

Personal

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Date of Birth: October 18, 1971
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Education

Graduate: 1998 Ph.D. in Physics, California Institute of Technology
 Thesis advisor Prof. H. Jeff Kimble
Undergrad: 1992 A.B. in Physics, Magna cum laude, Princeton University

Academic appointments

2003 – Associate Professor of Physics and Control & Dynamical Systems, Caltech
 2001 – 2002 Associate Professor of Physics, without tenure, California Institute of Technology
 1998 – 2001 Assistant Professor, California Institute of Technology
 1998 – 1999 Visiting Fellow in Chemistry, Princeton University

Selected awards

2005 Institute for Systems Research Distinguished Lectureship, Univ. of Maryland
 2002 Mohammed Dahleh Distinguished Lectureship, UCSB
 2000 – 2005 John D. and Catherine T. MacArthur Foundation Fellowship
 2000 Discover Magazine's Twenty Scientists to Watch in the Next Twenty Years
 2000 Classroom Teaching Award (Graduate Student Council, Caltech)
 2000 – 2003 Office of Naval Research Young Investigator Award
 1999 – 2001 A. P. Sloan Fellowship
 1999 Technology Review Magazine's top 100 young innovators
 1996 John Stager Stemple Memorial Prize in Physics (Department of Physics, Caltech)
 1996 Distinguished Graduate Student Lectureship (Graduate Student Council, Caltech)

Selected invited talks

2005 Gordon Research Conference on Quantum Information Science, Ventura
 2005 AAAS Annual Meeting, Washington D.C.
 2004 APS/DAMOP Annual Meeting, Tucson
 2003 Keynote Speaker at the SPIE Conference on Fluctuations and Noise, Santa Fe
 2002 TTI/Vanguard NextGens Technologies Conference, San Diego
 2002 2nd John Seely Brown Symposium on Technology and Society, Ann Arbor
 2002 6th Int'l Conference on Quantum Communication, Measurement and Computing, Cambridge
 2002 Gordon Conference on Research and Education in Physics: Quantum Mechanics, Mt. Holyoke
 2001 Coherent Scientific and Coherent Laser Group Plenary Lecture at ACOLS, Brisbane
 2001 13th Annual NAS Symposium on the Frontiers of Science, Irvine
 2001 Plenary talk at the 5th SIAM Conference on Control & its Applications, San Diego

Educational/outreach/synergistic activities

Panelist, "The Future of the Universe Science Fiction Film Festival" (1/01, Caltech); Invited participant, "Colloquium on Museums and the Community of Children" (6/01, Children's Museum of Los Angeles); Speaker, Watson Public Lecture Series (11/01, Caltech); Organizing Committee for 8th Annual NAE Symposium on Frontiers of Engineering; Panelist, Los Angeles Philharmonic's *Upbeat Live!* Series (4/02); The Retreat at Fort Baker Advisory Panel (ongoing); Teaching: Ph12, Ph98/125, Ph195, Ph196, Ph225, CDS110, CDS140, CDS270/273; Speaker and co-organizer of the Caltech "Computing Beyond Silicon Summer School" (2002 and 2004); Co-organizer of AFOSR/Caltech Workshop on "Principles and Applications of Control in Quantum Systems" (2004) and "Quantum Control Summer School" (2005); Inaugural Chair of the APS Topical Group on Quantum Information, Concepts and Computation

Articles in preparation

1. "Optimal error tracking via quantum coding and continuous syndrome measurement," R. van Handel and H. Mabuchi, submitted to Phys. Rev. Lett. (2005).
2. "Performance bounds on single particle tracking by fluorescence modulation," A. J. Berglund and H. Mabuchi, submitted to Appl. Phys. B (2005).
3. "Tensor polarizability and dispersive quantum measurement of multilevel atoms," JM Geremia, J. K. Stockton and H. Mabuchi, to appear in Phys. Rev. A (2005).

Publications in refereed journals

4. "Tracking-FCS: Fluorescence correlation spectroscopy of individual particles," A. J. Berglund and H. Mabuchi, Optics Express **13**, 8069-8082 (2005).
5. "Principles and applications of control in quantum systems," H. Mabuchi and N. Khaneja, International Journal of Robust and Nonlinear Control **15**, 647-667 (2005).
6. "Modeling and feedback control design for quantum state preparation," R. van Handel, J. K. Stockton, and H. Mabuchi, J. Opt. B: Quantum Semiclass. Opt. **7**, S179-S197 (2005).
7. "Quantum projection filter for a highly nonlinear model in cavity QED," R. van Handel and H. Mabuchi, J. Opt. B: Quantum Semiclass. Opt. **7**, S226-S236 (2005).
8. "Feedback control of quantum state reduction," R. van Handel, J. K. Stockton, and H. Mabuchi, IEEE T. Automat. Contr. **50**, 768 (2005).
9. "Suppression of spin-projection noise in broadband atomic magnetometry," JM Geremia, J. K. Stockton, and H. Mabuchi, Phys. Rev. Lett. **94**, 203002 (2005).
10. "Quantum information processing in cavity-QED," S. J. van Enk, H. J. Kimble, and H. Mabuchi, Quantum Information Processing **3**, 75 (2004).
11. "Proposed magneto-electrostatic ring trap for neutral atoms," A. Hopkins, B. Lev, and H. Mabuchi, Phys. Rev. A **70**, 053616 (2004).
12. "Deterministic Dicke state preparation with continuous measurement and control," J. K. Stockton, R. van Handel, and H. Mabuchi, Phys. Rev. A **70**, 022106 (2004).
13. "Feasibility of detecting single atoms using photonic bandgap cavities," B. Lev, K. Srinivasan, P. Barclay, O. Painter, and H. Mabuchi, IEEE T. Nanotechnol. **15**, S556 (2004).
14. "Quantum feedback control of atomic motion in an optical cavity," D. A. Steck, K. Jacobs, H. Mabuchi, T. Bhattacharya, and S. Habib, Phys. Rev. Lett. **92**, 223004 (2004).
15. "Bayesian estimation for species identification in single-molecule fluorescence microscopy," K. McHale, A. J. Berglund, and H. Mabuchi, Biophys. J. **86**, 3409 (2004).
16. "Real-time quantum feedback control of atomic spin-squeezing," JM Geremia, J. K. Stockton, and H. Mabuchi, Science **304**, 270 (2004).
17. "Feedback controller design for tracking a single fluorescent molecule," A. J. Berglund and H. Mabuchi, Appl. Phys. B **78**, 653 (2004).
18. "Robust Quantum Parameter Estimation: Coherent Magnetometry with Feedback," J. K. Stockton, JM Geremia, A. C. Doherty, and H. Mabuchi, Phys. Rev. A **69**, 032109 (2004).
19. "Quantum Kalman filtering and the Heisenberg limit in atomic magnetometry," JM Geremia, J. K. Stockton, A. C. Doherty, and H. Mabuchi, Phys. Rev. Lett. **91**, 250801 (2003).
20. "An atom mirror etched from a hard drive," B. Lev, Y. Lassailly, C. S. Lee, A. Scherer, and H. Mabuchi, Appl. Phys. Lett. **83**, 395-397 (2003).

Publications in refereed journals (continued)

21. "Quantum jumps between dressed states: a proposed cavity-QED test using feedback," J. E. Reiner, H. M. Wiseman, and H. Mabuchi, *Phys. Rev. A* **67**, 042106 (2003).
22. "Characterizing the entanglement of symmetric many-particle spin-1/2 systems," J. K. Stockton, J. M. Geremia, A. C. Doherty, and H. Mabuchi, *Phys. Rev. A* **67**, 022112 (2003).
23. "An inverse-problem approach to designing photonic crystals for cavity QED," JM Geremia, J. Williams, and H. Mabuchi, *Phys. Rev. E* **66**, 066606 (2002).
24. "Programmable logic devices in experimental quantum optics," J. Stockton, M. Armen, and H. Mabuchi, *J. Opt. Soc. Am. B* **19**, 3019 (2002).
25. "Cavity quantum electrodynamics: coherence in context," (invited review) H. Mabuchi and A. C. Doherty, *Science* **298**, 1372 (2002).
26. "Exact analysis of concatenated quantum codes," B. Rahn, A. C. Doherty, and H. Mabuchi, *Phys. Rev. A* **66**, 032304 (2002).
27. "Adaptive homodyne measurement of optical phase," M. A. Armen, J. K Au, J. K. Stockton, A. C. Doherty, and H. Mabuchi, *Phys. Rev. Lett.* **89**, 133602 (2002).
28. "Photon statistics and dynamics of Fluorescence Resonance Energy Transfer," A. J. Berglund, A. C. Doherty, and H. Mabuchi, *Phys. Rev. Lett.* **89**, 068101 (2002).
29. "Optimization of Q-factors in microcavities based on free-standing membranes," J. Vuckovic, M. Loncar, H. Mabuchi, and A. Scherer, *IEEE J. Quantum Electron.* **38**, 850 (2002).
30. "The quantum-classical transition in nonlinear dynamical systems," S. Habib, K. Jacobs, H. Mabuchi, R. Ryne, K. Shizume, and B. Sundaram, *Phys. Rev. Lett.* **88**, 040402 (2002).
31. "Design of photonic crystal microcavities for cavity QED," J. Vuckovic, M. Loncar, H. Mabuchi, and A. Scherer, *Phys. Rev. E* **65**, 016608 (2002).
32. "Quantum trajectories for realistic detection," P. Warszawski, H. M. Wiseman, and H. Mabuchi, *Phys. Rev. A* **65**, 023802 (2002).
33. "Quantum networks based on Cavity QED," H. Mabuchi, M. Armen, B. Lev, M. Loncar, J. Vuckovic, H. J. Kimble, J. Preskill, M. L. Roukes, and A. Scherer, *Quantum Information and Computation* **1**, Special Issue 7-12 (2001).
34. "Robust control in the quantum domain," A. C. Doherty, J. C. Doyle, H. Mabuchi, K. Jacobs, and S. Habib, in *Proceedings of the 39th IEEE Conference on Decision and Control* (2000).
35. "Sensitivity optimization in quantum parameter estimation," F. Verstraete, A. C. Doherty, and H. Mabuchi, *Phys. Rev. A* **64**, 032111 (2001).
36. "Ro-vibrational spectroscopy of the $v=6$ manifold in $^{12}\text{C}_2\text{H}_2$ and $^{13}\text{C}_2\text{H}_2$," H. K. Srivastava, A. Conjusteau, H. Mabuchi, A. Callegari, K. K. Lehmann, G. Scoles, M. Silva, and R. W. Field, *J. Chem. Phys.* **113**, 7376-7383 (2000).
37. "A sub-doppler resolution double resonance molecular beam infrared spectrometer operating at chemically relevant energies (~ 2 eV)," H. K. Srivastava, A. Conjusteau, H. Mabuchi, A. Callegari, K. K. Lehmann, and G. Scoles, *Rev. Sci. Instrum.* **71**, 4032-4038 (2000).
38. "Quantum feedback control and classical control theory," A. C. Doherty, S. Habib, K. Jacobs, H. Mabuchi, and S. M. Tan, *Phys. Rev. A* **62**, 012105 (2000).
39. "Physical Implementations for Quantum Communication in Quantum Networks," H. J. Briegel, J.-I. Cirac, W. Dur, S. J. van Enk, H. J. Kimble, H. Mabuchi, and P. Zoller, *Lect. Notes Comput. Sc.* **1509**, 373-382 (1999).
40. "Entanglement of Assistance," D. P. DiVincenzo, C. A. Fuchs, H. Mabuchi, J. A. Smolin, A. Thapliyal, and A. Ullman, *Lect. Notes Comput. Sc.* **1509**, 247-257 (1999).

Publications in refereed journals (continued)

41. "Full observation of single-atom dynamics in cavity QED," H. Mabuchi, J. Ye, and H. J. Kimble, *Appl. Phys. B* **68**, 1095-1108 (1999).
42. "Quantum manipulation and measurement of single atoms in optical cavity QED," J. Ye, C. J. Hood, T. Lynn, H. Mabuchi, D. W. Vernooy, and H. J. Kimble, *IEEE T. Instrum. Meas.* **48**, 608-612 (1999).
43. "Transmission of quantum information in a quantum network: A quantum optical implementation," S. J. van Enk, J. I. Cirac, P. Zoller, H. J. Kimble, and H. Mabuchi, *Fortschr. Phys.* **46**, 689-695 (1998).
44. "Retroactive quantum jumps in a strongly-coupled atom-field system," H. Mabuchi and H. M. Wiseman, *Phys. Rev. Lett.* **81**, 4620-4623 (1998).
45. "Atomic localization in optical cavity QED," Q. A. Turchette, M. S. Chapman, C. J. Hood, T. Lynn, H. Mabuchi, and H. J. Kimble, *Laser Phys.* **8**, 713-717 (1998).
46. "Standard Quantum Limits for broadband measurement," H. Mabuchi, *Phys. Rev. A* **58**, 123-127 (1998).
47. "High-Q measurements for fused silica microspheres in the NIR," D. W. Vernooy, V. I. Ilchenko, H. Mabuchi, E. W. Streed, and H. J. Kimble, *Opt. Lett.* **23**, 247-249 (1998).
48. "Quantum communication in a quantum network," J. I. Cirac, S. J. van Enk, P. Zoller, H. J. Kimble, and H. Mabuchi, *Phys. Scripta* **T76**, 223-232 (1998).
49. "Quantum state transfer in a quantum network – a quantum-optical implementation," S. J. van Enk, J. I. Cirac, P. Zoller, H. J. Kimble, and H. Mabuchi, *J. Mod. Opt.* **44**, 1727-1736 (1997).
50. "Quantum state transfer and entanglement distribution among distant nodes in a quantum network," J. I. Cirac, P. Zoller, H. J. Kimble, and H. Mabuchi, *Phys. Rev. Lett.* **78**, 3221-3224 (1997).
51. "Real-time detection of individual atoms falling through a high-finesse optical cavity," H. Mabuchi, Q. A. Turchette, M. S. Chapman, and H. J. Kimble, *Opt. Lett.* **21**, 1393-1395 (1996).
52. "Inversion of quantum jumps in quantum-optical systems under continuous observation," H. Mabuchi and P. Zoller, *Phys. Rev. Lett.* **76**, 3108-3111 (1996).
53. "Dynamical identification of open quantum systems," H. Mabuchi, *Quantum Semiclass. Opt.* **8**, 1103-1108 (1996).
54. "Measurement of conditional phase shifts for quantum logic," Q. A. Turchette, C. J. Hood, W. Lange, H. Mabuchi, and H. J. Kimble, *Phys. Rev. Lett.* **75**, 4710-4713 (1995).
55. "Quantum measurement in quantum optics," H. J. Kimble, O. Carnal, Z. Hu, H. Mabuchi, E. S. Polzik, R. J. Thompson, and Q. A. Turchette, *Ann. NY Acad. Sci.* **755**, 87-90 (1995).
56. "Blue-light-induced infrared-absorption in KNBO₃," H. Mabuchi, E. S. Polzik, and H. J. Kimble, *JOSA B* **11**, 2023-2029 (1994).
57. "Atom galleries for whispering atoms: binding atoms in stable orbits around an optical resonator," H. Mabuchi and H. J. Kimble, *Opt. Lett.* **19**, 749-751 (1994).
58. "Quantum nondemolition detection of single photons in an open resonator by atomic beam deflection," A. B. Matsko, S. P. Vyatchanin, H. Mabuchi, and H. J. Kimble, *Phys. Lett. A* **192**, 175-179 (1994).
59. "Spin transfer between laser-polarized ¹²⁹Xe nuclei and surface protons," B. Driehuys, G. D. Cates, W. Happer, H. Mabuchi, B. Saam, M. S. Albert, and A. Wishnia, *Phys. Lett. A* **184**, 88-92 (1993).

Publications in refereed journals (continued)

60. "Polarization-dependent frequency shifts from Rb-³He collisions," N. R. Newbury, A. S. Barton, P. Bogorad, G. D. Cates, M. Gatzke, H. Mabuchi, and B. Saam, *Phys. Rev. A* **48**, 558-568 (1993).
61. "Highly polarized muonic He produced by collisions with laser optically pumped Rb," A. S. Barton, P. Bogorad, G. D. Cates, H. Mabuchi, H. Middleton, N. R. Newbury, R. Holmes, J. McCracken, P. A. Souder, J. Xu, and D. Tupa, *Phys. Rev. Lett.* **70**, 758-761 (1993).
62. "Test of octupole coupled 5⁻ state in ¹⁴⁶Nd using proton inelastic-scattering," P. D. Cottle, M. A. Kennedy, K. W. Kemper, J. D. Brown, E. R. Jacobsen, Y. Y. Sharon, E. M. Leitch, H. Mabuchi, Z. Q. Mao, T. Slivka, and E. J. Greene, *Phys. Rev. C* **44**, 1668-1671 (1991).

Book chapters

1. "Atoms in microcavities: quantum electrodynamics, quantum statistical mechanics, and quantum information science," A. C. Doherty and H. Mabuchi, in *Optical Microcavities* (World Scientific Press, Singapore, 2004).
2. "Quantum feedback and the quantum-classical transition," H. Mabuchi, in J. D. Barrow, P. C. W. Davies and C. L. Harper, Jr. eds., *Science and Ultimate Reality: Quantum Theory, Cosmology and Complexity* (Cambridge University Press, Cambridge, 2004).

Patents

1. "Photonic crystal microcavities for strong coupling between an atom and the cavity field and method of fabricating the same," A. Scherer, J. Vuckovic, M. Loncar, and H. Mabuchi (US Patent #6,466,709 B1, issued 15 October 2002).