

Thaddeus D. Ladd

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Objective

- Academic research position combining teaching and world-class research; or
- Commercial-sector senior research position in game-changing nanoscience

Education

- Stanford University, Palo Alto, CA
 - 2005 Ph.D. in Applied Physics
 - 2000 M.S. in Applied Physics
- Harvey Mudd College, Claremont, CA
 - 1998 B.S. in Physics with high distinction
- Lincoln Park High School, Chicago, IL
 - 1994 International Baccalaureate Diploma

Status

- Natural-born U.S. Citizen
- Current SSBI

Research Experience

- **Dec 2009 – Present: HRL Laboratories, LLC, Malibu, CA**
 - Senior Research Staff Physicist in the Computational Physics Department of the Materials and Microsystems Laboratory.
 - PI on government-funded effort to develop control methodology and error modeling for silicon-based qubits
 - PI on internally funded research program on semiconductor-based quantum communication
 - Coordinated build of new quantum optics laboratory equipped for high-magnetic-field (10T), low-T (2K), microphotoluminescence and ultrafast optical control of single semiconductor nanostructures
 - PI on internally funded research program on GaN nanostructures for microelectronics, optics, and quantum information applications
 - Coordinating growth, fabrication, characterization, and modeling of GaN nanostructures for nonlinear integrated quantum optics
 - Performer on multiple programs investigating operation of various types of semiconductor qubit technologies, including collaborative efforts with international academic partners
 - Development of high-performance software for data modeling, error prediction, and high-speed electrical and optical control of semiconductor devices with potential applications as qubits, single-photon quantum memory interfaces, or quantum-limited sensing devices.

- Technical management of multiple staff members, including substantial interfacing with government customers. Critically includes team-building, both internally and via technical recruiting.
- Maintenance of strategy for public posture via coordination of conferences and publications.
- **July 2005 - Nov. 2009: Research performed at Stanford University, Palo Alto, CA**
 - 2006-2009: Employed by National Institute of Informatics, Tokyo, Japan,
 - 2005-2006: Employed by The University of Tokyo, Japan
 - Post-doctoral research as subgroup leader Yoshihisa Yamamoto.
 - Coordinated build of high-performance cryogenic quantum optics laboratory (acquired and qualified equipment including multiple laser systems ranging from IR to UV, CW and pulsed; magnetic cryostats; in-situ microscopy; optical and RF modulation electronics, optical characterization equipment, data acquisition equipment). Laboratory employed for spectroscopy and control of single quantum dots and impurities in addition to high-field imaging of iron-pnictide superconductors.
 - Advised, modeled, and occasionally performed measurements demonstrating full optical control of single spin qubits located in self-assembled quantum dots or semiconductor impurity structures
 - Managed experimental effort to measure and manipulate single semiconductor impurities in high-Q semiconductor microcavities
 - Developed theoretical approaches to hybrid and qubus quantum information processing based on semiconductor nanophotonics
- **Sept. 1998 - June 2005: Stanford University, Palo Alto, CA**
 - Doctoral thesis research. Dissertation: *Quantum Computing with Nuclear Spins in Semiconductors*. Advised by Yoshihisa Yamamoto. Theory of solid-state NMR quantum computing, with optical polarization and detection in both bulk semiconductors and semiconductor nanostructures; experimental study of nuclear coherence time in silicon and the slow noise processes limiting it as revealed by high-power NMR decoupling pulse sequences.
 - Collaborative efforts with
 - Kohei Itoh on silicon NMR and ESR
 - David Cory on solid-state NMR quantum information processing
 - Ian Fisher on growth of fluorapatite single crystals
- **June - Sept. 2002: IBM Corporation, San Jose, CA**
 - Internship at the Almaden Research Center with manager Bruce Gurney
 - Advised by Jeff Childress and Matt Carey
 - Built low-temperature cryostat for measurement of magnetoresistance and differential conductance of magnetic tunnel junction devices intended for hard-drive readhead applications.
- **Sept. 1996 - May 1998, Harvey Mudd College, Claremont, CA**
 - Undergraduate research
 - Advised by James Eckert and Patricia Sparks
 - An effort to measure the spin diffusion length of carriers in doped silicon, involving photolithographic microfabrication and magnetoresistance measurements of cobalt/silicon heterostructures, intended for spintronics applications.
- **June - Sept. 1997: The University of Illinois, Urbana-Champaign, IL**

- NSF-sponsored REU
- Advised by Michael Weissman
- Noise statistics measurements for investigating the domain dynamics of GMR field sensors.
- **June - Sept. 1996: Fermilab, Batavia, IL**
 - Internship in Drasko Jovanovic's program
 - Advised by Hogan Nguyen
 - Assembly and test of the electromagnetic calorimeter for KTeV (an experiment studying CP violation in K-mesons)
 - Code conversion (FORTRAN to C++) and hardware upgrade of a photomultiplier-tube testing facility.

Teaching Experience

- **Stanford University, Palo Alto, CA**
 - 2005 - 2007: Guest lecturer for graduate courses:
 - EE248, "Fundamentals of Noise Processes"
 - AP226, "Physics of Quantum Information"
 - 2003 - 2004: Teaching assistant to Mark Kasevich
 - Phys. 107, "Intermediate Physics Laboratory"
 - Advised undergraduate students in optics laboratory
 - Coached undergraduate students in technical writing
 - Co-authored manual on technical writing for physics majors: T. D. Ladd and D. Ugolini, "Writing Guide for Stanford Physics 107," available by request.
 - Phys. 70, "Modern Physics"
 - Gave weekly discussion sections, review sessions, and occasional lectures
 - Graded homework and exams
 - Sep. - Dec. 2002
 - Graduate mentor for Freshman Academic Resources and Mentoring (FARM)
- **The University of California, Berkeley, CA**
 - Nov. 2003: Guest lecturer for Phys. 191, "Quantum Information Science and Technology"
- **Harvey Mudd College, Claremont, CA**
 - 1997: Teaching assistant to James Eckert for Phys. 53, "Electricity and Optics Laboratory"
 - 1996-1998: Grader and tutor for assorted courses in physics and mathematics

Selected Skills

- **Theoretical Device Physics**
 - Quantum information, specializing in design and control theory of quantum computers and quantum repeaters
 - Quantum optics, specializing in control and characterization of solid-state nanostructures and impurities

- Solid-state magnetic resonance and spin dynamics, specializing in multi-pulse sequences
- Monte-Carlo and master-equation simulations using C++ and Matlab
- **Experimental Device Physics**
 - Optics at low temperatures (2K) and high magnetic fields (10T), specializing in microphotoluminescence and photoluminescence excitation in semiconductor nanostructures
 - Magnetic resonance, specializing in cryogenic solid-state NMR
 - Low temperature magnetic transport
- **Technical Communication**
 - Strong and experienced technical writer and speaker
 - Numerous conference presentations. Invitations include:
 - Second International Symposium on Dynamics in Artificial Quantum Systems, Tokyo, Japan, 2018
 - The 3rd Conference and Workshop on Spin-Based Quantum Information Processing, Sydney, Australia 2017
 - Bristol Quantum Information Technologies Workshop, Bristol, UK, 2016
 - March meeting of the American Physical Society, Denver, CO, 2014
 - Twelfth Annual Southwest Quantum Information Technology Network Workshop, Albuquerque, NM, 2012
 - Second International Conference on Quantum Error Correction, Los Angeles, CA, 2011
 - Eleventh Annual Southwest Quantum Information Technology Network Workshop, Seattle, WA, 2009
 - Workshop on Topological Cluster State Computing in Optics, Tokyo, Japan, 2008
 - First International Conference on Quantum Error Correction, Los Angeles, CA, 2007
 - NEC Workshop on Quantum Computing, Princeton, NJ, 2007 (invited)
 - Workshop on Linear Optical Quantum Information Processing, Baton Rouge, LA, 2006
 - Eighth Annual Southwest Quantum Information Technology Network Workshop, Albuquerque, NM, 2006
 - Invited seminars delivered at Stanford, Harvard, MIT, U. Illinois at Urbana-Champaign, U. Wisconsin, U. Michigan, Neils Bohr Institute, U. Tokyo, U. Hokkaido, U.C. San Diego, U.C. Berkeley, U. British Columbia, Simon Fraser University

Synergistic Activities

- 2015-2017. U.S. Representative for IUPAP section C17, "Laser Physics and Photonics."
- 2013-2015. Liaison for UCLA RIPs and Harvey Mudd Clinic programs
- Organizer for "Semiconductor Qubits" Focus Session, APS March Meeting, 2011–2015
- Co-organized DoD-sponsored "Workshop on Quantum Repeaters and Networks (WQRN)," May 15-17, 2015, Asilomar, CA and the second WQRN in Seefeld, Austria.
- Co-organized DoD-sponsored "International Workshop on Dynamical Decoupling," Oct. 5--6, 2009, Boulder, CO

- Organized NSF-sponsored workshop "CQED-based Quantum Computation using Topological Fault Tolerance," Feb. 5--6, 2009, Palo Alto, CA
- Regular reviewer for *Physical Review Letters*, *Physical Review A,B*, *Nature Physics*, *Nature Photonics*, and *Nature Communications*
- Proposal reviewer for NSF
- Author of multiple grant/contract proposals/RFI responses for NSF, ARO, IARPA, and DARPA

Publications

- "Optically Loaded Semiconductor Quantum Memory Register," D. Kim, A. A. Kiselev, R. S. Ross, M. T. Rakher, C. Jones, and T. D. Ladd. *Physical Review Applied* **5**, 024014 (2016)
- "Reduced Sensitivity to Charge Noise in Semiconductor Spin Qubits via Symmetric Operation," M. D. Reed, B. M. Maune, R. W. Andrews, M. G. Borselli, K. Eng, M. P. Jura, A. A. Kiselev, T. D. Ladd, S. T. Merkel, I. Milosavljevic, E. P. Pritchett, M. T. Rakher, R. S. Ross, A. E. Schmitz, A. Smith, J. A. Wright, M. F. Gyure, and A. T. Hunter. *Physical Review Letters* **116**, 110402 (2016)
- "Design and analysis of communication protocols for quantum repeater networks," C. Jones, D. Kim, M. T. Rakher, P. G. Kwiat, and T. D. Ladd. *New Journal of Physics* **18**, 083015 (2016)
- "Isotopically enhanced triple-quantum-dot qubit," K. Eng, T. D. Ladd, A. Smith, M. G. Borselli, A. A. Kiselev, B. H. Fong, K. S. Holabird, T. M. Hazard, B. Huang, P. W. Deelman, I. Milosavljevic, A. E. Schmitz, R. S. Ross, M. F. Gyure, and A. T. Hunter. *Science Advances* **1**, e1500214 (2015)
- "Listening with quantum dots," T. D. Ladd, *Nature Physics* **8**, 511 (2012)
- "Quantum Dots Tuned for Entanglement," T. D. Ladd, *Physics* **5**, 111 (2012)
- "Hyperfine-induced decay in triple quantum dots," T. D. Ladd, *Physical Review B* **86**, 125408 (2012)
- "Layered Architecture for Quantum Computing," N. C. Jones, R. Van Meter, A. G. Fowler, P. L. McMahon, J. Kim, T. D. Ladd, and Y. Yamamoto, *Physical Review X* **2**, 031007 (2012)
- "Path selection for quantum repeater networks," R. Van Meter, T. Satoh, T. D. Ladd, W. J. Munro, and K. Nemoto, *Networking Science* **3**, 82 (2013)
- "Dynamical decoupling of a qubit with always-on control fields," N. C. Jones, T. D. Ladd, and B. H. Fong, *New Journal of Physics* **14**, 093045 (2012)
- "Entangling Single Photons from Independently Tuned Semiconductor Nanoemitters," K. Sanaka, A. Pawlis, T. D. Ladd, D. J. Sleiter, K. Lischka, and Y. Yamamoto, *Nanoletters* **12**, 4611 (2012)
- "Coherent singlet-triplet oscillations in a silicon-based double quantum dot," B. M. Maune, M. G. Borselli, B. Huang, T. D. Ladd, P. W. Deelman, K. S. Holabird, A. A. Kiselev, I. Alvarado-Rodriguez, R. S. Ross, A. E. Schmitz, M. Sokolich, C. A. Watson, M. F. Gyure, and A. T. Hunter, *Nature* **481**, 344 (2012)
- "Ultrafast coherent control and suppressed nuclear feedback of a single quantum dot hole qubit," K. De Greve, P. L. McMahon, D. Press, T. D. Ladd, D. Bisping, C. Schneider, M. Kamp, L. Worschech, S. Höfling, A. Forchel, and Y. Yamamoto, *Nature Physics* **7**, 872 (2011)
- "Simple quantum logic gate with quantum dot cavity QED systems," T. D. Ladd and Y. Yamamoto, *Physical Review B* **84**, 235307 (2011)

- "Quantum Computers," T. D. Ladd, F. Jelezko, R. Laflamme, Y. Nakamura, C. Monroe, and J. L. O'Brien, *Nature* **464**, 45 (2010)
- "Pulsed Nuclear Pumping and Spin Diffusion in a Single Charged Quantum Dot," T. D. Ladd, D. Press, K. De Greve, P. L. McMahon, B. Friess, C. Schneider, M. Kamp, S. Höfling, A. Forchel, and Y. Yamamoto, *Physical Review Letters* **105**, 107401 (2010)
 - Also: "Nuclear feedback in a single electron-charged quantum dot under pulsed optical control," T. D. Ladd, D. Press, K. De Greve, P. L. McMahon, B. Friess, C. Schneider, M. Kamp, S. Höfling, A. Forchel, and Y. Yamamoto, *Proceedings of the SPIE* 7948, 79480U (2011)
- "Ultrafast optical spin echo in a single quantum dot," D. Press, K. De Greve, P. L. McMahon, T. D. Ladd, B. Friess, C. Schneider, M. Kamp, S. Höfling, A. Forchel, and Y. Yamamoto, *Nature Photonics* **4**, 367 (2010)
- Also: "Experimental approach to ultrafast optical spin echo of a single quantum dot electron spin," K. De Greve, D. Press, T. D. Ladd, B. Friess, P. L. McMahon, C. Schneider, M. Kamp, S. Höfling, A. Forchel, Y. Yamamoto, *Proceedings of the SPIE* **7611**, 76110K (2010)
- "Surface Code Quantum Communication," A. G. Fowler, D. S. Wang, C. D. Hill, T. D. Ladd, R. Van Meter, and L. C. L. Hollenberg, *Physical Review Letters* **104**, 180503 (2010)
- "Distributed Quantum Computer Architecture Using Semiconductor Nanophotonics," R. Van Meter, T. D. Ladd, A. G. Fowler, and Y. Yamamoto, *International Journal of Quantum Information* **8**, 295 (2010)
- "Indistinguishable photons from independent semiconductor nanostructures," K. Sanaka, A. Pawlis, T. D. Ladd, K. Lischka, and Y. Yamamoto, *Physical Review Letters* **103**, 053601 (2010)
- Also: "Quantum interference between photons emitted by independent semiconductor single-photon devices", K. Sanaka, A. Pawlis, T. D. Ladd, K. Lischka, and Y. Yamamoto, *Proceedings of the SPIE* **7225**, 72250I (2009)
- "Fluorine-doped ZnSe for applications in quantum information processing," T. D. Ladd, K. Sanaka, Y. Yamamoto, A. Pawlis, and K. Lischka, *Physica Status Solidi B* **247**, 1543 (2010)
- "Photon antibunching and magnetospectroscopy of a single fluorine donor in ZnSe," K. De Greve, S. M. Clark, D. Sleiter, K. Sanaka, T. D. Ladd, M. Panfilova, A. Pawlis, K. Lischka, and Y. Yamamoto, *Applied Physics Letters* **97**, 241913 (2010)
- "Quantum Hall charge sensor for single-donor nuclear spin detection in silicon," D. Sleiter, N. Y. Kim, K. Nozawa, T. D. Ladd, M. L. W. Thewalt and Y. Yamamoto, *New Journal of Physics* **12**, 093028 (2010)
- "Simultaneous sub-second hyperpolarization of the nuclear and electron spins of phosphorus in silicon by optical pumping of exciton transitions," A. Yang, M. Steger, T. Sekiguchi, M. L. W. Thewalt, T. D. Ladd, K. M. Itoh, H. Riemann, N. V. Abrosimov, P. Becker, and H.-J. Pohl, *Physical Review Letters* **102**, 257401 (2009)
 - Also: "Nuclear polarization of phosphorus donors in ^{28}Si by selective optical pumping," A. Yang, M. Steger, M. L. W. Thewalt, T. D. Ladd, K. M. Itoh, E. E. Haller, J. W. Ager III, H. Riemann, N. V. Abrosimov, P. Becker, and H.-J. Pohl, *AIP Conference Proceedings* **1199**, 375 (2009)
- "In-plane electronic anisotropy in underdoped $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$ revealed by partial detwinning in a magnetic field", J.-H. Chu, J. G. Analytis, D. Press, K. De Greve, T. D. Ladd, Y. Yamamoto, and I. R. Fisher, *Physical Review B* **81**, 214502 (2010)
- "Ultrafast optical spin echo for electron spins in semiconductors," S. M. Clark, K.-M. C. Fu, Q. Zhang, T. D. Ladd, C. Stanley, and Y. Yamamoto, *Physical Review Letters* **102**, 247601 (2009)

- Also: "Spin echo of electron spins in semiconductors using ultrafast, small-angle, optical pulses," S. M. Clark, K.-M. C. Fu, Q. Zhang, T. D. Ladd, C. Stanley, and Y. Yamamoto, *Proceedings of the SPIE* **7611**, 76110J (2010)
- "High-speed quantum repeaters and quantum computers with optically controlled spins in semiconductors," T. D. Ladd, K. Sanaka, K.-M. C. Fu, S. Koseki, D. Press, S. M. Clark, K. De Greve, and Y. Yamamoto, in *Semiconductor Quantum Bits*, Eds. O. Benson and F. Henneberger, p. 453 (2009)
- "Optically controlled semiconductor spin qubits for quantum information processing," Y. Yamamoto, T. D. Ladd, D. Press, S. Clark, K. Sanaka, C. Santori, D. Fattal, K.-M. Fu, S. Höfling, S. Reitzenstein, and A. Forchel, *Physica Scripta* **T37**, 014010 (2009)
- "Complete quantum control of a single quantum dot spin using ultrafast optical pulses," D. Press, T. D. Ladd, B. Zhang, and Y. Yamamoto, *Nature* **456**, 218 (2008)
 - Also: "Complete coherent control of a single electron spin in a quantum dot using ultrafast optical pulses," D. Press, T. D. Ladd, B. Zhang, and Y. Yamamoto, *Proceedings of the SPIE* **7225**, 722503 (2009)
- "Architecture-Dependent Execution Time of Shor's Algorithm," R. Van Meter, K. M. Itoh, and T. D. Ladd, in *Controllable Quantum States: Mesoscopic Superconductivity & Spintronics*, Eds. H. Takayanagi, J. Nitta, and H. Nakano, p. 183 (2008)
- "Quantum computers based on electron spins controlled by ultrafast off-resonant single optical pulses," S. M. Clark, K.-M. C. Fu, T. D. Ladd, and Y. Yamamoto, *Physical Review Letters* **99**, 40501 (2007)
- "System design for a long-line quantum repeater," R. Van Meter, T. D. Ladd, W. J. Munro, and Kae Nemoto, *IEEE/ACM Transactions on Networking* **17**, 1002 (2009)
- "Lasing of donor-bound excitons in ZnSe microdisks," A. Pawlis, M. Panfilova, D. J. As, K. Lischka, K. Sanaka, T. D. Ladd, and Y. Yamamoto, *Physical Review B* **77**, 153304 (2008)
 - Also: "Low-threshold ZnSe microdisk laser based on fluorine impurity bound-exciton transitions," A. Pawlis, M. Panfilova, K. Sanaka, T. D. Ladd, D. J. As, K. Lischka, Y. Yamamoto, *Microelectronics Journal* **40**(2),256 (2009)
- "Hybrid Quantum Computation in Quantum Optics," P. van Loock, W. J. Munro, Kae Nemoto, T. P. Spiller, T. D. Ladd, S. L. Braunstein and G. J. Milburn, *Physical Review A* **78**, 022303 (2008)
- "Hybrid quantum repeater based on dispersive CQED interactions between matter qubits and bright coherent light," T. D. Ladd, P. van Loock, K. Nemoto, W. J. Munro, and Y. Yamamoto, *New Journal of Physics* **8**, 184 (2006)
- "Hybrid quantum repeater using bright coherent light," P. van Loock, T. D. Ladd, K. Sanaka, F. Yamaguchi, Kae Nemoto, W. J. Munro, and Y. Yamamoto, *Physical Review Letters* **96**, 240501 (2006)
- "Coherence time of decoupled nuclear spins in silicon," T. D. Ladd, D. Maryenko, Y. Yamamoto, E. Abe, and K. M. Itoh, *Physical Review B* **71**, 014401 (2005)
- "Photocurrent-modulated optical nuclear polarization in bulk GaAs," A. K. Paravastu, P. J. Coles, J. A. Reimer, T. D. Ladd, and R. S. Maxwell, *Applied Physics Letters* **87**, 232109 (2005)
- "Multispin dynamics of the solid-state NMR free induction decay," H. Cho, T. D. Ladd, J. Baugh, D. G. Cory, and C. Ramanathan, *Physical Review B* **72**, 54427 (2005)
- "Optical detection of the spin state of a single nucleus in silicon," K.-M. C. Fu, T. D. Ladd, C. Santori, and Y. Yamamoto, *Physical Review B* **69**, 125306 (2004)
- "All-silicon quantum computer," T. D. Ladd, J. R. Goldman, F. Yamaguchi, Y. Yamamoto, E. Abe, and K. M. Itoh, *Physical Review Letters* **89**, 17901 (2002)

- Also: "Solid-State Silicon NMR Quantum Computer," E. Abe, and K. M. Itoh, T. D. Ladd, J. R. Goldman, F. Yamaguchi, and Y. Yamamoto, *Journal of Superconductivity: Incorporating Novel Magnetism* **16**(1), (2003)
- "Solid-state crystal lattice NMR quantum computation," T. D. Ladd, Y. Yamamoto, J. R. Goldman, and F. Yamaguchi, *Quantum Information and Computation* **1**, 56 (2001)
 - Also in *Experimental Quantum Computation and Information: Proceedings of the CXLVIII Course of the International School of Physics "Enrico Fermi,"* IOS Press, Amsterdam (2002)
 - Also: "Quantum computation in a one-dimensional crystal lattice with nuclear magnetic resonance force microscopy," J. R. Goldman, T. D. Ladd, F. Yamaguchi, and Y. Yamamoto, *Proceedings of the 15th International Conference on Laser Spectroscopy*, 333 (2002)
- "Decoherence in crystal lattice quantum computation," T. D. Ladd, J. R. Goldman, F. Yamaguchi, and Y. Yamamoto, *Appl. Phys. A* **71**, 27 (2000)
- "Magnet designs for a crystal lattice quantum computer," J. R. Goldman, T. D. Ladd, F. Yamaguchi, and Y. Yamamoto, *Appl. Phys. A* **71**, 11 (2000)
- "Nonlinear AC response and noise of a giant magnetoresistive sensor," J. R. Petta, Thaddeus Ladd, and M. B. Weissman, *IEEE Transactions on Magnetics* **36**, 2057 (2000)
- "Knots in the æther: Theories of matter in the past and present," Thaddeus Ladd, *Interface Journal* **17**, 3 (2000)
- "A model for arbitrary plane imaging, or the brain in pain falls mainly on the plane," Jeff Miller, Dylan Helliwell, and Thaddeus Ladd, *The UMAP Journal* **19**(3), 223 (1998)

Honors and Awards

- 2016 APS Outstanding Referee
- 2012 HRL "Darkstar" award
- 2012 HRL Outstanding Paper of the Year
- Fellow of the Fannie and John Hertz Foundation
- 1998 National Science Foundation Graduate Fellowship (declined)
- 1998 High distinction, honors in physics, honors in the humanities social sciences from Harvey Mudd College
- 1998 Alfred B. Focke Award for outstanding senior research in experimental physics
- 1998 Mathematical Contest in Modeling, rated Outstanding (top 2%)
- 1996 Vladimir Rojansky Prize for outstanding writing in quantum physics
- 1994 National Merit Scholarship