Erik Lucero

Contact Information

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Education

University of California at Santa Barbara
- PhD Candidate, Physics (expected 2011)
- MA Physics 2008

University of Colorado at Denver
- BS Applied Physics with Distinction Magna Cum Laude (2005)
- BS Electrical Engineering with Honors (2005)

Scholarships

- McNair Scholar (Fall 2003 – 2005)
- Ben Trujillo Scholar (2004/2005 Academic year)
- Phyllis Weisheit Schultz Scholar (2003/2004 Academic year)
- William R. Simmons Scholar (2002, 2003, 2004 Academic years)
- Morstad Scholar (2002/2003 Academics year)
- Engineering Dean's List (Fall 2003 – 2005)
- College of Liberal Arts and Sciences Dean's List (Fall 2003)

Fellowships

- Digital Materials Laboratory, RIKEN, Wako, Japan Fellow (Fall 2007)
- Graduate Assistance in Areas of National Need (GAANN) Fellow University of California at Santa Barbara and US Department of Education (DOE) (2006-2009)
- Broida Fellow University of California at Santa Barbara (2005-2007)
- National Institute of Standards and Technology (NIST) Professional Research Experience Program (PREP) Fellow (Spring 2001 – Summer 2004)

Honors

- University of Colorado at Denver Goldwater Nominee (2003)
- Eta Kappa Nu Member (International Electrical and Computer Engineering Honor Society)
- Golden Key Honor Society Member

Awards

- Best Student Presentation American Physics Society March meeting 2009 (Pittsburgh, PA) Jointly awarded by The Institute for Quantum Computing, University of Waterloo and the APS Topical Group on Quantum Information
- Outstanding poster presentation at 4th NTT Basic Research Labs school, Atsugi, Japan (November 2007)
- Certificate of Merit Colorado Engineering Council, Finalist for the Silver Medal (2005)

Awards (Continued)

- Undergraduate Research Opportunity Program (UROP) grant for Applied Physics Senior Thesis (2004)
- Awarded travel and living expenses to work with collaborator Dr. Kathryn A. Moler and her research staff at the Geballe Laboratory for Advanced Materials, Department of Applied Physics, Stanford University, Palo Alto, CA March 2003
- Full financial support by UCD's Associate Vice Chancellor of Student Affairs, Dr. Danny Martinez to deliver my talk at the 126th American Association of Physics Teachers (AAPT) meeting Austin, TX, January 2003

Publications

- **Thin film dielectric microstrip kinetic inductance detectors**, B. A. Mazin, D. Sank, S. McHugh, **Erik Lucero**, A. Merrill, J. Gao, D. Pappas, D. Moore, J. Zmuidzinas *Accepted Applied Physics Letters* (2010)
- **Quantum Process Tomography of a Universal Entangling Gate Implemented with Josephson Phase Qubits,** Radoslaw C. Bialczak, Markus Ansmann, Max Hofheinz, **Erik Lucero**, Matthew Neeley, Aaron O'Connell, Daniel Sank, Haohua Wang, James Wenner, Matthias Steffen, Andrew Cleland, John Martinis *Submitted to Nature Physics (2009).*
- **Decoherence Dynamics of Complex Photon States in a Superconducting Circuit**, H. Wang, M. Hofheinz, M. Ansmann, R. C. Bialczak, Erik Lucero, M. Neeley, A. D. O'Connell, D. Sank, M. Weides, J. Wenner, A. N. Cleland, John M. Martinis *Physics Review Letters* 103, 3200404 (2009).
- **Improving the Coherence Time of Superconducting Coplanar Resonators,** H. Wang, M. Hofheinz, J. Wenner, M. Ansmann, R. C. Bialczak, M. Lenander, **Erik Lucero**, M. Neeley, A. D. O'Connell, D. Sank, M. Weides, A. N. Cleland, and John M. Martinis *Applied Physics Letters* 95, 233508 (2009).
- **Violation of Bell's inequality in Josephson phase qubits**, Markus Ansmann, H. Wang, Radoslaw C. Bialczak, Max Hofheinz, **Erik Lucero**, M. Neeley, A. D. O'Connell, D. Sank, M. Weides, J. Wenner, A. N. Cleland and John M. Martinis *Nature* 461, 504-506 (2009).
- **Emulation of a Quantum Spin with a Superconducting Phase Qudit**, Matthew Neeley, Markus Ansmann, Radoslaw C. Bialczak, Max Hofheinz, **Erik Lucero**, Aaron D. O'Connell, Daniel Sank, Haohua Wang, James Wenner, Andrew N. Cleland, Michael R. Geller, John M. Martinis *Science* 325, 722 (2009).
- **Synthesizing arbitrary quantum states in a superconducting resonator**, Max Hofheinz, H. Wang, M. Ansmann, Radoslaw C. Bialczak, **Erik Lucero**, M. Neeley, A. D. O'Connell, D. Sank, J. Wenner, John M. Martinis and A. N. Cleland *Nature* 459, 546-549 (2009).
- **Measurement of the decay of Fock states in a superconducting quantum circuit**, H. Wang, M. Hofheinz, M. Ansmann, R. C. Bialczak, **Erik Lucero**, M. Neeley, A. D. O'Connell, D. Sank, J. Wenner, A. N. Cleland and John M. Martinis *Physics Review Letters* 101, 240401 (2008).
- **Generation of Fock states in a superconducting quantum circuit**, Max Hofheinz, E. M. Weig, M. Ansmann, Radoslaw C. Bialczak, **Erik Lucero**, M. Neeley, A. D. O'Connell, H. Wang, John M. Martinis and A. N. Cleland *Nature* 454, 310-314 (2008).
- **Gradiometric micro-SQUID susceptometer for scanning measurements of mesoscopic samples**, Martin E. Huber, Nicholas C. Koshnick, Hendrik Bluhm, Leonard J. Archuleta, Tommy Azua, Per G. Björnsson, Brian W. Gardner, Sean T. Halloran, **Erik Lucero**, and Kathryn A. Moler *Review of Scientific Instruments* 79, 053704 (2008)

Publications (Continued)

- **Reversal of the Weak Measurement of a Quantum State in a Superconducting Phase Qubit**, Nadav Katz, Matthew Neeley, M. Ansmann, Radoslaw C. Bialczak, M. Hofheinz, **Erik Lucero,** A. O'Connell, H. Wang, A. N. Cleland, John M. Martinis and Alexander N. Korotkov *Physics Review Letters* 101, 200401 (2008).
- **High fidelity gates in a Josephson qubit**, **Erik Lucero**, M. Hofhienz, M. Ansmann, Radoslaw C. Bialczak, N. Katz, Matthew Neeley, A.D. O'Connell, H. Wang, A.N. Cleland, and John Martinis, *Physics Review Letters* 100 227006 (2008).
- **Process Tomography of Quantum Memory in a Josephson Phase-Atomic Hybrid Qubit coupled to a Two-Level State**, Matthew Neeley, M. Ansmann, Radoslaw C. Bialczak, M. Hofhienz, N. Katz, **Erik Lucero**, A.D. O'Connell, H. Wang, A.N. Cleland, and John Martinis, *Nature Physics* 4, 523-526 (2008).
- **Microwave Dielectric Loss at Single Photon Energies and milliKelvin Temperatures**, Aaron D. O'Connell, M. Ansmann, R. C. Bialczak, M. Hofheinz, N. Katz, Erik Lucero, C. McKenney, M. Neeley, H. Wang, E. M. Weig, A. N. Cleland, and J. M. Martinis *Applied Physics Letters* 92, 112903 (2008).
- **Transformed Dissipation in Superconducting Quantum Circuits**, Matthew Neeley, M. Ansmann, Radoslaw C. Bialczak, M. Hofhienz, N. Katz, **Erik Lucero**, A.D. O'Connell, H. Wang, A.N. Cleland, and John Martinis, *Physics Review B* 77, 180508 (2008).
- **1/f Flux Noise in Josephson Phase Qubits**, Radoslaw C. Bialczak, R. McDermott, M. Ansmann, M. Hofhienz, N. Katz, **Erik Lucero**, Matthew Neeley, A.D. O'Connell, H. Wang, A.N. Cleland, and John Martinis, *Physics Review Letters* 99, 187006 (2007).
- **Measurement of the Entanglement of Two Superconducting Qubits via State Tomography**, Matthias Steffan, M. Ansmann, Radoslaw C. Bialczak, N. Katz, **Erik Lucero**, R. McDermott, Matthew Neeley, E.M. Weig, A.N. Cleland, and John M. Martinis, Science 313, Issue 5792, 1423-1425 (2006).
- **Coherent state evolution in a superconducting qubit from partial-collapse measurement**, N. Katz, M. Ansmann, Radoslaw C. Bialczak, **Erik Lucero**, R. McDermott, Matthew Neeley, Matthias Steffan, E.M. Weig, A.N. Cleland, John M. Martinis, and A.N. Korotkov, *Science* 312, Issue 5779, 1498-1500 (2006)
- **State tomography of capacitively shunted phase qubits with high fidelity**, Matthias Steffan, M. Ansmann, R. McDermott, N. Katz, Radoslaw C. Bialczak, **Erik Lucero**, Matthew Neeley, E.M. Weig, A.N. Cleland, and John M. Martinis, *Physics Review Letters* 97, 050502 (2006)
- **Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier**, **Erik Lucero** Senior Thesis University of Colorado (2005)

Presentations

- "Experimental bring-up procedures with metrology to improve superconducting qubit fidelities"Coherence in Superconducting Qubits 2010, San Diego, California, April 2010
- "Experimental bring-up procedures with metrology to improve superconducting qubit performance" 2010 APS March Meeting, Portland Oregon, March 2010
- "High fidelity gates in Josephson phase qubits"Invited Colloquium Institute for Quantum Computing, University of Waterloo, Waterloo, Canada, September 14, 2009
- "High fidelity gates in Josephson phase qubits"Invited 2009 APS March Meeting, Pittsburgh, Pennsylvania, March 2009
- "High fidelity gates in Josephson phase qubits"2008 APS March Meeting, New Orleans, Louisiana, March 2008

Presentations (Continued)

- "Methods for resolving errors at the fault tolerant threshold in Josephson phase qubits" Recent Status in Quantum Information Technology 4th NTT BRL School, Atsugi, Japan, November 20, 2007
- "Recent advances in Josephson phase qubits: Memory, gates, and Bell violation" Invited seminar NEC corporation, Tsukuba, Japan, November 16, 2007
- "Recent advances in Josephson phase qubits: Memory, gates, and Bell violation" Visiting fellow Digital Materials Laboratory, RIKEN, Wako, Japan, November 13, 2007
- "Precise measurements of single gate errors in Josephson phase qubits" 2007 APS March Meeting, Denver Colorado, March 6, 2007
- "Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier and High Bandwidth Low Noise Room Temperature Electronics for Readout of SQUID Sensors" 12th Annual McNair Scholars Symposium, University of California at Berkeley, August 14, 2004
- "Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier and SQUID Series Array" NIST PREP Poster Session, University of Colorado at Boulder, April 21, 2004
- "Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier and SQUID Series Array" Research Day, University of Colorado at Denver, April 9, 2004
- "High Bandwidth Low Noise Room Temperature Readout Electronics for Superconducting Quantum Interference Device (SQUID) Sensors" Research Day, University of Colorado at Denver, April 9, 2004
- "High-symmetry Micro-SQUID Susceptometer for Scanning Systems" Research Day, University of Colorado at Denver, April 9, 2004
- "Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier and SQUID Series Array" Institute of Electrical and Electronics Engineers (IEEE) Denver Technical Conference, Denver, CO, March 25, 2004
- "Linear Current-to-Voltage Converter Utilizing Superconducting Quantum Interference Device (SQUID) Operational Amplifier and SQUID Series Array" Ronald E. McNair 12th Annual National Research Conference, Lake Lawn Resort, Delavan, WI November 8, 2004
- "SQUID Laboratory Intern Recruitment Efforts" Classical Mechanics course, Metro State College of Denver, November 2003
- "Noise Thermometry in Undergraduate Laboratories Using a Fast Fourier Transform Spectrum Analyzer" 126th American Association of Physics Teachers Meeting, Austin, TX, January 2003
- "SQUID Laboratory Intern Recruitment Efforts" Society of Physics Students (SPS) Monthly Meeting, Metro State College of Denver, November 7, 2002
- "Linear Current-to-Voltage Converter Utilizing SQUID Operational Amplifier and SQUID Series Array" Applied Superconductivity Conference, Houston, TX, August 2002
- "A Glimpse of Linearizing a Non-Linear System: Investigation of the SQUID Op-Amp Current to Voltage Converter" Combined Society of Physics Students and American Association of Physics Teachers Colorado and Wyoming Regional Meeting Denver, CO April 27, 2002

Workshops: Training and Education I Have Created

- Microsoft Outlook© Training for University of Colorado at Denver faculty and staff (January 2000 – May 2001) Duration weekly, 1.5 hour seminars
- "Introduction to Word Processing" Training course, United States Small Business Administration Denver district office, June 2000 Duration 4 hours

- "Using Presentational Software in Academics" for Pamela W. Laird, Ph.D. Introduction to Public History class, University of Colorado at Denver, Spring 2000 Duration 1.25 hour
- "Building a Website: Understanding HTML" for Pamela W. Laird, Ph.D. Introduction to Public History class, University of Colorado at Denver, Spring 2000 Duration 1.25 hour

Employment

- **Graduate Student Researcher in Condensed Matter Experiment**
  - John Martinis' Group: Building a Quantum Computer with superconducting phase qubits
    - Designed (using Altium Protel) and built custom scalable analog and digital control electronics for qubits, posted here as *open source hardware* http://www.physics.ucsb.edu/~martinisgroup/electronics.html
    - Our open source hardware is now deployed in quantum computing efforts and Nuclear Magnetic Resonance research, around the world (University of Wisconsin, Madison; University Maryland; NEC, Japan; The Hebrew University of Jerusalem)
    - Helped to create the infrastructure for rapid prototyping techniques utilizing in-house solder reflow stations, sub-millimeter placement of surface mount components, mylar stencils for solder masks
    - Super-user for Heidelberg DWL 200 maskwriter an essential research and production tool for photolithography: My responsibilities included maintenance and training users
    - Experienced in semiconductor and superconductor fabrication techniques, including sputtering, junction oxidation, photolithography, reactive ion etching, wet etching, scanning electron microscope, plasma enhanced chemical vapor deposition, and reticle design.
    - Applied Taguchi methods (similar to "five sigma" techniques) to explore a detailed analysis and to guide the optimization of amorphous silicon a critical low loss dielectric for phase qubits
    - Created a collaboration with scientists at the National Renewable Energy Labs (NREL) in Golden, Colorado to grow high quality amorphous dielectrics using PECVD and hot-wire PECVD techniques (P.I. Wang, Qi).
    - Facilitated collaboration with scientists at NEC, Japan (P.I. Nakamura, Yasunobo). Based on our open source hardware. Which initiated a one year visiting scientist from NEC to join our one group (2009-2010)
    - Maintain IT infrastructure including tape-back-up of all electronic data, group website, and TWiki our research group's core knowledge base
- **GAANN Fellow**
  - University of California at Santa Barbara department of physics
    - Actively recruit undergraduates from the USA to pursue graduate degrees in physics
    - Attend undergraduate research conferences and mentor potential physics graduate students
- **Teaching Assistant**
  - "Practice of Science" honors physics, natural science, and engineering course University of California at Santa Barbara, Winter 2008 – Spring 2008
  - This two-quarter honors course is an elective course aimed at undergraduate students with potential careers spanning experimental science and technology
  - My role as a teaching assistant was non-traditional in contrast to typical physics lecture courses

Employment (Continued)

- **Teaching Assistant (cont.)**
    - Lecturing, leading discussions in class, helping students prepare scientific proposals, conduct advanced laboratory techniques, and deliver scientific presentations
    - Provide liaison mentoring between undergraduates and faculty
    - Conduct tours of California Nanosystems Institute cleanroom facilities and photolithography equipment
  - Upper division digital electronics lab University of California at Santa Barbara, Winter 2007
  - This laboratory is an elective for the major and is a practical course focused on programming and using field programmable gate arrays (FPGAs). The nature of my role as teaching assistant was to:
    - Assist in determination of an effective set of learning objectives for the courses and for each experiment
    - Grade problem sets and write solutions
    - Grade Laboratory Notebooks and provide guidance on good laboratory notebook technique
    - Troubleshoot malfunctioning experiments
  - Upper division analog electronics lab University of California at Santa Barbara, Fall 2006
  - These laboratories are required for the major and are the first opportunity at the junior/senior level for UCSB's physics department to instruct majors in practical laboratory skills and specifically electronics skills. The nature of my role as teaching assistant was to:
    - Assist in determination of an effective set of learning objectives for the courses and for each experiment
    - Grade problem sets and write solutions
    - Grade Laboratory Notebooks and provide guidance on good laboratory notebook technique
    - Troubleshoot malfunctioning experiments
  - Upper division experimental physics labs University of Colorado at Denver, Fall 2004/Spring 2005
  - 15-20 hours/week
  - These laboratories are required for the major, are a integral component of the physics departmental outcomes assessment, and the only opportunity for UCD's physics department to instruct majors in practical laboratory skills. The nature of my role as the upper division teaching assistant was to:
    - Assist in determination of an effective set of learning objectives for the courses and for each experiment
    - Assist in creation of an effective pre-lab preparation exercise for each experiment.
    - Re-create Lab Manuals with essential pieces and begin the migration from *The Art of Experimental Physics by* Preston and Dietz to *Experiments in Modern Physics by* Melissinos and Napolitano
    - Create and Maintain a server with private but external access for Instructor and TA to store electronic documents in development
    - Create and Maintain website for the course
      - http://physics.cudenver.edu/udlabs/
    - Grade problem sets and write solutions
    - Grade Pre-Lab questions and write solutions
    - Grade Laboratory Notebooks
    - Supervise student work on 1st semester, 2nd semester labs
    - Evaluate new software

Employment (Continued)

- Review all instructor ideas/changes
- Troubleshoot malfunctioning experiments
- **Graduate Student Mentor**
  - Mentored one College of Creative Studies Physics undergraduate student from UCSB (2009-2010)
    - Student has learned to model parts of our quantum system (single qubit dynamics) to contribute to the experimental bring-up and metrology.
    - Student is a coauthor on the upcoming metrology paper
    - Student will be composing a Senior Thesis on Randomized and Complete Benchmarking of a single Josephson Phase qubit
  - Mentored one Physics undergraduate student from UCSB
    - Student fabricated a dedicated cryostat to screen "high mu" toroidal cores as part of a redesign to a cryogenic bias-T.
    - Student submitted a Senior Thesis on the improved bias-T
  - Mentored one Electrical and Computer Engineering undergraduate student from UCSB (2006-2007)
    - Student learned Protel (a professional printed circuit board layout software tool) to design custom power microwave amplifiers and variable attenuators at microwave frequencies
  - Mentored one College of Creative Studies Physics undergraduate student from UCSB (2006-2007)
    - Student learned Protel and SPICE (to simulate circuit designs) to design custom radio frequency amplifiers that were deployed in our main qubit experiments
  - Mentor for Internship in Nanosystems Science Engineering and Technology (INSET) through UCSB and the California Nanosystems Institute (CNSI).
    - The undergraduate student from Santa Barbara's City College designed and built air-core inductor Bias-Ts that are were deployed in our cryogenic experiments (Summer 2006)
    - Student delivered a talk and a poster presentation on their work

- **Laboratory Coordinator**
  - Superconducting Quantum Interference Device (SQUID) Laboratory University of Colorado at Denver, Summer 2004 to Summer 2005
  - 5-8 hours/week
  - Provide both technical and infrastructure support to the laboratory and the interns including Information technologies (IT) solutions
- **Research Assistant**
  - SQUID Laboratory University of Colorado at Denver, Spring 2001 to Summer 2005
  - 10-15 hours/week during Fall and Spring semesters
  - 32-40 hours/week during summer and winter breaks
- **NIST PREP Fellow**
  - Electromagnetic Technology Division (814), Cryogenic Sensors, Spring 2001-Summer 2004
  - 10-15 hours/week during Fall and Spring semesters
  - 32-40 hours/week during summer and winter breaks
- **Physics Tutor**
  - High school student preparing for Accelerated Program (AP) Physics Exam, Spring 2003
  - 2 hours/week for 15 weeks
- **Research Assistant (Volunteer)**

- SQUID Laboratory University of Colorado at Denver, Fall 2000
- 8 hours/week

Employment (Continued)

- **Honorarium Instructor**
  - Two week Computer Literacy and Applications courses, University of Colorado at Denver Pre-Collegiate Program, Summer 2000, 2001
  - 32-40 hours/week
- **Instructor for Computer Information and Network Services**
  - University of Colorado at Denver, Fall 1999 – Spring 2001
  - 32-40 hours/week
  - Independently instructed the University of Colorado at Denver's student, faculty and staff on computer skills, through various free one-hour workshops ranging from the Microsoft Office© products, to UNIX, and web design
- **Laboratory Assistant for Computer Information and Network Services**
  - University of Colorado at Denver, Spring 1999 – Summer 1999
  - 20 – 30 hours/week
  - Provided technical assistance to students and faculty in the UCD public computing labs
- **Audio Visual Technician for Marriott**
  - Denver West Marriott, Golden CO, January 1997 – Spring 1999
  - 20-40 hours/week
  - Responsible for all audio visual equipment for banquets and meetings