

Joseph E. Reiner

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Education

State University of New York at Stony Brook, Stony Brook, NY

Ph. D. in physics August 2003

Thesis title: "Conditional Measurements, Quantum Feedback, and Cold Atoms in Cavity QED"

Thesis advisor: Dr. Luis A. Orozco.

M. A. in physics December 2000

Rochester Institute of Technology, Rochester, NY

B. S. in physics, June 1997

- Graduated with Highest Honors, Sigma Pi Sigma, Outstanding Undergraduate Award, Dean's List all quarters.

Research Experience

National Institute of Standards and Technology, Gaithersburg, MD

NRC Postdoctoral Fellow, July 2003 to present

- Creating stable nanotubes from polymer vesicles. These nanotubes will be used as templates for nanofluidic structures and as devices for studying single molecule transport. This work is being performed in collaboration with Dr. Laurie Locasio (NIST).
- Constructing a single molecule detector that utilizes an optical tweezer setup in collaboration with Dr. Lori Goldner (NIST).
- Developing methods for making micron sized reverse emulsions (water-in-oil) for optical trapping and manipulation in single molecule studies.
- Gained laboratory experience in the following areas:
 - Lasers/Optics*: ND:YAG fiber laser used as optical tweezers, ND:YAG frequency tripled pulse laser used as an optical scalpel, mode-locked a Ti:Saph femtosecond laser to be used for high precision cell nanosurgery.
 - Sample Preparation*: giant multilamellar liposomes and giant multilamellar polymersomes via electroformation, custom made quartz micropipette tips down to 200 nm inner diameter, cellular and vesicle manipulation with micropipettes, chemical cross linking of polymer with sodium persulfate based protocol.
 - Microfluidics*: Constructed PDMS based soft lithographic microfluidic structures along with all appropriate connections for creating pressure driven flow through channels. We use templates developed with photolithographic techniques in Dr. Michael Gaitan's group at NIST.
 - Detection*: Programmed NI Labview in order to observe single molecule fluorescence with a confocal detection setup.
 - Microscopy*: Zeiss Axiovert 100 converted into an optical tweezer setup, Zeiss Axiovert 200 LSM laser scanning microscope for capturing confocal images.

State University of New York at Stony Brook, Stony Brook, NY

Graduate Research Assistant, May 1999 to June 2003

- Continued to advance experimental and theoretical studies of a new third-order field correlation function applied to a strongly coupled, weakly driven, cavity QED system.
- Proposed and carried out the first conditioned quantum state feedback experiment in collaboration with Dr. Howard Wiseman (Queensland).
- Proposed a new type of conditioned feedback experiment that modifies the Mollow triplet for a strongly driven two level atom-cavity system. This work was carried out in collaboration with Dr. Howard Wiseman and Dr. Hideo Mabuchi (Caltech).
- Built a next generation cold atom source that continuously extracts Rb atoms from a 2-D magneto-optical trap with the moving molasses technique.
- Gained laboratory experience in the following areas:
 - Lasers/Optics:* Coherent MBR-110, Coherent 899 ring, Coherent Verdi series, New Focus Vortex, electro-optic modulation, acousto-optic modulation, fiber optic alignment, and general optical alignment techniques necessary for construction of a MOT and study of a cavity QED system.
 - Stabilization Techniques:* Saturation spectroscopy, Pound-Drever-Hall FM sideband locking for high finesse ($F=20000$) cavity stabilization, constructed several PID amplifiers for frequency stabilization of lasers.
 - Detection methods:* CCD camera and PMT fluorescence detection, APD single photon detection, homodyne detection, FM spectroscopy.
 - High Vacuum:* Ion pump, sorption pump, diffusion pump, roughing pump, alignment of atomic beam of Rb for cavity QED experiments.
 - Programming:* C++, MATLAB, MAPLE, FORTRAN, EXCEL, Labview CVI. Developed software for computer control of cavity stabilization and timing sequences for MOT detection, numerical modeling with quantum trajectories.
 - Machining:* constructed several pieces with lathe, mill, etc. from several different materials: aluminum, copper, steel.

Research Assistant, Summer 1998

- Performed numerical calculations that studied the transport properties of a superconducting cooper pair pump. Adviser: Dr. Dmitri Averin.

Rochester Institute of Technology, Rochester, NY

Research Assistant, Winter 1996 thru Summer 1997

- Studied magnetic properties of powder sample particles as part of an outsourcing project for Xerox.
- Gained experience with a vibrating source magnetometer and sample preparation.

Research Experiences for Undergraduates (REU) participation

Williams College, Williamstown, MA, 1996

Studied different theoretical proposals for possible tests of T-symmetry violation in atomic physics experiments. Adviser: Dr. Dennis Krause.

Rensselaer Polytechnic Institute, Rensselaer, NY, 1995

Performed optical studies to characterize the growth of III-V nanocrystals as a possible technique for growing quantum dots. Adviser: Dr. Peter Persans.

University of Massachusetts, Lowell Campus, Lowell, MA, 1994

Wrote computer programs to describe reflectivity properties of III-V dielectric mirror stacks. Adviser: Dr. Aram Karakashian.

Teaching Experience

National Institute of Standards and Technology, Gaithersburg, MD
Undergraduate Research Advisor, May 2004 to September 2004

- Supervised the research of two undergraduate summer research students. One student worked on the chemical cross-linking of polymer nanotubes and the other worked on mode-locking and characterizing a femtosecond Ti:Saph laser.

State University of New York at Stony Brook, Stony Brook, NY
Electricity and magnetism assistant lecturer, Fall 2002

- Occasionally lectured for junior level EM class in place of Professor Luis Orozco.

Introductory physics laboratory teaching assistant, Spring 1999

- Taught the laboratory component for a freshman level, non-science major, physics class. Duties included setting up experiments, lecturing students on topics, and grading laboratory reports.

Calculus for business majors recitation instructor, Fall 1998

- Taught two recitation sections of introductory calculus. Duties included lecture preparation, grading of homework and tests, and leading students in solving problem sets.

Optics laboratory teaching assistant, Spring 1998

- Taught the laboratory component for a junior level undergraduate optics class. Duties included setting up experiments, briefing students on topics, and grading laboratory reports.

Rochester Institute of Technology, Rochester, NY
Tutor, Fall 1993 to Spring 1997

- Worked as a part-time (15 hr/week) tutor in the on-campus math learning center and the physics department help room.

Awards and Fellowships

- Rochester Institute of Technology Outstanding Undergraduate Award (1996).
- American Physical Society, Division of Laser Sciences travel grant (1999-2000).
- Government Assistance for Areas of National Need Fellowship (1997-1999).
- Graduate Council Commendation to Distinguished Doctoral Students (2003).
- National Research Council/NIST Postdoctoral Research Associateship (2003-2005).

Publications

Articles in peer reviewed journals

1. J. E. Reiner, R. B. Kishore, C. Pfeifferkorn, K. Helmerson, "Stable polymer nanotubes stretched from polymersomes," in preparation, to be submitted to Science
2. J. E. Reiner, W. P. Smith, L.A. Orozco, H. M. Wiseman, Jay Gambetta, "Quantum feedback in a weakly driven cavity QED system," *Phys. Rev A* **70**, 023819 (2004).
3. J. E. Reiner, F. M. Dimler, L. A. Orozco, "Broadening and their effects in non-classical correlations on cavity QED with atomic beams," *J. Opt. B* **6**, 135-142 (2004).
4. J. E. Reiner, H. M. Wiseman, H. Mabuchi, "Quantum jumps between dressed states: a proposed cavity QED test using feedback," *Phys. Rev. A* **67**, 042106 (2003).

5. G. T. Foster, W. P. Smith, J. E. Reiner, L. A. Orozco, "Time-dependent electric field fluctuations at the sub-photon level," *Phys. Rev. A* **66**, 033807 (2002).
6. W. P. Smith, J. E. Reiner, L. A. Orozco, S. Kuhr, H. M. Wiseman, "Capture and release of a conditional state of a cavity QED system by quantum feedback," *Phys. Rev. Lett.* **89**, 133601 (2002).
7. G.T. Foster, W.P. Smith, J.E. Reiner, L.A. Orozco, "Third-order correlations in cavity quantum electrodynamics," *J. Opt. B* **4**, S281-S284 (2002).
8. J.E. Reiner, W.P. Smith, L.A. Orozco, H.J. Carmichael, P.R. Rice, "Time evolution and squeezing of the field amplitude in cavity QED," *J. Opt. Soc. Am. B* **18**, 1911-1921 (2001).
9. Strachan W. J., Reiner J., Goodhue W. D., Karakashian A. S., Casasanta V., Geller J. D., "Analysis of molecular beam epitaxy grown $\text{Ga}_{1-x}\text{Al}_x\text{As}/\text{Ga}_{1-y}\text{Al}_y\text{As}$ dielectric mirrors using complex indices of refraction," *J. Vac. Sci and Tech. B* **14**, 2318-2321 (1996).

Citations

1. B. D. Guenther (guest editor of special issue) "Optics in 2002", *Optics and Photonics News* **13**, No. 12 (December, 2002) pp. 13-61 one page review (p. 53) of article 6 above.
2. J. E. Reiner, W. P. Smith, L.A. Orozco, H. M. Wiseman, Jay Gambetta, "Quantum feedback in a weakly driven cavity QED system," Implementations section, *APS Virtual Journal of Quantum Information* **4**, Sept. 2004
3. W. P. Smith, J. E. Reiner, L. A. Orozco, S. Kuhr, H. M. Wiseman, "Capture and release of a conditional state of a cavity QED system by quantum feedback," Implementations section, *APS Virtual Journal of Quantum Information* **2**, Sept. 2002.

Book Chapter

H. J. Carmichael, G. T. Foster, L. A. Orozco, J. E. Reiner, P. R. Rice, "Intensity-field correlations of non-classical light" *Progress in Optics Volume 46*, Editor: Emil Wolf, Elsevier, New York 2004.

Presentations

Invited Talks

"Feedback with conditional measurements in cavity QED," Colloquium for the Department of Physics at Griffiths University, Queensland, Australia 2002. Invited by: Dr. Howard Wiseman.

"Optically-drawn nanotubes and mixing with liposomes and polymersomes," 2004 KY NanoMat International Workshop on Nanomaterials, Lexington, KY 2004. Invited by: Dr. Robert Cohn.

Submitted Talks

"Optical manipulation of liposomes and polymersomes with optical tweezers," SPIE optical science and technology meeting, Denver, CO 2004

"Control and information with conditional quantum measurements," Quantum Electronics and Laser Science Conference, Long Beach, CA, 2002.

“Using quantum feedback to preserve the vacuum Rabi oscillations in cavity QED,” Quantum Electronics and Laser Science Conference, Baltimore, MD, 2001.

“Time evolution and squeezing of the field amplitude in cavity QED,” Quantum Electronics and Laser Science Conference, San Francisco, CA, 2000.

“Time evolution and squeezing of the field amplitude in cavity QED,” Division of Atomic, Molecular, and Optical Physics Meeting of the APS, Storrs, CT, 2000.

Submitted Posters

“Optical Manipulation and formation of lipid and polymer nanotubes,” J. E. Reiner, R. Kishore, C. Pfefferkorn, SPIE optical technology meeting, Denver, CO 2004.

“Continuous cold atom beam for cavity QED studies,” J. E. Reiner, F. M Dimler, L. A. Orozco, Quantum Electronics and Laser Science Conference, Baltimore, MD 2003.

“Feedback with conditional measurements in cavity QED,” J.E. Reiner, W.P. Smith, S. Kuhr, H.M. Wiseman, L.A. Orozco, 8th Conference on Coherence and Quantum Optics, Rochester, NY, 2001.

“Analysis of molecular beam epitaxy grown $\text{Ga}_{1-x}\text{Al}_x\text{As}/\text{Ga}_{1-y}\text{Al}_y\text{As}$ dielectric mirrors using complex indices of refraction,” J. Reiner, W.D. Goodhue, A.S. Karakashian, New England Sectional meeting of the APS, Brown University, RI, 1995.

Professional Memberships and Activities

- American Physical Society
- Optical Society of America
- Peer reviewer for the Journal of Optics B – Quantum and Semiclassical Optics.
- Peer reviewer for Physical Review Letters and Physical Review A.