

Sean J. Bentley

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Academic Positions:

Assistant Professor, Department of Physics, Adelphi University, Sept. 2003-Present

Education:

Ph.D. in Optics, University of Rochester, Rochester, NY, 2004

Thesis: Transverse Effects in Nonlinear and Quantum Optics

M.S. in Electrical Engineering, University of Missouri-Rolla, Rolla, MO, 1997

Thesis: Optical Time-of-Flight Magnetic Field Sensor; GPA: 4.0

B.S. in Electrical Engineering with minor in Physics, University of Missouri-Rolla, 1995

Divisional Honors Scholar; *Magna Cum Laude*

Professional Registration and Societies:

- American Physical Society (APS)
 - Division of Laser Science (DLS)
- Optical Society of America (OSA)
- Institute of Electrical and Electronics Engineers (IEEE)
 - Lasers & Electro-Optics Society (LEOS)
- SPIE--The International Society for Optical Engineering
- Tau Beta Pi--Engineering Honor Society
- Eta Kappa Nu—Electrical Engineering Honor Society
- Registered Engineer-in-Training, Missouri, 1995

Book:

S. J. Bentley, *Introduction to Quantum Imaging: Ghost Imaging, Ghost Diffraction, and Quantum Lithography*, Taylor & Francis/CRC Press, Boca Raton, FL (under contract—in preparation).

Book Contributions:

1. S. J. Bentley, “The Photon Picture of Light,” *Encyclopedia of Modern Optics*, edited by Robert D. Guenther, Duncan G. Steel and Leopold Bayvel, Elsevier, Oxford, 2004 (ISBN 0-12-227600-0).
2. E. M. Nagasako, S. J. Bentley, R. W. Boyd, and G. S. Agarawal, “Nonclassical, Two-Photon Interferometry and Lithography with High-Gain Optical Parametric Amplifiers,” *Coherence and Quantum Optics VIII*, edited by N. P. Bigelow, J. H. Eberly, C. R. Stroud, Jr., and I. A. Walmsley, Springer (Kluwer Academic/Plenum), New York, 2004 (ISBN 0-30-648116-2).

Patent:

Interferometric Method for Improving the Resolution of a Lithographic System (pending).

Published Articles (peer reviewed):

1. S. J. Bentley, C. Malagon, C. V. Anderson, and G. Kaushik, "Fundamental test of complementarity using position-momentum entangled photons," (in preparation).
2. S. J. Bentley, "Nonlinear interferometric lithography for arbitrary two-dimensional patterns," *Journal of Micro/Nanolithography, MEMS, and MOEMS (JM3)* **7**, 013004 (2008).
3. S. J. Bentley, C. V. Anderson, and J. P. Dooher, "Three-photon absorption for nanosecond excitation in cadmium selenide quantum dots," *Optical Engineering* **46**, 128003 (2007).
4. S. J. Bentley, J. E. Heebner, and R. W. Boyd, "Transverse instabilities and pattern formation in two-beam-excited nonlinear optical interactions in liquids," *Optics Letters* **31**, 951 (2006).
5. R. W. Boyd and S. J. Bentley, "Recent progress in quantum and nonlinear optical lithography," *Journal of Modern Optics* **53**, 713 (2006).
6. S. J. Bentley and R. W. Boyd, "Nonlinear optical lithography for ultra-high sub-Rayleigh resolution," *Optics Express* **12**, 5735 (2004).
7. R. W. Boyd, R. S. Bennink, S. J. Bentley, and J. C. Howell, "Image formation using quantum-entangled photons," *Optics & Photonics News, Optics in 2004 Special December Issue*, 39 (2004).
8. J. C. Howell, R. S. Bennink, S. J. Bentley, and R. W. Boyd, "Realization of the Einstein-Podolsky-Rosen paradox using momentum- and position-entangled photons from spontaneous parametric down conversion," *Physical Review Letters* **92**, 210403 (2004).
9. R. S. Bennink, S. J. Bentley, R. W. Boyd, and J. C. Howell, "Quantum and classical coincidence imaging," *Physical Review Letters* **92**, 033601 (2004).
10. R. S. Bennink, S. J. Bentley, and R. W. Boyd, "'Two-photon' coincidence imaging with a classical source," *Physical Review Letters* **89**, 113601 (2002).
11. E. M. Nagasako, S. J. Bentley, R. W. Boyd, and G. S. Agarwal, "Parametric downconversion vs. optical parametric amplification: A comparison of their quantum statistics," *Journal of Modern Optics* **49**, 529 (2002).
12. E. M. Nagasako, S. J. Bentley, R. W. Boyd, and G. S. Agarwal, "Nonclassical two-photon interferometry and lithography with high-gain optical parametric amplifiers," *Physical Review A* **64**, 043802 (2001).
13. S. J. Bentley, R. W. Boyd, W. E. Butler, and A. C. Melissinos, "Spatial patterns induced in a laser beam by thermal nonlinearities," *Optics Letters* **26**, 1084 (2001).
14. G. S. Agarwal, R. W. Boyd, E. M. Nagasako, and S. J. Bentley, *Physical Review Letters* **86**, 1389 (2001) [comment].
15. S. J. Bentley, R. W. Boyd, W. E. Butler, and A. C. Melissinos, "Measurement of the thermal contribution to the nonlinear refractive index of air at 1064 nm," *Optics Letters* **25**, 1192 (2000).

Professional Presentations:

1. S. J. Bentley, "Arbitrary 2-D pattern formation beyond the Rayleigh limit," *Optical Society of America 91st Annual Meeting*, San Jose, CA, September 2007.
2. S. J. Bentley, "Testing complementarity with quantum entangled photons," *Optical Society of America 90th Annual Meeting*, Rochester, NY, October 2006.
3. R. Hixon, S. E. Watkins, S. J. Bentley, and M. A. Huggans, "Student robotics competition using Robolab and Lego Bricks," *Proceedings of the 2006 ASEE Midwest Section Annual Conference*, 13-15 September 2006, Kansas City, MO.
4. S. J. Bentley, C. V. Anderson, and J. P. Dooher, "Three-photon absorption in cadmium selenide quantum dots," *Conference on Lasers and Electro-Optics (CLEO)*, Long Beach, CA, May 2006, CWA6.
5. S. J. Bentley, C. V. Anderson, and J. P. Dooher, "Third-order nonlinearities of CdSe quantum dots," *Optical Society of America 89th Annual Meeting*, Tucson, AZ, October 2005.

6. R. W. Boyd, R. S. Bennink, S. J. Bentley, M. N. O'Sullivan-Hale, I. Ali Khan, and J. C. Howell, "Progress in quantum lithography and ghost imaging," The Physics of Quantum Electronics XXXV, Snowbird, Utah, January 2-6, 2005. (Invited Talk)
7. R. W. Boyd, R. S. Bennink, S. J. Bentley, M. N. O'Sullivan-Hale, I. Ali Khan, and J. C. Howell, "Image formation using quantum-entangled photons," Imaging at the Limits, Cargese, Corsica, France, September 5-11, 2004. (Invited Talk)
8. R. W. Boyd, R. S. Bennink, S. J. Bentley, M. N. O'Sullivan-Hale, I. Ali Khan, and J. C. Howell, "Image formation using quantum-entangled photons," International Quantum Electronics Conference, San Francisco, CA, May 16-20, 2004.
9. S. J. Bentley and R. W. Boyd, "Coherent control of four-wave mixing gain," Laser Science XIX, Tucson, AZ, October 2003.
10. M. S. Bigelow, S. J. Bentley, A. M. Marino, and R. W. Boyd, "Polarization properties of photons generated by two-beam excited conical emission," Laser Science XIX, Tucson, AZ, October 2003.
11. S. J. Bentley and R. W. Boyd, "Super-resolution by nonlinear optical lithography," Conference on Lasers and Electro-Optics (CLEO), Baltimore, MD, June 2003, CMH4.
12. R. S. Bennink, S. J. Bentley, R. W. Boyd, and J. C. Howell, "Quantum and classical aspects of coincidence imaging," Quantum Electronics and Laser Science Conference (QELS), June 1-6, 2003, QMH2.
13. S. J. Bentley, J. E. Heebner, and R. W. Boyd, "High-order spatial modulation instability," Optical Society of America 86th Annual Meeting, Orlando, FL, October 2002.
14. S. J. Bentley and R. W. Boyd, "Reducing the effect of laser beam filamentation," OPTO-Canada, Ottawa, Canada, May 2002.
15. E. M. Nagasako, S. J. Bentley, R. W. Boyd, and G. S. Agarwal, "Nonclassical, two-photon interferometry and lithography with high-gain optical parametric amplifiers," Eighth Rochester Conference on Coherence and Quantum Optics, Rochester, NY, June 13-16, 2001.
16. S. J. Bentley, R. W. Boyd, E. M. Nagasako, and G. S. Agarwal, "Quantum entanglement for optical lithography and microscopy beyond the Rayleigh limit," Quantum Electronics and Laser Science Conference (QELS), May 6-11, 2001, QTuD2.
17. S. J. Bentley, R. W. Boyd, W. E. Butler, and A. C. Melissinos, "Thermal nonlinearities and pattern formation in high-finesse Fabry-Perot cavities," Optical Society of America 84th Annual Meeting, Providence, RI, October 2000.
18. S. J. Bentley, R. W. Boyd, W. E. Butler, and A. C. Melissinos, "Measurement of the thermal refractive index of air at 1.064 microns using a cw laser," Nonlinear Optics: Materials, Fundamentals, and Applications, 391-393 (2000).
19. S. J. Bentley and S. E. Watkins, "Simulation of a coherent heterodyne array imaging system," Optical Society of 80th America Annual Meeting, Rochester, NY, October 1996.
20. S. E. Watkins, R. Gopisetty, S. J. Bentley, and R. A. Anderson, "Target velocity measurements from speckled images," Image Reconstruction and Restoration, Proc. SPIE 2302, 26-35 (1994).

Grant Proposals Submitted:

1. *Science and Math Applied Real-problem Teaching (SMART)*, \$300,000, National Science Foundation (to be submitted).
2. *CAREER: Optical Nonlinearities of Semiconductor Nanoparticle/Polymer Composites*, \$530,231, National Science Foundation.
3. *RUI: Quantification of Nonlocality by Conditioned Positive-Operator-Valued Measurements*, \$234,861, National Science Foundation (Co-PI).
4. *CAREER: Optical Nonlinearities of Quantum Dot-Based Composites: From Fundamental Quantum Mechanics to Applications in Ultra-high Resolution Lithography*, \$414,596, National Science Foundation.

5. *Implementation of Positive Operator-Valued Measurements on Photon Polarization States*, \$331,876, National Science Foundation (Co-PI).
6. *Nonlinear and Quantum Optical Properties of Quantum Dots for Generation of New Sources of Quantum States of Light*, \$31,146, Research Corporation Cottrell College Science Award (**awarded**).
7. *Precollege Outreach in GLOBECOM 2005*, \$5,500 of \$28,000 total for program, National Science Foundation (Sub-Contract as Pre-college Program Administrator; **awarded**).
8. *Fundamental Analysis of Quantum Microdots for Potential Applications*, \$4,900, Adelphi University, 2005 President's Faculty Development Award. (Co-Investigator; **awarded**)
9. *Collaborative Research for Quantum Optics Teaching Laboratory--Preparation for the Age of Quantum Information*, multi-university proposal with \$15,000 dedicated to Adelphi University, National Science Foundation.
10. *Exploring the Quantum-Classical Boundary: Undergraduate Research in Classical and Quantum Teleportation*, \$29,776, Research Corporation Cottrell College Science Award.
11. *Exploring the Quantum-Classical Boundary: Undergraduate Research in Classical and Quantum Teleportation*, \$4,500, Adelphi University, 2004 President's Faculty Development Award. (**awarded**)

Service & Professional Activities:

- Faculty Advisor, Adelphi Physics Club (2003-Present)
-Named an *Outstanding Chapter* of the Society of Physics Students (2005-06 & 2006-07)
- Organizing Committee Member, Adelphi Research Conference (2004-present); Co-Chair (Fall 2006-present)
- Science Instructor for summer middle school outreach through Groundworks (a youth support organization in Brooklyn, NY—Summer 2006 and 2007)
- College of Arts & Sciences Academic Affairs Committee Member (2007-Present)
- Pre-Medical Council Member (2006-Present)
- Intellectual Property Committee (2006-Present)
- NSF TOP Physics Mentor (2007-Present)
- Advisory Committee Member for University of Missouri-Rolla Electrical Engineering Reaccreditation (2007)
- Student & Pre-College Activities Chair, GLOBECOM 2005 (international conference of Communications Society of IEEE)
- Organized outreach to secondary school science class (2005-present)
- Junior Science & Humanities Symposium, LI Regional Reader & Judge (04, 05, 06, 07, 08)
- Rohm and Haas Electronic Materials Invitational Science Fair Judge (2006)
- Guided two Oceanside High School students in research projects (2005-06)
- Faculty Senate, Physics Departmental Representative (Spring 2004)
- Admissions & Retention Committee Member (Spring 2004)
- Authored primary proposal to reinstate M.S. program in physics
- Rubrics committee member (2006)
- Reviewer for *Physical Review Letters* (a journal of the APS)
- Reviewer for *Physical Review A* (a journal of the APS)
- Reviewer for *Optics Express* (a journal of the OSA)
- Reviewer for *Journal of the Optical Society of America A*
- Reviewer for *IEEE Transactions on Education*
- Reviewer for *Applied Optics* (a journal of the OSA)
- Various recruitment & promotional activities:

Update and development of departmental website; assistance in creation of departmental flyer and brochure; participation in university & departmental open houses and accepted student days.

Previous Experience:

- Graduate Research Assistant, August 1999-August 2003, University of Rochester, Rochester, NY
- Graduate Teaching Assistant, August 1998-May 1999, University of Rochester
- Graduate Teaching Assistant, August 1995-July 1997, University of Missouri-Rolla, Rolla, MO; taught EE 282—Circuits and Machines and seven sections of EE 220--Electronic Circuits Lab
- Graduate Research Assistant, Summer 1995 and Spring 1996, University of Missouri-Rolla
- Student Grader, August 1994-May 1995, University of Missouri-Rolla
- EXCEL Facilitator—Calculus I & II, August 1993-December 1994, University of Missouri-Rolla
- Electrical Engineering Departmental Aid, Summer 1994, University of Missouri-Rolla
- Engineering Intern, Summer 1993, Chillicothe Municipal Utilities, Chillicothe, MO

Honors & Awards:

- Chancellor's Fellow, 1995-1997
- IEEE Region 5 Paper Contest--Third Place, 1995
- IEEE UMR Student Branch Outstanding Member, 1994-1995
- Chancellor's Scholar, 1991-1995
- Curator's Scholar, 1991-1995
- Miner's Scholar, 1991-1995
- National Merit Scholar, 1991

Student Research Advised:

Charles Anderson (Spring 05-Summer 06)—B.S. Physics & Philosophy 2006; researched nonlinearities of quantum dots

- Now in the Optics M.S. program at the University of Rochester
- **Awarded 1st place student presentation at the New York State Section of the American Physical Society Fall 2005 Symposium**
- **Co-author on paper published in Optical Engineering** (see publications section above)
- Co-author on presentation at QELS 2006 (see presentations section above)
- Presented at the 2005 Annual Meeting of the Optical Society of America in Tucson, AZ
- Presented at the March Meeting of the American Physical Society in Baltimore, MD
- Presented at the 20th National Conference on Undergraduate Research in Asheville, NC
- Awarded 1st Place Science Talk at the 3rd Annual Adelphi University Research Conference

Camilo Malagon (Fall 04-continuing)—B.S. Physics 2007

- Completed his Honor's Thesis on complementarity with quantum entangled photons
- Will be co-author on journal submission involving thesis project
- Awarded 1st Place Science Talk at the 4th Annual Adelphi University Research Conference
- Will begin the Ph.D. program in Physics at Stony Brook University starting Fall 08

Kaitlin O'Neill (Spring 07-continuing)—Junior in Physics; researching quantum entanglement

- Presented at the 1st Commission on Independent Colleges and Universities Undergraduate Research Exposition in Albany, NY
- Will present at the 22nd National Conference on Undergraduate Research in Salisbury, MD
- Will present at the 5th Annual Adelphi University Research Conference

Deanna Nohs (Spring 04-Spring 05)—B.S. Physics 2005; researched quantum entanglement

- Currently employed as an environmental engineer
- Presented at the 19th National Conference on Undergraduate Research in Lexington, VA
- Awarded 1st Place Science Poster at the 2nd Annual Adelphi Undergraduate Research Conference

Gaurav Kaushik (Spring 05-continuing)—Junior in Physics

- Currently performing Honor's Thesis research on quantum entanglement
- Will begin the engineering program at Columbia University, Fall 07

Alexandre Manov (Fall 03-Spring 05)—B.S. Physics & Math 2005; researched quantum entanglement

- Went to applied physics Ph.D. program at Columbia University
- Presented at the 1st Annual Adelphi Undergraduate Research Conference

Hoda Rifai (Spring 07)—Junior in Physics; researching nonlinear optics

- Will begin the engineering program at Columbia University, Fall 07
- Presented at the 4th Annual Adelphi University Research Conference

George Harrison (Spring 07)—Senior in Physics; researching nonlinear optics

- Will begin the engineering program at Columbia University, Fall 07
- Presented at the 4th Annual Adelphi University Research Conference

Yusuf Yusufov (Summer 07-continuing)—Sophomore in Physics

Earland Pete (Spring 07)—Junior in Physics; researching nonlinear optics

- Presented at the 4th Annual Adelphi University Research Conference

Haralampos (Bob) Psaradellis (Summer 05)—B.S. Physics 2005; researched electronics for low noise twin optical detectors.

- Currently pursuing electrical engineering degree at Columbia University

Faith Barclay (Spring 04-Summer 04)—B.S. Physics 2004; researched quantum entanglement

- Completed engineering degree at Columbia University

Dulce Andrade (Spring 04)—B.S. Physics 2004; researched quantum entanglement

- Completed engineering degree at Columbia University

Charles DiGennaro (Fall 03-Summer 04)—B.S. Physics 2005; researched quantum entanglement

Bryan Mytko (Spring 05)—B.S. Physics 2005; researched quantum dots

Vismay Shah (Fall 05-Spring 06)—Researched quantum dots

Courses Taught at Adelphi:

- Physics 111--College Physics I: Lecture—Summer 04, 05, 06, 07
Lab—Fall 03 (2 sections); Summer 04, 05, 06, 07
- Physics 112—College Physics II: Lecture—Summer 04, 05
Lab— Summer 04, 05, Spring 06, 07
- Physics 113—Physics for Science Majors I: Lecture—Summer 05, 07
Lab—Summer 04, 05, Fall 05, Summer 06, 07
- Physics 114—Physics for Science Majors II: Lecture —Summer 05
Lab—Summer 04, 05; Spring 07
- Physics 211—Introduction to Mathematical Methods in Physics—Fall 03, 04, 05, 06, 07
- Physics 216—Modern Physics—Summer 04
- Physics 243—Analog Circuits: Lecture and Lab—Fall 04, 06, 07
- Physics 244—Digital Circuits: Lecture and Lab—Spring 04, 05, 06, 07, 08
- Physics 301—Mathematical Methods in Physics—Spring 05, 06, 07, 08
- Physics 322—Advanced Physics Laboratory: Lecture—Spring 07
Laboratory—Spring 04, 07
- Physics 390—Special Topics:
Quantum Mechanics II—Spring 06
- Physics 428—Quantum Mechanics—Fall 05, 06
- Physics 490—Independent Study:

- Modern Optical Physics—Fall 03
- Experimental Optical Physics—Spring 04
- Introduction to Quantum Optics—Spring 04
- Introduction to Thermodynamics, Electronics, and Optics Lab—Summer 04
- Engineering Mathematics—Fall 04
- Introduction to Quantum Physics—Fall 04
- Experimental Quantum Physics—Spring 05
- Optics—Spring 05
- Solid State Physics—Spring 05, 07
- Experimental Nonlinear Quantum Dots—Spring 05
- Partial Differential Equations—Spring 07

Previous Activities:

- University of Rochester Tae Kwon Do, 1999-Present; Black Belt 2001
- Optical Society of Greater St. Louis, Secretary, 1995-1997
- Institute of Electrical and Electronics Engineers
 - UMR Student Branch Secretary, Spring 1999.
 - UMR Student Branch Help Sessions Chair, Spring and Fall 1994
- Eta Kappa Nu--Electrical Engineering Honor Society
 - UMR Student Branch President, Fall 1995
 - UMR Student Branch Corresponding Secretary, Spring 1995
 - UMR Student Branch Special Projects Chair, Spring 1996
- UMR TECHS--Teaching, Encouraging, Caring, and Helping Students, Fall 1992-Spring 1993
- Chancellor's Leadership Class, Fall 1991-Spring 1992