

**Grant Biedermann**  
**Associate Professor**  
**Homer L. Dodge Professor of Atomic Physics**  
**CURRICULUM VITAE**

*Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma 73019*

*biedermann@ou.edu*

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**Educational History:**

- Degree: B. S., Engineering Physics (May, 2001)  
University of Oklahoma, Norman OK
- Degree: M. S., Physics (May, 2002)  
Yale University, New Haven CT
- Degree: Ph. D., Physics (November, 2007)  
Stanford University, Palo Alto CA

**Employment History:**

Present Position: H. L. Dodge Associate Professor of Physics, University of Oklahoma

Previous Positions:

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| 2015 – 2019 | Research Associate Professor, Dept. of Physics and Astronomy, University of New Mexico |
| 2013 – 2019 | Principal Member of the Technical Staff, Sandia National Laboratories                  |
| 2011 – 2015 | Adjunct Professor, Physics and Astronomy, University of New Mexico                     |
| 2008 – 2013 | Senior Member of the Technical Staff, Sandia National Laboratories                     |

**Patents:**

1. Microfabricated ion frequency standard, U.S. Patent # 7,859,350 (2010)
2. High data rate atom interferometric device through high recapture efficiency, U.S. Patent # 8,941,053 (2015)
3. High data rate atom interferometric device, U.S. Patent # 9,086,429 (2015)
4. Light-pulse atom interferometric device, U.S. Patent # 9,291,508 (2016)
5. Method and apparatus for quantum information processing using entangled neutral-atom qubits, U.S. Patent # 9,934,469 (2018)
6. Compact laser source with frequency modulators generating multiple lines, U.S. patent #11,545,815 (2023)
7. Passively pumped, polycrystalline ceramic high and ultra-high vacuum chambers, U.S. patent #11,766,651 (2023)
8. Suspended waveguides on membrane and needle structures towards photonic atom trap integrated platforms, U.S. patent #11,914,188 (2024)
9. Guided cold atom inertial sensors with membrane integrated photonics on atom trap integrated platforms, U.S. Patent #11,971,256 (2024)
10. Compact atom interferometry inertial navigation sensors with tailored diffractive optics. U.S. Patent #12/424,810 (2025)
11. Compact grating magneto-optical trap sensor head for inertial navigation in dynamic environments. U.S. Patent #12/449,256 (2025)
12. Phase modulation detection of a light pulse atom interferometer, University of Oklahoma, *Provisional patent filed* 63,748,644 (2025). Full patent written—to be filed by 1/23/26

## Publications:

1. L. A. Kraft, S. A. Meek, N. Marliere, A. Jozani and G. W. Biedermann, *Phase modulation detection of a strontium atom interferometer gyroscope*, Accepted for publication in Phys. Rev. Applied (2025).
2. M. Gaudesius, J. Lee, L. Kraft, J. Gordon, and G. W. Biedermann, *Magneto-optical trap loading with an effusive oven in a large optical access experiment*, Accepted for publication in Phys. Rev. A (2025).
3. Anupam Mitra, Tameem Albash, Philip Daniel Blocher, Jun Takahashi, Akimasa Miyake, Grant W. Biedermann, Ivan H. Deutsch, *Macrostates vs. Microstates in the Classical Simulation of Critical Phenomena in Quench Dynamics of 1D Ising Models*, New J. Phys. **27** 013026 (2025).
4. Kaustav Mukherjee, Grant W Biedermann, Robert J Lewis-Swan, *Programmable glassy dynamics using tunable disorder in tweezer arrays*, arXiv:2504.17659 (2025).
5. A. Bhowmik, M. Gaudesius, G. Biedermann, D. Blume, *Double, triple, and quadruple magic wavelengths for cesium ground, excited, and Rydberg states*, Phys. Rev. A **110**, 043114 (2024).
6. K. Mukherjee, G. W. Biedermann, R. J. Lewis-Swan, *Influence of disordered and anisotropic interactions on relaxation dynamics and propagation of correlations in tweezer arrays of Rydberg dipoles*, Phys. Rev. A **110**, 053320 (2024).
7. Ashok Kodigala, Michael Gehl, Gregory W Hoth, Jongmin Lee, Christopher T DeRose, Andrew Pomerene, Christina Dallo, Douglas Trotter, Andrew L Starbuck, Grant Biedermann, Peter DD Schwindt, Anthony L Lentine, *High-performance silicon photonic single-sideband modulators for cold-atom interferometry*, Science Advances **10**, eade4454 (2024).
8. Y. Zhang, A. Gaddie, H-V. Do, G. W. Biedermann, R. J. Lewis-Swan, *Simulating a two component Bose-Hubbard model with imbalanced hopping in a Rydberg tweezer array*, Phys. Rev. A **109**, 053317 (2024).
9. Adrian Orozco, William Kindel, Nicholas Karl, Yuan-Yu Jau, Michael Gehl, Grant Biedermann, Jongmin Lee, *A Low-Power Evanescent Field Atom Guide Based on Nanofiber Testbeds for Chip-Scale Quantum Inertial Sensors with Photonic Integrated Circuits*, arXiv:2311.07055 (2023).
10. Anupam Mitra, Sivaprasad Omanakuttan, Michael J. Martin, Grant W. Biedermann, Ivan H. Deutsch, *Neutral atom entanglement using adiabatic Rydberg dressing*, Phys. Rev. A **107**, 062609 (2023).
11. Lee, J., Ding, R., Christensen, J. et al. *A compact cold-atom interferometer with a high data-rate grating magneto-optical trap and a photonic-integrated-circuit-compatible laser system*. Nat Commun **13**, 5131 (2022).
12. Bethany J Little, Gregory W Hoth, Justin Christensen, Chuck Walker, Dennis J De Smet, Grant W Biedermann, Jongmin Lee, Peter DD Schwindt, *A passively pumped vacuum package sustaining cold atoms for more than 200 days*, AVS Quantum Sci. **3**, 035001 (2021)
13. Michael J Martin, Yuan-Yu Jau, Jongmin Lee, Anupam Mitra, Ivan H Deutsch, Grant W Biedermann, *A Mølmer-Sørensen Gate with Rydberg-Dressed Atoms*, arXiv:2111.14677 (2021).
14. Q. Guan, G. W. Biedermann, A. Schwettmann, and R. J. Lewis-Swan, *Tailored generation of quantum states in an entangled spinor interferometer to overcome detection noise*, Phys. Rev. A **104**, 042415 (2021).
15. Michael Gehl, William Kindel, Nicholas Karl, Adrian Orozco, Katherine Musick, Douglas Trotter, Christina Dallo, Andrew Starbuck, Andrew Leenheer, Christopher Derose, Grant Biedermann, Yuan-Yu Jau, And Jongmin Lee, *Characterization of Suspended Membrane Waveguides towards a Photonic Atom Trap Integrated Platform*, Optics Express, **29** 13129 (2021).
16. Jongmin Lee, Grant Biedermann, John Mudrick, Erica A. Douglas, and Yuan-Yu Jau, *Demonstration of a MOT in a Sub-Millimeter Membrane Hole*, Scientific Reports **11** 8807 (2021).

17. Brif, C., Ruzic, B., Biedermann, G. W., *Characterization of Errors in Interferometry with Entangled Atoms*. Physical Review Quantum, 1, 010306 (2020).
18. A. Mitra, M. J. Martin, G. W. Biedermann, A. M. Marino, P. M. Poggi, and I. H. Deutsch, *Robust Mølmer-Sørensen gate for neutral atoms using rapid adiabatic Rydberg dressing*, Physical Review A, 101, 030301(R) (2020).
19. Kodigala, M. Gehl, C. T. DeRose, D. Hood, A. T. Pomerene, C. Dallo, D. Trotter, P. Moore, A. L. Starbuck, J. Lee, G. Biedermann, and A. L. Lentine, *Silicon Photonic Single-Sideband Generation with Dual-Parallel Mach-Zehnder Modulators*, in *Conference on Lasers and Electro-Optics*, OSA Technical Digest (Optical Society of America, 2019), paper STh4N.6.
20. G. W. Biedermann, H. J. McGuinness, A. V. Rakholia, Y.-Y. Jau, D. R. Wheeler, J. D. Sterk, and G. R. Burns, *Atom interferometry in a warm vapor*, Phys. Rev. Lett. 118, 163601 (2017). *Editor's suggestion & Viewpoint*
21. Jongmin Lee, Michael J. Martin, Yuan-Yu Jau, Tyler Keating, Ivan H. Deutsch, and Grant W. Biedermann, *Demonstration of the Jaynes-Cummings ladder with Rydberg-dressed atoms*, Phys. Rev. A, 95, 041801(R) (2017).
22. Tyler Keating, Charles H. Baldwin, Yuan-Yu Jau, Jongmin Lee, Grant W. Biedermann, and Ivan H. Deutsch, *Arbitrary Dicke-State Control of Symmetric Rydberg Ensembles*, Phys. Rev. Lett., 117, 213601 (2016).
23. Y.-Y. Jau, A. M. Hankin, T. Keating, I. H. Deutsch, G. W. Biedermann, *Entangling Atomic Spins with a Strong Rydberg-Dressed Interaction*, Nature Physics, 12, 71 (2016).
24. G. W. Biedermann, X. Wu, L. Deslauriers, S. Roy, C. Mahadeswaraswamy, and M. A. Kasevich, *Testing Gravity with Cold-Atom Interferometers*, Phys. Rev. A 91, 033629 (2015). *Editor's suggestion*
25. Philippe F. Weck, Eunja Kim and Grant W. Biedermann, *Interaction of cesium adatoms with free-standing graphene and graphene-veiled SiO<sub>2</sub> surfaces*, RSC Adv., 5, 38623 (2015).
26. Tyler Keating, Robert L. Cook, Aaron Hankin, Yuan-Yu Jau, Grant W. Biedermann, Ivan H. Deutsch, *Robust quantum logic in neutral atoms via adiabatic Rydberg dressing*, Phys. Rev. A 91, 012337 (2014). *Editor's Suggestion*
27. Akash V. Rakholia, Hayden J. McGuinness, and Grant W. Biedermann, *Dual-Axis High-Data-Rate Atom Interferometer via Cold Ensemble Exchange*, Phys. Rev. Applied 2, 054012 (2014).
28. M. Hankin, Y.-Y. Jau, L. P. Parazzoli, C. W. Chou, D. J. Armstrong, A. J. Landahl, and G. W. Biedermann, *Two-atom Rydberg blockade using direct 6S to nP excitation*, Phys. Rev. A 89, 033416 (2014).
29. Sharon A. Kennedy, G.W. Biedermann, J.T. Farrar, T.G. Akin, S.P. Krzyzewski, E.R.I. Abraham, *Confinement of ultracold atoms in a Laguerre-Gaussian laser beam created with diffractive optics*, Optics Communications 321, 110 (2014).
30. Tyler Keating, Kritika Goyal, Yuan-Yu Jau, Grant W. Biedermann, Andrew J. Landahl, and Ivan H. Deutsch, *Adiabatic quantum computation with Rydberg-dressed atoms*, Phys. Rev. A 87, 052314 (2013).
31. G. W. Biedermann, K. Takase, X. Wu, L. Deslauriers, S. Roy, and M. A. Kasevich, *Zero-Dead-Time Operation of Interleaved Atomic Clocks*, Phys. Rev. Lett. 111, 170802 (2013).
32. L. P. Parazzoli, A. M. Hankin, and G. W. Biedermann, *Observation of Free-Space Single-Atom Matter Wave Interference*, Phys. Rev. Lett. 109, (2012). *Editor's suggestion & Viewpoint*
33. Hayden J. McGuinness, Akash V. Rakholia, and Grant W. Biedermann, *High data-rate atom interferometer for measuring acceleration*, Appl. Phys. Lett. 100, 011106 (2012).
34. S. A. Kemme; G. R. Brady; A. R. Ellis; J. R. Wendt; D. W. Peters; G. W. Biedermann; T. R. Carter; S. Samora; J. A. Isaacs; V. V. Ivanov; M. Saffman, *Ultrafast diffractive optical micro-trap arrays for neutral atom quantum computing*, Proc. of SPIE 8249, (2012).
35. G. W. Biedermann, F. M. Benito, K. M. Fortier, D. L. Stick, T. K. Loyd, P. D. D. Schwindt, C. Y. Nakakura, R. L. Jarecki Jr. and M. G. Blain, *Ultrasoother microfabricated mirrors for quantum information*, Appl. Phys. Lett. 97, 181110 (2010).

36. G. W. Biedermann, X. Wu, L. Deslauriers, K. Takase, and M. A. Kasevich, *Low-noise simultaneous fluorescence detection of two atomic states*, Optics Letters, Vol. 34, 347 (2009).

#### **Fields of research specialization**

- Laser cooling and trapping of neutral atoms
- Precision metrology via coherent control of atomic matter wave systems
- Entangling interactions of neutral atoms using Rydberg states
- Quantum information science with ultracold atoms

#### **Invited talks:**

1. Entanglement complexity and precision measurement with cold atom qubits, G. Biedermann, University of Michigan, April 2025
2. Entanglement complexity and atom interferometry with cold atom qubits, SPIE Photonics West, San Francisco, California, 2025
3. Entanglement complexity and precision measurement with cold atom qubits, Purdue University, 2024
4. Quantum synchronization with optically trapped cesium, Keck Workshop, Norman, OK, 2024
5. Experimental Quantum Gravity and Quantum Information, University of New Hampshire, 2022
6. Photonics West, San Francisco, California, 2020
7. Physics of Quantum Electronics, Snowbird, Utah, 2020
8. University of Oklahoma, Department of Physics colloquium, 2019
9. University of New Mexico, Department of Physics colloquium, 2019
10. Jet Propulsion Laboratory, group seminar, Pasadena CA, 2018
11. University of Illinois Urbana-Champaign, Quantum Information/AMO seminar, 2018
12. Los Alamos National Laboratory, Quantum lunch seminar, 2018
13. University of Oklahoma, Department of Physics colloquium, 2018
14. Berkeley, AMO Quantum Information seminar, 2018
15. Naval Postgraduate School, Monterey, CA 2018
16. American Physical Society, March Meeting, Los Angeles, CA 2018
17. National Institute of Standards and Technology, T&F division, group seminar, 2017
18. Frontiers of interacting systems of Rydberg atoms, ITAMP Harvard, 2017
19. American Physical Society, Four Corners Division, Las Cruces, NM 2016
20. Frontiers of Matter Wave Optics, Arcachon, France, 2016
21. American Physical Society, Division of Atomic, Molecular and Optical Physics (DAMOP) meeting, Rhode Island, 2016
22. AMO seminar, Rice University, Houston TX, 2016
23. International conference on Rydbergs in Durham (iCorD), Durham U.K., 2015
24. Group seminar, M. Kasevich group, Stanford University, 2015
25. Group seminar, Air Force Research Labs, Albuquerque NM, 2015
26. Science and engineering in quantum information systems (SEQIS) research challenge, Sandia National Laboratories, 2014
27. Center for quantum information and control (CQuIC) seminar, University of New Mexico, 2014
28. Center for quantum information and control (CQuIC) seminar, University of New Mexico, 2013
29. Second International Workshop on Adiabatic Quantum Computing (invited tutorial), London U.K. 2013
30. Group seminar, E. Rasel, University of Hannover, Germany 2013
31. American Physical Society March Meeting, Baltimore MD, 2013
32. Physics of Quantum Electronics (PQE), Snowbird Utah, 2012
33. Department colloquium, University of Nevada, Reno 2012
34. Quantum technology workshop, Santa Fe, NM 2010
35. Center for quantum information and control (CQuIC) seminar, University of New Mexico, 2009

36. Department of Physics colloquium, University of Oklahoma, Norman 2009

### Contributed Talks

1. IEEE Inertial Sensors and Systems, Hawaii, 2017
2. American Physical Society, Division of Atomic, Molecular and Optical Physics (DAMOP) meeting, Wisconsin, 2014
3. IEEE Inertial Sensors and Systems, Hawaii, 2015
4. Institute of Navigation, International Technical Meeting, Dana Point CA, 2015
5. Imperial College London, AMO group seminar, 2014
6. University of Birmingham, U.K., AMO group seminar, 2014

### Mentoring:

Ph. D. Theses supervised:

- Akash Rakholia (July 2015), “High data rate atom interferometry for measuring dynamic inertial conditions.”
- Aaron Hankin (August 2014), “Rydberg excitation of single atoms for applications in quantum information and metrology.”
- Adrian Orozco (UNM, May 2022), “Nano-fabricated Atomic Waveguides for Inertial Measurements.”
- Luke Kraft (ongoing)
- Alec Gaddie (ongoing)
- Jumin Lee (ongoing)
- Anuraj Laha (ongoing)
- Jason Gordon (ongoing)
- Hanbo Yang (ongoing)

M.S. Theses supervised:

- Nathan Marliere (December 2022), “Design and setup of an atom interferometer gyroscope using a strontium thermal beam.”

Post-doctoral research supervision:

- L. Paul Parazzoli (2011 – 2013)—converted to staff member at Sandia
- Hayden McGuinness (2011 – 2013) — converted to staff member at Sandia
- Jongmin Lee (2014 – 2017) — converted to staff member at Sandia
- Michael Martin, *Truman Fellow* (2015 – 2017) — Deputy Group Leader at LANL
- William Kindel (2018 – 2020) – converted to staff member at Sandia
- Bethany Little (2018 – 2020) – converted to staff member at Sandia
- Hoang-Van Do (2020 – 2025) — Assistant Professor and U. Massachusetts, Boston
- Akbar Jozhani (2021 – 2022)—PostDoc at Quantum Valley
- Marius Gaudesius (2021 – 2025)—PostDoc at Penn. State University

Additional student research supervision

- Visiting undergraduate research: Midshipman Elizabeth Kim, U.S. Naval Academy, Annapolis, MD. (summer 2016)
- Visiting graduate research: Rustin Nourshargh, University of Birmingham, U.K., year-long visit at Sandia National Laboratories starting March 2017
- Undergraduate research:
  - Jacob Sims, University of Oklahoma, Fall 2019 – Fall 2022
  - Angela Brown, University of Oklahoma, Spring 2020

- Jamie Boyd, University of Oklahoma, Fall 2020 – Spring 2022
- Isac Perez, University of Oklahoma, Fall 2020 – Spring 2021
- John Milligan, University of Oklahoma, Spring 2021 – Fall 2021
- Isabella Campbell, University of Oklahoma, Fall 2021 – Spring 2022
- Inhyeok Cho, University of Oklahoma, Fall 2022 – Spring 2023
- Sadie Priddy, University of Oklahoma, Fall 2022 – Fall 2023
- Jagger Mantooh, University of Oklahoma, Fall 2023 – Spring 2024
- Finn Woods, University of Oklahoma, Fall 2023 – Spring 2024
- Aubrey McNeil, University of Oklahoma, Spring 2024 – Spring 2025
- Eli Young, University of Oklahoma, Fall 2024 – Spring 2025
- Garrett Mayfield, University of Oklahoma, Spring 2025 – Fall 2025
- Kyle Moulton, University of Oklahoma, Fall 2025

**Service:**

Service to the Department of Physics and Astronomy, University of Oklahoma

- Associate Director, Center for Quantum Research and Technology (CQRT) at OU
- Undergraduate Studies Committee, Engineering Physics Advisor
- College of Engineering Transfer conference department roundtable
- Graduate recruitment committee
- CQRT committee, publicity
- CQRT committee chair, Industry and National Laboratory Partnerships
- Faculty search committees
- Department Academic Program Review committee
- College of Engineering Student Retention Taskforce

Service to the Department of Physics and Astronomy, University of New Mexico

- Student outreach via open house presentations and participation in a professionally produced recruiting video
- Senior Collaborating Participant of the NSF Center for Quantum Information and Control (CQuIC) at the University of New Mexico. I collaborate with Prof. Ivan Deutsch, and advise PhD student research

Service to the discipline

- Panel member for the U.S. Department of Energy's Office of Defense Nuclear Nonproliferation R&D (DNN R&D) Independent Review of Berkeley National Labs research project
- Panel member for the U.S. Department of Energy's Office of Defense Nuclear Nonproliferation R&D (DNN R&D) Independent Review of Sandia National Labs research project
- Panel member for the U.S. Department of Energy's Office of Defense Nuclear Nonproliferation R&D (DNN R&D) Independent Review of Los Alamos research project
- Reviewer for National Science Foundation proposals
- Panel member for NSF QLCI review
- Reviewer for Air Force Office of Scientific Research proposals
- Panel member at Air Force Global Strike Command quantum technology workshop (2018), AFOSR/ARO Quantum Technology Workshop (2019), NASA Quantum Technology Workshop (2019)
- Reviewer for peer-reviewed articles in journals such as Phys. Rev. Lett., Science, Applied Physics Letters, Optics Letters, Applied Phys. B, Optics Express, Scientific Reports and Phys. Rev. A

- Reviewer for proposals to the Laboratory Directed Research and Development fund at Sandia National Laboratories

### **Workshop organization**

- Co-Organizer, Optical Tweezers Workshop at OU, funded by the Avenir Foundation, June 2023

### **Honors, Awards and News Articles**

- Featured interview in College of Engineering, Engineering Physics Program Student outreach video <https://youtu.be/XdPUGilmyoA>
- Norman Campus Faculty Tribute Awards Research Grants, 2023. Award for obtaining grant funding in excess of \$1M.
- News article from the VPRP office on our new Keck grant <https://ou.edu/research-norman/news-events/2022/ou-physicists-receive-1-million-dollar-grant-to-explore-quantum-synchronization>
- Norman Campus Faculty Tribute Awards Research Grants, 2021. Award for obtaining grant funding in excess of \$1M.
- Homer L. Dodge Chair of Atomic Physics, 2019—present
- News article on our lab by OU Admissions and Recruitment: <https://www.ou.edu/admissions/sooner-stories/physics-lab>
- Up and Coming Innovator, Sandia National Laboratories, 2019