Physical Review A* **61**, 062309.1-10 (2000).
19. I. H. Deutsch, P. M. Alsing, J. Grondalski, S. Ghose, D. L. Haycock, and P. S. Jessen, "Quantum transport in magneto-optical double-potential wells", *Journal of Optics B: Quantum Semiclass Opt.* **2**, 633 (2000).
20. D. L. Haycock, J. Grondalski, I. H. Deutsch, and P. S. Jessen, "Mesoscopic quantum coherence in an optical lattice", *Physical Review Letters* **85**, 3365 (2000).
21 I. H. Deutsch, G. K. Brennen, and P. S. Jessen, "Quantum computing with neutral atoms in an optical lattice", - Special Issue on Physical Implementations of Quantum Computing – *Fortschritte der Physik* **48**, 925 (2000).
22. J. Grondalski, P. M. Alsing, and I. H. Deutsch, "Phase diffusion as a model for coherent suppression of tunneling in the presence of noise", *Physical Review E* **63**, 016114 (2001).
23. S. Ghose, P. M. Alsing, and I. H. Deutsch, "Atomic Motion in Magneto-Optical Double-Well Potentials: A New Testing Ground for Quantum Chaos", *Physical Review E* **64**, 056119 (2001).
24. P. S. Jessen, D. L. Haycock, G. Klose, G. A. Smith, I. H. Deutsch, and G. K. Brennen, "Quantum control and information processing in optical lattices", Quantum Information and Computation, **1**, 20 (2001). -- Special Issue on Implementation of Quantum Computation.

25. G. K. Brennen, I. H. Deutsch, and C. J. Williams "Quantum Logic for Trapped Atoms via Molecular Hyperfine Interactions", Physical Review A **65**, 022313 (2002).
26. R. Blume-Kohout, C. M. Caves, and I. H. Deutsch, "Climbing Mount Scalable: Physical-Resource Requirements for a Scalable Quantum Computer", *Foundations of Physics* **32**, 1641 (2002).
27. S. Ghose, P. M. Alsing, I. H. Deutsch, T. Bhattacharya, S. Habib, and K. Jacobs, "Recovering classical dynamics from coupled quantum systems through continuous measurement", *Physical Review A* **67**, 052102 (2003).
28. A. Silberfarb and I. H. Deutsch, "Continuous measurement with traveling wave probes", *Physical Review A* **68**, 013817 (2003).
29. R. Stock, E. L. Bolda, and I. H. Deutsch, "Quantum State Control via Trap-induced Shape Resonance in Ultracold Atomic Collisions", *Physical Review Letters* **91**, 183201 (2003).
30. T. Tessier, A. Delgado-Hilgado, I. Fuentes-Guridi, and I. H. Deutsch, "Entanglement generation in the two-atom Tavis-Cummings model", *Physical Review A* **68**, 062316 (2003).
31. A. Silberfarb and I. H. Deutsch, "Entanglement generated between a single atom and a laser pulse", *Physical Review A* **69**, 042308 (2004).
32. S. Ghose, P. M. Alsing, I. H. Deutsch, T. Bhattacharya, S. Habib, and K. Jacobs, "The transition to classical chaos in a coupled quantum system through continuous measurement", *Physical Review A* **69**, 052116 (2004).
33. I. H. Deutsch, P.S. Jessen, and R. Stock, "Quantum Computing with Neutral Atoms", special issue of *Quant. Inf. Proc.* **3**, 15 (2004).
34. C. M. Caves, I. H. Deutsch, and R. Blume-Kohout, "Physical-Resource Requirements and the Power of Quantum Computation", *Journal of Optics B* **6**, S801 (2004).
35. G. Smith, S. Chaudhury, P. S. Jessen, A. Silberfarb, and I. H. Deutsch, "Continuous Weak Measurement and Nonlinear Dynamics in a Cold Spin Ensemble", *Physical Review Letters* **93**, 163602 (2004).
36. R. Stock, A. Silberfarb, I. H. Deutsch, and E. L. Bolda, "Generalized pseudo-potentials for higher partial wave scattering", *Physical Review Letters* **94**, 023202 (2005).
37. A. Silberfarb and I. H. Deutsch, "Quantum-state reconstruction via continuous measurement", *Physical Review Letters* **95,** 030402 (2005).
38. S. Ghose, P. M. Alsing, B. C. Sanders, and I. H. Deutsch, "Entanglement vs. the quantum-to-classical transition", *Physical Review A* **72**, 014102 (2005).
39. T. Tessier, C. M. Caves, I. H. Deutsch, D. Bacon B. Eastin, "Efficient local simulation of n-qubit GHZ correlations", *Physical Review A* **72**, 032305 (2005).
40. R. Stock and I. H. Deutsch, "Trap-induced resonances in controlled collisions of cesium atoms", *Phys. Rev. A* **73**, 032701 (2006)
41. G. A. Smith, A. Silberfarb, I. H. Deutsch, and P. S. Jessen , "Efficient quantum-state estimation by continuous weak measurement and dynamical control", *Physical Review Letters* **97**, 180403 (2006).
42. I. Reichenbach, A. Silberfarb, R. Stock, and I. H. Deutsch, "A quasi-Hermitian pseudo potential for higher partial wave scattering", *Physical Review A* **74**, 042724 (2006).
43. D. Hayes, I. H. Deutsch, and P. S. Julienne, "Quantum logic via the exchange blockade in ultracold collisions", *Physical Review Letters* **98,** 070501 (2007).
44. I. Reichenbach and I. H. Deutsch "Sideband cooling while preserving coherences in the nuclear spin state in alkaline-earth-like atoms", *Physical Review Letters* **99**, 123001 (2007).
45. S Ghose, BC Sanders, PM Alsing, IH Deutsch, "Nonseparability of continuously measured quantum systems in the classical limit", *Canadian Journal of Physics* **85**, 633 (2007).
46. S. Chaudhury, S. Merkel, T. Herr, A. Silberfarb, I. H. Deutsch, and P. S. Jessen, "Quantum Control of the Ground Hyperfine Spin of a Cs Atom Ensemble", *Physical Review Letters* **99**, 163002 (2007).
47. S. G. Bhongale, S.J.J.M.F. Kokkelmans, I. H. Deutsch, "Analytic models of ultracold atomic collisions at negative energies for application to confinement-induced resonances", *Physical Review A* **77** 052702 (2008).
48. S. T. Merkel, I. H. Deutsch, and P. S. Jessen, "Quantum control of the hyperfine-coupled electron and nuclear spins in alkali atoms" *Physical Review A* **78**, 023404 (2008).
49. C. Trail, V. Madhok, and I. H. Deutsch, "Quantum ergodicity and entanglement in kicked coupled tops", *Physical Review E* **78**, 046211 (2008).
50. I. Reichenbach, P.S. Julienne, and I. H. Deutsch "Controlling nuclear spin exchange via optical Feshbach

resonances in ^{171}Yb", *Physical Review A* **80**, 020701 (R) (2009).
51. S. T. Merkel, G. K. Brennen, P. S. Jessen, and I. H. Deutsch, "Constructing general unitary maps from state preparations", *Physical Review A* **80**, 023424 (2009).
52. B. Mischuck, P. S. Jessen, and I. H. Deutsch, "Coherent control of atomic transport in spinor optical lattices" *Physical Review A* **81**, 023403 (2010).
53. S. T. Merkel, C. Riofrio, S. T. Flammia, and I. H. Deutsch, "Random unitary maps for quantum state reconstruction", *Physical Review A* **81**, 032126 (2010).
54. I. H. Deutsch and P. S. Jessen, "Quantum control and measurement of atomic spins in polarization spectroscopy", *Optics Communications* **283**, 681 (2010).
55. C. M. Trail, P. S. Jessen, and I. H. Deutsch, "Strongly Enhanced Spin Squeezing via Quantum Control", *Physical Review Letters* **105**, 193602 (2010).
56. K. Goyal, I. Reichenbach, and I. H. Deutsch, "p-wave Optical Feshbach Resonances in ^{171}Yb", *Physical Review A* **82**, 062704 (2010).
57. C. Riofrio, P. S. Jessen, and I. H. Deutsch, "Quantum tomography of the full hyperfine manifold of atomic spins via continuous measurement on an ensemble", *Journal of Physics B* **15**, 154007 (2011).
58. P. Hauke, E. Zhao, K. Goyal, I. H. Deutsch, W. V. Liu, and M. Lewenstein, "Time-reversal symmetry breaking of fermions in the p-band of an optical lattice," *Physical Review A* **84,** 051603(R) (2011).
59. B. E. Mischuk, S. T. Merkel, and I. H. Deutsch, "Control of inhomogeneous atomic ensembles of hyperfine qudits," *Physical Review A* **85**, 022302 (2012).
60. P. Hauke, F. Cucchietti, L. Tagaliacozzo, M. Lewenstein, and I. H. Deutsch, "Can one trust quantum simulators?" *Reports on Progress in Physics* **75**, 082401 (2012).
61. L. M. Norris, C. M. Trial, P. S. Jessen, and I. H. Deutsch, "Enhanced Squeezing of a Collective Spin via Control of Its Qudit Subsystems," *Physical Review Letters* **109**, 173603 (2012).
62. A. Smith, C. A. Riofrío, B. E. Anderson, H. Sosa-Martinez, I. H. Deutsch, P. S. Jessen "Quantum state tomography by compressed sensing: Fast and robust decoding of a quantum fingerprint," *Physical Review A* **87**, 030102(R) (2013).
63. T. Keating, K. Goyal, Y-Y Jau, G. W. Biedermann, A. Landahl, and I. H. Deutsch, "Adiabatic quantum computation with Rydberg-dressed atoms," *Physical Review A* **87**, 052314 (2013).
64. J. H. Lee, E. Montano, I. H. Deutsch, and P. S. Jessen, "Robust site-resolved quantum gates in an optical lattice via inhomogeneous control," *Nature Communications* **4**, 2027 (2013).
65. A. Smith, B. E. Anderson, H. Sosa-Martinez, C. A. Riofrío, I. H. Deutsch, P. S. Jessen, "Quantum Control in the Cs $6S_{1/2}$ Ground Manifold Using rf and μw Magnetic Fields," *Physical Review Letters* **111**, 170502 (2013).
66. V. Madhok, C. A. Riofrío, S. Ghose, and I. H. Deutsch, "Information gain in tomography - A quantum signature of chaos," *Physical Review Letters* **112**, 0414102 (2014).
67. B. Q. Baragiola, L. M. Norris, E. Montaño, P. G. Mickelson, P. S. Jessen, and I. H. Deutsch, "Three-dimensional light-matter interface for collective spin squeezing in atomic ensembles," *Physical Review A* **89**, 033850 (2014), *Editors Choice.*
68. C. H. Baldwin, A. Kalev, and I. H. Deutsch, "Quantum process tomography of unitary and near-unitary maps," *Physical Review A*, **90** 012110 (2014).
69. R. L. Cook, C. A. Riofrío, and I. H. Deutsch, "Single Shot Quantum State Estimation via a Continuous Measurement in the Strong Backaction Regime," *Physical Review A* **90**, 032113 (2014).
70. T. Keating, R. L. Cook, A. Hankin, Y-Y Jau, G. W. Biedermann, and I. H. Deutsch, "Robust quantum logic in neutral atoms via adiabatic Rydberg dressing," *Physical Review A* **91**, 012337 (2015).
71. B. E. Anderson, H. Sosa-Martinez, C. A. Riofrío, I. H. Deutsch, and P. S. Jessen, "Accurate and robust unitary transformation of a high-dimensional quantum system," *Physical Review Letters* **114**, (2015).
72. A. Kalev, R. Kosut, L. and I. H. Deutsch, "Quantum Tomography Protocols with positivity are compressed sensing protocols," Nature Quantum Information, **1**, 15018 (2015).
73. Y-Y Jau, A. Hankin, T. Keating, I. H. Deutsch, and G. W. Biedermann, "Entangling atomic spins with a Rydberg-dressed spin-flip blockade," Nature Phys. **12**, 71 (2016).
74. X. Qi, B. Q. Baragiola, P. S. Jessen, and I. H. Deutsch, "Dispersive response of atoms trapped near the surface of an optical nanofiber with applications to QND measurement and spin squeezing," *Physical Review A* **93**, 023817 (2016).

75. C. H. Baldwin, I. H. Deutsch, and A. Kalev, "Strictly-complete measurements for bounded-rank quantum-state tomography," *Physical Review A* **93**, 052105 (2016).
76. Tyler Keating, Charles H. Baldwin, Yuan-Yu Jau, Jongmin Lee, Grant W. Biedermann, Ivan H. Deutsch, "Arbitrary Dicke-State Control of Symmetric Rydberg Ensembles," *Physical Review Letters* **117**, 213601 (2016).
77. Vaibhav Madhok, Carlos, Riofrío, and Ivan H. Deutsch, "Review: Characterizing and quantifying quantum chaos with quantum tomography, *Pramana – J. Phys.* **87**, 65 (2016).
78. Jongmin Lee, Michael J. Martin, Yuan-Yu Jau, Tyler Keating, Ivan H. Deutsch, and Grant W. Biedermann, "Demonstration of the Jaynes-Cummings ladder with Rydberg-dressed atoms," *Physical Review A* **95**, 041801(R) (2017).
79. Hector Sosa-Martinez, Nathan K. Lysne, Charles H. Baldwin, Amir Kalev, Ivan H. Deutsch, and Poul S. Jessen, "Experimental study of optimal measurements for quantum state tomography," *Physical Review Letters* **119**, 150401 (2017).
80. Xiaodong Qi, Yuan-Yu Jau, and Ivan H. Deutsch, "Enhanced cooperativity for quantum nondemolition measurement induced spin squeezing of atoms coupled to a nanophotonic waveguide," *Physical Review A* **97**, 033829 (2018).
81. Ezad Shojaee, Christopher S. Jackson, Carlos A. Riofrio, Amir Kalev, and Ivan H. Deutsch, "Optimal pure-state qubit tomography via sequential weak measurements," *Physical Review Letters* **121**, 130404 (2018).
82. Gopikrishnan Muraleedharan, Akimasa Miyake, and Ivan H. Deutsch, "Quantum computational supremacy in the sampling of bosonic random walkers on a one-dimensional lattice," N. J. Phys. **21**, 053003 (2019) *Focus on Quantum Transport in Ultracold Atoms.*
83. Enrique Montano, Daniel Hemmer, Ben Q. Baragiola, Leigh M. Norris, Ezad Shojaee, Ivan H. Deutsch, Poul S. Jessen, "Squeezing the angular momentum of an ensemble of complex multi-level atoms," arXiv:1811.02519, submitted to *Physical Review A.*
84. Manuel H. Muñoz-Arias, Pablo M. Poggi, Poul S. Jessen, and Ivan H. Deutsch, "Simulating nonlinear dynamics of collective spins via quantum measurement and feedback," *Physical Review Letters* **124**, 110503 (2020).
85. Anupam Mitra, Michael J. Martin, Grant W. Biedermann, Alberto M. Marino, Pablo M. Poggi, and Ivan H. Deutsch, "Robust Mølmer-Sørensen gate for neutral atoms using rapid adiabatic Rydberg dressing," *Physical Review A, Rapid Communications* **101**, 030301(R) (2020).
86. Nathan K. Lysne, Kevin W. Kuper, Pablo M. Poggi, Ivan H. Deutsch, Poul S. Jessen, "A Small, Highly Accurate Quantum Processor for Intermediate-Depth Quantum Simulations," *Physical Review Letters* **124**, 230501 (2020).
87. Manuel H. Muñoz-Arias , Ivan H. Deutsch , Poul S. Jessen, and Pablo M. Poggi, "Simulation of the complex dynamics of mean-field *p*-spin models using measurement-based quantum feedback control ," *Physical Review A* **102**, 022610 (2020).
88. Pablo M. Poggi, Nathan K. Lysne, Kevin W. Kuper, Ivan H. Deutsch, and Poul S. Jessen, "Quantifying the sensitivity to errors in analog quantum simulation," arXiv:2007.01901.

Invited articles appearing as chapters in edited volumes or periodicals:

1. I. H. Deutsch and J. C. Garrison, "Spatial evolution of squeezed vacuum in a degenerate parametric amplifier", *Workshop on Squeezed States and Uncertainty Relations*, p. 137-146, D. Han, Y.S. Kim, and W. W. Zachary, eds., NASA Conference Publication 3135, 1992).
2. I. H. Deutsch, R. Y. Chiao, and J. C. Garrison, "The 'Diphoton': A two-photon bound state in self-focusing media", in *Foundations of Quantum Mechanics*, *Santa Fe Workshop,* 27-31 May,T. D. Black, M. M. Nieto, H. S. Pilloff, M. O. Scully, and R. M. Sinclair eds, (World Scientific, Singapore, 1992)**.**
3. R. Y. Chiao, I. H. Deutsch, E. M. Wright, and J. C. Garrison, "Solitons in quantum nonlinear optics", *Frontiers in Nonlinear Optics: the Serge Akhmanov Memorial Volume*, p. 151-182, H. Walter, N. Koroteev, and M. O. Scully, eds., (Institute of Physics Publishing, Bristol and Philadelphia, 1993).
4. R. Y. Chiao, P. G. Kwiat, I. H. Deutsch, and A. M. Steinberg, "Observation of a nonclassical Berry's phase in quantum optics", *Recent Developments in Quantum Optics*, p. 145-157 edited by R. Inguva, International Conference on Quantum Optics (1991 : Hyderabad, India), (Plenum Press, NY, NY, 1993).

5. G. Birkl, M. Gatzke, I. H. Deutsch, S. L. Rolston, and W. D. Phillips, "Bragg scattering from an optical lattice", Optics and Photonics News, **7**, 25 (1996).
6. I. H. Deutsch, G. K. Brennen, J. Grondalski, C. M. Caves, P.S. Jessen, S. E. Hamann, D. L. Haycock, and G. Klose, "Sideband cooling, state-control and quantum logic", *Laser Spectroscopy XIV International Conference*, R. Blatt, J. Eshner, D. Leibfried, and F. Schmidt-Kaler eds., (World Scientific, 1999).
7. "Quantum Information Processing in Optical Lattices", G.K. Brennen, I.H. Deutsch, and P.S. Jessen, *Proceeding to the International Conference on Experimental Implementation of Quantum Computing*, January 2001, R. Clark (Editor), (Rinton Press, 2001).
8. P.S. Jessen, D. L. Haycock, G. Klose, I. H. Deutsch, and G. K. Brennen, "Quantum Control and Entanglement Engineering with Cold Trapped Atoms", *ibid*.
9. I. H. Deutsch, G. K. Brennen, and P. S. Jessen, "Quantum computing with neutral atoms in an optical lattice" in *Scalable Quantum Computers: Paving the Way to Realization*, Samuel L. Braunstein (Editor), and Hoi-Kwong Lo (Editor), (Wiley, New York, 2001).
10. Poul S. Jessen, D. L. Haycock, G. Klose and G. Smith , P. M. Alsing, I. H. Deutsch, J. Grondalski and S. Ghose, "Coherent Tunneling and Quantum Control in an optical double-well potential", *Laser Spectroscopy XV International Conference*, (World Scientific, Singapore, 2001).
11. I. H. Deutsch and Poul Jessen, "Quantum Information Processing in Optical Lattices: Cold Atomic Qubits in a Virtual Crystal of Light", IEEE-LEOS Newsletter **6** ISSN: 1060-3301 pp. 3-7 (2002).
12. S. Ghose, P. M. Alsing, I. H. Deutsch, P. S. Jessen, D. L. Haycock, T. Bhattacharya, S. Habib, and K. Jacobs , "Quantum and Classical Dynamics Of Atoms In A Magneto-optical Lattice" *Proceedings to the 7th Experimental Chaos Conference*, (AIP, 2003).
13. T. Tessier, I. Deutsch, and A. Delgado-Hilgado, "Entanglement Sharing in the Tavis-Cummings Model", in *Quantum Information and Computation* edited by Eric Donkor, Andrew R. Pirich, Howard E. Brandt, (SPIE, Bellingham, Washington, 2003), pages 285-290.
14. C. M. Caves, I. H. Deutsch, and R. Blume-Kohout, "Physical-resource Requirements for Scalable Quantum Computation", in *Fluctuations and Noise in Photonics and Quantum Optics*, edited by D. Abbott, J.H. Shapiro, and Y. Yamamoto (SPIE, Bellingham, Washington, 2003), pages 425-433.
15. S. Ghose, P. M. Alsing, I. H. Deutsch, B. Sanders , "The Quantum to Classical Transition in Entangled Systems via Continuous Measurements", *Proceedings to Quantum Communication Measurement and Computation,* Glasgow Scotland 2004 (AIP, Melville, NY, 2004), pages 61-66.

Invited Talks

1. Department Colloquium: Physics Dept., University of Strathclyde, Glasgow U.K., (May 1993). "The Diphoton: A Two-Photon Bound State in Self-Focusing Medium".
2. Department Colloquium: Physics Dept., Hunter College, New York, New York, (Apr. 1994). "Reduction of Quantum Noise in Optical Soliton Communication".
3. Department Colloquium: Optical Sciences Center, University of Arizona, Tucson, (Nov. 1995). "Bragg-Scattering in Optical Lattices".
4. Atomic Molecular Optical Physics Summer School: University of New Mexico, Los Alamos, (July 1996). "Laser Cooling and Optical Lattices".
5. Atomic Physics Seminar: University of Texas, Austin (October 1996), "Local Dynamics of Laser Cooling in Optical Lattices".
6. Atomic Molecular Optical Physics Summer School: University of New Mexico, Los Alamos, (June 1997). "Laser Cooling - 'Atoms Refrigerated by Laser Light' ".
7. Quantum Technology Seminar Series: Los Alamos National Laboratory, (Nov. 1997). "Quantum State Preparation in Optical Lattices".
8. DAMOP Conference Experience for Undergraduates: University of New Mexico, Los Alamos, (May 1998). "Quantum Information in Quantum Optics".
9. Symposium in Honor of William D. Phillips: National Institute of Standards and Technology, (June 1998). "Quantum State Control and Tunneling in Optical Lattices".
10. Atomic Physics Seminar: Berkeley, (Dec. 1998). "Quantum Logic Gates in Optical Lattices".
11. Workshop on Bose-Einstein Condensation and Degenerate Fermi Gases: JILA – University of Colorado (Feb. 1999). "Quantum Logic Gates in Optical Lattices".
12. Atomic and Condensed Matter Physics Seminar: University of Toronto, (March 1999).

"Quantum Logic Gates with Neutral Atoms in Optical Lattices".

13. Department Colloquium: Optical Sciences Center, University of Arizona, Tucson, (April. 1999). "Quantum Logic Gates with Neutral Atoms in Optical Lattices".
14. Atomic Physics Seminar: Berkeley, (Oct. 1999). "Coherent Control of Neutral Atoms in Optical Lattices".
15. Atomic Physics Seminar: University of Michigan, Ann Arbor (March 2000). "Coherent Control of Atomic Dynamics in Optical Lattices".
16. Pan American Advanced Studies Institute (PASI): Angra dos Reis, Brazil, (April 2000). "Introduction to Quantum Computation", "Introduction to Laser Cooling and Trapping".
17. APS-DAMOP Annual Meeting: University of Connecticut, Storrs (June 2000). "Entangling Dipole-Dipole Interactions for Quantum Logic in Optical Lattices".
18. Optical Society of America Annual Meeting: Providence, RI (October 2000). "Quantum Optical Implementations of Quantum Information Processing".
19. International Conference on Experimental Implementation on Quantum Computation: Syndey, Australia (January 2001). "Quantum Information Processing in Optical Lattices".
20. Atomic Physics Gordon Conference Williamstown MA, (June 2001), Discussion Leader: "Quantum Information".
21. Institute for Quantum Information: Caltech CA (September 2001), "Quantum Information Processing in Optical Lattices".
22. Institute for Theoretical Physics: UCSB CA (October 2001), "Quantum Information Processing in Optical Lattices".
23. Department Colloquium: Colorado State University CO (November 2001), "The Ultimate Microprocessor: Quantum Computing with Single Atoms".
24. Institute for Theoretical Physics: UCSB CA (December 2001), "Physical Resource Requirements for Scalable Quantum Computation".
25. 4th Annual Workshop of the Southwest Quantum Information and Technology (SQuInT) Network: National Institute of Standards and Technology, Boulder CO (March 2002), "Climbing Mount Scalable: Physical Resource Requirements for Scalable Quantum Computing".
26. AMO Distinguished Lecture Series: University of Maryland (March 2002), "Quantum Information Processing in Optical Lattices".
27. Neutral Atom Quantum Computing Workshop: National Institute of Standards and Technology, Gaithersburg MD (June 2002), "Quantum Information Processing in Optical Lattices".
28. Laboratory Colloquium: Sandia National Laboratoy, Albuqueruque NM (June 2002), "Quantum Information Processing with Ultra-Cold Atoms".
29. "Quantumware" Workshop: Paul Sabatier University, Toulouse France (July 2002), "Quantum Information Processing in Optical Lattices".
30. IPAM/MSRI Workshop on Quantum Computing: Institute for Pure and Applied Mathematics, UCLA, Westwood CA (October 2002), "Quantum Control with Neutral Atoms".
31. Joint Atomic Physics Seminar: Institute for Theoretical Atomic and Molecular Physics, Harvard University (March 2003), "Quantum Information Processing with Ultracold Atoms".
32. Quantum Information Science Seminar: University of Illinois, Urbana (March 2003), "Quantum Information Processing with Ultracold Atoms".
33. The Toronto Quantum Information Seminar: University of Toronto (March 2003), "Quantum Information Processing with Ultracold Atomic Qubits".
34. Simons Conference on Quantum and Reversible Computation, Stony Brook, (May 2003), "Quantum Information Processing with Trapped Ultracold Atoms"
35. Quantum Enabled Science and Technology Meeting, Santa Fe New Mexico (August 2003), "Continuous Measurement and Quantum Control".
36. Quantum Fluids and Solids, University of New Mexico (October 2003), "Quantum Computing in Optical Lattices"
37. Optical Society of America, Tucson Arizona (October 2003), "Quantum Computing in Optical Lattices"
38. QUEST, La Thullie Italy (March 2004), "Quantum Information Processing in Optical Lattices".
39. APS-DAMOP Annual Meeting, University of Arizona, Tucson (May 2004). "Entanglement in Atom Molecular and Optical Systems".

40. Quantum Lunch, Los Alamos National Laboratory (July 2004), "Quantum Control with Ultracold Atoms".
41. Department Colloquium, University of Calgary, Canada (September 2004). "Quantum Control and Information Processing with Ultracold Atoms".
42. Optical Society of America, Rochester New York (October 2004), "Quantum Control in Optical Lattices".
43. Quantum Information Seminar, University of Toronto (March 2005), "Quantum Control Ultracold Atoms"
44. APS March Meeting, Los Angeles California (March 2005), "Quantum Control of Ultracold Atoms".
45. Quantum Optic VI, Krynica Poland (June 2005), "Quantum State Reconstruction via Continuous Measurement".
46. QUEST, Santa Fe New Mexico (August 2005), "Quantum State Reconstruction via Continuous Measurement".
47. NIST Atomic Physics Seminar, Bouder CO (September 2005), "Quantum Information Processing with Ultracold Atomic Ensembles".
48. Department Colloquium, Carleton College MN (October 2005), "The Ultimate Microprocessor: Single Atoms as Quantum Bits".
49. Department Colloquium, Union College NY (November 2005), "The Ultimate Microprocessor: Single Atoms as Quantum Bits".
50. Harvard-MIT Center for Ultracold Atoms Seminar, Cambridge MA (March 2006), "Quantum Information Processing with Ultracold Atoms".
51. Quantum Information Seminar, Institut d'Optique, Orsay France (July 2006), "Quantum Information Processing with Ultracold Atoms".
52. Field Institute Workshop on Decoherence, Tororonto Canada (August 2006), "Quantum-State Estimation via Continuous Measurement".
53. ITAMP Workshop on Group-II Atoms, Cambridge MA (September 2006), "Quantum computing with nuclear spin in group-II elements."
54. JQI Seminar, University of Maryland, College Park MD (March 2007), "Quantum Information Processing with Nuclear Spin in Group-II".
55. QIS Seminar, Massachusetts Institute of Technology, Cambridge MA (April 2007), "Quantum Control of Atomic Spins".
56. QIP Seminar, Sandia National Laboratories, Albuquerque NM (May 2007), "Quantum Control of Atomic Spins".
57. Department Colloquium, University of Oregon, Eugene OR (September 2008), "Quantum Control of Atomic Spins".
57. APS March Meeting, New Orleans LA (March 2008), "Quantum Information Processing with Alkaline-Earth-Like Atoms".
58. APS-DAMOP Meeting, Penn State PA (May 2008), "Quantum Control with Ultracold Atoms".
59. Quantum Information and Control in Queensland, Cairns Australia (July 2008), "Quantum Control of Spins in Ultracold Atoms".
60. ITAMP: Open Quantum Systems, Decoherence and Control, Harvard, Cambridge MA (November 2008), "Quantum Control and Measurement of Atomic Spins".
61. Department Colloquium, University of Southern Florida (January 2009), "Quantum Computing with Ultracold Atoms".
62. Atomic Physics Seminar, University of Wisconsin (April 2009), "Quantum Control of Spins in Ultracold Atoms".
63. Workshop: Cooling & Calculating, Quantum Walks and Feedback, Bonn Germany (July 2009), "Quantum Control of Spins in Ultracold Atoms".
64. Department Colloquium, University of Arizona (August 2009), "Quantum Control and Measurement: Two Keys to Quantum Information Processing".
64. Workshop: Ultracold Group II Atoms: Quantum Metrology and Information, Joint Quantum Institute, College Park MD (September 2009), "Quantum Control of Nuclear Spins in Alkaline-Earth-Like Atoms".
65. Department Colloquium, University of Washington (October 2009), "Quantum Control and Measurement: Two Keys to Quantum Information Processing".
66. Joint-Quantum-Institute, University of Maryland, College Park MD (February 2010), "Quantum Control of Mesoscopic Spin Ensembles."

67. University of Aarhus, (May 2010) "Quantum Control of Mesoscopic Spin Ensembles."
68. Niels Bohr Institute, Copenhagen Denmark, (May 2010) "Quantum Control of Mesoscopic Spin Ensembles."
69. University of Mainz, Germany, (May 20101), "Quantum Control of Mesoscopic Spin Ensembles."
70. Center for Nonlinear Studies Seminar, Los Alamos National Laboratories, Santa Fe NM (June 2010), "Quantum Control of Atomic Spins".
71. Center for Quantum Information and Quantum Control, University of Toronto (September 2010), "Extreme Spin Squeezing on Cold Atomic Ensembles."
72. Institute for Quantum Computation Colloquium, University of Waterloo (September 2010), "Extreme Spin Squeezing on Cold Atomic Ensembles."
73. US-Spain Bilateral Meeting of Information Technology, Santa Fe NM (December 2010), "Quantum Simulation, Dream or Nightmare?"
74. APS March Meeting, Dallas TX (March 2011), Tutorial on Quantum Simulation.
75. Department Colloquium , Brown University, (May 2011), "Controlling the Quantum World."
76. APS DAMOP, Atlanta GA (June 2011), "Enhanced Spin Squeezing via Collective and Individual Atomic Control."
77. Sandia National Laboratories, Livermore CA, (October 2011) "Quantum Control of Atomic Spins".
78. Atomic Physics Seminar, University of California Berkeley, (October 2011) "Quantum tomography via continuous measurement".
79. Winter School Lecturer, Institute for Atomic, Molecular, Optical Physics, (January 2012) "Quantum Control of Atomic Spins".
80. 11^{1th} International Conference on Quantum Communication, Measurement, and Computing, Vienna Austria (August 2012), "Fast quantum tomography via continuous measurement and control".
81. APS Four Corners Meeting, Socorro NM, (October 2012) "Quantum Control and Measurement of Atomic Spins."
82. Gordon Conference on Atomic Physics, (June 2013) "New Directions in the Atom-Light Interface."
83. Institute for Physics, Rio de Janeiro, Brazil, (August 2013) "Quantum Control and Measurement of Spins in Ultracold Atomic Gases)."
83. Quantum Information School and Workshop, Paraty, Brazil, (August 2013) "Quantum Control, Measurement, and Tomography."
84. Institute for Atomic-Molecular Physics, Harvard University, (October 2013) "Quantum Control and Measurement."
85. APS March Meeting, Denver CO, (March 2014) "Quantum Control and Measurement of Atomic Spins."
86. Georgia Tech, Atlanta Georgia, (May 2014) "Quantum Control and Measurement of Atomic Spins."
87. Gordon Research Seminar on Quantum Science, Stonehill College, MA, (July 2014) "Quantum Simulation: Dream or Nightmare?"
88. APS 4 Corners Meeting, Orem UT (October 2014) "Quantum Control and Measurement of Atomic Spins."
89. Center for Theory of Quantum Matter, University of Colorado Boulder (March 2014), "Control and Measurement of Atomic Spins: A Testbed for Quantum Information Processing."
90. Asia-Pacific Conference and Workshop on Quantum Information Science, (December 2015), "Control and Measurement of Atomic Spins."
91. Australian and New Zealand School in Ultracold Physics, (December 2015) "Control and Continuous Measurement."
92. University of Sydney (December 2015), "Control and Measurement of Atomic Spins."
93. Macquarie University (December 2015), "Control and Measurement of Atomic Spins."
94. Department Colloquium, Dartmouth College (May 2016), "Controlling and Quantum World in Ultracold Atomic Spins."
95. Les Houches School in Theoretical Physics: Current Trends in Atomic Physics (July 2016) "Quantum control, Measurement and Tomography."
96. Yale Quantum Institute (March 2017), " The Power of Being Positive: Compressed Sensing in the Quantum World."
97. Department Colloquium, Harvey Mudd College (April 2017), "Breaking Heisenberg: Controlling the

Quantum World."

98. Korea Physical Society, Daejeon Korea (April,2017), "Optimal Control of Atomic Spins."
99. APS DAMOP, Sacramento CA (June 2017), "Arbitrary Dicke State Control of Symmetric Rydberg Ensembles."
100. PRACQSYS, Seattle Washington (July 2017), " The Power of Being Positive: Compressed Sensing in the Quantum World."
101. Depart Colloquium, University of Oklahoma (October 2017), "Controlling and Quantum World in Ultracold Atomic Spins."
102. Quantum Computation & Simulation, Bilbao Spain (February 2018), "Quantum supremacy in the sampling of bosonic random walkers on a one-dimensional lattice."
103. Department Colloquium, University of Maryland, Baltimore (April 2018), "Controlling and Quantum World in Ultracold Atomic Spins."
104. University of Colorado (June 2018), "Quantum supremacy in sampling bosonic quantum random walkers."
105. PRACQSYS, Paris France (July 2018), "Quantum computational supremacy in the sampling of bosonic random walkers on a one-dimensional lattice."
106. Institut d'Optique, Paris France (July 2018), "Quantum control with Rydberg-dressed atoms."
107. Gordon Research Seminar, Massachusetts (July 2018), Keynote Address, "The Nature of Quantum Complexity."
108. Department Colloquium, Williams College (September 2018), "Breaking Heisenberg: Controlling the Quantum World."
109. CQIQC Seminar, University of Toronto (March 2019), "Quantum control with Rydberg-dressed atoms."
110. Department Colloquium, Bates College (March 2019), "Breaking Heisenberg: Controlling the Quantum World."
111. QFarm Seminar, Stanford University (October 2019), "Quantum information processing with spins in cold atomic ensembles."
112. AMO Physics Seminar, University of California, Berkeley (October 2019), "Quantum information processing with spins in cold atomic ensembles."
113. Department Colloquium, Institute for Quantum Computing (November 2019), "Quantum information processing with spins in cold atomic ensembles."

Research/Workshop Funding

Present Funding

Title: *Robust Entangling Quantum Logic Gates Based on Rydberg-Dressed Atoms*
PI: Ivan Deutsch
Funding agency: Sandia National Laboratories
Performance period: 3 months starting June 10, 2019. Amount $30,000.

Title: *Robust Quantum Complexity in the Dynamics of the Bose-Hubbard Model*
PI: Ivan Deutsch, co-PI: Akimasa Miyake
Funding agency: Google
Performance period: 1 months starting January 1, 2019. Amount $125,000.

Title: *Quantum Complexity, Chaos, and Implications for Analog Quantum Simulation*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting September 1, 2018. Amount: $240,000

Title: *FRHTP: Center for Quantum Information and Control (CQuIC)*
PI: Carlton Caves; co-PIs: Ivan Deutsch, Akimasa Miyake, F. Elohim Becerra, Poul Jessen
Funding agency: National Science Foundation
Performance period: 5 years starting September 1, 2016. Amount: $2,265,198

Title *Symmetric Many-Body Correlations in Atomic Ensembles*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 4 years starting August 1, 2016. Amount: $320,956

Previous Funding

Title: *A Unified Approach to Quantum Tomography, Open Systems Control and Quantum Simulation*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting September 1, 2015. Amount: $210,000

Title: *Atom Traps on a Microfabricated Optical Waveguide Platform for Quantum-Limited Spin-Squeezed Magnetometry and Quantum Information Applications*
PI: Ivan Deutsch
Funding agency: Sandia National Laboratories
Performance period: 20 months starting February 1, 2016. Amount: $100,000

Title: *Center for Quantum Information and Control (CQuIC)*
PI: Carlton Caves; co-PIs: Ivan Deutsch and Poul Jessen
Funding agency: National Science Foundation
Performance period: 2 years starting September 1, 2015. Amount: $891,062

Title: *A New Approach to Entangling New Atoms*
PI: Ivan Deutsch
Funding agency: Sandia National Laboratories
Performance period: 3 years starting October 1, 2013. Amount: $210,000

Title *Quantum Control, Measurement, and Information in Atomic Spin Ensembles*
PI: Ivan Deutsch
Funding agency: National Science Foundation

Performance period: 3 years starting August 1, 2013. Amount: $210,000

Title: *Center for Quantum Information and Control (CQuIC)*
PI: Carlton Caves; co-PIs: Ivan Deutsch and Poul Jessen
Funding agency: National Science Foundation
Performance period: 3 years starting August 1, 2012. Amount: $1,330,540

Title: *An Optical Nanofiber Based Quantum Interface*
PI: Poul Jessen, co-PI: Ivan Deutsch
Performance period: 3 years starting August 1, 2011, Amount $183,129

Title: *Long Distance Quantum Key Distribution via Encoded Optical Solitons*
PI: Ivan Deutsch
Funding Agency: Los Alamos National Laboratory
Performance period: 6 months starting June 1, 2013, Amount $50,000

Title: *Adiabatic Quantum Computation with Trapped Neutral Atoms*
PI: Ivan Deutsch
Funding Agency: Sandia National Laboratories
Performance period: 3 years starting February 1, 2011, Amount $500,000

Title: *Quantum Control, Measurement, and Information in Atomic Spin Ensembles*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting August 1, 2010. Amount: $261,386

Title: *Quantum Control of Mesoscopic Collective Spin States*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting August 1, 2010. Amount: $261,386

Title: *Center for Quantum Information and Control (CQuIC)*
PI: Carlton Caves; co-PIs: Ivan Deutsch and Poul Jessen
Funding agency: National Science Foundation
Performance period: 3 years starting August 1, 2009. Amount: $1,259,811.00

Title: *Quantum Control of Qudits and Quantum Transport in Optical Lattices*
PI: Ivan Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting August 1, 2009. Amount: $193,726

Title: *Southwest Quantum Information and Technology Workshop*
PI: Ivan Deutsch
Funding Agency: Army Research Office
Performance period: 1 year starting February 15, 2011. Amount $10,000

Title: *Workshop on AMO theory: Recent developments and a vision for the future*
PI: Klaus Bartschat, co-PIs: Doerte Blume, Carlton Caves, and Ivan Deutsch
Performance period: 1 year starting June 1, 2011, Amount $7,697

Title: *Quantum Control of Trapped Atoms for Improved Stability of Optical Clocks*
PI: Ivan H. Deutsch
Funding agency: Office of Navy Research
Performance period: 3 years starting February 1, 2007. Amount: $366,700

Title: *Quantum Control of Atomic Spins*
PI: Ivan H. Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting May 1, 2007. Amount: $225,000

Title: *Elements of Neutral Atom Quantum Computing with Optical Control*
PI: Ivan Deutsch
Funding Agency: National Institute of Standards & Technology
Performance period: 1 years starting January 1, 2009. Amount: $90,000

Title: *High Fidelity Gates and Qubit Addressing in an Optical Lattice Quantum Processor*
PI: Ivan Deutsch; Co-PI Poul Jessen
Funding agency: National Science Foundation
Performance period: 3 years starting July 15, 2006. Amount: $ 200,000

Title: *Quantum Control of Atoms in Optical Traps for High-Fidelity Quantum Logic*
PI: Ivan Deutsch
Funding agency: National Institute of Standards and Technology
Performance period: 4 years starting July 1, 2004. Amount: $220,000

Title: *Entanglement and the Power of Quantum Computation*
PI: Carlton M. Caves; Co-PI: Ivan H. Deutsch
Funding agency: Army Research Office
Performance period: 3 years beginning June 9, 2004. Amount: $370,828

Title: *Quantum Control of Complex Systems: Atomic Ensembles in Optical Lattices*
PI: Ivan H. Deutsch
Funding agency: National Science Foundation
Performance period: 3 years starting May 1, 2004. Amount: $180,000

Title: *Quantum Computing and Graduate Research Fellowship*
PI: Ivan H. Deutsch, Co-PI: Carlton M. Caves
Funding agency: Army Research Office
Performance period: 3 years beginning May 1, 2004. Amount: $100,000

Title: *Southwest Quantum Information and Technology Workshops*
PI: Ivan H. Deutsch; co-PI: Carlton M. Caves
Funding agency: Army Research Office
Performance period: 3 years beginning January 1, 2004. Amount: $50,000

Title: *Quantum Control of Ultracold Atoms for Improved Frequency Standards*
PI: Ivan H. Deutsch
Funding agency: Office of Naval Research
Performance period: 3 years beginning April 1, 2003. Amount: $306,293

Title: *Studies of Continuously Measured Atomic Systems*
PI: Ivan H. Deutsch, Co-PI: Paul Alsing
Funding agency: Los Alamos National Laboratory
Performance period: 2 months beginning May 1, 2003. Amount: $15,913

Title: *SQuInT Student Summer School and Retreat*
PI: Ivan H. Deutsch, Co-PI: K. Birgitta Whaley

Funding agency: National Science Foundation
Performance period: 1 year beginning May 1, 2003. Amount: $19,138.

Title: *Quantum Information Processing with Laser-Trapped Neutral Atoms*
PI: Ivan H. Deutsch
Funding agency: National Institute of Standards and Technology
Performance period: 3 years beginning September 1, 2001. Amount: $90,000

Title: *Quantum Control and Chaos of Entangled Spinor Wavepackets*
PI: Ivan H. Deutsch, Co-PI: Paul M. Alsing
Funding agency: National Science Foundation
Performance period: 3 years beginning September 1, 2001. Amount: $120,000

Title: *Fundamental Studies of Quantum Information Processing with Neutral Atoms*
PI: Ivan H. Deutsch, Co-PI: Carlton M. Caves
Funding agency: Army Research Office
Performance period: 3 years beginning June 1, 2001. Amount: $300,000

Title: *Quantum Logic for Neutral Atoms in Optical Lattices*
PI: Ivan H. Deutsch
Funding agency: Office of Naval Research
Performance period: 3 years beginning April 1, 2000. Amount: $300,000

Title: *Southwest Quantum Information and Technology Network*
PI: Ivan H. Deutsch, Co-PI: Carlton M. Caves
Funding agency: Office of Naval Research
Performance period: 3 years beginning October 1, 1998. Amount: $15,000

Title: *Quantum Control of Atomic Motion in Optical Lattices*
PI: Ivan H. Deutsch, Co-PI: Paul M. Alsing
Funding agency: National Science Foundation
Performance period: 3 years beginning September 1, 1998. Amount: $159,992

Title: *Analysis of Implementations of Quantum Computation*
PI: Ivan H. Deutsch, Co-PI: Richard Hughes
Funding Agency: Los Alamos National Laboratory
Performance period: 1 year beginning September 1, 1997. Amount: $26,000

Teaching

Student advisement:

Current Ph. D. Students

Gopikrishnan Muraleedharan, Karthik Chinni, Anupam Mitra, Manuel Muñoz.

Ph. D. Theses Supervised (Graduated)

1. John Grondalski (Dec. 2000), "Studies of Atomic Motion and Diagnostics in Optical Lattices."
2. Gavin Brennen (Dec. 2001), "Entangling Dipole-Dipole Interactions with Neutral Atoms in Optical Lattices."
3. Shohini Ghose (Dec. 2003), "Quantum and Classical Dynamics of Atoms in a Magnetoptical Lattice."
4. Tracey Tessier (Dec. 2004), "Complementarity and Entanglement in Quantum Information Theory."
5. René Stock (May 2005), "Trap-induced Resonances in Controlled Atomic Collisions for Quantum information."
6. Andrew Silberfarb (May 2006), "Atoms, Photons, and Information."

7. Seth Merkel (Aug. 2009), "Quantum Control of *d*-Dimensional Quantum Systems with Application to Alkali Atomic Spin."
8. Iris Reichenbach (Aug. 2009), "Optical Control and Quantum Information Processing with Ultracold Alkaline-Earth-Like Atoms."
9. Douglas Bradshaw (May 2010), "Dispersion, Controlled Dispersion, and Three Applications."
10. Brian Mischuck (Aug. 2010), "Control of neutral atoms in optical lattices."
11. Collin Trail (May 2011), "Coherent Control of Collective Atomic Spins."
12. Carlos Riofrío (Dec. 2011), "Continuous Measurement Quantum State Tomography of Atomic Ensembles."
13. Vaibhav Madhok (July 2012), "Quantum Correlations, Chaos and Information."
14. Robert Cook (Nov. 2012), "Continuous Measurement and Approximation Methods in Quantum Optical Systems."
15. Ben Baragiola (July 2014), "Open systems dynamics for propagating quantum fields.
16. Leigh Norris (July 2014), "Internal Spin Control, Squeezing and Decoherence in Ensembles of Alkali Atomic Spins"
17. Tyler Keating (March 2016), "Quantum Information in Rydberg-Dressed Atoms."
18. Charles Baldwin (August 2016), "Efficient and robust methods for quantum tomography."
19. Xiaodong Qi (May 2018), "Dispersive Quantum Interface with Atoms and Nanophotonic Waveguides."
20. Ezad Shojaee (May 2019), "Continuous measurement and control for quantum state tomography, state preparation, and metrology."

M.S. Theses Supervised (Graduated)

1. Iris Reichenbach (December 2004), "Generalized Scattering Length for Negative Energies."
2. Paul Blackburn (May 2012) "Design and Construction of a Bose Einstein Condensate Machine."

B.S. Honors Theses Supervised (Graduated)

1. Richard Hipsh, (May 1997) "Nonlinear beam-propagation and optical solitons."
2. Jason Knight, (December 1997) "Soliton modes of a nonlinear Fabry-Pérot resonator."
3. David Hayes (May 2005) "Quantum Logic with Spin 1/2 Neutral Atoms in Double Gaussian Wells."
4. Ezequiel Carrasco (May 2013) "Robustness of boson sampling in linear optical interferometer."

Member of Dissertation Committee

1. Briggs Atherton, "Control and Exploitation of a Mode-Locked Laser's Phase: Towards a Better Atomic Clock", Ph.D. Optical Sciences, May 1997.
2. Mark Gulley, "Non-Resonant Two-Photon Detachment of H Ions with 1.165 eV Photons", Ph.D. Physics, May 1997.
3. Howard Barnum, "Quantum Information Theory", Ph. D. Physics, Ph.D. in Physics, May 1998.
4. Matthew Smith, "A Master Oscillator Power Amplifier Laser System Operating at 780 nm and a Magneto-Optic Trap", M. S. Physics, Ph.D. in Physics Aug. 1998.
5. Michael Nielson, "Quantum Information Theory", Ph.D. Physics, July 1998.
6. Wei Guo, "Multile Scattering from Optically Trapped Atoms", Ph.D. Optical Sciences, Dec. 2000.
7. Raymond Nelson, "Development of Thin Film PdMn High Resolution Thermometry Measurement of the ^{4}He Superfluid Boundary Layer and Other Applications", Ph.D. in Physics Aug. 2001.
8. R. Jason Jones, "High Resolution Optical Frequency Metrology with Stabilized Femosecond Laers", Ph.D. Optical Sciences, Dec. 2001.
9. Mark Tracy, "The Classical Limit of the Quantum Baker's Map", Ph. D. in Physics, Dec. 2002.
10. Pranaw Rungta, "heoretical Investigations of Separability and Entanglement of Bipartite Quantum Systems", Ph. D. in Physics, Dec. 2002.
11. Mark Endlow, "Applications of Ab-Initio Quantum Chemistry: Investigations of Gas Phase Stable Polyanions and Relating Calculated Physical Properties to Biological Activties", Ph. D. in Chemistry, Dec. 2002.
12. Joseph Renes, "Frames, Designs, and Spherical Codes in Quantum Information Theory", Ph. D. in Physics, May 2004.

13. Ladan Arrisan, "Frequency stablization of mode-locked lasers with dark line resonances", Ph. D. in Optical Sciences and Engineering, Ph. D in Physics, May 2006.
14. Steven Flammia, "*Informationally Complete Quantum Measurements and Entanglement Bounds*", May 2007.
15. Brian Eastin, "Error Channels and the Threshold for Fault-tolerant Quantum Computation", PhD. in Physics, August 2007.
16. Animesh Datta, "Studies on the Role of Entanglement in Mixed-state Quantum Computation", PhD in Physics, August 2008.
17. Clark Highstrete, "Microwave Spectroscopy of Nanowires and Nanotubes", PhD. in Physics, August 2008.
18. Sergio Boixo, Nonlinear Quantum Metrology", PhD. in Physics, August 2008.
19. Matthew Elliot,"Stabilizer States and Local Realism", PhD in Physics, August 2008.
20. Bradley Chase, "Parameter Estimation, Model Reduction and Quantum Filtering", PhD in Physics, August 2009.
21. Jae Hoon Lee, "Sub-Wavelength Resonance Imaging And Addressing Of Cesium Atoms Trapped In An Optical Lattice", PhD in Optical Science (University of Arizona), May 2012.
22. Paul Blackburn, "Design and Construction of a Bose Einstein Condensate Machine ", MS in Physics, May 2012.
23. Aaron Denney, "Fourier Analysis of Quantum Algorithms in Discrete and Continuous Spaces", PhD in Physics, May 2012.
24. Alexandre Tacla, "Nonlinear Interferometry with Bose-Einstein Condensates", PhD in Physics, May 2012.
25. Jonas Anderson, "Fault-tolerance in two-dimensional topological systems", PhD in Physics, August 2012.
26. Chris Cesare, "Topological Code Architectures for Quantum Computation," PhD in Physics, May 2014.
27. Aaron Hankin, "Rydberg Excitation of Single Atoms for Applications in Quantum Information and Metrology ", PhD in Physics, August 2014.
28. Jacob Miller, PhD in Physics, August 2017
29. Jonathan Gross, PhD in Physics, August 2018
30. Adrian Chapman, PhD in Physics, August 2018
31. Matthew Curry, PhD in Physics, May 2019
32. Anirban Chowdhury, PhD in Physics, May 2019

Classroom Teaching

Spring 1995	Atoms and Photons (Co-Instructor with Dr. W. D. Phillips) University of Maryland, Physics 718
Fall 1995	Physics 500, Advanced Seminar "Laser cooling of neutral atoms"
Spring 1996	Physics 405, Electricity and Magnetism I
Fall 1996	Physics 406, Electricity and Magnetism II
Spring 1997	Physics 405, Electricity and Magnetism I
Fall 1997	Physics 406, Electricity and Magnetism II Physics 500, Advanced Seminar "Laser cooling and Atom Optics", (Co-Instructor with Prof. S. Prasad)
Spring 1998	Physics 511, Graduate Electrodynamics (Developed new curriculum)
Fall 1998	Physics 521, Graduate Quantum Mechanics I (Developed new curriculum)
Spring 1999	Physics 511, Graduate Electrodynamics
Fall 1999	Physics 566, Quantum Optics Physics 500, Advanced Seminar, "Introduction to Quantum Information and Computation", (Co-Instructor with Prof. C. M. Caves)
Spring 2000	Physics 511, Graduate Electrodynamics
Fall 2000	Physics 521, Graduate Quantum Mechanics Phys 500, Advanced Seminar "Interpretations of Quantum Mechanics"
Spring 2001	Physics 522, Graduate Quantum Mechanics

Spring 2002	Physics 566, Quantum Optics
Fall 2002	Physics 521, Graduate Quantum Mechanics I
Spring 2003	Physics 522, Graduate Quantum Mechanics II
Fall 2003	Physics 491, Upper Division Quantum Mechanics I
	Physics 500, Graduate Seminar – Laser Cooling and Trapping of Atoms
Spring 2004	Physics 492, Upper Division Quantum Mechanics II
Fall 2004	Physics 566, Quantum Optics
Spring 2005	Physics 531, Atomic and Molecular Structure.
Fall 2005	Special Course at Sandia National Laboratories,
	"Introduction to Quantum Information"
Spring 2006	Physics 511, Graduate Electrodynamics
Fall 2006	Physics 566, Quantum Optics
	Physics 500, Advanced Seminar
	"Laser cooling and trapping of atoms and ions"
Spring 2007	Physics 405, Electricity and Magnetism I
Fall 2007	Physics 406, Electricity and Magnetism II
Spring 2008	Physics 522, Graduate Quantum Mechanics II
Fall 2008	Physics 566, Quantum Optics
Spring 2009	Physics 405, Electricity and Magnetism I
Fall 2010	Physics 566, Quantum Optics
Spring 2011	Physics 522, Graduate Quantum Mechanics II
Fall 2011	Physics 531, Modern Atomic Physics
Spring 2012	Physics 511, Graduate Electricity and Magnetism
Fall 2012	Physics 406, Electricity and Magnetism II
Fall 2013	Physics 566, Quantum Optics I
Spring 2014	Physics 566, Quantum Optics II
Fall 2014	Physics 521, Graduate Quantum Mechanics I
Spring 2015	Physics 522, Graduate Quantum Mechanics II
Fall 2015	Physics 566, Quantum Optics I
Spring 2016	Physics 522, Quantum Mechanics II
Fall 2016	Physics 566, Quantum Optics I
Fall 2017	Physics 566, Quantum Optics I
Spring 2018	Physics 522, Quantum Optics II
Fall 2018	Physics 491, Upper Division Quantum Mechanics I
Spring 2019	Physics 492, Upper Division Quantum Mechanics II
Fall 2019	Physics 566, Quantum Optics I
Spring 2020	Physics 581, Quantum Optics II

Service

Service to the Department of Physics and Astronomy

- Colloquium Committee, Fall 2018-Present.
- New Faculty Member Search Committee Chair, Quantum Information Theorist, 2017-2018.
- Graduate Committee, Fall 2017-Present.
- Dept. of Physics and Astronomy Long-Range-Planning Committee, Chair, 2016.
- Associate Chair for Graduate Affairs, Fall 2010-Spring 2016.
- New Faculty Member Search Committee, CHTM Experimentalist, 2013-2014.
- New Faculty Member Search Committee, Optics Experimentalist, 2012-2013.
- New Faculty Member Search Committee, Quantum Information Theorist, 2011-2012.
- Long-Range Planning and Academic Program Review, Spring 2009.
- Graduate Exam Committee, Chair, 2004-2009.

- Graduate Admissions and Curriculum Committee Chair, Spring 2001, Fall 2002-Spring 2004.
- Conducted review and formulated reform of graduate comprehensive exam procedure.
- Center for Advanced Studies Steering Committee, Spring 2002-2004.
- Ad hoc committee for revising Physics 466/467, Spring 1999.
- Ad hoc graduate recruitment committee, Summer 1997.
- Undergraduate Committee, Spring 1997 – Spring 2000.
- Optical Sciences Committee, Spring 1996 – Spring 1997.
- Colloquium Committee, Spring 1996.

University Service

- Director, Center for Quantum Information and Control (CQuIC), July 2018-present.
- College of Arts & Sciences Regents' Professor Selection Committee, 2018.
- UNM Research Strategic Planning Committee, 2016.
- UNM Council on Strategic Research Initiatives (CSRI), 2013.
- Center for Advanced Studies Director, 2005 - 2009.
- University of New Mexico Faculty Senate, 2003 –2004.

Service to the Discipline

- Reviewer: Refereed journals, NSF proposals and panels, Institute reviews.
- American Physical Society, Division of Atomic Molecular Optical Physics (DAMOP) Program Committee, Chair Subcommittee on Quantum Information Science, 2016-2019.
- National Academy of Sciences, National Research Council Reviewer, 2016-2018.
- National Academy of Sciences, Intelligence Science & Technology Experts Group (ISTEG) 2015-Present
- National Academy of Sciences: Committee on Atomic, Molecular, and Optical Sciences, 2013-2016.
- Coordinator of "SQuInT" – Southwest Quantum Information and Technology, 1999-2015.
- Judge for student presentations at the APS 4 Corners Meeting, Orem Utah, October 2014.
- Program Co-Organizer, "Quantum Control of Complex Systems," Kavli Institute for Theoretical Physics, Santa Barbara, (2013).
- Co-PI of National Review of Theoretical Atomic Molecular and Optical Physics (2011), including data gathering, NSF workshop organization, and final report authorship, "Theoretical Atomic-Molecular-Optical Physics: "Recent Developments and a Vision for the Future".
- Program committee, American Physical Society, Division of Atomic Molecular Optical Physics (DAMOP) 2010-2013.
- Secretary Treasurer, American Physical Society, Topical Group on Quantum Information, 2009-2011.
- Panel Member for NSF, NASA, DOE grants.

Outreach

- DAMOP Experience for Undergraduates, Los Alamos National Laboratory, (1998).
- Meet the Scientists" Forum, APS April Meeting Albuquerque New Mexico, (2002).
- "Byron's Bytes", KOAT Television tech. analyst (2005).