

CURRICULUM VITAE

Carol E. Tanner
Professor of Physics
University of Notre Dame
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EDUCATION

Ph.D. Physics from the University of California-Berkeley, December 1985
M.A. Physics from the University of California-Berkeley, June 1982
B.S. Eng. Physics with High Honors from the University of Illinois-Urbana, May 1980

AWARDS AND HONORS

Fellow of the American Physical Society, November 2002
Kaneb Teaching Award, University of Notre Dame, May 2001
Nominated for Presidential Faculty Fellow Award October 1992
National Institute of Standards and Technology, Precision Measurements Grant Recipient 1992
Clare Boothe Luce Chaired Assistant Professorship, Henry Luce Foundation 1990-1995
National Research Council Postdoctoral Associateship Awardee 1988
Victor F. Lenzen Memorial Scholarship Award 1981, University of California-Berkeley
Bronze Tablet-University Honors 1980, University of Illinois-Urbana
Dean's List 1978-1980, University of Illinois-Urbana
Frederick W. Ring Scholarship Award 1978, Thornton Community College
Physics and Mathematics Achievement Awards 1978, Thornton Community College
Freshman Chemistry Achievement Award 1977, Thornton Community College

EMPLOYMENT AND APPOINTMENTS

Professor, of Physics, University of Notre Dame, Notre Dame, Indiana
August 2006-Present
Research Affiliate, National Institute of Standards and Technology, Boulder, Colorado,
September 1, 2003-Present
Visiting Professor, JILA/University of Colorado and Research Affiliate NIST, Boulder,
Colorado, October 1, 2002-August 22, 2003
Research Affiliate, National Institute of Standards and Technology, Boulder, Colorado,
September 1, 2001-September 31, 2002
Associate Professor, Department of Physics, College of Science, University of Notre Dame,
August 1996-August 2006
Claire Boothe Luce Chaired Assistant Professor of Physics, University of Notre Dame,
August 1990-1995

Assistant Professor, Department of Physics, University of Notre Dame, Notre Dame, Indiana
August 1990-1996
National Research Council Research Associate, National Institute of Standards and Technology,
Gaithersburg, Maryland, November 1988-July 1990
Research Associate, JILA-University of Colorado, Boulder, Colorado December 1985-
November 1988
Graduate Student Research Assistant, Department of Physics, University of California-Berkeley
and Lawrence Berkeley Laboratory, May 1982-1985
Teaching Assistant and Head Teaching Assistant, Department of Physics, University of
California-Berkeley, September 1980-May 1982
Research Intern, Xerox Corp., Palo Alto Research Center, Palo Alto, CA, June 1981-
September 1981
Research Associate, Semiconductor Electronics Research Department, Bell Laboratories,
Murray Hill, NJ, May 1980-September 1980

PROFESSIONAL SERVICE

Chair, American Physical Society (APS) Topical Group on Precision Measurements and
Fundamental Constants, April 2005-Present.
Member of Executive Committee, APS Division of Laser Science, November 2002-Present.
Chair Elect, APS Topical Group on Precision Measurements and Fundamental Constants, April
2004-05.
Vice Chair, APS Topical Group on Precision Measurements and Fundamental Constants, April
2003-04.
Member of Executive Committee, APS Division of Atomic, Molecular and Optical Physics,
May 1998-2001.
Member of External Review Panel for the Physics Department at the University of Nevada,
Reno, October 1998.
Chair of Ph.D. Thesis Prize Committee, APS Division of Atomic, Molecular and Optical
Physics, May 1997-1998.
Member of Ph.D. Thesis Prize Committee, APS Division of Atomic, Molecular, and Optical
Physics, May 1996-1998.
Member of Fellowship Committee, APS Topical Group on Precision Measurements and
Fundamental Constants, May 1996-1997.
Chair of Committee on Educational Activities, APS Topical Group on Precision Measurements
and Fundamental Constants, May 1995-1997.
Member of the Executive Committee, APS Topical Group on Precision Measurements and
Fundamental Constants, April 1994-1997.
Member of Committee on Atomic Molecular and Optical Physics (CAMOS), 2009-2012

UNIVERSITY OF NOTRE DAME SERVICE

Committee on Women Faculty and Students, 2007-
College Council, 2007-
Undergraduate Financial Aid Task Force, Fall 2004
Academic Council Undergraduate Studies Committee, 2004-05
Subcommittees on Grade Inflation, AP Credit, Academic Code of Honor

Academic Council, Graduate Studies Committee, 2003-04
Academic Council 2003-04, 2004-05
Research and Sponsored Programs 2002-Present
Member of Faculty and Student Committee on Women 2001-03
Co-Chair of Faculty and Student Committee on Women 2000-01

COLLEGE OF SCIENCE SERVICE

Clare Boothe Luce Professor Selection Committee, College of Science 2000-01
Clare Boothe Luce Professor Selection Committee, College of Science 1999-00

DEPARTMENT OF PHYSICS SERVICE

Appointments & Promotions, Fall 2007
Strategic Planning 2005-06
Demonstrations & Instructional Labs Committee 2004-05, 2005-06, Spring 2007
Undergraduate Recruitment 2007 (Chair in Spring 2007)
Undergraduate Recruitment 2003-04, 2004-05, 2005-06
Space Development and Utilization 2003-04, 2004-05, 2005-06
Research Services and Safety 2003-04, 2004-05, 2007
Graduate Admissions Committee 2000-01
Colloquium Committee 1999-00, 2007
Instructional Laboratories Committee 1999-00
Research Services Committee 1999-00
Colloquium Committee 1998-99
Chair Instructional Laboratories Committee 1998-99
Chair Research Services Committee 1998-99
Colloquium Committee 1998-99
Instructional Laboratories Committee 1997-1998
Research Services Committee 1997-98
Colloquium Committee 1997-98
Instructional Laboratories Committee 1996-97
Research Services Committee 1996-97
Colloquium Committee 1996-97
Instructional Laboratories Committee 1995-96
Research Services Committee 1995-96
Instructional Laboratories Committee 1994-95
Research Services Committee 1994-95
Instructional Laboratories Committee 1993-94
Research Services Committee 1993-94
Space Utilization Committee 1992-93
Research Services Committee 1992-93
Chair Colloquium Committee 1991-92
Undergraduate Curriculum Committee 1991-92
Colloquium Committee 1990-91
Undergraduate Curriculum Committee 1990-91

COURSE DEVELOPMENT

Funded course development project: National Science Foundation, Undergraduate Laboratory Improvement Program, “Lasers and Modern Optics for Undergraduates,”
August 1, 1996 through July 31, 1999, Amount: \$ 60,000 (undergraduate equipment only).
PI: Carol Tanner, Co-PIs: H. Gordon Berry and John M. LoSecco

PUBLICATIONS

1. "Static Polarizabilities from Norm-Conserving Pseudopotentials," G.B. Bachelet, C. Tanner, and M. Schluter, *Phys. Stat. Sol. (b)* **110**, 313 (1982).
2. "Theoretical Study of the Atomic and Electronic Structure of the c-4x4 Reconstructed GaAs(100) Surface," D.J. Chadi, C. Tanner, and J. Ihm, *Surface Science* **120**, L425-L430, (1982).
3. "Measurement of Stark Amplitudes a, b in the $6^2P_{1/2} \rightarrow 7^2P_{1/2}$ Transition in Atomic Thallium," C.E. Tanner and E.D. Commins, *Phys. Rev. Lett.* **56**, 332 (1986).
4. "Precision Measurement of the Stark Shift in the $6^2S_{1/2} \rightarrow 7^2S_{1/2}$ Cesium Transition Using a Frequency-Stabilized Laser Diode," C.E. Tanner and C. Wieman, *Phys. Rev. A*, **38**, 162 (1988).
5. "Atomic Beam Collimation Using a Laser Diode with a Self-Locking Power Buildup Cavity," C.E. Tanner, B.P. Masterson, and C.E. Wieman, *Opt. Lett.* **13**, 357 (1988).
6. "Precision Measurement of the Hyperfine Splitting in the $6^2P_{3/2}$ State of ^{133}Cs ," C.E. Tanner and C. Wieman, *Phys. Rev. A*, **38**, 1616 (1988).
7. "432nm Source Based on Efficient Second Harmonic Generation of GaAlAs Diode Laser Radiation in a Self-Locking External Resonant Cavity," G.J. Dixon, C.E. Tanner, and C.E. Wieman, *Opt. Lett.* **14**, 731 (1989).
8. "Optical Molasses," P.D. Lett, W.D. Phillips, S.L. Rolston, C.E. Tanner, R.N. Watts, and C.I. Westbrook, *Journal of the Optical Society of America B*, **6**, 2085 (1989).
9. "Localization of Atoms in a Three-Dimensional Standing Wave," C.I. Westbrook, R.N. Watts, C.E. Tanner, S.L. Rolston, W.D. Phillips, P.D. Lett, and P.L. Gould, *Phys. Rev. Lett.*, **65**, 33 (1990).
10. "Reply to a Comment on "Localization of Atoms in a Three-Dimensional Standing Wave,"" C.I. Westbrook, R.N. Watts, C.E. Tanner, S.L. Rolston, W.D. Phillips, and P.D. Lett, *Phys. Rev. Lett.*, **66**, 2413 (1991).
11. "Measurements of Fluorescence from Cold Atoms: Localization in Three Dimensional Optical Standing Waves," C.I. Westbrook, P. Jessen, C.E. Tanner, P.D. Lett, S.L. Rolston, R.N. Watts, Proceedings of the Twelfth International Conference on Atomic Physics July 1990, "Atomic Physics 12," eds. J.C. Zorn and R.R. Lewis, American Institute of Physics, New York 1991.
12. "Optical Molasses: Cold Atoms for Precision Measurements," W.D. Phillips, P.D. Lett, S.L. Rolston, C.E. Tanner, R.N. Watts, C.I. Westbrook, C. Salomon, J. Dalibard, A. Clairon, and S. Guellati, *IEEE Trans. on Inst. and Meas.*, **40**, 78 (1991).

13. "Measurement of Parity Nonconservation in Atoms," C.E. Wieman, S. Gilbert, C. Noecker, B.P. Masterson, C. Tanner, C. Wood, D. Cho, M. Stephens, Proceedings of the 1992 Fermi Summer School on Frontiers of Laser Spectroscopy.
14. "Measurement of the $6p\ ^2P_{3/2}$ State Lifetime in Atomic Cesium," C.E. Tanner, A.E. Livingston, R.J. Rafac, F.G. Serpa, K.W. Kukla, H.G. Berry, L. Young, and C.A. Kurtz, *Phys. Rev. Lett.* **69**, 2765 (1992).
15. "A High Purity, Spin Polarized Atomic Cesium Beam," B.P. Masterson, C.E. Tanner, H.J. Patrick, and C.E. Wieman, *Phys. Rev. A* **47**, 2139 (1993).
16. "Precision Lifetime Measurements of Cs $6p\ ^2P_{1/2}$ and $6p\ ^2P_{3/2}$ by Single Photon Counting," L. Young, W.T. Hill III, S.J. Sibener, S.D. Price, C.E. Tanner, C.E. Wieman, S.R. Leone, *Phys. Rev. A* **50**, 2174 (1994).
17. "Precision Lifetime Measurements of the $6p\ ^2P_{1/2, 3/2}$ States in Atomic Cesium," R.J. Rafac, C.E. Tanner, A.E. Livingston, K.W. Kukla, H.G. Berry, C.A. Kurtz, *Phys. Rev. A* **50**, R1976 (1994).
18. "Precision Lifetime Measurements Using Laser Excitation of a Fast Atomic Beam," C.E. Tanner, A.E. Livingston, R.J. Rafac, K.W. Kukla, H.G. Berry, C.A. Kurtz, *NIM B* **99**, 117-120 (1995).
19. "Measurement of Parity Nonconservation and an Anapole Moment in Cesium," C.S. Wood, S.C. Bennett, D. Cho, B.P. Masterson, J.L. Roberts, C.E. Tanner, C.E. Wieman, *Science* **275**, 1759 (21 March 1997).
20. "Measurement of the $^{133}\text{Cs}\ 6p\ ^2P_{1/2}$ State Hyperfine Structure," R.J. Rafac and C.E. Tanner, *Phys. Rev. A* **56**, 1027 (1997).
21. "Laser Doppler Velocimetry of a Fast Beam with a Temperature Stabilized Solid Etalon," D. DiBerardino, R.J. Rafac, D.M. Glantz, C.E. Tanner, *Opt. Com.* **143**, 118 (1997).
22. "Lifetime Measurements of Cesium $5d\ ^2D_{5/2, 3/2}$ and $11s\ ^2S_{1/2}$ States using Pulsed-Laser Excitation," D. DiBerardino, C.E. Tanner, A. Sieradzan, *Phys. Rev. A* **57**, 4204 (1998).
23. "Measurement of the ratio of the cesium D-line transition strengths," R.J. Rafac and C.E. Tanner, *Phys. Rev. A* **58**, 1087-1097 (1998).
24. "Wavelength Dependent Photoresponse in YBCO Thin-Film Systems," S.T. Ruggiero, M.P. Mischke, C.E. Tanner, A.J. Wilson, L.R. Vale, and D.A. Rudman, *IEEE Trans. Appl. Superconductivity* **9**, 3182-3185 (1999).
25. "Fast-Beam Laser Lifetime Measurements of the Cesium $6p\ ^2P_{1/2, 3/2}$ States," R.J. Rafac, C.E. Tanner, A.E. Livingston, and H.G. Berry, *Phys. Rev. A* **60**, 3648 (1999).

26. "Diode Lasers for Fast-beam Laser Experiments," V. Gerginov, B. Laughman, D. DiBerardino, R.J. Rafac, S.T. Ruggiero, C.E. Tanner, *Optics Communications* **187** (2001) 219-230, 1 Jan. 2001.
27. "High-precision Frequency Measurements in Thermal ^{133}Cs Cell," Vladislav Gerginov and Carol E. Tanner, *Proc. SPIE* vol. 4397, p. 166-170, 2001.
28. "Imperfect Detectors in Linear Optical Quantum Computers", S. Glancy, J.M. LoSecco, H.M. Vasconcelos, and C.E. Tanner, *Phys. Rev. A* **65**, 062317-1 through 7, June 2002.
29. "Fiber-Optic Bundle Light-Collection Systems and Calculations of Collection Efficiency," D. DiBerardino, R.J. Rafac, S. Boone, V. Gerginov, and C.E. Tanner, *Opt. Com.* **210** (2002) 233-243, 15 September 2002.
30. "The $^{199}\text{Hg}^+$ Single Ion Optical Clock: Recent Progress," U. Tanaka, S. Bize, C. E. Tanner, R. E. Drullinger, S. A. Diddams, L. Hollberg, W. M. Itano, D.J. Wineland, J. C. Bergquist, *J. Phys. B: At. Mol. Opt. Phys.* **36** (2003) 545-551, 23 January 2003.
31. "Heterodyne Frequency Calibration of High Resolution Cesium Spectra Using Diode Lasers," V. Gerginov and C.E. Tanner, *Optics Communications* **216** (2003) 391-399, 15 February 2003.
32. "Optical Frequency Standards Based on the $^{199}\text{Hg}^+$ Ion," U. Tanaka, J.C. Bergquist, S. Bize, S.A. Diddams, R.E. Drullinger, L. Hollberg, W.M. Itano, C.E. Tanner, and D.J. Wineland, *IEEE Transactions on Instrumentation and Measurement* **52**, No. 2, p. 245-249, April 2003.
33. "Testing the Stability of Fundamental Constants with the $^{199}\text{Hg}^+$ Single Ion Optical Clock," S. Bize, S.A. Diddams, U. Tanaka, C.E. Tanner, W.H. Oskay, R.E. Drullinger, T.E. Parker, T.P. Heavner, S.R. Jefferts, L. Hollberg, W.M. Itano, and J.C. Bergquist, *Phys. Rev. Lett.* **90**, 150802-1 through 4, 18 April 2003.
34. "Fluorescence of a Highly Collimated Atomic Cesium Beam: Theory and Experiment," V. Gerginov and C.E. Tanner, *Optics Communications* **222** (2003) 17-28, 6 May 2003.
35. "Magneto-optic Effects in Spin-injection Devices," S.T. Ruggiero, T. Williams, C.E. Tanner, S. Potashnik J. Moreland, and W.H. Rippard, *Appl. Phys. Lett.* **82**, 4599-4601 (2003), 23 June 2003. {Also selected for inclusion in the June 30, 2003 issue of the *Virtual Journal of Nanoscale Science & Technology*. }
36. "Observation of the Nuclear Magnetic Octupole Moment of ^{133}Cs ," V. Gerginov, A. Derevianko, and C.E. Tanner, *Phys. Rev. Lett.* **91**, 072501-1 through 4, 15 August 2003.
37. "Off-diagonal hyperfine interaction between the $6p_{1/2}$ and $6p_{3/2}$ levels in ^{133}Cs ," W.R. Johnson, H.C. Ho, C.E. Tanner, and A. Derevianko, *Phys. Rev. A* **70**, 014501, 1-3 (2004).

38. "Optical frequency measurements of $6s\ ^2S_{1/2}$ - $6p\ ^2P_{3/2}$ transitions in a ^{133}Cs atomic beam using a femtosecond laser frequency comb," V. Gerginov, C.E. Tanner, S. Diddams, A. Bartels, L. Hollberg, *Phys. Rev. A* **70**, 042505 (2004).
39. "Optical frequency measurements of $6s\ ^2S_{1/2}$ - $6p\ ^2P_{3/2}$ transition in ^{133}Cs using an atomic beam and a femtosecond laser frequency comb," V. Gerginov, C.E. Tanner, S.A. Diddams, A. Bartels, L. Hollberg, Conference on Lasers and Electro-Optics, 2004 (CLEO). Volume: 1, 788-789 May 17 – 19, 2004.
40. "The mercury-ion optical clock: Towards a measurement of the quadrupole shift," W.H. Oskay, A. Bartels, S.A. Diddams, C.W. Oates, G. Wilpers, L. Hollberg, D.J. Wineland, W.M. Itano, C.E. Tanner, and J.C. Bergquist, Proc. 18th European Frequency and Time Forum, (CDROM), (2004) 4p.
41. "High resolution spectroscopy with a femtosecond laser frequency comb," V. Gerginov, C.E. Tanner, S. Diddams, A. Bartels, L. Hollberg, *Optics Letters*, Vol. 30, July 1, 2005.
42. "Absolute optical frequency measurements of the $6s\ ^2S_{1/2}$ - $6p\ ^2P_{1/2}$ (D_1) transitions in ^{133}Cs and their impact on the fine structure constant," V. Gerginov, K. Calkins, C.E. Tanner, S. Diddams, J. McFerran, A. Bartels, L. Hollberg, *Phys. Rev. A*, accepted for publication, October 2005.
43. "Magneto-optic Effects in Ferromagnetic Films," C.E. Tanner, T. Williams, S. Schwall, S.T. Ruggiero, S. Potashnik, J.M. Shaw, C.M. Falco, *Optics Communications*, in press October 2005.
44. "The nuclear magnetic octupole moment of ^{87}Rb from spectroscopic measurements of hyperfine splittings," V. Gerginov, A. Derevianko, C.E. Tanner, H.C. Ho, W.R. Johnson, in preparation for publication, 2005.
45. "A new approach for small particle size measurement using laser wavelength scanning," F. Li, C.E. Tanner, S.T. Ruggiero, in preparation for publication, 2005.
46. "Observation of the Nuclear Magnetic Octupole Moment of ^{87}Rb from Spectroscopic Measurements of Hyperfine Intervals," Vladislav Gerginov, Carol E. Tanner, and W. R. Johnson, *Canadian Journal of Physics* **87** 101-104 (2009).

PATENTS

Sealed Fiber-Optic Bundle Feedthrough

Filed preliminary U.S. Patent Application Feb. 2000

Filed U.S. Patent Application: No. 09/783,416 February 2001

Patent Number 6445869 issued September 3, 2002

Biological Size Analyzer

S.T. Ruggiero and C.E. Tanner

Filed preliminary U.S. Patent Application No: 60/627,151

CONTRIBUTED CONFERENCE PRESENTATIONS (posters and talks)

“Measurement of Stark Amplitudes in the $6^2P_{1/2} \rightarrow 7^2P_{1/2}$ Transition of Atomic Thallium,” C.E. Tanner and E.D. Commins, APS Div. of Atomic Mol. and Optical Phys. Meeting (DAMOP) June 1986.

“Demonstration of a Spontaneous Force Atom Trap,” C. Tanner, D. Sesko, R. Watts, and C. Wieman, DAMOP May 1987, post dead line contribution.

“Atomic Beam Collimation Using a Laser Diode with a Self-locking Power Buildup Cavity,” C.E. Tanner, B.P. Masterson, and C. Wieman, DAMOP April 1988.

“Precision Measurements of the Stark Shift and the Hyperfine Structure in the ^{133}Cs $6P_{3/2}$ State Using a Frequency Stabilized Laser Diode,” C.E. Tanner and C. Wieman, DAMOP April 1988.

“Efficient Second-Harmonic Generation at 432 nm by Passive Optical Locking of a GaAlAs Laser Diode to a Nonlinear Power Buildup Cavity,” Opt. Soc. of America Conference Oct.-Nov. 1988.

“Multilevel Atoms: Cooling Below the Doppler Limit,” P.D. Lett, C.I. Westbrook, R.N. Watts, S.L. Rolston, C.E. Tanner, W.D. Phillips, Coherence and Quantum Optics, Rochester, 1989.

“A New Approach for Measuring the Dipole Moment of the Electron,” C.E. Tanner, B.P. Masterson, and C. Wieman, DAMOP May 1989.

“Heterodyne Detection of the Fluorescence Spectrum of Na Atoms in Optical Molasses,” C.E. Tanner, C.I. Westbrook, R.N. Watts, S.L. Rolston, W.D. Phillips, P.D. Lett, and P.L. Gould, DAMOP May 1990.

“The Fluorescence Spectrum of Optical Molasses,” C.I. Westbrook, R.N. Watts, C.E. Tanner, S.L. Rolston, W.D. Phillips, and P.D. Lett, International Quantum Electronics Conference 1990.

“Measurement of the $6P$ Lifetime in the Cs Atom,” R.J. Rafac, C.E. Tanner, A.E. Livingston, F.G. Serpa, K.W. Kukla, H.G. Berry, L. Young, and C.A. Kurtz, DAMOP May 1992.

“Measurement of the $6S_{1/2}$ - $7S_{1/2}$ Stark Induced Transition Amplitude in Atomic Cesium,” R.J. Rafac, C.E. Tanner, DAMOP May 1993.

“Measurements of Excited-State Lifetimes in Atomic Cesium,” C.E. Tanner, A.E. Livingston, R.J. Rafac, F.G. Serpa, K.W. Kukla, H.G. Berry, L. Young, and C.A. Kurtz, DAMOP May 1993.

“Precision Lifetime Measurements in Atomic Cesium,” L. Young, W.T. Hill, S.J. Sibener, S. Price, C.E. Wieman, S.R. Leone, and C.E. Tanner, IQEC May 1993.

“Precision Measurements of Excited-State Lifetimes in Atomic Cesium with Diode Lasers,” C.E. Tanner, A.E. Livingston, R.J. Rafac, F.G. Serpa, K.W. Kukla, H.G. Berry, L. Young, and C.A. Kurtz, Optical Society of America/Interdisciplinary Laser Science Conference, Oct. 1993.

“Delayed Coincidence Measurement of the $6p\ ^2P_{1/2}$ State Lifetime in Atomic Cesium,” R.J. Rafac, D. DiBerardino, C.E. Tanner, DAMOP April 1994.

“Measurements of Excited-State Lifetimes in Atomic Lithium,” C.E. Tanner, A.E. Livingston, R.J. Rafac, K.W. Kukla, H.G. Berry, C.A. Kurtz, DAMOP April 1994.

“Precision Lifetime Measurements of Cs $6p\ ^2P_{1/2}$ and $6p\ ^2P_{3/2}$ by Single Photon Counting,” L. Young, W.T. Hill, S.J. Sibener, S.D. Price, C.E. Tanner, C.E. Wieman, S.R. Leone, Fourteenth International Conference on Atomic Physics July 31-August 5, 1994.

“Precision Density Calibration for Absolute Transition Strength Measurements in Atomic Cesium,” R.J. Rafac and C.E. Tanner, Fourteenth International Conference on Atomic Physics July 31-August 5, 1994.

“Measurements of Atomic Lifetimes in Cesium and Lithium,” C.E. Tanner, R.J. Rafac, A.E. Livingston, K.W. Kukla, H.G. Berry, C.A. Kurtz, Fourteenth International Conference on Atomic Physics July 31-August 5, 1994.

“Fast-Beam Laser Measurement of the $2p\ ^2P_{1/2, 3/2}$ State Lifetimes in Atomic Lithium,” C.E. Tanner, R.J. Rafac, K.W. Kukla, A.E. Livingston, H.G. Berry, C.A. Kurtz, DAMOP May 1995.

“Cascade Photon Coincidence Measurement of the $6p\ ^2P_{1/2, 3/2}$ State Lifetime in Atomic Cesium,” D. DiBerardino, R.J. Rafac, C.E. Tanner, DAMOP May 1995.

“Precision Density Measurements Via Direct Absorption in an Atomic Cesium Vapor Cell,” R.J. Rafac, C.E. Tanner, DAMOP May 1995.

“Precision Lifetime Measurements by Laser Excitation of Fast Ion Beams,” J. Riley, A. Vasilyev, H.G. Berry, C. Tanner, A.E. Livingston, DAMOP May 1996.

“Determination of Cesium Vapor Density by Absorption Measurements,” R.J. Rafac and C.E. Tanner, Fifteenth International Conference on Atomic Physics 5-9 August 1996.

“Precision Measurements of Atomic Lifetimes by Laser Excitation of Fast Atomic Beams,” C.E. Tanner, A. Vasilyev, H.G. Berry, A.E. Livingston, Fifteenth International Conference on Atomic Physics 5-9 August 1996.

“Precision Lifetimes and Hyperfine Structures Using Laser Excitation of Fast Ion Beams,” A. Vasilyev, H.G. Berry, C.E. Tanner, A.E. Livingston, Fifteenth International Conference on Atomic Physics 5-9 August 1996

“Absorption Measurement of the Ratio of Cesium $6\ ^2P_J$ Oscillator Strengths,” R.J. Rafac and C.E. Tanner, APS and DAMOP, April 1997.

“Laser Doppler Velocimetry of a Fast Atomic Lithium Beam,” D. DiBerardino, R.J. Rafac, and C.E. Tanner, APS and DAMOP, April 1997.

“Wavelength Dependent Response in YBCO Thin-Film Systems,” S.T. Ruggiero, C.E. Tanner, and A.J. Wilson at the Fall Meeting of the Materials Research Society, Boston, MA, December 1997.

“Lifetime Measurements of Cesium $5d\ ^2D_{5/2, 3/2}$ and $11s\ ^2S_{1/2}$ States Using Pulsed-Laser Excitation,” D. DiBerardino and C.E. Tanner, DAMOP, May 1998.

“Vapor Pressure of Cesium between 270 and 370 K via Laser Absorption,” Robert J. Rafac and Carol E. Tanner, DAMOP, Santa Fe, NM, May 1998.

“Precision Ratio Measurements of Cesium Transition Strengths,” Robert J. Rafac and Carol E. Tanner, Sixteenth International Conference on Atomic Physics, Windsor, Ontario, August 3-7, 1998.

“Wavelength-Dependent Photoresponse in YBCO Thin-Film Systems,” S.T. Ruggiero, N. Crain, M. Mischke, C.E. Tanner, A.J. Wilson, L.R. Vale, and D.A. Rudman, Applied Superconductivity Conference (1998).

“Absolute Absorption Measurements of the Cesium Line Strengths $6s\ ^2S_{1/2} \rightarrow 7p\ ^2P_J$ ($J = 1/2, 3/2$),” C.E. Tanner and R.J. Rafac, Centennial APS and DAMOP, April 1999.

“ ^{133}Cs ($I=7/2$) $6\ ^2P_{3/2}$ Hyperfine Structure Measurements,” Vladislav Gerginov and Carol Tanner, Centennial APS and DAMOP, April 1999.

“Decay Lifetime Measurement for Cs $7\ P_{1/2}$ and $7\ P_{3/2}$ States,” A.A. Vasilyev, H.G. Berry, and C.E. Tanner, Centennial APS and DAMOP, April 1999.

“Absolute Absorption Measurements of the Cesium Line Strengths $6s\ ^2S_{1/2} \rightarrow 7p\ ^2P_J$ ($J = 1/2, 3/2$),” C.E. Tanner and R.J. Rafac, International Conference on Atomic Physics, Florence, Italy, June 2000.

“Cs Atomic Structure Studies Using Diode Lasers”, V.P. Gerginov and C.E. Tanner, DAMOP Storrs, Connecticut, 14-17 June 2000.

“High Precision Frequency Measurements in Thermal ^{133}Cs Cell,” V. Gerginov and C. Tanner, Eleventh International School on Quantum Electronics, 18-22 September 2000, Varna, Bulgaria. (Selected for inclusion in the SPIE proceedings.)

“Laser absorption-fluorescence experiments in helium,” I. Savukov, H.G. Berry, C.E. Tanner, DAMOP 2001, London Ontario, May 2001.

“Cesium Line Strengths by Absorption,” C.E. Tanner and R.J. Rafac, DAMOP 2001, London Ontario, May 2001.

“Thermal Beam Spectroscopy of ^{133}Cs ,” Vladislav Gerginov and C.E. Tanner, DAMOP 2001, London Ontario, May 2001.

“Imperfect Detectors in Linear Optical Quantum Computers”, S. Glancy, J.M. LoSecco, H.M. Vasconcelos, and C.E. Tanner, Fourth annual meeting of the Southwestern Quantum Information and Technology network (SQUINT) NIST, Boulder, CO, March 8-10, 2002

“Wavelength-Dependent Photoresponse in $\text{YBa}_2\text{CuO}_{7-\delta}$ ”, M.P. Mischke, S.T. Ruggiero, C.E. Tanner, L.R. Vale, Indianapolis, IN, APS March Meeting, March 18-22, 2002.

“Hyperfine Spectroscopy of Cesium at the kHz Level,” V. Gerginov and C.E. Tanner, DAMOP 2002, Williamsburg, VA, May 28-June 1, 2002.

“Construction of Fiber-optic Light Collection Systems and Calculations of Collection Efficiency,” D. DiBerardino, S. Boone, V. Gerginov, R.J. Rafac, C.E. Tanner, DAMOP 2002, Williamsburg, VA, May 28-June 1, 2002.

“Laser Heterodyne Frequency Measurements of the ^{133}Cs $6p\ ^2P_{3/2}$ State Hyperfine Splitting,” V. Gerginov and C.E. Tanner, 34 Conference of the European Group for Atomic Spectroscopy (EGAS 34), Sofia Bulgaria, 9-12 July 2002.

“Investigation into the Nuclear Moments of ^{133}Cs ,” V. Gerginov and C.E. Tanner, XVIII International Conference on Atomic Physics (ICAP 2002), Cambridge, MA, 28 July-2 August 2002.

“Magneto-optic Effects in Ferromagnetic-based Spin Injection Devices Films,” S.T. Ruggiero, T. Williams, C.E. Tanner, S. Potashnik, J. Moreland, and W.H. Rippard, Bull. Am. Phys. Soc. **48**, 313 (2003), APS March Meeting 2003.

“High Resolution Spectroscopy Reveals the Nuclear Magnetic Octupole Moment of ^{133}Cs ,” C.E. Tanner and V. Gerginov, Topical Group on Precision Measurements and Fundamental Constants, APS Meeting, April 5-8, 2003, Philadelphia, Pennsylvania.

“The Mercury-Ion Optical Clock and the Search for Temporal Variation of Fundamental Constants,” W.H. Oskay, S. Bize, S.A. Diddams, R.E. Drullinger, T.P. Heavner, L. Hollberg, W.M. Itano, S.R. Jefferts, T.E. Parker, U. Tanaka, C.E. Tanner, and J.C. Bergquist, Joint Meeting of the IEEE International Frequency Control Symposium and 17th European Frequency and Time Forum, Tampa, FL, 5-8 May 2003.

“Testing the stability of fundamental constants with the $^{199}\text{Hg}^+$ single-ion optical clock”, W.H. Oskay, S. Bize, S.A. Diddams, U. Tanka, C.E. Tanner, T. Parker, R.E. Drullinger, T. Heavener, S.R. Jefferts, L. Hollberg, W.M. Itano, J.C. Bergquist, DAMOP May 2003, Boulder, CO.

“Nuclear Magnetic Octupole Moment of ^{133}Cs Through High Resolution Laser Spectroscopy” V. Gerginov and C.E. Tanner, DAMOP May 2003, Boulder, CO.

“Towards a measurement of the quadrupole shift in the mercury-ion optical clock,” W.H. Oskay, A. Bartels, S.A. Diddams, C.W. Oates, G. Wilpers, L. Hollberg, D. J. Wineland, W.M. Itano, C.E. Tanner, and J.C. Bergquist, European Frequency and Time Forum (EFTF), 5-7 April 2004, University of Surrey, Guildford, UK.

“Optical frequency measurements of $6s\ ^2S_{1/2}$ - $6p\ ^2P_{3/2}$ transition in ^{133}Cs using an atomic beam and a femtosecond laser frequency comb,” V. Gerginov, C.E. Tanner, S. Diddams, A. Bartels, and L. Hollberg, Conference On Laser Electro-Optics/International Quantum Electronics Conference (CLEO/IQEC) May 16-21, 2004, The Moscone Center West, San Francisco, California, USA

“Precise frequency measurements of $6s\ ^2S_{1/2}$ - $6p\ ^2P_{3/2}$ transition in ^{133}Cs atomic beam using a femtosecond laser frequency comb,” V. Gerginov, C.E. Tanner, S. Diddams, A. Bartels, L. Hollberg, Conference on Precision Electromagnetic Measurements (CPEM) 27 June - 2 July 2004, London, UK.

“Optical frequency measurements of D_2 line in ^{133}Cs ,” V. Gerginov, C.E. Tanner, S.A. Diddams, A. Bartels and L. Hollberg, DAMOP May 25-29, 2004, Marriott University Park Hotel, Tucson, Arizona.

“Absolute optical frequency measurements of the D_1 and D_2 lines in ^{133}Cs ,” K. Calkins, V. Gerginov, C.E. Tanner, S.A. Diddams, A. Bartels and L. Hollberg, Frontiers in Optics and Laser Science Conference, OSA & DLS, 16-20 October 2004, Hilton El Conquistador Tucson, Arizona, USA.

“Absolute Optical Frequency Measurements of the Cesium D_1 Transitions in a Thermal Atomic Beam using a Femtosecond Laser Frequency Comb,” C.E. Tanner, V. Gerginov, K. Calkins, S. Diddams, A. Bartels, J. McFerran, Leo Hollberg, APS, April 2005, Tampa, Florida.

“High resolution spectroscopy with a femtosecond laser frequency comb,” V. Gerginov, C.E. Tanner, S. Diddams, A. Bartels, and L. Hollberg CLEO/QELS 22-27 May 2005, Baltimore Convention Center, Baltimore, Maryland, USA.

“Direct spectroscopy of cesium with a femtosecond laser frequency comb,” V. Gerginov, C.E. Tanner, S.A. Diddams, A. Bartels, L. Hollberg, 17th International Conference On Laser Spectroscopy (ICOLS), 19-24 June 2005, Cairngorms National Park, Scotland.

“High-Resolution Spectroscopy with Femtosecond Optical Combs,” J.E. Stalmaker, S.A. Diddams, T.M. Fortier, V. Gerginov, Y. Le Coq, V. Mbele, C.W. Oates, D. Ortego, C.E. Tanner, and L. Hollberg, Invited Talk CThX3 (given by Stalmaker), Conference on Lasers and Electro-Optics/Quantum Electronics CLEO/QELS 2007, May 6-11, 2007, Baltimore, MD.

“Absolute Optical Frequency Measurements in Cs and Their Impact on Atom Interferometry and the Fine Structure Constant,” V. Gerginov, K. Calkins, C.E. Tanner, J.J. McFerran, S. Diddams, A. Bartels, and L. Hollberg, Poster No. 34 (by invitation only), 18th International Conference on Laser Spectroscopy, ICOLS 2007, Jun. 24-29, 2007, Telluride, CO.

“Direct Spectroscopy of Cesium in a Vapor Cell with a Femtosecond Laser Frequency Comb,”
V.L. Mbele, J.E. Stalnaker, T.M. Forier, S.A. Diddams, L. Hollberg, V. Gerginov, C.E. Tanner,
Poster No. 64 (by invitation only), 18th International Conference on Laser Spectroscopy, ICOLS
2007, Jun. 24-29, 2007, Telluride, CO.

INVITED CONFERENCE PRESENTATIONS (talks presented by names underlined)

“A Heterodyne Measurement of the Fluorescence Spectrum of Optical Molasses,” W.D. Phillips, C.I. Westbrook, R.N. Watts, S.L. Rolston, C.E. Tanner, P.D. Lett, and P.L. Gould, Ninth International Conference on Laser Spectroscopy 1989.

“Atoms in Optical Molasses: Applications to Frequency Standards,” W.D. Phillips, P.D. Lett, S.L. Rolston, C.E. Tanner, R.N. Watts, C.I. Westbrook, C. Salamon, J. Dalibard, A. Clarion, S. Guellati, Fourth European Frequency and Time Forum Neuchatel, 13-15 March 1990.

“Atoms in Optical Molasses,” W.D. Phillips, P.D. Lett, S.L. Rolston, C.E. Tanner, R.N. Watts, C.I. Westbrook, Conference on Precision Electromagnetic Measurements 1990.

“Measurements of Fluorescence from Cold Atoms: Localization in Three Dimensional Optical Standing Waves,” C.I. Westbrook, P. Jessen, C.E. Tanner, P.D. Lett, S.L. Rolston, R.N. Watts, Twelfth International Conference on Atomic Physics July 1990.

“Measurement of Parity Nonconservation in Atoms,” C.E. Wieman, S. Gilbert, C. Noecker, B.P. Masterson, C. Tanner, C. Wood, D. Cho, M. Stephens, 1992 Fermi Summer School on Frontiers of Laser Spectroscopy.

“Precision Measurements of Atomic Lifetimes,” C.E. Tanner, Fourteenth International Conference on Atomic Physics July 31-August 5, 1994, proceedings published in *Atomic Physics 14*, ed. C.E. Wieman and D. Wineland, American Institute of Physics, New York 1995.

“Precision Lifetime Measurements Using Laser Excitation of a Fast Atomic Beam,” C.E. Tanner, E.A. Livingston, R.J. Rafac, K.W. Kukla, H.G. Berry, C.A. Kurtz, presented at Thirteenth International Conference on the Application of Accelerators in Research and Industry November 7-10, 1994., proceedings published in *Nuclear Instruments and Methods B*, **99** (1995) 117-120.

“Inside Cesium,” C.E. Tanner, presented at *Atoms, Photons, and Their Interaction: A Symposium in Honor of W.D. Phillips* (1997 recipient of a Nobel Prize in Physics) at the National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, June 17-19, 1998.

Session on Fundamental Symmetries, Chair: C.E. Tanner, DAMOP Storrs, Connecticut, 14-17 June 2000.

“Hyperfine Structure of the Cs $6p\ ^2P_{3/2}$ state: Can we measure a nuclear magnetic octupole moment?” C.E. Tanner, Invited oral presentation at Workshop on the Tests of Fundamental Symmetries in Atoms and Molecules at the Institute for Theoretical Atomic and Molecular Physics at Harvard-Smithsonian Center for Astrophysics, Boston, November 29-December 1, 2001.

“Optical Frequency Standards Based on the $^{199}\text{Hg}^+$ Ion,” U. Tanaka, J.C. Bergquist, R.E. Drullinger, W.M. Itano, C.E. Tanner, and D.J. Wineland, Conference on Precision Electromagnetic Measurements (CPEM), 16-21 June 2002.

“Optical Timepieces Using Single, Laser Cooled Mercury Ions,” J.C. Bergquist, S. Bize, R.E. Drullinger, W.M. Itano, U. Tanaka, C.E. Tanner, D.J. Wineland, S.A. Diddams, Th. Udem, L. Hollberg, International Quantum Electronics Conference 2002, June 22-27, 2002, Moscow, Russia.

“The $^{199}\text{Hg}^+$ Optical Frequency Standard,” R.E. Drullinger, U. Tanaka, C.E. Tanner, S. Bize, W. Itano, D. J. Wineland, J.C. Bergquist, International Conference on Precision Physics of Simple Atomic Systems, St. Petersburg, Russia June 30-July 4, 2002.

“The $^{199}\text{Hg}^+$ Single Ion Optical Clock” R.E. Drullinger, U. Tanaka, C.E. Tanner, S. Bize, W. Itano, D. J. Wineland, J.C. Bergquist, S.A. Diddams, and L. Hollberg, International Conference on Trapped Charged Particles and Fundamental Interactions 2002, Wildbad-Kreuth, Germany, August 25-30, 2002.

“Femtosecond laser frequency combs: optical synthesizers for high precision spectroscopy and frequency metrology,” S. A. Diddams, A. Bartels, T. Fortier, E. Ivanov, J. McFerran, W. Oskay, G. Wilpers, C.W. Oates, J.C. Bergquist, L. Hollberg, V. Gerginov, and C.E. Tanner, EQEC June 2005, Munich, Germany.

INVITED COLLOQUIA AND SEMINARS

“Parity Non-Conservation in Atomic Cesium,” October 6, 1988, Physic Department Colloquium, Kansas State University.

“Parity (and Time Reversal) Nonconservation in Atomic Cesium,” February 8, 1989, Center for Atomic, Molecular, and Optical Physics Colloquium, National Institute of Standards and Technology.

“Parity (and Time Reversal) Nonconservation in Atomic Cesium,” February 15, 1989, Department of Physics Colloquium, University of Notre Dame.

“Parity (and Time Reversal) Nonconservation in Atomic Cesium,” August 28, 1989, Department of Physics Seminar, Purdue University.

“Optical Molasses,” August 29, 1989, Department of Physics Seminar, Purdue University.

“Optical Molasses,” December 4, 1989, Department of Physics Colloquium, Virginia Commonwealth University.

“Heterodyne Detection of Atoms in Optical Molasses,” June 7, 1990, Atomic Physics Seminar, University of Notre Dame.

“Optical Molasses,” October 11, 1990, Atomic and Molecular Physics Seminar, Argonne National Laboratory.

“Parity Nonconservation in Atomic Cesium,” February 26, 1991, The College of Science Distinguished Scholar Lecture Series, University of Notre Dame.

“Precision Lifetime Measurements as a Test of Atomic Many-Body Theory in Parity-Nonconservation Calculations,” October 31, 1991, Atomic and Molecular Physics Seminar, Argonne National Laboratory.

“Laser Cooling and Trapping of Neutral Atoms,” February 26, 1992, lecture given as part of NSF Young Scholars project at Notre Dame, Trinity High School, South Bend, Indiana.

“Measurement of the 6P State Lifetime in Atomic Cesium,” September 10, 1992, Physics Department Seminar, Indiana University-Purdue University at Indianapolis.

“Measurement of the 6P State Lifetime in Atomic Cesium,” October 13, 1992, Department of Physics Colloquium, York University, East York, Ontario, Canada.

“Lifetime Measurements in Cesium: Tests of Atomic Many-Body Theory in Parity Nonconservation Calculations,” March 18, 1993, Atomic and Molecular Physics Seminar, Argonne National Laboratory.

“Absolute Calibration of Atomic Parity Nonconservation Measurements,” Department of Physics Colloquium, Western Michigan University, November 16, 1993.

“Precision Lifetime Measurements using Laser Excitation of a Fast Atomic Beam,” Atomic Physics Seminar, Department of Physics, University of Notre Dame, May 1, 1995.

“Precision Lifetime Measurements using Laser Excitation of a Fast Atomic Beam,” Physical Chemistry Seminar, Department of Chemistry and Biochemistry, University of Notre Dame, May 4, 1995.

“Precision Measurements of Atomic Lifetimes,” Atomic Physics Seminar, State University of New York-Stony Brook, March 15, 1996.

“Journey to the Center of Cesium,” Department of Physics Colloquium, Central Michigan University, Mount Pleasant, Michigan, November 19, 1998.

“Measuring a Nuclear Magnetic Octupole Moment”, NIST, Time and Frequency Division, Ion Storage Group Seminar, December 14, 2001.

“High Resolution Spectroscopy of Atomic Hyperfine Structure Reveals the Nuclear Magnetic Octupole Moment of ^{133}Cs ,” Seminar at European Laboratory for Non-linear Spectroscopy (LENS) in Firenze, Italy, July 8, 2003.

“A journey to the Center of Cesium: Observation of the Nuclear Magnetic Octupole Moment of ^{133}Cs ,” Department Colloquium, University of Washington, Seattle, February 24, 2004.

“The $^{199}\text{Hg}^+$ Optical Clock,” Atomic Physics Seminar, University of Washington, Seattle, February 24, 2004.

“Absolute Optical Frequency Measurements in ^{133}Cs and the Fine Structure Constant,” Department Colloquium, Western Michigan University, November 8, 2004.

“Absolute Optical frequency measurements of $6s\ ^2S_{1/2} - 6p\ ^2P_{1/2}$ (D1) transitions in ^{133}Cs and their impact on the fine-structure constant,” Invited Seminar of Center for Ultra-cold Atoms MIT/Harvard, Presented in Department of Physics Harvard University, October 4, 2005.

WORKSHOPS

“Precision Measurements of Atomic Lifetimes in Alkali-Like Systems,” Carol E. Tanner, 16th Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Poster Presentation, November 1995.

“Precision Measurements of Atomic Lifetimes in Alkali-Like Systems,” Carol E. Tanner, 17th Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Invited Oral Presentation, October 1996.

“Precision Measurements of Atomic Lifetimes in Alkali and Alkali-Like Systems,” Carol E. Tanner, 18th Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Poster Presentation, September 1997.

“Precision Measurements of Atomic Lifetimes and Hyperfine Energies in Alkalis-Like Systems,” Carol E. Tanner, 19th Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Poster Presentation, October 1998.

20th Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, October 1999.

21st Workshop of the Atomic Physics Program, U.S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, September 2000.

“Hyperfine Structure of the Cs $6p \ ^2P_{3/2}$ state: Can we measure a nuclear magnetic octupole moment?” Invited oral presentation at Workshop on the Tests of Fundamental Symmetries in Atoms and Molecules at the Institute for Theoretical Atomic and Molecular Physics at Harvard-Smithsonian Center for Astrophysics, Boston, November 29-December 1, 2001.

BOOK CHAPTERS

“Laser Excitation of Fast Atomic Beams for Precision Lifetime Measurements,” Chapter 18 in *Accelerator-Based Atomic Physics Techniques and Applications*, ed. by J. Austin and S. Shafroth, New York; AIP Press, 1997.

GRADUATE STUDENTS

Louis J. Nardella, Master of Science Degree May 1992

Robert J. Rafac, Completed Ph.D. Thesis Aug. 97, "High Precision Absolute Measurements of Transition Strengths in Neutral Cesium." Recipient of the Eli J. and Helen Shaheen Graduate School Award in Science.

Diana DiBerardino, Completed Ph.D. Thesis Aug. 98, "Lifetime Measurements in Neutral Alkalis."

Vladislav Gerginov, Defended Thesis April 1, 2003, Graduated May 2003, "Observation of the Nuclear Magnetic Octupole Moment of ^{133}Cs Through High-Resolution Laser Spectroscopy"

Keith Gordon Calkins, Defended Thesis March 16, 2005, Graduated May 2005, "Absolute Optical Frequency Measurements of the Cesium D_1 Transition and Their Effect on Alpha, the Fine Structure Constant"

Jennifer Reinig, 5th year graduate student (M.Sc. Jan. 2007)

Levente Borvak, 4th year graduate student

Frank Li, 4th year graduate student (with S. Ruggiero)

Worked in collaboration with:

Alex Vasilyev (Principal Advisor: Prof. Gordon Berry) Graduated December 2001

Igor Savukov (Principal Advisor: Prof. Gordon Berry) Graduated Summer 2002

Scott Glancy (Principal Advisor: Prof. John LoSecco) Graduated Summer 2004

Working in collaboration with:

Hilma Vasconcelos (Principal Advisor: Prof. John LoSecco) Ph.D. August 2006

POST DOCTORAL RESEARCH ASSOCIATES

Vladislav Gerginov, May 2003-October 2006

UNDERGRADUATE THESIS STUDENTS

Eric Schreiber, Completed Thesis April 1993, "Design and Construction of an LNA Laser at $1.08\ \mu\text{m}$." Selected as one of the two most outstanding Research Projects in the College of Science for 1993.

**RESEARCH EXPERIENCE FOR UNDERGRADUATE STUDENTS
SPONSORED BY NSF**

Robert Taub	1991
Phillip Koppers	1992
Christine Gustafson	1993
David Glantz	1995
Dan Chitwood	1998

ND WORK STUDY AND RESEARCH STUDENTS

Michael McKerns
Germain Linares
Ashling McKenna
John Kenny
Brian Laughman
Patrick Mickel
Adam Gadzinski

VISITING SCHOLARS

Prof. Steven Boone-on sabbatical from Hanover College, Hanover, IN
September 2000-August 2001