

Dr. Martin John Madsen

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EDUCATION

- August 2006 Ph.D. in Physics, *University of Michigan*, Ann Arbor, MI
Advisor: Chris Monroe, Physics
Thesis Title: “*Advanced Ion Trap Development and Ultrafast Laser-Ion Interactions*”
- August 2004 Masters of Science in Physics, *University of Michigan*, Ann Arbor, MI
- May 2001 Bachelors of Science in Honors Physics, *Purdue University*, West Lafayette, IN
Graduated with Highest Distinction

TEACHING EXPERIENCE

- 2012-present **Associate Professor of Physics**, Wabash College
Crawfordsville, IN
- 2006-2012 **Assistant Professor of Physics**, Wabash College
Crawfordsville, IN
- Fall 2005 **Discussion Session Instructor**, University of Michigan
Ann Arbor, MI
- 2000 **Teaching Assistant**, Purdue University
West Lafayette, IN

RESEARCH EXPERIENCE

- 2006-present **Principal Investigator**, Wabash College
Crawfordsville, IN
Trapped Ion Quantum Information Laboratory
- 2010-2012 **Research Collaboration**, Purdue University
West Lafayette, IN
Collaborator: Yong Chen
- 2001-2006 **Graduate Student Research Assistant**, University of Michigan
Ann Arbor, MI
Supervisor: Chris Monroe
- 1999-2000 **Undergraduate Research Technician**, Purdue University
West Lafayette, IN
Supervisor: David Nolte

COURSES TAUGHT

2013,2014	Physics 111 <i>General Physics I</i>
2007 2011,2013	Physics 310 <i>Intermediate Classical Mechanics</i>
2006-2011 2014-2015	Physics 381/382 <i>Advanced Laboratory</i> Upper-level research course for physics majors
2010, 2011	Physics 277 <i>Special Topics in Physics</i> 2010 Topic: "Light" 2011 Topic: "Medieval Arms and Armor"
2011,2014	Freshman Tutorial Topic: "The Lord of the Rings"
2011, 2012	Physics 210 <i>Modern Physics</i> With accompanying lab
2011	Physics 104 <i>Adventures in Physics: Acoustics of musical instruments,</i> An introductory course for non-science majors
2010	Physics 316 <i>Quantum Optics</i>
2009-2010 2014-2015	Physics 105 <i>Adventures in Physics: Mythbusters</i> A lab science course for non-science majors
2009	Physics 288 <i>Independent Study</i> Nathan Rutz: "Alternative Energy Science"
2009	Physics 220 <i>Electronics</i> With accompanying lab
2008	Division I 178 <i>Alternative Energy</i> A lab science course for non-science majors
2007	Cultures and Traditions An all-College history and literature survey course
2007-2009 2012, 2014	Physics 112 <i>Electricity, Magnetism, and Waves</i> For science majors with accompanying lab
2006-2009 2013-2014	Physics 111 Lab <i>Introductory Mechanics</i> Lab instructor
2006- 2008, 2010	Physics 114 <i>Electricity, Magnetism, and Waves</i> For physics majors with accompanying lab

STUDENT PRESENTATIONS

Yang Yang, "Anomalous motion of trapped ion microspheres," Poster presented at the 2015 Celebration of Student Research, Scholarship, and Creative Work, Wabash College, January 23, 2015

- Bradon Badger, Eric Need, Kelly Sullivan, **“Always on Target,”** Poster presented at the *2015 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 23, 2015
- William Costakis, Logan Rice, **“Characterizing a Spatial Light Modulator,”** Poster presented at the *2012 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 27, 2012
- Christopher Gorman, Derek Fritz, **“A Measurement of Cosmic Ray Muon Flux through Scintillator Bars,”** Poster presented at the *2012 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 27, 2012
- Evan Groninger, Yijun Tang, Ben Foster, **“Chaotic Double Pendulum,”** Poster presented at the *2012 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 27, 2012
- Tyler Buresh, Zachary Rohrbach, **“Modeling the Exit Velocity of a Compressed Air Cannon,”** Poster presented at the *2012 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 27, 2012
- Tyler Buresh, Zachary Rohrbach, Jeff Soller, **“Brownian Motion in Optical Tweezers,”** Poster presented at the *2011 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 28, 2011
- Zachary Rohrbach, Tyler Buresh, Jeff Soller, **“A Measurement of the Cosmic Ray Muon Flux Through Large-Area Scintillators,”** Poster presented at the *2011 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 28, 2011
- Lucian Lupinski, Rabin Paudel, **“Ytterbium Experiments,”** Poster presented at the *2011 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 28, 2011
- Rabin Paudel, Lucian Lupinski, Jonathan Barlow, Scott Pond, **“Atomic Ytterbium Beam Experiments at an Undergraduate Physics Laboratory,”** Poster presented at the *American Physics Society March Meeting 2010*, Portland, Oregon, March 17, 2010
- Diego Aliaga, William C. Beard, and Jacob Castilow, **“Exit Velocity of a Steel Ball Launched from a Pressurized Cannon,”** Poster presented at the *2010 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 29, 2010
- Scott Pond and Jonathan Barlow, **“Spontaneous Emission of Yb and Light Decay Measurements with a CCD,”** Poster presented at the *2010 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 29, 2010
- Bradley Vest and Thomas Warn, **“Chaotic Motion,”** Poster presented at the *2010 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 29, 2010
- Rabin Paudel, Lucian Lupinski, **“Towards an Atomic Ytterbium Beam,”** Poster presented at the *Midwest Cold Atomic Workshop*, Chicago, IL, November 2009
- Dan Brown and Micah Milliman, **“Critical Temperature of YBCO Using Change in Potential”**, Poster presented at the *2009 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 30, 2009

Adam Fritsch, Sam Krutz, Tom Pizarek, “**Band Gap Energies of Silicon and Germanium,**” Poster presented at the *2009 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 30, 2009

Chris Beard and Rabin Paudel, “**The Quantum Wabash Gentleman,**” Poster presented at the *2008 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 25, 2008

Adam Fritsch, Kyle Prifogle, Tom Pizarek, Sabir Shrestha, “**Analysis of the Circular Motion of an Electron Beam in Real Helmholtz Coils,**” Poster presented at the *2007 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 26, 2007

UNDERGRADUATE RESEARCH STUDENTS

Summer 2014

Yang Yang (Class of 2017)

Project: A 2D Ion Trap Array

Presented Poster at the *2015 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 23, 2015

Summer 2013

Andrew Skowronski (Class of 2013)

Project: Brownian motion of a Trapped Microsphere Ion

Presented Talk at the Physics Department Colloquium, Wabash College, September 18, 2013

Published as: Madsen, M.J and Skowronski, A.D., “Brownian Motion of a Trapped Microsphere Ion” in the *American Journal of Physics* (2014) in press.

Summer 2010

Chris Gorman (Class of 2013)

Project: Halo Ion Trap Development

Presented Talk at the *2011 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 28, 2011

Published as: Madsen, M.J. and Gorman, C.H., “Compact toroidal ion-trap design and optimization”, *Physical Review A*, v 82, 043423 (2010)

Summer 2009

Yijun Tang (Class of 2012)

Project: Temperature Distribution Along a Tungsten Filament

Presented Talk at the *2010 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 29, 2010

Lucian Lupinski (Class of 2011)

Project: Angular Normal Modes of a Circular Coulomb Cluster

Presented Talk at the *2010 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 29, 2010

Published as: Lupinski, L.W. and Madsen, M.J., “Angular normal modes of a circular Coulomb cluster”, *Journal of Mathematical Physics*, v 50, 112902 (2009)

Summer 2008

Sam Krutz (Class of 2009)

Project: Mode-Locking an Optical Cavity to a HeNe Laser
Poster Presented at the *2009 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 30, 2009

Chris Beard (Class of 2010)

Project: Halo Trap Design
Presented Talk at a Physics Department Colloquium, Wabash College, September 2008.

Summer 2007

Chris Beard (Class of 2010)

Project: The Quantum Wabash Gentleman
Poster Presented at the *2008 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 25, 2008

Rabin Paudel (Class of 2010)

Project: The Quantum Wabash Gentleman
Poster Presented at the *2008 Celebration of Student Research, Scholarship, and Creative Work*, Wabash College, January 25, 2008

COLLEGE SERVICE

2013-present	Safety Committee Co-chair and Assistant to the Dean of the College Wabash College <i>Crawfordsville, IN</i> Organized annual fire and severe weather drills, annual lab safety inspections, Chemical Hygiene Officer, Assistant Radiation Safety Officer, IDEM and EPA compliance officer
2014-present	Freshman Tutorial Co-Chair Wabash College <i>Crawfordsville, IN</i>
2010-2014	Swords and Foils Student Club Faculty Advisor Wabash College <i>Crawfordsville, IN</i>
2009-2012	Faculty Development Committee Chair, 2011-2012 Wabash College <i>Crawfordsville, IN</i>
2006-2014	Society of Physics Students Faculty Advisor Wabash College

Crawfordsville, IN
Organized annual Demonstration Show, Pi Day physics outreach, Journal Club activities, and Physics Heptathlon

- 2007-2012 **Safety Committee Co-chair**
Wabash College
Crawfordsville, IN
Organized annual fire and severe weather drills, annual lab safety inspections
- 2008-2010 **MCAT Preparation Session**
Wabash College
Crawfordsville, IN
Supervised the physics preparation section
- 2007-2009 **Faculty Service Committee Co-chair**
Wabash College
Crawfordsville, IN

PROFESSIONAL SERVICE

Article reviewer for: *Physical Review Letters, Physical Review A, Physics Letters A, Applied Physics B, The Physics Teacher*

Grant reviewer for the *National Science Foundation*

VOLUNTEER AND COMMUNITY SERVICE

- 2009-2014 Carnegie Museum “Pi Day” outreach activities for elementary and middle school children held on the first Saturday in March
- 2000-2007 American Red Cross, Disaster Services Volunteer

PROFESSIONAL MEMBERSHIPS

American Physical Society

American Association of Physics Teachers

HONORS AND AWARDS

- 2012 *New Directions Initiative* grant from the Great Lakes Colleges Association for flipping the Physics 111 classroom and using digital media
- 2012 *New Directions Initiative* grant from the Great Lakes Colleges Association for the measurement of noise in graphene
- 2012-2013 *McClain-McTurnan-Arnold Research Scholar Award*, Wabash College
- 2001-2003 *Rackham Fellowship*, University of Michigan

- 2002 *Peter Franken Award*, Department of Physics, University of Michigan. “Awarded to a first or second year graduate student who has done outstanding work in Physics.”
- 2000, 2001 *Richard W. King Memorial Award*, Department of Physics, Purdue University. “In recognition of past achievements and future promise as a student of physics.”

PUBLICATIONS

(* denotes undergraduate co-authors)

21. Madsen, M.J and Skowronski, A.D.*, “**Brownian Motion of a Trapped Microsphere Ion**” *American Journal of Physics*, v 82, pp 934-940 (2014).
20. Rohrbach, Z.J.*, Buresh, T.R.*, Madsen, M.J. “**Modeling the exit velocity of a compressed air cannon**”, *American Journal of Physics*, v 80, pp 24-27 (2012)
19. Madsen, M.J. “**Physics Myth Busting: A Lab-Centered Course for Non-Science Students**”, *The Physics Teacher*, v 49, pp 448-451 (2011)
18. Madsen, M.J., Brown*, D.R., Krutz*, S.R., and Milliman*, M.J., “**Measuring the molecular polarizability of air,**” *American Journal of Physics*, v 79, pp 428-430 (2011)
17. Madsen, M.J. and Gorman*, C.H., “**Compact toroidal ion-trap design and optimization,**” *Physical Review A*, v 82, 043423 (2010)
16. Lupinski*, L.W. and Madsen, M.J., “**Angular normal modes of a circular Coulomb cluster**”, *Journal of Mathematical Physics*, v 50, 112902 (2009)
15. Madsen, M. J., “**Ohm’s law for a wire in contact with a thermal reservoir,**” *American Journal of Physics*, v 77, n 6, June 2009, pp 516-519.
14. Moehring, D. L., Madsen, M. J., Younge, K. C., Kohn*, R. N. Jr., Maunz, P., Duan, L.-M., and Monroe, C., “**Quantum networking with photons and trapped atoms,**” *Journal of the Optical Society of America B*, v 24, n 2, Feb 2007, p. 300
13. Maunz, P., Moehring, D. L., Madsen, M. J., Kohn*, R. N. Jr., Younge, K. C., and Monroe, C., “**Quantum Interference of Photon Pairs from Two Trapped Atomic Ions,**” *quant-ph/0608047* (2006)
12. Deslauriers, L., Acton, M., Blinov, B. B., Brickman, K.-A., Haljan, P. C., Hensinger, W. K., Hucul*, D., Katnik, S., Kohn*, R. N., Lee, P. J., Madsen, M. J., Maunz, P., Olmschenck, S., Moehring, D. L., Stick, D., Sterk, J., Yeo*, M., Younge, K. C., and Monroe, C., “**Efficient photoionization-loading of trapped cadmium Ions with ultrafast pulses,**” *Physical Review A (Atomic, Molecular, and Optical Physics)*, v 74, 2006, p 063421
11. Duan, L.-M., Madsen, M. J., Moehring, D. L., Maunz, P., Kohn*, R. N. Jr., and Monroe, C., “**Probabilistic Quantum Gates between Remote Atoms through Interference of Optical Frequency Qubits,**” *Physical Review A (Atomic, Molecular, and Optical Physics)*, vol 73, 2006, p 062324
10. Madsen, M. J., Moehring, D. L., Maunz, P., Kohn*, R. N. Jr., Duan, L.-M., and Monroe, C., “**Ultrafast Coherent Coupling of Atomic Hyperfine and Photon Frequency Qubits,**” *Physical Review Letters*, vol 97, 2006, p 040505

9. Blinov, B. B., Kohn*, R. N. Jr., Madsen, M. J., Maunz, P., Moehring, D. L., and Monroe, C., **“Broadband laser cooling of trapped atoms with ultrafast pulses”** *Journal of the Optical Society of America B*, v 23, n 6, June 2006, p 1170
8. Stick, D., Hensinger, W. K., Madsen, M. J., Olmschenk, S., Schwab, K., and Monroe, C., **“Ion trap in a Semiconductor Chip”** *Nature Physics*, v 2, 2006, p 36
7. Moehring, D. L., Blinov, B. B., Gidley, D.W., Kohn, R. N. Jr., Madsen, M. J., Sanderson*, T.D., Vallery, R.S., and Monroe, C., **“Precision lifetime measurements of a single trapped ion with ultrafast laser pulses”** *Physical Review A (Atomic, Molecular, and Optical Physics)*, v 73, n 2, 14 Feb 2006, p 023413
6. Moehring, D. L., Acton, M., Blinov, B. B., Brickman, K.-A., Deslauriers, L., Haljan, P. C., Hensinger, W. K., Hucul*, D., Kohn*, R. N., Lee, P. J., Madsen, M. J., Maunz, P., Olmschenk, S., Stick, D., Yeo*, M., Monroe, C., and Rabchuk, J., **“Ion Trap Networking: Cold, Fast, and Small”** *Laser Spectroscopy XVII*, E. Hinds, A. Ferguson, and E. Riis, eds. (World Scientific, 2005) pg. 421
5. Moehring, D.L., Madsen, M.J., Blinov, B.B., Monroe, C., **“Experimental Bell inequality violation with an atom and a photon,”** *Physical Review Letters*, v 93, n 9, 27 Aug 2004, p 090410/1-4
4. Madsen, M.J., Hensinger, W.L., Stick, D., Rabchuk, J.A., Monroe, C., **“Planar ion trap geometry for microfabrication,”** *Applied Physics B-Lasers and Optics*, v 78, n 5, Mar 2004, p 639-651
3. Lee, P.J., Blinov, B.B., Brickman, K., Deslauriers, L., Madsen, M.J., Miller, R., Moehring, D.L., Stick, D., Monroe, C. **“Atomic qubit manipulations with an electro-optic modulator,”** *Optics Letters*, v 28, n 17, 1 Sep 2003, p 1582-4
2. Deslauriers, L., Haljan, P.C., Lee, P.J., Brickman, K-A., Blinov, B.B., Madsen, M.J., Monroe, C. **“Zero-Point cooling and low heating of trapped $^{111}\text{Cd}^+$ ions,”** *Physical Review A (Atomic, Molecular, and Optical Physics)*, v 70, n 4, Apr 2003, p 043408/1-5
1. Blinov, B.B., Deslauriers, L., Lee, P., Madsen, M.J., Miller*, R., Monroe, C., **“Sympathetic cooling of trapped Cd^+ isotopes,”** *Physical Review A (Atomic, Molecular, and Optical Physics)*, v 65, n 4, Apr 2002, p 040304/1-4

PRESENTATIONS

“Doing research in the Advanced Lab: a hybrid approach,” an invited talk presented at the 2013 American Association of Physics Teachers (AAPT) Summer Meeting, Portland, OR, in the *ALPHA Labs in the Classroom* section on July 17, 2013.

“Wait- what if we look at this idea?,” an invited talk presented at the Denison University Physics Department Colloquium on March 29, 2013.

“Physics Myth Busting,” an invited talk presented at the 2012 American Association of Physics Teachers (AAPT) Summer Meeting, Philadelphia, PA, in the *Physics of Entertainment* section on July 31, 2012.

“Physics Myth Busting: A lab-centered physics course for non-science students,” talk presented at the 2011 and 2012 Big Bash Reunions, Wabash College, June 2011 and 2012

“Physics Myth Busting: A lab-centered physics course for non-science students,” talk presented at the Physics Department Colloquium, Wabash College, September 2010

“Atomic Ytterbium Beam Experiments at an Undergraduate Physics Laboratory,” poster presented at the *Division of Atomic, Molecular, and Optical Physics (DAMOP)*, Houston, TX, May 2010

“Compact Halo Ion Traps,” revised poster presented at the *Midwest Cold Atomic Workshop*, Chicago, IL, November 2009

“Measuring the Molecular Polarizability of Air,” poster presented at the 2009 AAPT/APS Advanced Lab Workshop, Ann Arbor, MI, July 2009

“Research Model for Advanced Lab,” poster presented at the 2009 AAPT/APS Advanced Lab Workshop, Ann Arbor, MI, July 2009

“Compact Halo Ion Traps,” poster presented at the *Gordon Conference for Atomic Physics*, Tilton, NH, July 2009

“Halo Ion Traps,” invited talk presented at the national New Laser Scientists Conference in Rochester, NY, October 23, 2008

“Energy: A model interdepartmental, integrated lab/lecture course for non-majors,” invited talk presented at the Biannual Conference on Chemical Education, Bloomington, IN, July 29, 2008

“The (Monon) Bell Inequality,” 3rd annual Monon Bell invited talk, DePauw University, November 2007

“Trapping Ions on a Shoestring” poster presented at the *Gordon Conference for Atomic Physics*, Tilton, NH, July 2007

“Who killed Schrödinger’s Cat?” invited talk presented at Indiana State University, October 2006

“Ultrafast Optical Rabi Oscillations on a Single Ion” talk presented at *APS Division of Atomic, Molecular, and Optical Physics (DAMOP)*, University of Tennessee, Knoxville, TN, May 2006

“Probabilistic entanglement of two remotely-located trapped ions” poster presented at the *Gordon Conference for Atomic Physics*, Tilton, NJ, June 2005

“Hot Topics in Cool Ions and Fast Lasers x2,” invited talk at the January 2005 FOCUS Center luncheon, University of Michigan, Ann Arbor, MI.

“Fabrication of a GaAs/AlGaAs ion trap for quantum computing,” talk presented at *APS Division of Atomic, Molecular, and Optical Physics (DAMOP)*, University of Arizona, Tucson, AZ, May 2004

“Quantum control of individual cold ions with fast shaped laser pulses,” poster presented at *Workshop on Trapped Ion Quantum Computing 2004*, University of Michigan, Ann Arbor, MI, May 2004

“Towards Micro-fabricated Ion Trap Quantum Computing,” talk presented at the *APS Ohio-Michigan Section Meeting*, Michigan State University, Lansing, MI, April 2003

“Trapped Cadmium Ions for Clean Quantum Computing,” poster presented at *International Conference of Atomic Physics (ICAP)*, MIT, Cambridge, MA, August 2002