DAVID MINOT WELD

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Research Interests

Nonequilibrium dynamics, Floquet engineering, anyons, quantum simulation of ultrafast phenomena, quantum sensing, quasiperiodicity, energy harvesting, quantum interfaces.

Education

Ph.D. in Physics, Stanford University April 2007
Dissertation: *Design, Construction, and Operation of an Apparatus for Detecting Short-Length-Scale Deviations From Newtonian Gravity.*

B.A. in Physics, Harvard University June 1998
Magna cum laude, phi beta kappa

Research Experience

Assistant Professor Sept. 2011 – present
University of California, Santa Barbara

Research Scientist July 2010 – Sept. 2011
Massachusetts Institute of Technology
Led ^{87}Rb BEC experiment and initiated a new ^{7}Li BEC experiment.

Postdoctoral Fellow Jan. 2007 – July 2010
Massachusetts Institute of Technology
Proposed, developed the theory of, and demonstrated spin gradient thermometry and spin gradient demagnetization cooling of ultracold atoms.

Graduate Student Researcher Sept. 1999 – Nov. 2006
Stanford University
Developed a novel cryogenic probe of weak mass-dependent forces, and used it to constrain deviations from Newtonian gravity at length scales of 10 μm.

Honors & Awards

National Science Foundation CAREER Award	2016
UC President's Research Catalyst Award (Lead PI)	2015
Presidential Early Career Award for Scientists & Engineers (PECASE)	2014
Hellman Family Faculty Fellow	2013
Alfred P. Sloan Research Fellow	2013
Young Investigator Prize, Air Force Office of Scientific Research	2012
Richard Whited Endowed Chair in Interdisciplinary Science	2011 – 2017
ARCS Fellowship	2004 – 2005
National Defense Science & Engineering Graduate Fellowship	1999 – 2002

Publications

Transport in Floquet-Bloch bands. K. M. Fujiwara, K. Singh, Z.A. Geiger, R. Senaratne, S. V. Rajagopal, M. Lipatov, and D.M. Weld. arXiv:1806.07858 (2018).

Observation and Uses of Position-space Bloch Oscillations in an Ultracold Gas. Z. Geiger, K. M. Fujiwara, K. Singh, R. Senaratne, S. V. Rajagopal, M. Lipatov, T. Shimasaki, R. Driben, V. V. Konotop, T. Meier, and D. M. Weld. *Phys. Rev. Lett.* **120**, 213201 (2018). (Selected as an Editor's Choice, featured with a commentary in *Physics*.)

Quantum Simulation of Ultrafast Dynamics Using Trapped Ultracold Atoms. R. Senaratne, S. V. Rajagopal, T. Shimasaki, P. E. Dotti, K. M. Fujiwara, K. Singh, Z.A. Geiger, and D.M. Weld. *Nature Communications* **9**, 2065 (2018).

Energy Harvesting with a Liquid-Metal Microfluidic Influence Machine. C. Conner, T. de Visser, J. Loessberg, S. Sherman, A. Smith, S. Ma, M. Napoli, S. Pennathur, and D.M. Weld. *Phys. Rev. Applied* **9**, 044008 (2018).

Experimental Realization of a Relativistic Harmonic Oscillator. K.M. Fujiwara, Z.A. Geiger, K. Singh, R. Senaratne, S.V. Rajagopal, M. Lipatov, T. Shimasaki, and D.M. Weld. *New J. Phys.* **20**, 063027 (2018).

Observation of Two-beam Collective Scattering Phenomena in a Bose-Einstein Condensate. I. Dimitrova, W. Lunden, J. Amato-Grill, N. Jepsen, Y. Yu, M. Messer, T. Rigaldo, G. Puentes, D.M. Weld, and W. Ketterle. *Phys. Rev. A* **96**, 051603(R) (2017).

Quantum Emulation of Extreme Non-equilibrium Phenomena with Trapped Atoms. S.V. Rajagopal, K.M. Fujiwara, R. Senaratne, K. Singh, Z.A. Geiger, and D.M. Weld. *Ann. Phys.* **529**, 1700008 (2017).

Photoacoustic Ultrasound Sources from Diffusion-limited Aggregates. K. Patel, M. Brubaker, A. Kotlerman, R. Salazar, E. Wolf, D.M. Weld. *Appl. Phys. Lett.* **109**, 183109 (2016).

Fibonacci Optical Lattices for Tunable Quantum Quasicrystals. K. Singh, K. Saha, S.A. Parameswaran, and D. M. Weld. *Phys. Rev. A* **92**, 063426 (2015).

Adiabatic Cooling of Bosons in Lattices to Magnetic Ordering. J. Schachenmayer, D.M. Weld, H. Miyake, G.A. Siviloglou, A.J. Daley, and W. Ketterle. *Phys. Rev. A* **92**, 041602(R) (2015).

Effusive Atomic Oven Nozzle Design Using an Aligned Microcapillary Array. R. Senaratne, S. Rajagopal, Z. Geiger, K. Fujiwara, V. Lebedev, and D.M. Weld. *Rev. Sci. Instrum.* **86**, 023105 (2015).

Self-assembled Zeeman Slower Based on Spherical Permanent Magnets. V. Lebedev and D. M. Weld. *J. Phys. B* **47**, 155003 (2014). (Cover Article)

Bragg Scattering as a Probe of Atomic Wavefunctions and Quantum Phase Transitions in Optical Lattices. H. Miyake, G. Siviloglu, G. Puentes, D.E. Pritchard, W. Ketterle, and D.M. Weld. *Phys. Rev. Lett.* **107**, 175302 (2011).

Spin Gradient Demagnetization Cooling of Atoms in an Optical Lattice. P. Medley, D. Weld, H. Miyake, D. Pritchard, and W. Ketterle. *Phys. Rev. Lett.* **106**, 195301 (2011).

Towards Quantum Magnetism with Ultracold Atoms. D.M. Weld and W. Ketterle. *J. Phys. Conf. Ser.* **264**, 012017 (2011).

Thermometry & Refrigeration in the Two-component Mott Insulator. D.M. Weld, H. Miyake, P. Medley, D. Pritchard, and W. Ketterle. *Phys. Rev. A* **82**, 051603(R) (2010).

Spin Gradient Thermometry for Ultracold Atoms in Optical Lattices. D.M. Weld, P. Medley, H. Miyake, D. Hucul, D. Pritchard, and W. Ketterle. *Phys. Rev. Lett.* **103**, 245301 (2009).

New Apparatus for Detecting Micron-scale Deviations from Newtonian Gravity. D.M. Weld, J. Xia, B. Cabrera, and A. Kapitulnik. *Phys. Rev. D* **77**, 062006 (2008).

Improved Constraints on Non-Newtonian Forces at 10 μm. A. Geraci, S.J. Smullin, D.M. Weld, J. Chiaverini, and A. Kapitulnik. *Phys. Rev. D* **78**, 022002 (2008).

Feedback Control and Characterization of a Microcantilever Using Optical Radiation Pressure. D.M. Weld and A. Kapitulnik. *Appl. Phys. Lett.* **89**, 164102 (2006).

Constraints on Yukawa-type Deviations from Newtonian Gravity at 20 μm. S.J. Smullin, A. Geraci, D.M. Weld, J. Chiaverini, S. Holmes and A. Kapitulnik. *Phys. Rev. D* **72**, 122001 (2005).

Testing Gravity at Short Distances. S.J. Smullin, A. Geraci, D.M. Weld, and A. Kapitulnik. In *SLAC Summer Institute on Particle Physics*, Aug 2004.

New Experimental Constraints on Non-Newtonian Forces Below 100 μm. J. Chiaverini, S. Smullin, A. Geraci, D.M. Weld, and A. Kapitulnik. *Phys. Rev. Lett.* **90**, 151101 (2003).

Cryogenic IR/Optical/UV Fast Spectrophotometers for the Study of Time-Variable Astronomical Sources. A.J. Miller, B. Cabrera; R.W. Romani, J.M. Martinis, S.W. Nam, D.M. Weld, and J.P. Castle. *Proc. SPIE* **4131**, 278 (2000).

Teaching

Classroom Instruction & Course Development: Taught upper-division undergraduate quantum mechanics, electromagnetism, solid-state physics, and statistical mechanics. Taught and supervised expansion of honors sophomore lab class and senior lab class. Completely redesigned and taught a graduate course on special topics in condensed matter physics. Designed and taught a new graduate atomic physics course (now Physics 228) on subjects including atomic structure, atom-atom interactions, atom-field interactions, laser cooling and trapping, quantum gases, and modern experimental techniques.

Integration of Teaching and Research: Supervisor for ten undergraduate theses and thirty-two student-quarters of Physics 199, guiding undergraduate students through hands-on research. Instructor for seventy-four student-quarters of Physics 596, guiding graduate students working on advanced research projects. Worked to strengthen undergraduate laboratory research classes by commissioning a new senior lab unit on atomic spectroscopy and helping to enlarge the capacity of the honors sophomore lab sequence. Led a team which conceived, secured funding for, and installed a $600,000 facility to distribute spectroscopy-grade laser light to ten research and teaching labs in Broida hall, opening up numerous exciting possibilities for direct integration of cutting-edge research with laboratory classes.

Metrics: Instructor ratings exceed departmental averages for every course taught. Nominated by the physics department for a campus-wide Distinguished Teaching Award in 2018.

Professional Activities, Mentoring, and Outreach

- *Leadership Activities:* Director of the California Institute for Quantum Emulation, a multicampus research institute supported by UCOP and CNSI. Lead PI for the Broadly-tunable Illumination Facility for Research, Outreach, Scholarship, and Training (BIFROST), a multi-user light source facility supplying tunable wideband spectroscopy-grade light to ten research and teaching labs in Broida Hall.

- *Mentoring:* Faculty Advisor for Training in Teaching and Mentoring at UCSB's Center for Science and Engineering Partnerships. Scientific mentor for three postdocs, eleven graduate students, and twenty-six undergraduates (combining UCSB and MIT). PI/mentor for five Worster Summer Research Fellowships, seven Summer Undergraduate Research Fellowships, one INSET fellowship, and one EUREKA fellowship.

- *Outreach to K-12 Students:* Performed scientific demonstrations and presentations on topics such as superconductivity, Bose-Einstein condensation, and fractals for audiences ranging in age from second grade through high school. Visited geographically and economically diverse schools in such cities as San Jose CA, Redwood City CA, Malden MA, Baltimore MD and Goleta CA. Worked with UCSB's successful "Physics Circus" elementary school outreach program.

- *Postdoctoral Professional Development:* Founded, organized, and ran a "soft skills" seminar series for postdocs at Harvard and MIT. Continued to engage with professional education of young scientists at UCSB, serving as a panelist for the professional development seminar series at the Center for Science and Engineering Partnerships.

- *Other Professional Activities:* APS DAMOP session chair, member of American Physical Society, reviewer for Physical Review Letters and other journals.

Invited Talks

Cold Atom Capabilities: Prospects for Low-Energy Physics at the Sensitivity Frontier.
Kavli Institute for Theoretical Physics program on "Prospects for high-energy physics at the sensitivity frontier," Santa Barbara CA, May 2018

Extreme Nonequilibrium Phenomena in Driven Quantum Gases.
UCSD Physics Seminar, San Diego CA, May 2018

Extreme Nonequilibrium Phenomena in Driven Ultracold Gases.
UIUC Physics Seminar, Urbana IL, November 2017

Extreme Nonequilibrium Phenomena in Driven Ultracold Gases.
Cal Poly SLO Physics Colloquium, San Luis Obispo, CA, October 2017

Extreme Nonequilibrium Phenomena in Driven Ultracold Gases.
Stanford AMO Seminar, Stanford, CA, October 2017

Extreme Nonequilibrium Phenomena in Driven Ultracold Gases.
U. Toronto Physics Seminar, Toronto, Ontario, July 2017

From photoacoustics to Floquet matter: fun with classical and quantum driven systems.
UCI Physics Seminar, Irvine, CA, May 2017

Exploring Extreme Nonequilibrium Phenomena with Cold Atoms.
UCB Physics Seminar, Berkeley, CA, April 2017

Cold Atom Quantum Emulation.
USC Physics Colloquium, Los Angeles, CA, March 2016

New Targets and New Directions for Quantum Emulation.
IQE Symposium, Berkeley, CA, January 2016

New Frontiers In Optical Lattice Dynamics.
"Many-body Dynamics Out of Equilibrium" workshop, Dresden, Germany, March 2015

Simulation of Quantum Materials Using Ultracold Trapped Gases.
Materials Research Outreach Symposium, Santa Barbara, CA February 2015

Nonequilibrium Dynamics & New Quantum Phenomena with Ultracold Li and Sr.
AFOSR/ARO Program Review, Houston, TX, January 2015

Prospects and Challenges of Quantum Simulation.
CM/AMO Seminar, Stanford University, May 2014

Prospects and Challenges of Quantum Simulation.
CM/AMO Seminar, University of Texas, Austin, May 2014

New Frontiers for Quantum Simulation in Optical Lattices.
APS March Meeting, March 2014

Prospects and Challenges of Quantum Simulation.
CM/AMO Seminar, University of Washington, October 2013

Prospects and Challenges of Quantum Simulation.
Physics Colloquium, UC Merced, September 2013

Prospects and Challenges of Neutral Atom Quantum Simulation.
Condensed Matter Seminar, Caltech, April 2013

Prospects and Challenges of Neutral Atom Quantum Simulation.
AMO Seminar, UCLA, March 2013

Cold Atom Quantum Simulation.
Physics Colloquium, Harvey Mudd College, March 2013

Cold Atom Quantum Simulation.
Physics Colloquium and Inaugural Lecture for Whited chair, UCSB, November 2012

New Frontiers for Ultracold Atoms.
New Laser Scientists Conference, Rochester, October 2012

Towards Quantum Simulation: Thermometry and Cooling with Ultracold Spin Mixtures in Optical Lattices. Physics Department Seminar, UC Irvine, February 2012

Ultracold Spin Mixtures and Bragg Diffraction.
Aspen Winter Conference, Aspen, Colorado, January 2012

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
Physics Department Seminar, New York University, March 2011.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
Physics Department Seminar, University of California Santa Barbara, February 2011.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
Physics Department Seminar, Stanford University, February 2011.

Thermometry and Cooling with Ultracold Spin Mixtures in Optical Lattices.
Physics Department Seminar, University of Michigan, January 2011.

Thermometry and Cooling with Ultracold Spin Mixtures in Optical Lattices.
Physics Department Seminar, Princeton University, January 2011.

Thermometry and Cooling with Ultracold Spin Mixtures in Optical Lattices.
Special CM Seminar, Northwestern University, January 2011.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
Seminar, Amherst College, January 2011.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
CMP Seminar, University of Massachusetts Amherst, January 2011.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
"Beyond Standard Optical Lattices" workshop, Kavli Institute for Theoretical Physics, University of California Santa Barbara, November 2010.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
James Franck Institute Seminar, University of Chicago, November 2010.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
ITAMP Lunch Seminar, Harvard University, November 2010.

Thermometry and Refrigeration in the Two-component Mott Insulator.
"Quo vadis BEC?" conference, Max Planck Institute, Dresden, Germany, August 2010

The Basics of Quantum Simulation.
"Quo vadis BEC?" summer school, Max Planck Institute, Dresden, Germany, August 2010

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation.
Physics Department Seminar, New York University, April 2010.

Thermometry and Cooling with Ultracold Spin Mixtures: Towards Quantum Simulation
Physics Department Seminar, Stony Brook University, April 2010.

An Experimental Search for Short-Length-Scale Deviations from Newtonian Gravity (With Remarks on Simulating Quantum Magnetism Using Cold Atoms).
Aspen Winter Conference, Aspen, Colorado, January 2009

Towards Quantum Simulation in Optical Lattices. International Symposium on Ultracold Quantum Gases and Atomtronics, Örenäs Slott, Sweden, November 2007