

# Dr. Martin John Madsen

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Department of Physics  
Wabash College  
P.O. Box 352  
Crawfordsville, IN 47933

Phone: 765-361-6071  
Fax: 765-361-6340  
email: madsenm@wabash.edu  
<http://www.iontrap.wabash.edu>

## EDUCATION

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- 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

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- 2006-present **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

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- 2010-present **Research Collaboration**, Purdue University  
*West Lafayette, IN*  
Collaborator: Yong Chen
- 2006-present **Principal Investigator**, Wabash College  
*Crawfordsville, IN*  
Trapped Ion Quantum Information Laboratory
- 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

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

## STUDENT PRESENTATIONS

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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

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*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**

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2010-present	<b>Western Martial Arts Student Club Faculty Advisor</b> Wabash College <i>Crawfordsville, IN</i>
2009-present	<b>Faculty Development Committee</b> Wabash College <i>Crawfordsville, IN</i>
2006-present	<b>Society of Physics Students Faculty Advisor</b> Wabash College

*Crawfordsville, IN*

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

2007-  
present

**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**

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

Grant reviewer for the *National Science Foundation*

## **VOLUNTEER AND COMMUNITY SERVICE**

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2000-2007 American Red Cross, Disaster Services Volunteer

1998-2004 Boy Scouts of America volunteer Scoutmaster and Cub Scout den leader

1994-1996 Missionary for the Church of Jesus Christ of Latter-day Saints in the Caracas Venezuela Mission

## **PROFESSIONAL MEMBERSHIPS**

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American Physical Society

American Association of Physics Teachers

## **HONORS AND AWARDS**

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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."

1988 *Eagle Scout*, Boy Scouts of America

## PUBLICATIONS

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(\* denotes undergraduate co-authors)

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, 448 (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., Olmschenck, 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  $\text{Cd}^+$  isotopes,”** *Physical Review A (Atomic, Molecular, and Optical Physics)*, v 65, n 4, Apr 2002, p 040304/1-4

## PRESENTATIONS

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

**“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,”** 3<sup>rd</sup> 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