

# Curriculum Vitae

## Matthew R. Dietrich

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Physics of Cold Atoms and Ions and Fundamental Symmetries

### Education

- 2009 December** Ph.D. in Physics, University of Washington, Seattle, WA  
Thesis: Barium Ions for Quantum Computation Advisor: Boris Blinov
- 2006 June** M.S. in Physics, University of Washington, Seattle, WA
- 2004 June** B.A. in Physics and Math/Computer Science, Lawrence University, Appleton, WI

### Awards

- 2008 May** Hans G. Dehmelt Prize for outstanding graduate work in table-top experimental physics
- 2004 February** J. Bruce Brackenridge Prize for outstanding physics major with a strong academic record and great promise for continued work in physics

### Research Experience

- 08/2015 – Present** Radium EDM Experiment, Medium Energy Physics, Argonne National Lab  
Assistant Physicist

Currently I lead efforts on the radium electric dipole moment (EDM) measurement experiment in the physics division at Argonne National Laboratory. We have succeeded in measuring the EDM of radium-225 for the first time, which is also the first time laser cooling and trapping techniques have been applied to an EDM measurement of any kind. Now we are working towards an upgraded measurement with dramatically improved sensitivity.

- 04/2014 – 08/2015** Quantum Control of Molecular Ions, Northwestern University  
Research Assistant Professor

At Northwestern, I worked to demonstrate quantum control of ionic molecules, building on the group's previous success in all-optical rotational cooling of aluminum hydride. We developed an improved source of aluminum hydride ions, and built most of the infrastructure needed for ground state translational cooling. These are important steps towards quantum logic spectroscopy of single molecular ions.

- 08/2010 – 04/2014** Radium EDM Experiment, Medium Energy Physics, Argonne National Lab  
Postdoctoral Appointee – Supervisor: Zheng-Tian Lu

I was the lead postdoc on the search for the radium nuclear electric dipole moment (EDM) at Argonne. We developed a suite of techniques, including a magneto-optic trap and two dipole traps to capture, transport and polarize cold radium atoms for an anticipated EDM experiment. Working along with two graduate students in our trap lab, we observed for the first time nuclear precession of cold, trapped radium atoms. This breakthrough brought us very close to a first EDM measurement.

**01/2006 – 07/2010** Ion Trap Quantum Computing, University of Washington  
Graduate Student Research Assistant  
Postdoctoral Research Associate – Supervisor: Boris Blinov

As a graduate student I was responsible for the initial development of a new laboratory in Paul trap quantum computing, up to the demonstration of the first barium ion qubit, which was my thesis research. We demonstrated coherent control of both microwave and optical transitions, and used this for precision spectroscopy and to explore improved qubit readout techniques. I also assisted another graduate student in developing a new trap geometry for highly efficient optical detection of ions. I worked closely with many undergraduate researchers in this laboratory setting during my thesis studies.

**06/2003 – 09/2003** Simulation of Sonic Mach Cones in Dusty Plasmas, Baylor University  
REU Student – Supervisor: Lorin Matthews

## **Presentations**

### *Invited Talks at Conferences*

**2017 December** Workshop on Quantum Sensing (Lemont, IL)  
**2017 May** Advances in Rare Isotope Science (Keystone, CO)  
**2016 April** Munich-Michigan Joint EDM Meeting (East Lansing, MI)  
**2016 February** International Workshop on Ultracold Group II Atoms (Paris, France)  
**2014 October** 4<sup>th</sup> Joint Meeting of Division of Nuclear Physics, US and Japan (Hawaii, HI)  
**2012 November** Midwest Cold Atom Workshop (Urbana-Champaign, IL)  
**2012 July** Project X Physics Study (Batavia, IL)  
**2011 November** Midwest Cold Atom Workshop (Evanston, IL)  
**2010 June** 13<sup>th</sup> International Conference on Quantum Optics and Information (Kiev, Ukraine)

### *Colloquia and Seminars*

**2018 January** Argonne National Laboratory Physics Division Colloquium (Lemont, IL)  
**2017 November** Physics Colloquium at University of New Brunswick (Fredericton, Canada)  
**2016 March** High Energy Physics Seminar (Lemont, IL)  
**2015 October** Physics Colloquium at Northwestern University (Evanston, IL)  
**2013 November** University of Virginia (Charlottesville, VA)  
**2013 November** Northwestern University (Evanston, IL)  
**2013 September** University of Connecticut (Storrs, CT)  
**2012 November** Seminar: Physics Department, University of Indiana (Bloomington, IN)

### *Contributed Talks*

**2017 October** Meeting of the APS Division of Nuclear Physics (Pittsburgh, PA)  
**2017 June** 48<sup>th</sup> Meeting Division of Atomic, Molecular and Optical Physics (Sacramento, CA)  
**2014 June** 7<sup>th</sup> International Conference on Laser Probing (East Lansing, MI)  
**2013 June** 44<sup>th</sup> Meeting Division of Atomic, Molecular and Optical Physics (Quebec City, Quebec, Canada)  
**2012 June** 43<sup>rd</sup> Meeting Division of Atomic, Molecular and Optical Physics (Orange County, CA)

<b>2011 June</b>	42 <sup>nd</sup> Meeting Division of Atomic, Molecular and Optical Physics (Atlanta, GA)
<b>2009 February</b>	11 <sup>th</sup> Annual Southwest Quantum Information and Technology (Seattle, WA)
<b>2008 June</b>	9 <sup>th</sup> International Workshop on Non-Neutral Plasma Physics VII (New York, NY)
<b>2008 May</b>	39 <sup>th</sup> Meeting Division of Atomic, Molecular and Optical Physics (University Park, PA)

## Service

<b>2017-2018</b>	Intersections of Nuclear Physics and Quantum Information (NPQI), Co-chair
<b>2017</b>	Workshop on Quantum Sensors for High Energy Physics Program Committee
<b>2017-2018</b>	Student Lunch Seminar Organizing Committee, Chair
<b>2017</b>	Physics Division Computing Committee
<b>2016-2017</b>	Colloquium Committee
<b>2016</b>	Physics Open House Committee

## Publications

### *Journals*

“Alignment of a Vector Magnetometer to an Optical Prism”, M. R. Dietrich, K. G. Bailey, T. P. O’Connor, *Rev. Sci. Instr.* **88**, 055105 (2017) [arXiv:1612.07235]

“Improved Limit on the  $^{225}\text{Ra}$  Electric Dipole Moment”, M. Bishof, R. H. Parker, K. G. Bailey, J. Greene, R. J. Holt, M. R. Kalita, W. Korsch, N. D. Lemke, Z.-T. Lu, P. Mueller, T. P. O’Connor, J. T. Singh, and M. R. Dietrich, *Phys. Rev. C* **94** 025501 (2016) [arXiv:1606.04931]

“Raman Sideband Cooling of a  $^{138}\text{Ba}^+$  ion using a Single Zeeman Interval”, C. M. Seck, M. G. Kokish, M. R. Dietrich, and B. C. Odom, *Phys. Rev. A* **93** 053415 (2016) [arXiv:1603.09322]

“Simple and Compact Nozzle Design for Laser Vaporization Sources”, M. G. Kokish, M. R. Dietrich, and B. C. Odom, *J. Phys. B: At. Mol. Opt. Phys.* **49** 035301 (2016) [arXiv:1509.04208]

“First Measurement of the Atomic Electric Dipole Moment of  $^{225}\text{Ra}$ ”, R. H. Parker, M. R. Dietrich, M. R. Kalita, N. D. Lemke, K. G. Bailey, M. Bishof, J. P. Greene, R. J. Holt, W. Korsch, Z.-T. Lu, P. Mueller, T. P. O’Connor, and J. T. Singh, *Phys. Rev. Lett.* **114** 233002 (2015) [arXiv:1504.07477]

“Measurement of the Hyperfine Quenching Rate of the Clock Transition in  $^{171}\text{Yb}$ ”, C.-Y. Xu, J. Singh, J. C. Zappala, K. G. Bailey, M. R. Dietrich, J. P. Greene, W. Jiang, N. D. Lemke, Z.-T. Lu, P. Mueller, and T. P. O’Connor, *Phys. Rev. Lett.* **113** 033003 (2014) [arXiv:1406.2340]

“Efficient, Tightly-Confined Trapping of  $^{226}\text{Ra}$ ”, R. H. Parker, M. R. Dietrich, K. Bailey, J. P. Greene, R. J. Holt, M. R. Kalita, W. Korsch, Z.-T. Lu, P. Mueller, T. P. O’Connor, J. Singh, I. A. Sulai, and W. L. Trimble, *Phys. Rev. C* **86** 065503 (2012) [arXiv:1305.7131]

“Adiabatic passage in the presence of noise”, T. Noel, M. R. Dietrich, N. Kurz, G. Shu, J. Wright, and B. B. Blinov, *Phys. Rev. A* **85** 023401 (2012) [arXiv:1108.2671]

“Efficient fluorescence collection and ion imaging with the “tack” ion trap”, Gang Shu, Chen-Kuan Chou, Nathan Kurz, Matthew R. Dietrich, and Boris B. Blinov, *J. Opt. Soc. Am. B* **28**, 2865-2870 (2011) [arXiv:1108.5306]

“Measurement of Lande g factor of 5D5/2 state of BaII with a single trapped ion”, N. Kurz, M. R. Dietrich, Gang Shu, T. Noel, B. B. Blinov, *Phys. Rev. A* **82** 030501 (2010) [arXiv:1007.1481]

“Hyperfine and Optical Barium Ion Qubits”, M. R. Dietrich, N. Kurz, T. Noel, G. Shu and B. B. Blinov, *Phys. Rev. A* **81** 052328 (2010) [arXiv:1004.1161]

“Efficient fluorescence collection from trapped ions with an integrated spherical mirror”, Gang Shu, N. Kurz, M. R. Dietrich and B. B. Blinov, *Phys. Rev. A* **81** 042321 (2010) [arXiv:0911.4958]

“Trapped ion imaging with a high numerical aperture spherical mirror”, Gang Shu, M. R. Dietrich, N. Kurz and B. B. Blinov, *J. Phys. B: At. Mol. Opt. Phys.* **42** 154005 (2009)

“Precision measurement of the branching ratio in the  $6P_{3/2}$  decay of BaII with a single trapped ion”, N. Kurz, M. R. Dietrich, Gang Shu, R. Bowler, J. Salacka, V. Mirgon and B. B. Blinov, *Phys. Rev. A* **77** 060501(R) (2008)

### ***Conference Proceedings***

“Progress Towards the Search for the Permanent Electric Dipole Moment of Radium-225”, K. G. Bailey, M. R. Dietrich, J. P. Greene, R. J. Holt, M. R. Kalita, W. Korsch, N. D. Lemke, Z. T. Lu, P. Mueller, T. P. O’Connor, R. H. Parker and J. T. Singh, *Journal of Physics: Conference Series*, PAVI 2014

“Barium Ions for Quantum Computation”, M. R. Dietrich, A. Avril, R. Bowler, N. Kurz, J. S. Salacka, G. Shu and B. B. Blinov, *Non-Neutral Plasma Physics: Workshop on Non-Neutral Plasmas*, James R. Danielson and Thomas Sunn Pedersen, eds., *AIP Conf. Proc.* **1114** (1) 25 (2009)

### ***Unpublished***

“Use of a Microcontroller for Fast Feedback Control of a Fiber Laser”, M. R. Dietrich and B. B. Blinov, [arXiv:0905.2484]