Curriculum Vitae - Shimon Kolkowitz

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Research Appointments

University of Wisconsin - Madison

- Associate Professor - Department of Physics, July, 2022 - Present.
- Assistant Professor - Department of Physics, January, 2018 - July, 2022.
- Faculty Affiliate - Department of Engineering Physics, 2019 - Present.

JILA, NIST, and University of Colorado, Boulder

- National Research Council (NRC) postdoctoral research associate, 2015 - 2017.

Education

- Ph.D. Physics, Harvard University, 2015.
- A.M. Physics, Harvard University, 2011.
- B.S. Physics, *with distinction*, Stanford University, 2008.

Honors and Awards

- Sloan Research Fellowship, 2022.
- NSF CAREER Award, 2022.
- International Quantum U Tech Accelerator (AFRL/AFOSR) competition winner, 2020.
- Packard Fellowship for Science and Engineering, 2019.
- Gordon and Betty Moore Foundation Lectureship Award, 2019.
- National Research Council (NRC) Postdoctoral Fellowship, 2015 - 2017.
- Outstanding Presentation Award, NIST Boulder Laboratories Postdoctoral Poster Symposium, 2016.
- National Science Foundation Graduate Research Fellowship, 2013 - 2015.
- National Defense Science and Engineering Graduate Fellowship, 2010 - 2013.

Journal publications

- A. Gardill, I. Kemeny, Y. Li, M. Zahedian, M.C. Cambria, X. Xu, V. Lordi, A. Gali, J.R. Maze, J. Choy, and S. Kolkowitz, "Super-resolution Airy disk microscopy of individual color centers in diamond," *ACS Photonics*, (2022). https://doi.org/10.1021/acsphotonics.2c00713
- X. Zheng, J. Dolde, V. Lochab, B.N. Merriman, H. Li, and S. Kolkowitz, "Differential clock comparisons with a multiplexed optical lattice clock," *Nature* **602**, 425-430 (2022). https://www.nature.com/articles/s41586-021-04344-y
- Y. Wu, S. Kolkowitz, S. Puri, and J.D. Thompson, "Erasure conversion for fault-tolerant quantum computing in alkaline earth Rydberg atom arrays," *Nature Communications*, **13**, 4657 (2022). https://www.nature.com/articles/s41467-022-32094-6
- A. Gardill, I. Kemeny, M.C. Cambria, Y. Li, H.T. Dinani, A. Norambuena, J.R. Maze, V. Lordi, and S. Kolkowitz, "Probing charge dynamics in diamond with an individual color center," *Nano Letters*, **21** (16), 6960-6966 (2021). https://pubs.acs.org/doi/abs/10.1021/acs.nanolett.1c02250
- L.V.H. Rodgers, L.B. Hughes, M. Xie, P.C. Maurer, S. Kolkowitz, A.C. Bleszynski Jayich, and N.P. de Leon, "Materials challenges for quantum technologies based on color centers in diamond," *MRS Bulletin*, **46**, 623-633 (2021). https://link.springer.com/article/10.1557/s43577-021-00137-w
- B.F. Bachman, Z.R. Jones, G.R. Jaffe, J. Salman, R. Wambold, Z. Yu, J.T. Choy, S.J. Kolkowitz, M.A. Eriksson, M.A. Kats, and R.J. Hamers, "High-Density Covalent Grafting of Spin-Active Molecular Moieties to Diamond Surfaces," *Langmuir*, **37** (30), 9222-9231 (2021). https://pubs.acs.org/doi/full/10.1021/acs.langmuir.1c01425
- J. Van Damme, X. Zheng, M. Saffman, M.G. Vavilov, and S. Kolkowitz, "Impacts of random filling on spin squeezing via Rydberg dressing in optical clocks," *PRA,* **103**, 023106 (2021). https://journals.aps.org/pra/abstract/10.1103/PhysRevA.103.023106
- M.C. Cambria, A. Gardill, Y. Li, A. Norambuena, J.R. Maze, and S. Kolkowitz, "State-dependent phonon-limited spin relaxation of nitrogen-vacancy centers," *Physical Review Research,* **3**, 013123 (2021). https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.3.013123
- R.A. Wambold, Z. Yu, Y. Xiao, B. Bachman, G. Jaffe, S. Kolkowitz, J.T. Choy, M. Eriksson, R.J. Hamers, and M.A. Kats, "Adjoint-optimized nanoscale light extractor for nitrogen-vacancy centers in diamond," *Nanophotonics,* **10**(1), 393-401 (2021). https://www.degruyter.com/document/doi/10.1515/nanoph-2020-0387/html
- A. Gardill, M.C. Cambria, and S. Kolkowitz, "Fast relaxation on qutrit transitions of nitrogen-vacancy centers in nanodiamonds," *Physical Review Applied* **13**, 034010 (2020). https://journals.aps.org/prapplied/abstract/10.1103/PhysRevApplied.13.034010
- E. Barausse, *et al.* (LISA Consortium), "Prospects for Fundamental Physics with LISA," *General Relativity and Gravitation,* **52**, 81 (2020). https://link.springer.com/article/10.1007/s10714-020-02691-1

- M.A. Sedda, *et al.*, "The Missing Link in Gravitational-Wave Astronomy: Discoveries waiting in the decihertz range," *Classical & Quantum Gravity* **37**, 21 (2020). https://doi.org/10.1088/1361-6382/abb5c1
- S. Kimmel and S. Kolkowitz, "No-go bounds for quantum seals," *Physical Review A* **100**, 052326 (2019). https://journals.aps.org/pra/abstract/10.1103/PhysRevA.100.052326
- S.L. Bromley, S. Kolkowitz, T. Bothwell, D. Kedar, A. Safavi-Naini, M.L. Wall, C. Salomon, A.M. Rey, and J. Ye, "Dynamics of interacting fermions under spin-orbit coupling in an optical lattice clock," *Nature Physics* **14**, 399-404 (2018). https://www.nature.com/articles/s41567-017-0029-0
- S. Kolkowitz, S.L. Bromley, T. Bothwell, M.L. Wall, G.E. Marti, A.P. Koller, X. Zhang, A.M. Rey, and J. Ye, "Spin-orbit coupled fermions in an optical lattice clock," *Nature* **542**, 66-70 (2017). https://www.nature.com/articles/nature20811
- S. Kolkowitz, I. Pikovski, N. Langellier, M.D. Lukin, R.L. Walsworth, and J. Ye, "Gravitational wave detection with optical lattice atomic clocks," *Physical Review D* **94**, 124043 (2016). https://journals.aps.org/prd/abstract/10.1103/PhysRevD.94.124043
- S. Kolkowitz, A. Safira, A.A. High, R.C. Devlin, S. Choi, Q.P. Unterreithmeier, D. Patterson, A.S. Zibrov, V.E. Manucharyan, H. Park, and M.D. Lukin, "Probing Johnson noise and ballistic transport in normal metals with a single spin qubit," *Science* **347**, no. 6226 (2015). https://www.science.org/doi/10.1126/science.aaa4298
- S. Kolkowitz, Q.P. Unterreithmeier, S.D. Bennett, and M.D. Lukin, "Sensing distant nuclear spins with a single electron spin." *Physical Review Letters*, **109**: 137601 (2015). https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.109.137601
- S. Kolkowitz, A.C.B. Jayich, Q.P. Unterreithmeier, S.D. Bennett, P. Rabl, J.G.E. Harris, and M.D. Lukin, "Coherent sensing of a mechanical resonator with a single-spin qubit," *Science* **335**, no. 6076 (2012). https://www.science.org/doi/10.1126/science.1216821
- S.D. Bennett, S. Kolkowitz, Q.P. Unterreithmeier, P. Rabl, A.C.B. Jayich, J.G.E. Harris, and M.D. Lukin, "Measuring mechanical motion with a single spin," *New Journal of Physics* **14**, 125004 (2012). https://iopscience.iop.org/article/10.1088/1367-2630/14/12/125004
- P. Rabl, S. Kolkowitz, F.H.L. Koppens, J.G.E. Harris, P. Zoller, and M.D. Lukin, "A quantum spin transducer based on nanoelectromechanical resonator arrays," *Nature Physics* **6**, 602-608 (2010). https://www.nature.com/articles/nphys1679
- P. Fierlinger, R. DeVoe, B. Flatt, G. Gratta, M. Green, S. Kolkowitz, F. Leport, M. Montero Diez, R. Neilson, K. O'Sullivan, A. Pocar, and J. Wodin, "A microfabricated sensor for thin dielectric layers," *Review of Scientific Instruments* **79**, 045101 (2008). https://aip.scitation.org/doi/10.1063/1.2906402
- D.S. Leonard, *et al.* (EXO Collab.), "Systematic study of trace radioactive impurities in candidate construction materials for EXO-200," *Nuclear Instruments and Methods in Physics Research Sect. A* **591**, 490 (2008). https://www.sciencedirect.com/science/article/abs/pii/S016890020800346X

- R. Abramitzky, L. Einav, S. Kolkowitz, and R. Mill, "On the optimality of line call challenges in professional tennis," *International Economic Review* **53**, 939-964 (2012). https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-2354.2012.00706.x

Submitted pre-prints

- X. Zheng, J. Dolde, H.M. Lim, and S. Kolkowitz, "A lab-based test of the gravitational redshift with a miniature clock network," *arXiv:2207.07145* (2022). https://arxiv.org/abs/2207.07145
- M. Zahedian, J. Liu, R. Vidrio, S. Kolkowitz, J.T. Choy, "Depth dependence of the radiative lifetime of shallow color centers in single crystalline diamond," *arXiv:2207.07217* (2022). https://arxiv.org/abs/2207.07217
- A. Sharma, S. Kolkowitz, M. Saffman, "Analysis of a Cesium lattice optical clock," *arXiv:2203.08708* (2022). https://arxiv.org/abs/2203.08708

Book chapters

- S. Kolkowitz and J. Ye, "Precision Timekeeping: Optical Atomic Clocks," pp. 139-156 in Handbook of Laser Technology & Applications, 2nd Ed., C. Guo, Ed., CRC Press, London (2021). (Invited) https://tinyurl.com/2p83dcvs

Technical reports and white papers

- V. Schkolnik, et al. "Optical Atomic Clock aboard an Earth-orbiting Space Station (OACESS): Enhancing searches for physics beyond the standard model in space." *arXiv:2204.09611* (2022). https://arxiv.org/abs/2204.09611
- D. Antypas, et al. "New Horizons: Scalar and Vector Ultralight Dark Matter." *arXiv:2203.14915* (2022). https://arxiv.org/abs/2203.14915
- S. Kolkowitz, J.M. Hogan, I. Pikovski, J.K. Thompson, J. Ye, "Decadal Survey on Biological and Physical Sciences (BPS) Research in Space 2023-2032 - Topical: Gravitational wave detection with optical atomic clocks in space." (2021). https://tinyurl.com/4f3c6y56
- D. Budker, et al. "Quantum Sensors for High Precision Measurements of Spin-dependent Interactions." *arXiv:2203.09488* (2022). https://arxiv.org/abs/2203.09488
- D. Carney, et al. "Snowmass 2021: Quantum Sensors for HEP Science–Interferometers, Mechanics, Traps, and Clocks." *arXiv:2203.07250* (2022). https://arxiv.org/abs/2203.07250
- I. Alonso, et al. "Cold Atoms in Space: Community Workshop Summary and Proposed Road-Map." *arXiv:2201.07789* (2022). https://arxiv.org/abs/2201.07789
- Z. Ahmed, et al. "New Technologies for Discovery." *arXiv:1908.00194* (2019). https://arxiv.org/abs/1908.00194

Patents

- S. Kolkowitz, A. Sharma, M. Saffman, "Alkali Metal Optical Clock." Provisional patent application filed with USPTO, March, 2022.
- S. Kolkowitz, J. Thompson, "Efficient Quantum Error Correction in Neutral Atoms by Conversion to Erasure Errors." Provisional patent application filed with USPTO, January, 2022.
- S. Kolkowitz, M.C. Cambria, A. Gardill, "Super-Resolution Optical Microscope." Provisional patent application filed with USPTO, September, 2021.
- S. Kolkowitz, A. Safira, A.A. High, R.C. Devlin, S. Choi, Q.P. Unterreithmeier, D. Patterson, A.S. Zibrov, V.E. Manucharyan, H. Park, M.D. Lukin, "A sensor for measurements using Johnson noise in materials." United States Patent #10197497, published 2/5/2019.

Professional Activities

- Co-founder and organizing board member for the Virtual AMO Seminar (VAMOS) series.
- Education, Workforce Development, and Outreach Major Activities Lead for Hybrid Quantum Architectures and Networks NSF QLCI Institute.
- Panelist and research proposal reviewer for US National Science Foundation, US Department of Energy, US Army Research Office, Israel Science Foundation, U.S.–Israel Binational Science Foundation, Research Corporation for Science Advancement, National Research Foundation of Singapore, German Research Foundation (DFG) and NWO Domain Science.
- Panelist for NDSEG Fellowship.
- Referee for journals including *Physical Review Letters, Physical Review X, Physical Review X Quantum, Physical Review A, Physical Review B, Physical Review Applied, New Journal of Physics, Journal of Optics, Nature Communications, Nature Physics, npj Quantum, Review of Scientific Instruments, Communications Chemistry, Journal of Micromechanics and Microengineering,* and *Nano Letters.*
- Wisconsin Quantum Institute official spokesperson and Steering Committee member.
- Madison Teaching and Learning Excellence Fellow.
- Organizer and presenter for the University of Wisconsin - Madison "Wonders of Physics" program.

Research funding

- PI on grants from ARO, AFOSR, NSF, DOE, David and Lucile Packard Foundation, Northwestern Center for Fundamental Physics/John Templeton Foundation, NIST, and Wisconsin Alumni Research Foundation (WARF).
- Lead-PI on $4M DOE Materials and Chemical Sciences Research for Quantum Information Science grant.

Invited talks

- Texas A&M Condensed Matter Seminar, College Station, TX - September 23rd, 2022
- ICAP 2022, Toronta, Canada - July 20th, 2022
- Ultrafast Dynamics and Metastability VII, Hersonissos, Crete, Greece - June 8th, 2022
- DAMOP 2022, Orlando, FL - June 1st, 2022
- NSLS-II CFN Joint Users' Meeting Workshop, (virtual) - May 26th, 2022
- Quantum Matter Seminar, Caltech, CA - April 1st, 2022
- Special Seminar, UC Santa Barbara, CA - March 11th, 2022
- AMO Seminar, UC Berkeley, CA - Feb. 14th, 2022
- SPIE Photonics West On-Demand, (virtual) - February, 2022
- PQE 2022, (virtual) - Jan. 10th, 2022
- DOE BES Theoretical Condensed Matter Physics PI Meeting, (virtual) - Nov. 26th, 2021
- Workshop on Q-NEXT characterization needs for Argonne Scientific User Facilities, (virtual) - Sep. 30th, 2021
- Community Workshop on Cold Atoms in Space (CERN Quantum Technology Initiative), (virtual) - Sep. 23rd, 2021
- OSA Optical Sensors and Sensing Congress, (virtual) - July 21st, 2021
- MRS Bulletin Webinar, "Materials Science for Quantum Computing," (virtual) - July 14th, 2021
- SPIE Photonics West, (virtual) - March, 2021
- ARO Physics Review meeting, (virtual) - April 14th, 2021
- Physics colloquium (virtual), North Carolina State - Oct. 19th, 2020
- Packard Fellow Meeting - Virtual New Fellow Presentation - Sep. 20th, 2020
- CQE Research Briefing - Virtual seminar - May. 21st, 2020
- SPIE Photonics West, San Francisco, CA - Feb. 2nd, 2020
- ARO Atomic and Molecular Physics Review meeting, Durham, NC - Jan. 30th, 2020
- PQE 2020, Snowbird, UT - Jan. 10th, 2020
- ITAMP Workshop: "Laboratory Cosmology: AMO Physics Techniques and Applications," Harvard, MA - Sep. 16th, 2019

- Gordon and Betty Moore Foundation Lecture, Stevens Institute of Technology, NJ - July 10th, 2019
- Engineering Physics Seminar, University of Wisconsin-Madison, WI - May. 7th, 2019
- Physical Chemistry Seminar, University of Wisconsin-Madison, WI - March. 5th, 2019
- Physics colloquium, Lawrence University, WI - Feb. 19th, 2019
- SPIE Photonics West, San Francisco, CA - Feb. 6th, 2019
- CPAD Instrumentation Frontier Workshop 2018, Brown University, RI - Dec. 9th, 2018
- Midwest Cold Atom Workshop, University of Illinois Urbana-Champaign, IL - Nov. 10th, 2018
- Chaos and Complex Systems Seminar, University of Wisconsin-Madison, WI - Sep. 11th, 2018
- AMO/QI seminar, University of Illinois Urbana-Champaign, IL - Mar. 28th, 2018
- Physics Department colloquium, University of Wisconsin-Madison, WI - Feb. 23rd, 2018
- SRitp workshop: "Beyond Standard Model Physics in direct, indirect and tabletop experiments," Weizmann Institute, Israel - Nov. 13th, 2017
- AMO seminar, UC Berkeley, CA - Oct. 4th, 2017
- College of Optical Sciences colloquium, University of Arizona, AZ - Feb. 2nd, 2017
- Atomic Physics Seminar, University of Wisconsin-Madison, WI - Jan. 24th, 2017
- Special Physics colloquium, UC Santa Barbara, CA - Jan. 5th, 2017
- CNAM colloquium, University of Maryland, MD - Oct. 6th, 2016
- ITAMP workshop: "Laboratory Cosmology: AMO Physics Techniques and Applications for Cosmological Phenomena," Harvard, MA - Sep. 12th, 2016
- NASA Fundamental Physics workshop, Dana Point, CA - Apr. 11th, 2016
- ITAMP weekly seminar, Harvard, MA - Mar. 31st, 2016
- Winter school workshop: "Advanced atomic sources and extreme cooling of atoms and molecules: techniques and applications," Les Houches, France - Jan. 27th, 2016
- Condensed Matter and Biophysics seminar, Washington University in St. Louis, MO - Dec. 1st, 2014
- AMO seminar, UC Berkeley, CA - Nov. 25th, 2014
- Boston Area Carbon Nanoscience seminar, MIT, MA - Oct. 24th, 2014
- Atomic, Bio, and Condensed Matter seminar, University of Washington, WA - Oct. 16th, 2014
- Center for Ultracold Atoms triple feature seminar, Harvard-MIT, MA - Sep. 30th, 2014

- California NanoSystems Institute seminar, UC Santa Barbara, CA - June 1st, 2012
- ITAMP workshop: "Optomechanics and Macroscopic Cooling," Harvard, MA - Feb. 7th, 2011
- Condensed Matter special seminar, Weizmann Institute, Israel - Jan. 31st, 2011

Public outreach lectures

- Space Place Public Lecture, University of Wisconsin - Madison, WI - March 8th, 2022
- Industrial Internet Consortium Member Meeting Keynote speaker, (virtual) - June, 2021
- Madison Astronomical Society Talk, Virtual - Aug. 14th, 2020
- Business Engagement Day on Campus RED Talk, University of Wisconsin - Madison, WI - Aug. 15th, 2019
- Science on Tap public talk, Madison, WI - May 1st, 2019
- Science Hall colloquium, Lawrence University, WI - Feb. 18th, 2019
- Madison Technical Club lecture, Madison, WI - Feb. 13th
- Technology Advisors Circle seminar, Benhamou Global Ventures, Palo Alto, CA - Feb. 5th, 2019
- Contributed talk, "Color: Pixels, Palettes, and Perception Symposium," University of Wisconsin - Madison, WI - Mar. 3rd, 2018

Recent courses taught

- Physics 779: Advanced Quantum Computing (Spring 2020, Spring 2021, Spring 2022)
- Physics 545: Introduction to Atomic Structure (Fall 2020, Fall 2021, Fall 2022)
- Physics 707: Quantum Computing Laboratory (Summer 2020)
- Physics 625: Applied Optics (Fall 2018, Fall 2019)
- Physics 325: Wave Motion and Optics (Spring 2018)