Murray Holland

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Professional Preparation:

University of Oxford, UK	Physics	D.Phil	1994
University of Auckland, NZ	Physics	MSc.	1990
University of Auckland, NZ	Physics and Mathematics	BSc	1988

Professional Appointments:

2013-2014	Chair of JILA, University of Colorado, Boulder, CO, USA
2011-2012	Associate Chair of JILA, University of Colorado, Boulder, CO, USA
2010-Present	Professor of Physics, University of Colorado, Boulder, CO, USA
2003-2010	Associate Professor of Physics, University of Colorado, Boulder, CO, USA
1996-2003	Assistant Professor of Physics, University of Colorado, Boulder, CO, USA
1995-1996	Postdoctoral Research Associate, University of Colorado Boulder, CO, USA
1994-1995	Lindemann Fellow of the English-Speaking Union (UK), University of Colorado, Boulder, CO, USA
1993-1994	Junior Research Fellow, St John's College, Oxford (UK)

Relevant Technical Expertise:

Quantum optics theory, theory of ultracold quantum gases, quantum information science (theory and applications), quantum computing, quantum metrology

Selected Awards and Honors

- Fellow of the American Physical Society, 2004
- Department of Physics, Outstanding Physics Teacher Award, CU Boulder, 2024–2025
- Marinus Smith Award, University of Colorado Boulder, 2019
- Member at Large, Exec Committee of DAMOP, American Physical Society, 2011–2013
- College Scholar, University of Colorado, 2012
- Junior Faculty Development Award, University of Colorado 1997
- Rutherford Scholar of the Royal Society (England), 1990–1993

Dissertation: D.Phil.

"A measurement approach to the quantum dynamics of open systems." Advisor: Keith Burnett

Peer Reviewed Papers

[1.] Charles Marrder, Shuo Sun, Murray J Holland, 'Group-Theoretic Reinforcement Learning of Dynamical Decoupling Sequences', *arXiv preprint arXiv:2512.13890* (2025).

[2.] Noah Lordi, John Drew Wilson, Murray J Holland, Joshua Combes, 'Noise Constraints on Sensitivity Scaling in Quantum Nonlinear Metrology', *Physical Review Letters, 135, 190802* (2025).

[3.] Christopher Wilson, John Drew Wilson, Luke Coffman, Shah Saad Alam, Murray J Holland, 'Geometric Invariants of Quantum Metrology', *arXiv preprint arXiv:2507.06128* (2025).

[4.] Jarrod T Reilly, Simon B Jäger, John Cooper, Murray J Holland, 'Fully Collective Superradiant Lasing with Vanishing Sensitivity to Cavity Length Vibrations', *arXiv preprint arXiv:2506.12267* (2025).

[5.] C. LeDesma, K. Mehling, M. Holland, 'Vector Atom Accelerometry in an Optical Lattice', *Science Advances 11 (23), eadt7480* (2025).

[6.] Kendall Mehling, Murray Holland, Catie LeDesma, 'High-Precision Phase Control of an Optical Lattice with up to 50 dB Noise Suppression', arXiv preprint arXiv:2504.13264 (2025); accepted for *Physical Review Applied,* in press.

[7.] Catie LeDesma, Kendall Mehling, Murray Holland, 'Vector atom accelerometry in an optical lattice', *Quantum Sensing, Imaging, and Precision Metrology III, 13392,41 – 42, SPIE* (2025).

[8.] Murray Holland, Kendall Mehling, Catie LeDesma, 'Programmable quantum sensing using ultracold atoms in 3D optical lattices', *Quantum Sensing, Imaging, and Precision Metrology III, 13392, 30 – 32, SPIE* (2025).

[9.] Lyryl HC Vaecairn, Jarrod T Reilly, John Drew Wilson, Simon B Jäger, Murray Holland, 'Engineering tunable decoherence-free subspaces with collective atom-cavity interactions', *Physical Review A, 111, 033718* (2025).

[10.] C. LeDesma, K. Mehling, J.D. Wilson, M. Nicotra, M. Holland, 'Universal Gate Set for Optical Lattice Based Atom Interferometry', accepted for *Physical Review Research*, available as *arXiv preprint arXiv:2410.17472* (2024).

[11.] Shah Saad Alam, Victor E Colussi, John Drew Wilson, Jarrod T Reilly, Michael A Perlin, Murray J Holland, 'Robust Quantum Sensing with Multiparameter Decorrelation', *arXiv preprint arXiv: 2405.07907* (2024).

[12.] John Drew Wilson, Jarrod T Reilly, Haoqing Zhang, Chengyi Luo, Anjun Chu, James K Thompson, Ana Maria Rey, Murray J Holland, 'Entangled Matter-waves for Quantum Enhanced Sensing, *Physical Review A 110, L041301* (2024).

[13.] N. J. C. Papadopoulos, J. T. Reilly, J. D. Wilson, and M. J. Holland, 'Reductive Quantum Phase Estimation', *Physical Review Research 6(3), 033051* (2024).

[14.] Chengyi Luo, Haoqing Zhang, Vanessa PW Koh, John D Wilson, Anjun Chu, Murray J Holland, Ana Maria Rey, James K Thompson 'Momentum-exchange interactions in a Bragg atom interferometer suppress Doppler dephasing', *Science 384 (6695), 551-556* (2024).

[15.] Victor E. Colussi, Justin Copenhaver, Maximilian Seifert, Michael Perlin, Murray Holland, "Machine learning designed optical lattice atom interferometer," Proc. SPIE 12912, Quantum Sensing, Imaging, and Precision Metrology II, 129120J (2024).

[16.] J. Shao, L. -Y. Chih, M. Naris, M. Holland and M. M. Nicotra, "Application of Quantum Optimal Control to Shaken Lattice Interferometry," *2023 American Control Conference (ACC)*, San Diego, CA, USA, pp. 4593-4598 (2023)

[17.] J. T. Reilly, J. D. Wilson, S. B. Jäger, C. Wilson, and M. J. Holland, 'Optimal Generators for Quantum Sensing', *Physical Review Letters 131(15)* 2023.

[18.] Catie LeDesma, Kendall Mehling, Jieqiu Shao, John Drew Wilson, Penina Axelrad, Marco M Nicotra, Dana Z Anderson, Murray Holland, `Demonstration of a programmable optical lattice atom interferometer', Physical Review Research **6**, 43120 (2024).

[19.] J. T. Reilly, S. B. Jäger, J. D. Wilson, J. Cooper, S. Eggert, and M. J. Holland, 'Speeding Up Squeezing with a Periodically Driven Dicke Model', *Physical Review Research 6 (3), 033090*, 2024.

[20.] S. V. Bettadpur *et al.*, 'The Quantum Pathways Institute (QPI)-Developing Spaceborne Quantum 2.0 Sensing for Next Generation Mass Change Measurement', *AGU23*, 2023.

[21.] M. M. Nicotra *et al.*, 'Modeling and Control of Ultracold Atoms Trapped in an Optical Lattice: An Example-driven Tutorial on Quantum Control', *IEEE Control Systems Magazine*, vol. 43, no. 1, pp. 28–43, 2023.

[22.] L.-Y. Chih, D. Z. Anderson, and M. Holland, 'Reinforcement Learning for Rotation Sensing with Ultracold Atoms in an Optical Lattice, *Physical Review Research 6 (4), 043191,* (2024).

[23.] G. W. Harmon, J. T. Reilly, M. J. Holland, and S. B. Jäger, 'Mean-field Floquet theory for a three-level cold-atom laser', *Physical Review A*, vol. 106, no. 1, p. 013706, 2022.

[24.] J. T. Reilly, S. B. Jäger, J. Cooper, and M. J. Holland, 'Adiabatic control of decoherence-free subspaces in an open collective system', *Physical Review A*, vol. 106, no. 2, p. 023703, 2022.

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[27.] J. P. Bartolotta *et al.*, 'Entropy transfer from a quantum particle to a classical coherent light field', *Physical Review Research*, vol. 4, no. 1, p. 013218, 2022.

[28.] S. B. Jäger, H. Liu, J. Cooper, and M. J. Holland, 'Collective emission of an atomic beam into an off-resonant cavity mode', *Physical Review A*, vol. 104, no. 5, p. 053705, 2021.

[29.] S. B. Jäger, H. Liu, A. Shankar, J. Cooper, and M. J. Holland, 'Regular and bistable steady-state superradiant phases of an atomic beam traversing an optical cavity', *Physical Review A*, vol. 103, no. 1, p. 013720, (2021).

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[31.] A. Shankar, J. T. Reilly, S. B. Jäger, and M. J. Holland, 'Subradiant-to-subradiant phase transition in the bad cavity laser', *Physical Review Letters*, vol. 127, no. 7, p. 073603, 2021.

[32.] L.-Y. Chih and M. Holland, 'Reinforcement-learning-based matter-wave interferometer in a shaken optical lattice', *Physical Review Research*, vol. 3, no. 3, p. 033279, 2021.
[33.] A. Shankar *et al.*, 'Broadening of the drumhead-mode spectrum due to in-plane thermal fluctuations of two-dimensional trapped ion crystals in a Penning trap', *Physical Review A*, vol. 102, no. 5, p. 053106, 2020.
[34.] S. B. Jäger, M. J. Holland, and G. Morigi, 'Superradiant optomechanical phases of cold atomic gases in optical resonators', *Physical Review A*, vol. 101, no. 2, p. 023616, 2020.
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[40.] H. Liu *et al.*, 'Proposal for a rugged mHz-linewidth superradiant laser driven by a hot atomic beam', *arXiv e-prints*, p. arXiv-2009, 2020.
[41.] A. Shankar, E. Jordan, K. A. Gilmore, A. Safavi-Naini, J. J. Bollinger, and M. J. Holland, 'Modeling near ground-state cooling of two-dimensional ion crystals in a Penning trap using electromagnetically induced transparency', *Physical Review A*, vol. 99, no. 2, p. 023409, 2019.
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