

Ashton S. Bradley

Associate Professor
Department of Physics, University of Otago
730 Cumberland Street, Dunedin 9010, New Zealand
Tel.: +61 (3) 479-4121
Email: ashton.bradley@otago.ac.nz
ResearcherID: <https://www.webofscience.com/wos/author/record/912971>

EDUCATION

- 2005 PhD Theoretical Physics, Victoria University of Wellington, New Zealand
Thesis: *Theoretical Investigations of Trapped Ultra-Cold Bose Gases: Rotating Bose-Einstein Condensation and Anomalous Segregation*
Research Advisor: Prof. Crispin W. Gardiner
- 2001 MSc Theoretical Physics, University of Auckland, New Zealand
Thesis: *Theory of the Non-Markovian atom laser*
Research Advisors: Prof. Joseph Hope, AProf. Matthew J. Collett
- 1998 BSc Double Major, Physics and Mathematics
University of Auckland, New Zealand

RESEARCH AND PROFESSIONAL EXPERIENCE

University of Otago

- | | |
|--------------|--|
| 2021-present | Associate Professor |
| 2017-2020 | Senior Lecturer (above the bar) |
| 2016-2017 | Senior Lecturer |
| 2014-2016 | Senior Research Fellow and Rutherford Discovery Fellow |
| 2011-2013 | Research Fellow and Rutherford Discovery Fellow |
| 2008-2010 | NZFRST Postdoctoral Fellow |

University of Queensland

- | | |
|-----------|---|
| 2007-2008 | Research Fellow, ARC CoE for Quantum-Atom Optics |
| 2005-2006 | Postdoctoral Research Fellow, ARC CoE for Quantum-Atom Optics |

University of Auckland

- | | |
|------|--------------------|
| 2002 | Research Associate |
|------|--------------------|

MAJOR SCIENTIFIC ACHIEVEMENTS

- Formulation and first simulations of the stochastic projected Gross-Pitaevskii equation
- Prediction of bright tripartite entanglement in triply concurrent parametric oscillation
- Reservoir theory of spinor Bose-Einstein condensates
- Prediction of an inverse-energy cascade in two-dimensional quantum turbulence
- Ab-initio modelling of experimental vortex dipole formation and 2D quantum turbulence
- Theory of vortex clustering transition in compressible quantum fluids.
- Anomalous vortex fluid theory for planar superfluids

RECOGNITION, AWARDS, FELLOWSHIPS

2018-present	PI Dodd-Walls CoRE for Photonic and Quantum Technologies
2011-2016	Inaugural Rutherford Discovery Fellowship
2009-2011	New Zealand Foundation for Research, Science, and Technology Fellowship
2005-2008	University of Queensland Postdoctoral Fellowship
2003-2005	TEC Top Achiever Doctoral Scholarship
1998	Senior Prizes in Physics & Mathematics, University of Auckland

PROFESSIONAL ACTIVITIES

- *Self-Organisation* Question Leader, Dodd-Walls CoRE for Photonic and Quantum Technologies
- Reviewer for scientific journals: Nature, Science, Reviews of Modern Physics, Physical Review Letters, Physical Review A, E, B; SciPost, Physical Review Fluids, Proceedings of the National Academy of Sciences
- Member of the American Physical Society

POPULAR MEDIA

- New findings on fluid turbulence ([Radio NZ](#)); Order emerges from chaos in 2D vortices ([Physics Today](#)); Anomalous hydrodynamics ([Asia-Pacific Physics Newsletter](#)); Unlocking superfluid mysteries ([Otago Daily Times](#)); Quantum Whirlpools ([Our Changing World](#), [Radio NZ](#)); Spontaneous vortices ([Physics Today](#)); Teleportation of Matter waves ([Phys.Org](#))

FIVE MOST CITED PAPERS

(12/6/2022 from ISI Web of Science)

- [1] C. N. Weiler, T. W. Neely, D. R. Scherer, **A. S. Bradley**, M. J. Davis & B. P. Anderson, *Spontaneous vortices in the formation of Bose–Einstein condensates*, [Nature](#) **455**, pp. 948–951 (2008)
- [2] P. Blakie†, A. Bradley†, M. Davis, R. Ballagh & C. Gardiner, *Dynamics and statistical mechanics of ultra-cold Bose gases using c-field techniques*, [Advances in Physics](#) **57**, pp. 363–455 (2008)
- [3] T. W. Neely, E. C. Samson, **A. S. Bradley**, M. J. Davis & B. P. Anderson, *Observation of Vortex Dipoles in an Oblate Bose-Einstein Condensate*, [Physical Review Letters](#) **104**, p. 160401 (2010)
- [4] T. W. Neely, **A. S. Bradley**, E. C. Samson, S. J. Rooney, E. M. Wright, K. J. H. Law, R. Carretero-González, P. G. Kevrekidis, M. J. Davis & B. P. Anderson, *Characteristics of Two-Dimensional Quantum Turbulence in a Compressible Superfluid*, [Physical Review Letters](#) **111**, p. 235301 (2013)
- [5] **A. S. Bradley** & B. P. Anderson, *Energy Spectra of Vortex Distributions in Two-Dimensional Quantum Turbulence*, [Physical Review X](#) **2**, p. 041001 (2012)

PUBLICATIONS

(Total citations: > **2,800**, h-index: **27**)

- [1] Z. Mehdi, J. J. Hope, S. S. Szigeti & **A. S. Bradley**, *Mutual friction and diffusion of two-dimensional quantum vortices*, [Physical Review Research](#) **5**, p. 013184 (2023)
- [2] A. N. da Silva, R. K. Kumar, **A. S. Bradley** & L. Tomio, *Vortex generation in stirred binary Bose-Einstein condensates*, [Physical Review A](#) **107**, p. 033314 (2023)
- [3] **A. S. Bradley**, J. Clarke, T. W. Neely & B. P. Anderson, *Scaling dynamics of the ultracold Bose gas*, [Physical Review A](#) **106**, p. 053316 (2022)
- [4] **A. S. Bradley**, R. K. Kumar, S. Pal & X. Yu, *Spectral analysis for compressible quantum fluids*, [Physical Review A](#) **106**, p. 043322 (2022)
- [5] M. T. Reeves, K. Goddard-Lee, G. Gauthier, O. R. Stockdale, H. Salman, T. Edmonds, X. Yu, **A. S. Bradley**, M. Baker, H. Rubinsztein-Dunlop, M. J. Davis & T. W. Neely, *Turbulent Relaxation to Equilibrium in a Two-Dimensional Quantum Vortex Gas*, [Physical Review X](#) **12**, p. 011031 (2022)
- [6] Z. Mehdi, **A. Bradley**, J. Hope & S. Szigeti, *Superflow decay in a toroidal Bose gas: The effect of quantum and thermal fluctuations*, [SciPost Physics](#) **11**, p. 080 (2021)
- [7] M. D. E. Denys, M. K. Olsen, L. S. Trainor, H. G. L. Schwefel & **A. S. Bradley**, *Steady states, squeezing, and entanglement in intracavity triplet down conversion*, [Optics Communications](#) **484**, p. 126699 (2021)
- [8] M. M. Cawte, M. T. Reeves & **A. S. Bradley**, *Neutral Vortex Necklace in a Trapped Planar Superfluid*, [Journal of Low Temperature Physics](#) **202**, pp. 310–328 (2021)
- [9] R. G. McDonald, P. S. Barnett, F. Atayee & **A. Bradley**, *Dynamics of hot Bose-Einstein condensates: Stochastic Ehrenfest relations for number and energy damping*, [SciPost Physics](#) **8**, p. 029 (2020)
- [10] P. Sompet, S. S. Szigeti, E. Schwartz, **A. S. Bradley** & M. F. Andersen, *Thermally robust spin correlations between two 85 Rb atoms in an optical microtrap*, [Nature Communications](#) **10**, p. 1889 (2019)
- [11] Y. P. Sachkou, C. G. Baker, G. I. Harris, O. R. Stockdale, S. Forstner, M. T. Reeves, X. He, D. L. McAuslan, **A. S. Bradley**, M. J. Davis & W. P. Bowen, *Coherent vortex dynamics in a strongly interacting superfluid on a silicon chip*, [Science](#) **366**, pp. 1480–1485 (2019)

- [12] G. Gauthier, M. T. Reeves, X. Yu, **A. S. Bradley**, M. A. Baker, T. A. Bell, H. Rubinsztein-Dunlop, M. J. Davis & T. W. Neely, *Giant vortex clusters in a two-dimensional quantum fluid*, [Science](#) **364**, pp. 1264–1267 (2019)
- [13] M. M. Cawte, X. Yu, B. Anderson & **A. Bradley**, *Snell's Law for a vortex dipole in a Bose-Einstein condensate*, [SciPost Physics](#) **6**, p. 032 (2019)
- [14] M. K. Olsen, T. W. Neely & **A. S. Bradley**, *Mesoscopic Dynamical Differences from Quantum State Preparation in a Bose-Hubbard Trimer*, [Physical Review Letters](#) **120**, p. 230406 (2018)
- [15] X. Yu & **A. S. Bradley**, *Emergent Non-Eulerian Hydrodynamics of Quantum Vortices in Two Dimensions*, [Physical Review Letters](#) **119**, p. 185301 (2017)
- [16] M. T. Reeves, T. P. Billam, X. Yu & **A. S. Bradley**, *Enstrophy Cascade in Decaying Two-Dimensional Quantum Turbulence*, [Physical Review Letters](#) **119**, p. 184502 (2017)
- [17] M. K. Olsen & **A. S. Bradley**, *Quantum-correlated twin-atom laser from a Bose-Hubbard system*, [Physical Review A](#) **95**, p. 063607 (2017)
- [18] X. Yu, T. P. Billam, J. Nian, M. T. Reeves & **A. S. Bradley**, *Theory of the vortex-clustering transition in a confined two-dimensional quantum fluid*, [Physical Review A](#) **94**, p. 023602 (2016)
- [19] S. J. Rooney, A. J. Allen, U. Zülicke, N. P. Proukakis & **A. S. Bradley**, *Reservoir interactions of a vortex in a trapped three-dimensional Bose-Einstein condensate*, [Physical Review A](#) **93**, p. 063603 (2016)
- [20] R. G. McDonald & **A. S. Bradley**, *Brownian motion of a matter-wave bright soliton moving through a thermal cloud of distinct atoms*, [Physical Review A](#) **93**, p. 063604 (2016)
- [21] S.-W. Su, S.-C. Gou, **A. S. Bradley**, O. Fialko & J. Brand, *Oscillons in coupled Bose-Einstein condensates*, [Physical Review A](#) **91**, p. 023631 (2015)
- [22] M. T. Reeves, T. P. Billam, B. P. Anderson & **A. S. Bradley**, *Identifying a Superfluid Reynolds Number via Dynamical Similarity*, [Physical Review Letters](#) **114**, p. 155302 (2015)
- [23] M. K. Olsen & **A. S. Bradley**, *Quantum ultracold atomtronics*, [Physical Review A](#) **91**, p. 043635 (2015)
- [24] R. G. McDonald & **A. S. Bradley**, *Reservoir interactions during Bose-Einstein condensation: Modified critical scaling in the Kibble-Zurek mechanism of defect formation*, [Physical Review A](#) **92**, p. 033616 (2015)
- [25] G. M. Lee, S. A. Haine, **A. S. Bradley** & M. J. Davis, *Coherence and linewidth of a continuously pumped atom laser at finite temperature*, [Physical Review A](#) **92**, p. 013605 (2015)
- [26] **A. S. Bradley**, S. J. Rooney & R. G. McDonald, *Low-dimensional stochastic projected Gross-Pitaevskii equation*, [Physical Review A](#) **92**, p. 033631 (2015)
- [27] T. P. Billam, M. T. Reeves & **A. S. Bradley**, *Spectral energy transport in two-dimensional quantum vortex dynamics*, [Physical Review A](#) **91**, p. 023615 (2015)
- [28] S. J. Rooney, P. B. Blakie & **A. S. Bradley**, *Numerical method for the stochastic projected Gross-Pitaevskii equation*, [Physical Review E](#) **89**, p. 013302 (2014)
- [29] M. T. Reeves, T. P. Billam, B. P. Anderson & **A. S. Bradley**, *Signatures of coherent vortex structures in a disordered two-dimensional quantum fluid*, [Physical Review A](#) **89**, p. 053631 (2014)
- [30] K. J. H. Law, T. W. Neely, P. G. Kevrekidis, B. P. Anderson, **A. S. Bradley** & R. Carretero-González, *Dynamic and energetic stabilization of persistent currents in Bose-Einstein condensates*, [Physical Review A](#) **89**, p. 053606 (2014)
- [31] **A. S. Bradley** & P. B. Blakie, *Stochastic projected Gross-Pitaevskii equation for spinor and multicomponent condensates*, [Physical Review A](#) **90**, p. 023631 (2014)

- [32] T. P. Billam, M. T. Reeves, B. P. Anderson & **A. S. Bradley**, *Onsager-Kraichnan Condensation in Decaying Two-Dimensional Quantum Turbulence*, [Physical Review Letters](#) **112**, p. 145301 (2014)
- [33] S.-W. Su, S.-C. Gou, **A. Bradley**, O. Fialko & J. Brand, *Kibble-Zurek Scaling and its Breakdown for Spontaneous Generation of Josephson Vortices in Bose-Einstein Condensates*, [Physical Review Letters](#) **110**, p. 215302 (2013)
- [34] S. J. Rooney, T. W. Neely, B. P. Anderson & **A. S. Bradley**, *Persistent-current formation in a high-temperature Bose-Einstein condensate: An experimental test for classical-field theory*, [Physical Review A](#) **88**, p. 063620 (2013)
- [35] M. T. Reeves, T. P. Billam, B. P. Anderson & **A. S. Bradley**, *Inverse Energy Cascade in Forced Two-Dimensional Quantum Turbulence*, [Physical Review Letters](#) **110**, p. 104501 (2013)
- [36] T. W. Neely, **A. S. Bradley**, E. C. Samson, S. J. Rooney, E. M. Wright, K. J. H. Law, R. Carretero-González, P. G. Kevrekidis, M. J. Davis & B. P. Anderson, *Characteristics of Two-Dimensional Quantum Turbulence in a Compressible Superfluid*, [Physical Review Letters](#) **111**, p. 235301 (2013)
- [37] S. J. Rooney, P. B. Blakie & **A. S. Bradley**, *Stochastic projected Gross-Pitaevskii equation*, [Physical Review A](#) **86**, p. 053634 (2012)
- [38] M. Reeves, B. P. Anderson & **A. S. Bradley**, *Classical and quantum regimes of two-dimensional turbulence in trapped Bose-Einstein condensates*, [Physical Review A](#) **86**, p. 053621 (2012)
- [39] O. Fialko, **A. S. Bradley** & J. Brand, *Quantum Tunneling of a Vortex between Two Pinning Potentials*, [Physical Review Letters](#) **108**, p. 015301 (2012)
- [40] **A. S. Bradley** & B. P. Anderson, *Energy Spectra of Vortex Distributions in Two-Dimensional Quantum Turbulence*, [Physical Review X](#) **2**, p. 041001 (2012)
- [41] S. J. Rooney, P. B. Blakie, B. P. Anderson & **A. S. Bradley**, *Suppression of Kelvin-induced decay of quantized vortices in oblate Bose-Einstein condensates*, [Physical Review A](#) **84**, p. 023637 (2011)
- [42] T. M. Wright, **A. S. Bradley** & R. J. Ballagh, *Nonequilibrium dynamics of vortex arrest in a finite-temperature Bose-Einstein condensate*, [Physical Review A](#) **81**, p. 013610 (2010)
- [43] S. J. Rooney, **A. S. Bradley** & P. B. Blakie, *Decay of a quantum vortex: Test of nonequilibrium theories for warm Bose-Einstein condensates*, [Physical Review A](#) **81**, p. 023630 (2010)
- [44] T. W. Neely, E. C. Samson, **A. S. Bradley**, M. J. Davis & B. P. Anderson, *Observation of Vortex Dipoles in an Oblate Bose-Einstein Condensate*, [Physical Review Letters](#) **104**, p. 160401 (2010)
- [45] S. L. W. Midgley, M. K. Olsen, **A. S. Bradley** & O. Pfister, *Analysis of a continuous-variable quadripartite cluster state from a single optical parametric oscillator*, [Physical Review A](#) **82**, p. 053826 (2010)
- [46] S. L. W. Midgley, **A. S. Bradley**, O. Pfister & M. K. Olsen, *Quadripartite continuous-variable entanglement via quadruply concurrent down-conversion*, [Physical Review A](#) **81**, p. 063834 (2010)
- [47] D. Baillie, P. B. Blakie & **A. S. Bradley**, *Geometric scale invariance as a route to macroscopic degeneracy: Loading a toroidal trap with a Bose or Fermi gas*, [Physical Review A](#) **82**, p. 013626 (2010)
- [48] T. M. Wright, **A. S. Bradley** & R. J. Ballagh, *Finite-temperature dynamics of a single vortex in a Bose-Einstein condensate: Equilibrium precession and rotational symmetry breaking*, [Physical Review A](#) **80**, p. 053624 (2009)
- [49] M. K. Olsen & **A. S. Bradley**, *Numerical representation of quantum states in the positive-P and Wigner representations*, [Optics Communications](#) **282**, pp. 3924–3929 (2009)
- [50] **A. S. Bradley**, *Scale-invariant thermodynamics of a toroidally trapped Bose gas*, [Physical Review A](#) **79**, p. 033624 (2009)
- [51] P. B. Blakie, C. Ticknor, **A. S. Bradley**, A. Martin, M. J. Davis & Y. Kawaguchi, *Numerical method for evolving the dipolar projected Gross-Pitaevskii equation*, [Physical Review E](#) **80**, p. 016703 (2009)

- [52] T. M. Wright, R. J. Ballagh, **A. S. Bradley**, P. B. Blakie & C. W. Gardiner, *Dynamical thermalization and vortex formation in stirred two-dimensional Bose-Einstein condensates*, [Physical Review A](#) **78**, p. 063601 (2008)
- [53] P. Blakie†, A. Bradley†, M. Davis, R. Ballagh & C. Gardiner, *Dynamics and statistical mechanics of ultra-cold Bose gases using c-field techniques*, [Advances in Physics](#) **57**, pp. 363–455 (2008)
- [54] C. N. Weiler, T. W. Neely, D. R. Scherer, **A. S. Bradley**, M. J. Davis & B. P. Anderson, *Spontaneous vortices in the formation of Bose–Einstein condensates*, [Nature](#) **455**, pp. 948–951 (2008)
- [55] M. K. Olsen, S. Haine, **A. S. Bradley** & J. J. Hope, *From squeezed atom lasers to teleportation of massive particles*, [European Physical Journal-Special Topics](#) **160**, pp. 331–342 (2008)
- [56] M. K. Olsen & **A. S. Bradley**, *Bright bichromatic entanglement and quantum dynamics of sum frequency generation*, [Physical Review A](#) **77**, p. 023813 (2008)
- [57] **A. S. Bradley**, C. W. Gardiner & M. J. Davis, *Bose-Einstein condensation from a rotating thermal cloud: Vortex nucleation and lattice formation*, [Physical Review A](#) **77**, p. 033616 (2008)
- [58] S. Wüster, B. J. Dabrowska-Wüster, **A. S. Bradley**, M. J. Davis, P. Blair Blakie, J. J. Hope & C. M. Savage, *Quantum depletion of collapsing Bose-Einstein condensates*, [Physical Review A](#) **75**, p. 043611 (2007)
- [59] C. Pennarun, **A. S. Bradley** & M. K. Olsen, *Tripartite entanglement and threshold properties of coupled intracavity down-conversion and sum-frequency generation*, [Physical Review A](#) **76**, p. 063812 (2007)
- [60] M. K. Olsen, **A. S. Bradley**, S. A. Haine & J. J. Hope, *Quantum statistical measurements of an atom laser beam*, [Nuclear Physics A](#), Few-Body Problems in Physics **790**, pp. 733c–736c (2007)
- [61] P. Jain, **A. S. Bradley** & C. W. Gardiner, *Quantum de Laval nozzle: Stability and quantum dynamics of sonic horizons in a toroidally trapped Bose gas containing a superflow*, [Physical Review A](#) **76**, p. 023617 (2007)
- [62] **A. S. Bradley**, M. K. Olsen, S. A. Haine & J. J. Hope, *Raman scheme to measure the quantum statistics of an atom laser beam*, [Physical Review A](#) **76**, p. 033603 (2007)
- [63] M. K. Olsen, **A. S. Bradley** & M. D. Reid, *Continuous variable tripartite entanglement and Einstein–Podolsky–Rosen correlations from triple nonlinearities*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **39**, pp. 2515–2533 (2006)
- [64] M. K. Olsen & **A. S. Bradley**, *Asymmetric polychromatic tripartite entanglement from interlinked $\chi^{(2)}$ parametric interactions*, [Physical Review A](#) **74**, p. 063809 (2006)
- [65] A. A. Norrie, R. J. Ballagh, C. W. Gardiner & **A. S. Bradley**, *Three-body recombination of ultracold Bose gases using the truncated Wigner method*, [Physical Review A](#) **73**, p. 043618 (2006)
- [66] M. K. Olsen, L. I. Plimak, S. Rebić & **A. S. Bradley**, *Phase-space analysis of bosonic spontaneous emission*, [Optics Communications](#) **254**, pp. 271–281 (2005)
- [67] M. K. Olsen & **A. S. Bradley**, *Continuous variable tripartite entanglement from twin nonlinearities*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **39**, pp. 127–143 (2005)
- [68] **A. S. Bradley**, P. B. Blakie & C. W. Gardiner, *Properties of the stochastic Gross–Pitaevskii equation: Finite temperature Ehrenfest relations and the optimal plane wave representation*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **38**, pp. 4259–4280 (2005)
- [69] **A. S. Bradley**, M. K. Olsen, O. Pfister & R. C. Pooser, *Bright tripartite entanglement in triply concurrent parametric oscillation*, [Physical Review A](#) **72**, p. 053805 (2005)
- [70] M. K. Olsen, **A. S. Bradley** & S. B. Cavalcanti, *Fock-state dynamics in Raman photoassociation of Bose-Einstein condensates*, [Physical Review A](#) **70**, p. 033611 (2004)

- [71] **A. S. Bradley**, J. J. Hope & M. J. Collett, *Steady-state quantum statistics of a non-Markovian atom laser. II*, [Physical Review A](#) **68**, p. 063611 (2003)
- [72] **A. S. Bradley** & C. W. Gardiner, *Theory of Ramsey spectroscopy and anomalous segregation in ultracold rubidium*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **35**, pp. 4299–4323 (2002)
- [73] C. W. Gardiner & **A. S. Bradley**, *Theory of the cold collision frequency shift in 1S-2S spectroscopy of Bose-Einstein-condensed and non-condensed hydrogen*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **34**, pp. 4673–4687 (2001)
- [74] C. W. Gardiner & **A. S. Bradley**, *Analysis of $g(2)$ for the cold collision frequency shift in the hydrogen condensate experiments*, [Journal of Physics B: Atomic, Molecular and Optical Physics](#) **34**, pp. 4663–4672 (2001)

May 29, 2023