

Michael E. Goggin, Ph.D.

Physics Department
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EDUCATION

Ph.D. 1988, University of Arkansas, Fayetteville, AR Major: Physics
Dissertation: "Classical and Quantum Chaos of Nonlinear Driven Systems"
Advisor: Peter Milonni
B.S. 1983, Oakland University, Rochester, MI Major: Physics Minor: Mathematics

SUMMARY OF PROFESSIONAL POSITIONS

8/10 - present Professor, Physics Department, Truman State Univ., Kirksville, MO
8/03 - 8/10 Associate Professor, Physics Department, Truman State Univ., Kirksville, MO
1/08 - 7/08 On sabbatical at the Physics Department, Univ. of Queensland, Brisbane, QLD, Australia
5/07 - 12/07 On sabbatical at the Physics Department, Univ. of Illinois at Urbana-Champaign, Urbana, IL
6/03 - present Visiting Scientist, Physics Department, Univ. of Illinois at Urbana-Champaign, Urbana, IL
12/06 - 6/07 Physics Consultant, A. T. Still Research Institute, A. T. Still University, Kirksville, MO
8/98 - 8/03 Assistant Professor, Physics Department, Truman State Univ., Kirksville, MO
8/92 - 6/98 Assistant Professor, Physics Department, Univ. of Southern Indiana, Evansville, IN
9/90 - 12/92 College Assistant Professor & Adjunct Assistant Professor, New Mexico State Univ., Las Cruces, NM
2/90 - 7/92 Optical Engineer, PSR Services, Inc., White Sands Missile Range, NM
11/89 - 1/90 Substitute Teacher, Tempe, Paradise Valley, and Mesa, AZ School Districts
10/88 - 9/89 Postdoctoral Research Associate, Physics Dept., New Mexico State Univ., Las Cruces, NM
6/88 - 9/88 Summer Research Scholar, Quantum Optics Branch, Air Force Weapons Laboratory, Kirtland AFB, NM
5/86 - 6/88 Graduate Research Assistant, Physics Dept., Univ. of Arkansas, Fayetteville, AR (Work performed at Los Alamos National Lab, Los Alamos, NM)
8/84 - 5/86 Graduate Teaching Assistant, Physics Dept., Univ. of Arkansas, Fayetteville, AR

PROFESSIONAL SOCIETY MEMBERSHIPS

Sigma Pi Sigma

American Physical Society

Optical Society of America

Council on Undergraduate Research

Sigma Xi (Life Member)

American Association of Physics Teachers

- President Kirksville Chapter, 2011-2012
- President-elect Kirksville Chapter, 2010-2011
- President Kirksville Chapter, 2001-2002
- President-elect Kirksville Chapter, 1999-2001
- Delegate to annual meeting, 1999 and 2000

- Vice President Indiana Section 1997-1998

COURSES TAUGHT

- PRIMO College Prep Academy (a course for college bound high school students): Summer 2000, Summer 2001
- Physical Science for Elementary Teachers (PSET): Fall 1985, Spring 1985
- Introduction to Physical Science (physics for non-science-majors): Summer 1993, Spring 1994, Spring 1995, Spring 1996, Summer 1996, Fall 1996, Spring 1997, Spring 1998, Summer 1998
- Concepts of Physics (physics for non-science majors): Fall 2002, Fall 2003, Spring 2004, Fall 2004, Spring 2005, Fall 2005, Fall 2006, Spring 2007, Spring 2009
- Concepts of Physics Laboratory: Fall 2002, Fall 2003, Spring 2004, Fall 2004, Spring 2005, Fall 2005, Fall 2006, Spring 2007, Spring 2009
- Physics Seminar (first-year seminar for majors): Fall 2002, Fall 2003, Fall 2008, Fall 2009, Fall 2011
- College Physics I (non-calculus introductory class): Summer 1985, Fall 1992, Fall 1993, Fall 1994, Summer 1995, Fall 1995, Fall 1996, Summer 1997, Fall 1997
- College Physics I Laboratory: Fall 1992, Fall 1993, Fall 1994, Summer 1995, Fall 1995, Summer 1997, Fall 1997
- College Physics II (non-calculus introductory class): Spring 1989, Fall 1992, Spring 1993, Spring 1994, Spring 1995, Summer 1995, Spring 1996, Spring 1997, Summer 1997, Spring 1998
- College Physics II Laboratory: Fall 1992, Spring 1993, Spring 1994, Spring 1995, Summer 1995, Spring 1996, Spring 1997, Summer 1997, Spring 1998
- Intermediate Physics I (calculus-based introductory class): Fall 1994, Fall 1995, Fall 1998, Fall 1999, Fall 2000, Fall 2001
- Intermediate Physics I Laboratory: Fall 1994, Fall 1995, Fall 1998, Fall 1999, Fall 2000, Fall 2001
- Intermediate Physics II (calculus-based introductory class): Spring 1995, Spring 1996, Spring 1999, Spring 2000, Spring 2001, Spring 2002, Spring 2003
- Intermediate Physics II Laboratory: Spring 1995, Spring 1996, Spring 1999, Spring 2000, Spring 2001, Spring 2001, Spring 2003
- Analytical Mechanics: Fall 1994, Fall 1995
- Electromagnetic Fields: Spring 1993, Fall 1997
- Modern Physics I: Fall 1993, Fall 1998, Fall 1999, Fall 2000, Fall 2001, Fall 2002, Fall 2011
- Modern Physics II: Spring 2000, Spring 2001, Spring 2002, Spring 2003
- Electronics: Fall 2006, Fall 2008, Fall 2009, Fall 2010, Spring 2011, Fall 2011
- Advanced Laboratory I: Fall 2003, Fall 2004, Fall 2005, Spring 2006, Spring 2007, Spring 2009, Spring 2010, Fall 2010, Spring 2011
- Advanced Laboratory II: Fall 2003, Fall 2004
- Physics and Human Thought: Fall 1997
- Quantum Mechanics I: Fall 1996
- Advanced Topics - Chaos: Spring 1999
- Advanced Topics - Optics: Spring 2004, Spring 2006, Spring 2007, Spring 2010
- Advanced Topics - Quantum Information Theory: Spring 2005
- Nonlinear Dynamics (graduate course): Spring 1992

EXPANDED EMPLOYMENT HISTORY

Assistant Professor, Associate Professor, and Professor Physics Department, Truman State University, Kirksville, MO

Duties: Teach undergraduate physics courses, advise students, conduct research, and contribute to institutional service activities. The teaching load is 12 contact hours per semester. In addition to teaching my classes I have supervised a number of different student research projects, the details of which are given below.

I have contributed in the following service capacities:

- Responsible for the Electronics and Advanced Laboratory classrooms and equipment including the associated computers and software including a departmental license for LabVIEW. (This is a significant component of a full-time staff position in Physics Departments of similar institutions.)
- In charge of our department computer lab consisting of 3 Windows machines and 1 Linux machine. This is in addition to the computers mentioned above.
- Chair, School of Science and Mathematics Science Education Committee, 2009-2010 academic year
- Member, Truman Faculty Forum Committee, 2005-2007 and 2009-2011 academic years
- Member, Truman Faculty Research Conference Organizing Committee, 2009-2010 academic year
- Chair, University confidential committee, 2010-2011 academic year (may be verified with the Provost's office)
- Chair, University confidential committee, 2009-2010 academic year (may be verified with the Provost's office)
- Member, University confidential committee, 2008-2009 academic year (may be verified with the Provost's office)
- Member, College of Arts and Sciences confidential committee, 2008-2009 academic year (may be verified with Adam Davis, Associate Dean for CAS at the time)
- Drove Society of Physics Students group to Chicago to visit Argonne National Lab and Fermilab (March 2007)
- Co-organizer (with Matt Beaky) of the Annus Mirabilis Colloquium Series at Truman State University. Additionally, I created, with some input from Winston Vanderhoof, the publicity poster for the series of talks.
- Still an active member of the Society of Physics Students
- Hosted faculty/student BBQ's at my home twice a year (beginning and end of year) Every year except during and immediately following sabbatical
- Webmaster for the Kirksville Chapter of Sigma Xi
- Make presentations to prospective students (multiple times per year)
- Chaired a departmental search committee for two tenure-track positions
- Mentor for one of the newly hired faculty members
- Wrote our Discipline Action Plan (co-author with Peter Rolnick)(5 years)
- Screened student abstracts for the NCUR meeting (2 years)
- Member of Ad Hoc Faculty Compensation Committee
- Read student portfolios (3 years)
- Drove Society of Physics Students group to Chicago to visit Fermilab, the Museum of Science and Industry, and Adler Planetarium (March 2000)
- Taught PRIMO College Prep Academy, Summer 2000 & 2001
- Alternate Science representative to Undergraduate Council

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- Drove (with Michael Ottinger) several Physics students to the Centennial Meeting of the American Physical Society in Atlanta, GA (March 1999)
- Hosted faculty/student BBQ's at my home twice a year (beginning and end of year) and occasionally end of Fall semester too.
- Active participant in Society of Physics Students meetings.

Visiting Scientist, Physics Department, University of Illinois at Urbana-Champaign, Urbana, IL

Duties: Develop diode-laser pumped spontaneous parametric downconversion entangled-photon source. Construct single-photon counting modules using avalanche photodiodes with active-quenching. Assist on other experiments as needed.

Physics Consultant, A. T. Still Research Institute, A. T. Still University, Kirksville, MO

Duties: Perform a physical/optical analysis of the *Intra- and Interobserver Reliability Protocol for use with the Digital Camera Measuring System (DCMS)* and report on it.

Assistant Professor, Physics Department, University of Southern Indiana, Evansville, IN

Duties: Teach undergraduate physics courses, maintain laboratory and demonstration equipment, advise students, conduct research, and serve on committees. The teaching load is 12 credit hours per semester, which is typically 15 contact hours. I revised the lab manual for the first semester introductory courses. I initiated "computerizing" the introductory labs. I developed a "liberal arts physics course" for advanced students of any major. In addition to teaching, I was a major contributor, as Chair of the Computer Committee, to improving the computing facilities for faculty and students in the School of Science and Engineering Technology (SET). I was also *de facto* webmaster and system administrator for the internet server before I left. I was involved in the following university and community committees, programs, and organizations:

- Faculty advisor to the Acolytes of Space and Time, the USI physics club.
- University Economic Benefits Committee, 3 years (Chair 1 year).
- Chair of the SET Computer Advisory Committee, 5 years.
- University Honor Student Symposium, Participant 3 years, Organizer 1 year.
- Search Committee for a new dean of the School of Science and Engineering Technology.
- Contributor to the physical science subject matter guidelines for the Indiana Tech Prep Program.
- Member of ChemQuery (a group of local scientists and physicians that informs the public on scientific matters, particularly those involving the environment and health).

Optical Engineer, PSR Services, Inc., White Sands Missile Range, NM

Duties: Designed and used setups to perform optical measurements. Developed improved technique for measuring optical density of optical equipment. Redesigned and set up an optical bench for performing measurements in the visible and near-infrared. Although I am prohibited from explaining what I did or measured I can say that the work involved lasers of various type, CCD imagers, interferometers, and sundry other optical elements, including aligning an off-axis parabolic mirror.

College Assistant Professor and Adjunct Assistant Professor, New Mexico State Univ., Las Cruces, NM

Duties: Taught a graduate course in nonlinear dynamics and supervised a Ph.D. student in nonlinear dynamics.

Substitute Teacher, Tempe, Paradise Valley, and Mesa, AZ School Districts

Duties: Substituted for several science teachers. Was preferred science substitute at Corona del Sol High School, Tempe, AZ.

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Postdoctoral Research Associate, New Mexico State University, Las Cruces, NM

Duties: Taught second semester non-calculus introductory physics. Studied the logistic map with quantum correlations and sensitive dependence in quantum systems.

Summer Research Scholar, Quantum Optics Branch, Air Force Weapons Lab, Kirtland AFB, NM

Duties: Performed theoretical research in quantum optics. Studied the effects of the field distribution, detuning, and coupling strengths on collapse and revival phenomena in atoms.

Graduate Research Assistant, University of Arkansas, Fayetteville, AR

Duties: Performed research at Los Alamos National Laboratory for Dr. Peter Milonni of the T-12 Group. Studied the quantum-mechanical aspects of classically chaotic driven systems.

Graduate Teaching Assistant, University of Arkansas, Fayetteville, AR

Duties: Taught (i.e. had full responsibility for the class) first semester non-calculus introductory physics once and Physical Science for Elementary Teachers (PSET) twice. The PSET class was a combination lecture, demonstration, and laboratory class designed to introduce future elementary school teachers to the concepts and methods of physical science. Conducted problem sessions (i.e. was a TA) for both semesters of Calculus-based Physics.

STUDENT PROJECTS MENTORED

Theoretical Modeling of Downconversion in Biaxial Crystals

Student: Gaurab Rimal

Theoretical Modeling of Ghost Imaging Involving Polarization Sensitive Optics

Student: A.J. Alexander

Modified Littrow Configuration External Cavity Diode Laser with Fixed Output Beam

Students: Nirjal Sapkota, Om Goit

Measurement and Analysis of Power Distribution in Diffraction Gratings as a Function of Incidence Angle

Students: Raghav Chhetri, Violet Poole, Nathan Klessig, Anne Ahlvers, Aaron Thompson, Kevin Satzinger

Construction of an Aurora Detector

Students: David Kiblinger, Isaac Angert

Synchronization of Chaotic Circuits

Student: Mark Kirchhoff

Experiments in spectroscopy using a nitrogen-laser pumped dye laser

Student: Phil Schiff

Laser Cooling and Trapping of Rubidium

Students: Kevin Koch, Danielle Camarota, Adam Bauer, Bryan Bichsel, Nicole Jones, L. Suzanne Leslie, Michael Cone, Lucas Ward, Bryan McClellan, Kyle Bailey, Marek Haruza, Stan Park, David Kiblinger, Ross Coleman, Adam Gouge, Nirjal Sapkota, Tom Hogan

Plotting Semi-Classical Trajectories for Simple Quantum-Mechanical Systems with the Wigner Quasi-Distribution Function

Students: Kenny Boyce, Kevin Haworth, Kirt Page

Simulating Quantum Photon Communication Through Free Space

Student: Michelle Hannon

Phase-Space Dependence of Short-Time Lyapunov Exponents

Student: Heather Mollé, Cameron Moore

Nonlinear Systems of Coupled Pendulums
Student: Adam Woodson

Analyzing Neural Systems Using Chaos Theory
Student: Francesca Gervasio

STUDENT PRESENTATIONS FOR WHICH I WAS MENTOR

Anne M. Ahlvers, "Power absorption in Diffraction Gratings", at the Truman State University Student Research Conference, Kirksville, MO (April 12, 2011).

Zachary O. Haralson, "Construction of a Dichroic Atomic Vapor Laser Lock", at the Truman State University Student Research Conference, Kirksville, MO (April 12, 2011).

Gaurab Rimal, "Theoretical Modeling of Downconversion in a Biaxial Crystal", at the Truman State University Student Research Conference, Kirksville, MO (April 12, 2011).

Aaron M. Thompson, Anne M. Ahlvers, Kevin J. Satzinger, "Power Losses in Diffraction Gratings", National Conference on Undergraduate Research, Ithaca, NY (April 1, 2011). (POSTER)

A. J. Alexander, "Theory of 'Ghost Imaging' experiments with polarization dependent optical devices", National Conference on Undergraduate Research, Missoula, MT (April 15, 2010).

Isaac Angert and David Kiblinger, "An Optical Aurora Detector to Aid Mid-latitude Viewing of the Northern Lights", at the Truman State University Student Research Conference, Kirksville, MO (April 13, 2010).

Thomas C. Hogan, "Implementing a Dichroic Atomic Vapor Laser Lock for Use in Laser Cooling Gaseous Rb", at the Truman State University Student Research Conference, Kirksville, MO (April 13, 2010).

Andrew J. Alexander, "Theory of 'Ghost Imaging' Experiments with Polarization Dependent Optical Devices", at the Truman State University Student Research Conference, Kirksville, MO (April 13, 2010).

Nathan Klessig, "Measurement and analysis of power distribution in all orders as a function of incidence angle for a series of diffraction gratings", National Conference on Undergraduate Research, La Crosse, WI (April 17, 2009).

Nathan Klessig, "Measurement and Analysis of Power Distribution in all Orders as a Function of Incidence Angle for a Series of Diffraction Gratings", at the Truman State University Student Research Conference, Kirksville, MO (April 7, 2009).

Violet Poole and Raghav Chhetri, "Measurement and Analysis of the Power Distribution in Diffraction Gratings as a Function of Incident Angle and Wavelength", National Conference on Undergraduate Research, San Rafael, CA (April 14, 2007).

Nirjal Sapkota, "Modified Littrow Configuration External Cavity Diode Laser with Tunable Fixed Output Beam", National Conference on Undergraduate Research, San Rafael, CA (April 14, 2007).

Violet M. Poole and Raghav Chhetri, "Measurement and Analysis of the Power Distribution in Diffraction Gratings as a Function of Incident Angle and Wavelength", at the Truman State University Student Research Conference, Kirksville, MO (April 3, 2007).

Nirjal Sapkota, "Modified Littrow Configuration External Cavity Diode Laser with Tunable Fixed Output Beam", at the Truman State University Student Research Conference, Kirksville, MO (April 3, 2007).

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Raghav Chhetri, "Measurement, Analysis and Theoretical Basis of Power Distribution in Diffraction Gratings as a Function of Incident Angle", Symposium on Undergraduate Research, Division of Laser Science of the American Physical Society, LS XXII, Rochester, NY (October, 9 2006).

David Kiblinger, "Construction of an Aurora Detector", at the Annual Meeting of the Missouri Academy of Sciences, Kirksville, MO (April 21, 2006). *This presentation won First Place in the Physics Session of the Collegiate Division.*

Raghav Chhetri, "Measurement and Analysis of Power Distribution in Diffraction Gratings as a Function of Incidence Angle", at the Truman State University Student Research Conference, Kirksville, MO (April 20, 2006).

David Kiblinger, "Construction of an Aurora Detector", at the Truman State University Student Research Conference, Kirksville, MO (April 20, 2006).

David Kiblinger, "Construction of an Aurora Detector", at the National Undergraduate Research Conference, Asheville, NC (April 7, 2006).

Marek Haruza, Ross Coleman, David Kiblinger, and James H. Park, "External Cavity Diode Laser Development", at the National Undergraduate Research Conference, Asheville, NC (April 6, 2006). (POSTER)

Marek Haruza, Ross Coleman, David Kiblinger, and James H. Park, "External Cavity Diode Laser Development", at the Arkansas INBRE Spring Undergraduate Research Conference, Fayetteville, AR (February 24, 2006). (POSTER) *This poster won Third Place in the Physics Section.*

David Kiblinger, "Construction of an Aurora Detector", at the Winter Meeting of the American Association of Physics Teachers, Anchorage, AK (January 23, 2006).

Marek Haruza, Ross Coleman, David Kiblinger, and James H. Park, "External Cavity Diode Laser Development", at the Truman State University Student Research Conference, Kirksville, MO (April 14, 2005). (POSTER)

Cameron C. Moore, "Exploring Regions of 'Chaos' in the Logistic Map", at the Truman State University Student Research Conference, Kirksville, MO (April 14, 2005).

L. Suzanne Leslie, Stan Park, Kyle Bailey, and Bryan McClellan, "Cooling and Trapping of Rubidium Atoms", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 6, 2004). (POSTER)

Michelle A. Hannon, "Simulating Quantum Photon Communication Through Free Space", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 10, 2003).

Kevin J. Haworth, "Plotting Semi-Classical Trajectories for Simple Quantum Mechanical Systems with the wigner Quasi-Distribution Function", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 10, 2003).

Michael Cone, Todd J. Lansford, L. Suzanne Leslie, and Lucas Ward, "Laser Cooling and Trapping of Rubidium Atoms", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 10, 2003). (POSTER)

Heather Mollé, "Exploring Phase Space Using Short Term Lyapunov Exponents", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 10, 2003).

Philip R. Schiff, "Experiments in Atomic and Molecular Spectroscopy", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 10, 2003).

Michael Cone, Todd J. Lansford, L. Suzanne Leslie, and Lucas Ward, "Laser Cooling and Trapping of Rubidium Atoms", at the National Undergraduate Research Conference, Salt Lake City, UT (March 12-15, 2003). (POSTER)

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Michael Cone, Nikki Jones, Todd Lansford, L. Suzanne Leslie, Lucas Ward, "Laser Cooling and Trapping of Rubidium", at the Truman State University Undergraduate Research Conference, Kirksville, MO (April 11, 2002). (POSTER)

Adam Bauer, Danielle Camarota, Lucas Ward, Nicole Jones, and Todd Lansford, "Laser Cooling and Trapping of Rubidium", at the Truman State University Undergraduate Research Conference, Kirksville, MO (March 29, 2001). (POSTER)

Kevin Koch, "Laser Cooling and Trapping of Atoms Using Electronic Detuning", at the Truman State University Undergraduate Research Symposium, Kirksville, MO (March 22, 2000).

Adam Woodson, "Spatiotemporal Chaos in a Numerical Coupled Oscillator System", at the Truman State University Undergraduate Research Symposium, Kirksville, MO (March 22, 2000). (POSTER)

PRESENTATIONS

"Physics and Information", Michael Goggin, Faculty Research Conference, Truman State University, Kirksville, MO, 12 September 2009.

"Experimental investigation of the connection between weak measurements and violation of the Leggett-Garg Inequality", Michael Goggin, Marcelo Almeida, Marco Barbieri, Benjamin Lanyon, Jeremy OBrien, Andrew White, Geoff Pryde, DAMOP 2009, the annual meeting of the Division of Atomic, Molecular, and Optical Physics of the American Physical Society, Charlottesville, VA, 20-23 May 2009. (POSTER)

"Quantum computing with zero entanglement", B. P. Lanyon, M. Barbieri, M. P. Almeida, A. G. White, and M. E. Goggin, Frontiers in Optics 2008, Rochester, NY, 19-23 October 2008.

"Entangled Sources and Gates for (Real World) Quantum Computing", Michael E. Goggin, Gleb Akselrod, Marcelo P. Almeida, Marco Barbieri, Geoff Gillett, Ben Lanyon, Radhika Rangarajan, Andrew White, Paul G. Kwiat, ARO/NSA/IARPA Quantum Computing & Quantum Algorithms Program Review, Buckhead, GA, 11-15 August 2008. (POSTER)

"Measuring the fault-tolerance of an experimental optical quantum gate", Till J. Weinhold, Kevin J. Resch, Geoff J. Pryde, Jeremy L. OBrien, Andrew G. White, and Michael E. Goggin, ICO-21, 21st Congress of the International Commission for Optics (ICO), Sydney, Australia, 7-10 July 2008.

"Improved 405-nm Diode-Pumped Downconversion Entanglement Source", M. E. Goggin, N. A. Peters, J. T. Barreiro, J. A. Yasi, R. Rangarajan, and P. G. Kwiat, Frontiers in Optics 2006, Rochester, NY, 8-12 October 2006. (POSTER)

"Light Quanta: A Worldline", Michael Goggin, Annus Mirabilis Colloquium, Truman State University, Kirksville, MO, 15 February 2005.

"Deterministic Chaos and the Jurassic Park Hypothesis", public lecture at the Linda Hall Library of Science and Technology, Kansas City, MO, 19 April 2001.

"Simple Derivation of Axis-Scaling in Spacetime Diagrams", at the Fall 2000 meeting of the Missouri section of the American Association of Physics Teachers, Rolla, MO, 21 October 2000.

"Physics and Human Thought: Reflections on a New Course", at the 1998 Winter Meeting of the American Association of Physics Teachers, New Orleans, LA, 4-8 January 1998.

"Physics in Film", at the 1997 Winter Meeting of the American Association of Physics Teachers, Phoenix, AZ, January 7, 1997. Also at the Annual Meeting of the Indiana Section of AAPT, W. Lafayette, IN 10 April 1997.

"Quantum Chaos. What is it?", at the 1995 Annual Meeting of the Indiana Section of the American Association of Physics Teachers, Indianapolis, IN, 8 April 1995.

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“Chaos in quantum optics: the contributions of Jay Ackerhalt”, an invited presentation for a Memorial Session Celebrating Contributions of Jay R. Ackerhalt at the 8th Interdisciplinary Laser Science Conference, Albuquerque, NM, September 23, 1992.

“Classical and Quantum Chaos in Nonlinear Driven Systems” at the Conference on Periodic Orbits, Phase Space Structures, and Chaos in Quantum Systems, Los Alamos, NM, December 17, 1987.

Various colloquia given at Truman State University; Western Illinois University; University of Missouri, Columbia; University of Missouri, St. Louis; Indiana University-Purdue University, Indianapolis; University of the South; University of Southern Indiana; New Mexico State University; University of New Mexico; the Air Force Weapons Lab; and Los Alamos National Laboratory.

PUBLICATIONS

Michael E. Goggin, “Lab Course Goals: Science or Writing?”, *Science* **333** 524 (2011). (Letter to the Editor)

J. O. Owens, M. A. Broome, D. N. Biggerstaff, M. E. Goggin, A. Fedrizzi, T. Linjordet, M. Ams, G. D. Marshall, J. Twamley, M. J. Withford and A. G. White, “Two-photon quantum walks in an elliptical direct-write waveguide array”, *New Journal of Physics*, **13** 075003 (2011).

M. E. Goggin, M. P. Almeida, M. Barbieri, B. P. Lanyon, J. L. O’Brien, A. G. White, and G. J. Pryde, “Violation of the Leggett-Garg inequality with weak measurements of photons”, *Proceedings of the National Academy of Sciences of the USA* **108**, 1256 (2011). An earlier draft is available at arXiv:0907.1679v1 (2009).

B. P. Lanyon, J. D. Whitfield, G. G. Gillett, M. E. Goggin, M. P. Almeida, I. Kassal, J. D. Biamonte, M. Mohseni, B. J. Powell, M. Barbieri, A. Aspuru-Guzik, and A. G. White, “Towards quantum chemistry on a quantum computer”, *Nature Chemistry* **2**, 106 (2010)

R. Rangarajan, M. Goggin, and P. Kwiat, “Optimizing type-I polarization-entangled photons”, *Optics Express* **17**, 18920-18933 (2009).

B. Lanyon, J. Whitfield, G. Gillett, M. Goggin, M. Almeida, I. Kassal, J. Biamonte, M. Mohseni, B. Powell, M. Barbieri, A. Aspuru-Guzik, and A. White, “Quantum Chemistry on a Quantum Computer: First Steps and Prospects”, in *Frontiers in Optics, OSA Technical Digest (CD)* (Optical Society of America, 2009), paper JWD3.

M. Barbieri, M. E. Goggin, M. P. Almeida, B. P. Lanyon, and A. G. White, “Complementarity in variable strength quantum non-demolition measurements”, *New Journal of Physics* **11**, 093012 (2009). (Chosen by the editors of Institute of Physics (IOP) journals to be included in IOP Select.)

B. Lanyon, M. Barbieri, M. Almeida, A. White, and M. Goggin, “Quantum Computing with Zero Entanglement”, in *Frontiers in Optics, OSA Technical Digest (CD)* (Optical Society of America, 2008), paper FTuC7.

Michael E. Goggin, “Review of the Intra- and Interobserver Reliability Protocol for use with the Digital Camera Measuring System (DCMS)”, technical report submitted to A. T. Still Research Institute, Kirksville College of Osteopathic Medicine (July 2007).

M. Goggin, N. Peters, J. Barreiro, J. Yasi, R. Rangarajan, and P. Kwiat, “Improved 405-nm Diode-Pumped Down-conversion Entanglement Source”, in *Frontiers in Optics, OSA Technical Digest (CD)* (Optical Society of America, 2006), paper JWD73.

N. A. Peters, J. T. Barreiro, M. E. Goggin, T.-C. Wei, and P. G. Kwiat, “Remote State Preparation: Arbitrary remote control of photon polarizations for quantum communication”, in *Free-Space Laser Communications V*. Edited by Voelz, David G.; Ricklin, Jennifer C. *Proceedings of the SPIE*, Volume 5893, pp. 52-61 (2005).

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Nicholas A. Peters, Julio T. Barreiro, Tzu-Chieh Wei, Michael E. Goggin, and Paul G. Kwiat, "Arbitrary Remote State Preparation of Photon Polarization", in *Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science and Photonic Applications, Systems and Technologies 2005* (Optical Society of America, Washington, DC, 2005), presentation QTuG6.

Nicholas A. Peters, Julio Barreiro, Michael E. Goggin, Tzu-Chieh Wei, and Paul G. Kwiat, "Remote state preparation: Arbitrary remote control of photon polarization", *Physical Review Letters* **94**, 150502 (2005).

P.G. Kwiat, J.B. Altepeter, J.T. Barreiro, M.E. Goggin, E. Jeffrey, N.A. Peters, and A. VanDevender, "The Conversion Revolution: Down-, Up- and Sideways-", *AIP Conf. Proc.* 734, 337 (2004) (Proceedings of the Seventh International Conference on Quantum Communication, Measurement and Computing (QCMC), Strathclyde, UK, July 25-29, 2004).

M.E. Goggin and R.H. Dalling, "A Response to D. Auerbach's "Comment on 'Chaos is not an artifact of finite-digit arithmetic'"", *American Journal of Physics* **63**, 277 (1995).

R.H. Dalling and M.E. Goggin, "Chaos Is Not An Artifact of Finite-Digit Arithmetic", *Am. J. Phys.* **62**, 563 (1994). (Selected for inclusion in **Chaos and Nonlinear Dynamics** edited by Robert C. Hilborn and Nicholas B. Tufillaro (American Association of Physics Teachers, 1998))

M.E. Goggin, "M22 OD Measurement Result", PSRS Note 148 (PSR Services, WSMR, NM 1991).

M.E. Goggin, S.Z. Peplinski, and M. Gallardo, "An Improved Optical Density (D) Measurement Method", PSRS Note 143 (PSR Services, WSMR, NM 1990).

M.E. Goggin, B. Sundaram, and P.W. Milonni, "The Quantum Logistic Map", *Physical Review* **A41**, 5705 (RC) (1990).

R.L. Ingraham, M.E. Goggin, and P.W. Milonni, "Sensitivity to Initial Conditions in Classical and Quantum Dynamics", in *Coherence and Quantum Optics VI* ed. by J.H. Eberly et al. (Plenum, NY, 1990).

M.E. Goggin, M.P. Sharma, and A. Gavrielides, "Effects of the Binomial Field Distribution on Collapse and Revival Phenomena in a Three-Level Atom", *Journal of Modern Optics* **37**, 99 (1990).

P.W. Milonni, J.R. Ackerhalt, and M.E. Goggin, "Notes on Classical and Quantum Theories of Driven Nonlinear Systems", in *Lasers Molecules and Methods* ed. by J.O. Hirschfelder, R.E. Wyatt and R.D. Coalson (Wiley, NY, 1989). (A.k.a. *Advances in Chemical Physics* **73**, 867 (1989) ed. by I. Prigogine and S.A. Rice.)

Michael E. Goggin, "Classical and Quantum Chaos of Nonlinear Driven Systems", Ph.D. dissertation, unpublished, University of Arkansas, Fayetteville, AR 1988.

M.E. Goggin and P.W. Milonni, "Driven Morse oscillator: Classical chaos and quantum theory for two-frequency excitation", *Physical Review* **A38**, 5174 (1988).

P.W. Milonni, R.J. Cook, and M.E. Goggin, "Radiation Pressure from the vacuum: Physical interpretation of Casimir force", *Physical Review* **A38**, 1621 (1988).

M.E. Goggin and P.W. Milonni, "Driven Morse oscillator: Classical chaos, quantum theory, and photodissociation", *Physical Review* **A37**, 796 (1988).

P.W. Milonni, J.R. Ackerhalt, and M.E. Goggin, "Quasiperiodically kicked quantum systems", *Physical Review* **A35**, 1714 (1987).

P.W. Milonni, J.R. Ackerhalt, and M.E. Goggin, "Quantum-Mechanical Aspects of Classically Chaotic Driven Systems", in *Proceedings of the Fourth International Conference on Multiphoton Processes*, ed. by P.L. Knight and S.J. Smith (Cambridge University Press, 1987).

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