Adam M. Kaufman

CONTACT INFORMATION

JILA, University of Colorado at Boulder
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Boulder, CO, 80309

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APPOINTMENTS

JILA, **University of Colorado**, Boulder, CO, USA

JILA Fellow, Associate Professor Adjoint **March 2022 to present**

Associate JILA Fellow, Assistant Professor Adjoint **July 2017 to March 2022**

Harvard University, Cambridge, MA, USA

Postdoctoral Research Fellow **July 2015 to July 2017**

- Advisor: Markus Greiner

JILA, **University of Colorado**, Boulder, CO, USA

Research Associate **August 2009 to May 2015**

- Advisor: Cindy Regal

EDUCATION

University of Colorado, Boulder, CO, USA

Ph.D., Physics, May 2015

- Thesis: *Laser cooling to indistinguishability: atomic Hong-Ou-Mandel interference and entanglement through spin exchange.*
- Advisor: Professor Cindy A. Regal
- Thesis committee: Cindy A. Regal, Ana Maria Rey, Deborah S. Jin, David J. Wineland, Juan Restrepo

Amherst College, Amherst, MA, USA

B.A., Physics and Computer Science, May 2009

- Thesis: *Radio-frequency dressing of atomic Feshbach resonances.*
- Thesis distinction: nominated *summa cum laude* by the department of physics.
- Advisor: Professor David S. Hall

AWARDS

Friedrich Wilhelm Bessel Research Award, 2024
AFOSR Young Investigator Prize, 2023
I. I. Rabi Prize, American Physics Society (APS), 2023
New Horizons in Physics Prize, 2023
ONR Young Investigator Award, 2020
APS Division of AMO Physics (DAMOP) thesis prize winner, 2016
Finalist for Harvard Quantum Optics Center fellowship
International Conference on Atomic Physics 2014, poster prize
National Defense Science and Engineering Graduate Fellowship, 2012-2014
Sigma Xi Procter grant-in-aid of research prize, nominated by Deborah S. Jin, 2010

SYNERGISTIC ACTIVITIES

Referee: *Nature*, *Science*, *Physical Review Letters*, *Physical Review X*, *Physical Review A*
Organizer: Founder of the Virtual AMO Series, Aspen Summer School (2022), CUbit Quantum Seminar Series
Proposal review: Army Research Office, Air Force Office of Science Research, Department of Energy, European Research Council, Swiss National Science Foundation

MENTORSHIP

Visiting students and undergraduates Benjamin Johnston (CU), Felix Rönchen (Bonn), Kaizhao Wang (ETH)
Ph.D. Students: Aaron Young, William Eckner, Joanna Lis, Aruku Senoo, Tingyou Tan, Alec Cao, Theo Lukin Yelin, Gaurav Milind Vaidya, Kaizhao Wang, Jamie Boyd
Post-doctoral researchers: Matthew Norcia, Alec Jenkins, Nathan Schine, William Mcgrew, Nelson Darkwah Oppong, Matteo Marinelli, Alexander Baumgaertner

PUBLICATIONS (MOST RECENT FIRST)

A. Cao, W. J. Eckner, T. L. Yelin, A. W. Young, S. Jandura, L. Yan, K. Kim, G. Pupillo, J. Ye, N. D. Oppong, **A. M. Kaufman**, *Multi-qubit gates and 'Schrödinger cat' states in an optical clock, arXiv*, 2024

Y. Hong, M. Marinelli, **A. M. Kaufman**, A. Lucas, *Long-range enhanced surface codes, arXiv*, 2023

A. W. Young, S. Geller, W. J. Eckner, N. Schine, S. Glancy, E Knill, **A. M. Kaufman**, *An atomic boson sampler, Nature,* **629**, 311 (2024)

Daniel González-Cuadra, Dolev Bluvstein, Marcin Kalinowski, Raphael Kaubruegger, Nishad Maskara, Piero Naldesi, Torsten V. Zache, **Adam M. Kaufman**, Mikhail D. Lukin, Hannes Pichler, Benoît Vermersch, Jun Ye, Peter Zoller *Fermionic quantum processing with programmable neutral atom arrays,* PNAS 120, 35

J. Lis, A. Senoo, W. Mcgrew, Felix Ronchen, Alec Jenkins, **A. M. Kaufman**, *Mid-circuit operations using the omg architecture in neutral atom arrays, Phys. Rev. X,* **13**, 041035

W. Eckner, N. D. Oppong, A. Cao, A. W. Young, W. Milner, J. Robinson, J. Ye, **A. M. Kaufman**,*Realizing spin squeezing with Rydberg interactions in a programmable optical clock, Nature,* **621**, 734 (2023)

J. T. Young, S. R. Muleady, M. A. Perlin, **A. M. Kaufman**, A. M. Rey, *Enhancing spin squeezing using soft-core interactions Phys. Rev. Res,* **5**, L012033 (2022)

Y. Hong, J. T. Young, S. R. Muleady, M. A. Perlin, **A. M. Kaufman**, A. Lucas, *Quantum error correction in a time-dependent transverse field Ising model Phys. Rev. A,* **106**, 022432 (2022)

A. W. Young, W. Eckner, N. Schine, A. M. Childs, **A. M. Kaufman**, *Tweezer-programmable 2D quantum walks in a Hubbard-regime lattice, Science,* **377**, 6608 (2022)

A. Jenkins*, J. Lis*, A. Senoo, W. Mcgrew, **A. M. Kaufman**, *Ytterbium nuclear-spin qubits in an optical tweezer array, Phys. Rev. X,* **12**, 021027

N. Schine*, A. W. Young*, W. Eckner, M. Martin, **A. M. Kaufman**, *Long-Lived Bell states in an array of optical clock qubits,* , *Nature Physics, in press*(2022)

A. M. Kaufman and Kang-Kuen Ni, *Quantum science with optical tweezer arrays of ultracold atoms and molecules*, *Nature Physics* **17**, 1324-1333 (2021)

A. M. Kaufman *Photons and atomic qubits get a better connection*, *Science Perspective,* **373**, 6562 (2021)

W. Eckner, A. Young, N. Schine, **A. M. Kaufman**, *High-Power, Fiber-Laser-Based Source for Magic-Wavelength Trapping in Neutral-Atom Optical Clocks*, Rev. Sci. Instrum. **92**, 093001 (2021)

M. Zaletel, **A. M. Kaufman**, D. S. Kurn, and N. Yao, *P*reparation of Low Entropy Correlated Many-Body States via Conformal Cooling Quenches *Phys. Rev. Lett.* **126**, 103401 (2021).

J. T. Young, P. Bienias, R. Belyansky, **A. M. Kaufman**, A, V. Gorshkov, *Asymmetric blockade and multi-qubit gates via dipole-dipole interactions*, *Phys. Rev. Lett.* **127**, 120501 (2021).

A. W. Young, W. J. Eckner, W. R. Milner, D. Kedar, M. A. Norcia, E. Oelker, N. Schine, J. Ye, **A. M. Kaufman**, *A tweezer clock with half-minute atomic coherence at optical frequencies and high relative stability*, *Nature,* **588**, 408 (2020)

- Nature news and views: *Quantum engineering for optical clocks*

R. Belyansky, J. T. Young, P. Bienias, Z. Eldredge, **A. M. Kaufman**, P. Zoller, *Nondestructive cooling of an atomic quantum register via state-insensitive Rydberg interactions*, *Phys. Rev. Lett.* **123**, 213603 (2019).

R. Kaubruegger, P. Silvi, C. Kokail, R. V. Bijnen, A. M. Rey, J. Ye, **A. M. Kaufman**, P. Zoller, *Variational Spin-Squeezing Algorithms on Programmable Quantum Sensors*, *Phys. Rev. Lett.* **123**, 260505 (2019).

M. A. Norcia, A. W. Young, W. Eckner. E. Oelker, J. Ye, **A. M. Kaufman** *Seconds-scale coherence on an optical clock transition in a tweezer array*, *Science,* **366**, 6461 (2019)

R. Swan, A. Safavi-Naini, **A. M. Kaufman**, Ana Maria Rey, *Dynamics of quantum information*, *Nature reviews physics*, (2019)

J. Cotler, S. Choi, A. Lukin, H. Gharibyan, T. Grover, M. E. Tai, M. Rispoli, R. Schittko, P. M. Preiss, **A. M. Kaufman**, M. Greiner, H. Pichler, P. Hayden, *Quantum Virtual Cooling*, *Phys. Rev. X* **9**, 031013 (2019).

M. A. Norcia, A. W. Young, **A. M. Kaufman**, Microscopic control and detection of ultracold strontium in optical tweezer arrays, *Phys. Rev. X* **8**, 041054 (2018).

- Physics viewpoint: *Viewpoint: Alkaline Atoms Held with Optical Tweezers*
- Nature news and views: *The next step in making arrays of single atoms*

A. Lukin, M. Rispoli, R. Schittko, M. E. Tai, **A. M. Kaufman**, S. Choi, V. Khemani, J. Léonard, M. Greiner Probing entanglement in a many-body-localized system, *Science,* **364**, 6437 (2019)

A. M. Kaufman, M. C. Tichy, F. Mintert, A. M. Rey, C. A. Regal, *The Hong-Ou-Mandel effect with atoms*, AAMOP Volume 67: Chapter 7, (2018)

B. J. Lester, Y. Lin, M. O. Brown, **A. M. Kaufman**, R. J. Ball, E. Knill, A. M. Rey, C. A. Regal, *Measurement-based entanglement of non-interacting bosonic atoms*, *Phys. Rev. Lett.* **120**, 193602 (2017).

L. Isaev, **A. M. Kaufman**, G. Ortiz, A. M. Rey *Topological superfluidity with repulsive alkaline-earth atoms in optical lattices*, arXiv:1710.02768 (2017)

Y. He, F. Grusdt, **A. M. Kaufman**, M. Greiner, A. Vishwanath, *Realizing and adiabatically preparing bosonic integer and fractional quantum hall states in optical lattices*, Phys. Rev. B. **96**, 201103(R) (2017).

M. E. Tai, A. Lukin, M. Rispoli, R. Schittko, Tim Menke, P. M. Preiss, Fabian Grusdt, **A. M. Kaufman**, and M. Greiner, *Microscopy of the interacting Harper-Hofstadter model in the two-body limit*, *Nature* **546**, 519 (2017).
- Nature news and views: *Quantum physics: interactions propel a magnetic dance*

A. M. Kaufman, M. E. Tai, A. Lukin, M. Rispoli, R. Schittko, and M. Greiner, *Quantum thermalization through entanglement in an isolated many-body system*, *Science* **353**, 794 (2016).
- Science perspective: *Thermalization in small quantum systems*

A. M. Kaufman, and C. A. Regal, *Viewpoint: Electron model capture by Atom Pair*, *Physics* **8**, 16 (2015).

A. M. Kaufman, B. J. Lester, M. Foss-Feig, M. Wall, A. M. Rey, and C. A. Regal, *Entangling two transportable neutral atoms via local spin exchange*, Nature **527**, 208 (2015).

B. J. Lester, N. Luick, **A. M. Kaufman**, C. M. Reynolds, and C. A. Regal, *Rapid Production of Uniformly Filled Arrays of Neutral Atoms*, Phys. Rev. Lett. **115**, 073003 (2015).

B. J. Lester, **A. M. Kaufman**, C. A. Regal, *Raman cooling imaging: Detecting single atoms near their ground state of motion*, *Phys. Rev. A* **90**, 011804(R) (2014).

A. M. Kaufman, B. J. Lester, C. M. Reynolds, M. L. Wall, M. Foss-Feig, K. R. A. Hazzard, A. M. Rey, C. A. Regal, *Two-particle quantum interference in tunnel-coupled optical tweezers*, *Science* **345**, 306 (2014).
- Science perspective: *Quantum systems under control*

A. M. Kaufman, B. J. Lester, C. A. Regal, *Cooling a Single Atom in an Optical Tweezer to Its Quantum Ground State*, *Phys. Rev. X* **2**, 041014 (2014).
- Nature research highlight: *Atom cooled to ground state*
- Science Editors Choice: *A single-atom lasso*

D. V. Freilich, D. M. Bianchi, **A. M. Kaufman**, T. K. Langin, D. S. Hall, *Real-Time Dynamics of Single Vortex Lines and Vortex Dipoles in a Bose-Einstein Condensate*, *Science* **329**, 1182 (2010).

A. M. Kaufman, R. P. Anderson, T. Hanna, E. Tiesinga, P. S. Julienne, D. S. Hall, *Radio-frequency dressing of multiple Feshbach resonances*, *Phys. Rev. A* **80**, 050701(R) (2009).

Presentations

Invited Colloquium, Caltech Physics Department, Pasadena, April 2024, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Seminar, Workshop on cavity QED and two-electron atoms, Tokyo, March 2024, Using alkaline-earth qubits for metrology and quantum computation

Invited Colloquium, University of California Berkeley, March 2024, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Colloquium, DoD Basic Sciences Research Forum, March 2024, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Seminar, PQE, January 2024, Quantum science with microscopically-controlled arrays of alkaline-earth atoms
Invited Colloquium, Princeton University PQI, December 2023, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Colloquium, Penn State University, November 2023, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Colloquium, Stanford University, November 2023, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited Colloquium,University of Washington, October 2023, Programmable control of indistinguishable particles: from qubits to clocks to many-body physics
Invited seminar, BEC Conference, September 2023, *Microscopically-controlled arrays of alkaline-earth atoms*
Invited seminar, US-Ukraine Quantum Forum, Aug 2023, *Microscopically-controlled arrays of alkaline-earth atoms*
Invited seminar, Simulating many-body systems: Recent results and near-term opportunities in quantum hardware" Aug. 2023, *Quantum computing and simulation with neutral atoms*
Invited seminar, Heraeus workshop, *Microscopically-controlled arrays of alkaline-earth atoms*
Invited seminar, International workshop on Laser Physics, July 2023, *Microscopically-controlled arrays of alkaline-earth atoms*
Invited presentation, DAMOP Rabi prize session, June 2023, *Microscopically-controlled arrays of alkaline-earth atoms*
Invited seminar, ITAMP Rydberg workshop, May 2023, *New directions using alkaline earth qubits*
Invited seminar, Ultra quantum matter school, May 2023, *Programmable control of indistinguishable particles*
Invited Colloquium, University of Wisconsin, May 2023, *Programmable control of indistinguishable particles: from samplings to clocks to qubits*
Invited Colloquium, John Hopkins University, April 2023, *Programmable control of indistinguishable particles: from samplings to clocks to qubits*
Invited Colloquium, University of Colorado, March 2023, *Programmable control of indistinguishable particles: from samplings to clocks to qubits*
Invited talk, Physical Quantum Electronics, Jan. 2023, *Quantum science with microscopically-controlled arrays of alkaline-earths*
Invited talk, Quantum Innovations, Virtual, Japan, Nov. 2022: *Quantum metrology and computing using microscopically-controlled arrays of alkaline-earths*
Invited Colloquium, Harvard University, Nov. 2022, *Programmable control of indistinguishable particles: from samplings to clocks to qubits*
Invited talk, SQUINT, Oct. 2022, *Quantum science with microscopically-controlled arrays of alkaline-earths*
Invited Colloquium. QFARM-Stanford, Oct. 2022, *Quantum science with microscopically-controlled arrays of alkaline-earths*
Invited talk, Quantum Sensors and Tests of New Physics, Oct. 2022: *Quantum metrology and computing using microscopically-controlled arrays of alkaline-earths*
Invited talk, KITP (Quantum Many-body dynamics and NISQ systems), Sept. 2022: *Atom arrays of alkaline-earths*
Invited presentation, GRC late breaking topics talk, July 2022: *Quantum science with microscopically-controlled arrays of two-electron atoms*

Invited presentation, ICAP hot topics talk, July 2022: *Quantum science with microscopically-controlled arrays of two-electron atoms*
Invited seminar, QSIT Monte Verita, June 2022: *Quantum science with microscopically-controlled arrays of two-electron atoms*
Invited colloquium, MPQ, June 2022: *Quantum science with microscopically-controlled arrays of two-electron atoms*
Invited colloquium, RIKEN, June 2022: *Quantum science with microscopically-controlled arrays of two-electron atoms*
Invited symposium, DAMOP, May 2022: *Quantum information science with optical tweezer arrays of neutral atoms*
Invited seminar, Columbia Quantum Science seminar, May 2022: *New frontiers in atom arrays using alkaline-earth atoms*
Invited talk, EFTF and IEEE IFC symposium, April 2022: *Tweezer clocks: a new platform for quantum metrology*
Invited seminar, MIT IQuISE, April 2022: *New frontiers in atom arrays using alkaline-earth atoms*
Invited seminar, WE Heraeus Seminar - Frontiers in Quantum Gas Microscopy, April 2022: *New frontiers in atom arrays and quantum gas microscopes using alkaline-earth atoms*
Invited seminar, APS March meeting, March 2022: *New frontiers in atom arrays using alkaline-earth atoms*
Invited seminar, DPG meeting, March 2022: *New frontiers in atom arrays using alkaline-earth atoms*
Invited colloquium, Purdue Unviversity, Nov. 2021: *New frontiers in atom arrays using alkaline-earth atoms*
Invited seminar, Center for Ultracold Atoms, Nov. 2021: *New frontiers in atom arrays using alkaline-earth atoms*
Invited seminar, Novel movements for Clocks and Sensors Workshop , Sept. 2021: *Metrology and entanglement with assembled arrays of atoms*
Invited seminar, Condensed matter summer school, July 2021: *Alkaline-earth atoms in optical tweezers*
Invited JFI Seminar, University of Chicago, June 2021: *Metrology and entanglement with assembled arrays of atoms*
Invited seminar, Princeton University, April 2021: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited Colloquium, Colorado School of Mines, March 2021: *Metrology in optical tweezer arrays*
Invited Colloquium, Heidelberg University, January 2021: *Quantum metrology in optical tweezer arrays*
Invited presentation,Israel Quantum Computing Community (Qubit), January 2021: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited presentation, OSA Quantum 2.0, September 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited Colloquium, CQT Singapore, June 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited talk, Virtual AMO Seminar, April 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited talk, Stanford University, QFARM, April 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited talk, March Meeting, March 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology* Cancelled - COVID-19
Invited talk, PQE, January 2020: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*

Invited seminar, Hamburg University, Dec. 2019: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited colloquium, University Nevada Reno, Sept 2019: *Atoms arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited talk, FiO/Ls conference, Sept. 2019: *Frontiers in Optical Atomic Clocks: Challenges, New Platforms, and Entanglement*
Invited talk, BEC conference, Sept. 2019: *Atom arrays of ultracold strontium: new tools for many-body physics and metrology*
Invited talk, DAMOP, June 2019: *Microscopic control and detection of ultracold strontium in optical arrays: new tools in quantum information science and metrology*
Invited talk, CQuIC seminar UNM, 2019: *Microscopic control and detection of ultracold strontium in optical arrays: new tools in quantum information science and metrology*
Invited talk, 13th Japan-US Joint Seminar on Quantum Electronics and Laser Spectroscopy, October 2018: *Microscopic control of ultracold strontium*
Invited talk, MPQ, Seminar, May 2018: *Studies in entanglement with ultracold neutral atoms*
Invited talk, ETH, May 2018: Colloquium *Synthesizing, controlling, and probing quantum states through microscopy*
Invited talk, KITP Frontiers of Quantum information, 2017: *Studies in entanglement through microscopy of ultracold neutral atoms*
Invited talk, March meeting, 2017: *Quantum thermalization through entanglement*
Invited colloquium, Columbia, 2017: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited colloquium, BU, 2017: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited colloquium, JILA, 2017: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited colloquium, Princeton, 2017: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited colloquium, Harvard, 2016: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited colloquium, UCSB, 2016: *Synthesizing and probing quantum states of low-entropy atomic systems*
Invited seminar, BU, 2016: *Quantum thermalization through entanglement*
Invited seminar, JILA, 2016: *Quantum thermalization through entanglement*
Invited seminar, Stanford, 2016: *Quantum thermalization through entanglement*
Invited, QCMC, Singapore, 2016: *Atomic to generalized Hong-Ou-Mandel interference: probing entanglement in the dynamics of many-body systems*
Invited, Quantum Lunch, Los Alamos, 2016: *Quantum thermalization through entanglement*
Invited, DAMOP thesis prize session, 2016: *Laser cooling atoms to indistinguishability*
Contributed talk, SQUINT, 2016: *A self-thermalizing quantum many-body state*
Invited Talk, Snowbird, 2016: *Measuring entanglement entropy in a thermalizing many-body state*
Invited Seminar, Yale University, 2015: *Interfering and entangling single neutral atoms*
Invited seminar, Amherst College, 2015: *Two-particle quantum interference in tunnel coupled optical tweezers*
Contributed talk, SQUINT, 2015: *Interfering and entangling single neutral atoms*
Invited talk, Harvard, 2015: *Interfering and entangling single neutral atoms*
Poster, International Conference on Atomic Physics, Washington DC, 2014: *Two-particle quantum interference in tunnel coupled optical tweezers*
Invited seminar, Harvard, Boston MA (2014): *Two-particle quantum interference in tunnel coupled optical tweezers*

Invited seminar, ETH, Zurich (2014): *Two-particle quantum interference in tunnel coupled optical tweezers*
Invited seminar, Heidelberg University, Germany, 2014: *Two-particle quantum interference in tunnel coupled optical tweezers*
Invited seminar, Hamburg University, Hamburg Germany (2014): *Two-particle quantum interference in tunnel coupled optical tweezers*
Contributed talk, APS March Meeting, Denver CO (2014): *Hong-Ou-Mandel effect in tunnel-coupled optical tweezers*
Poster, Bose-Einstein Condensation - Frontiers in Quantum Gases, Sant Feliu De Guixols, Spain 2013: *Laser-cooled atoms in optical tweezers: Coherent tunneling Bose Statistics*
Contributed talk, DAMOP, Quebec City, Canada, 2013: *Experiments with laser cooled, ground-state atoms in optical tweezers*
Contributed talk, DAMOP, Orange County, California, 2012: *Raman sideband cooling of a single neutral atom in a micro scale dipole trap*
Invited seminar, JQI, University of Maryland (2012): *Cooling a single atom to its quantum ground state*
Invited seminar, NIST, Boulder CO, 2012: *Raman sideband cooling of a single neutral atom in an optical tweezer*
Poster, QIPC, ETH Zurich, 2011: *Towards ultracold single neutral atoms in microscale optical dipole traps*
Poster, ICAP, Cairns Australia, 2010: *Radio-frequency dressing of multiple Feshbach Resonances*