

N P Robins

Associate Professor - Australian National University

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languages

english

moderate german

metier

laser cooling

ultra-cold atoms

quantum sensors

synopsis

I see myself as equal parts researcher, teacher and technologist. I am inspired by an enormous range of material, from the fascinating physics of ultra-cold atoms to the bubble blowing habits of shrimp. As a teacher, I aim to maximise student engagement to achieve improved learning outcomes. I have applied this philosophy across the first, third and honours years, and won a number of teaching awards and accolades for my contributions. My current research is aimed at producing a continuously pumped atom laser (the matter wave equivalent of an optical laser), building precision sensors based on atom interferometry with Bose-Einstein condensates, and undertaking experiments utilising Bose-Einstein condensates with tuneable interactions.

academic history

from 2013	Continuing Staff, Department of Quantum Science	RSPE, ANU
2010-2014	QEII Fellow, Department of Quantum Science	RSPE, ANU
2004-2010	Research Fellow & CI, Australian Centre for Quantum Atom Optics	ANU

qualifications

2004	PhD, Experimental and Theoretical Physics <i>Bose-Einstein condensation and the atom laser</i>	Australian National University
2000	B.Sc (first class honours), Theoretical Physics <i>The theory of an atom laser</i>	Australian National University

prizes, awards and fellowships

2010-2014	Australian Research Council Queen Elizabeth II Fellowship <i>Advanced atomic sources for precision measurement</i>	
2014	Vice-Chancellor's Citation for Outstanding Contribution to Student Learning <i>For radically innovative teaching practices in first year, incorporating elements of studio teaching, inquiry-based learning, and modern technology that motivate and inspire student learning.</i>	
2013	Joint Colleges of Science Award for Teaching Excellence <i>For pioneering a new approach to teaching physics in first year</i>	
2004-2008	Australian Research Council Postdoctoral Fellowship <i>The first pumped atom laser</i>	
2009	State Winner (NSW, ACT), Tall Poppy Science Awards	
2009	Finalist, Eureka Prize for scientific research	
2004	Australian Academy of Science International Travel Award	

two most significant educational achievements

- 2011-2014 **Foundations of Physics, PHYS1001**
Transforming a service course into a model for innovative education. Recognition through the 2013 joint colleges of science teaching award, and the 2014 VC citation for teaching excellence.
- 2005-2014 **Contribution to honours teaching and learning**
Restructuring of honours year, supervising 5 university medal winning honours students, development and running of a national program of honours exchange courses.

six most significant research publications

- A Bright Solitonic Matter-Wave Interferometer
G.D. McDonald, C.C.N. Kuhn, K.S. Hardman, S. Bennetts, P.J. Everitt, P.A. Altin, J.E. Debs, J.D. Close, N.P. Robins
Phys. Rev. Lett. **113**, 013002 (2014).
- Precision atomic gravimeter based on Bragg diffraction
P. A. Altin, M. T. Johnsson, V. Negnevitsky, G. R. Dennis, R. P. Anderson, J. E. Debs, S. S. Szigeti, K. S. Hardman, S. Bennetts, G. D. McDonald, L. D. Turner, J. D. Close, N. P. Robins
New J. Phys. **15** 023009 (2013).
- Atom lasers: production, properties and prospects for precision inertial measurement
N.P. Robins, P.A. Altin, J.E. Debs, J.D. Close
Physics Reports **529**, 265 (2013).
- Cold-atom gravimetry with a Bose-Einstein condensate
J.E. Debs, P.A. Altin, T.H. Barter, D. Doering, G.R. Dennis, G.D. McDonald, J.D. Close, and N.P. Robins
Phys. Rev. A **84**, 033610 (2011).
- A pumped atom laser
N.P. Robins, C. Figl, M. Jeppesen, G.R. Dennis, J.D. Close
Nature Physics **4**, 731 (2008).
- Achieving peak brightness in an atom laser
N.P. Robins, C. Figl, S.A. Haine, A.K. Morrison, M. Jeppesen, J.J. Hope, and J.D. Close
Phys. Rev. Lett. **96**, 140403 (2006).

Research Funding

2016-2018	Australian Research Council Discovery Project DP160104965 <i>solitonic matterwaves in atomic metamaterials, Cls Robins and Close</i>	\$398,00
2015-2017	Australian Research Council Discovery Project DP150100356 <i>A high flux continuous atom laser, Cls Robins, Savage, Close, Schreck, Pfau, Weiss and Ketterle</i>	\$415,000
2014/2015	Defence Science and Technology Organisation, Special Projects <i>State of the art gravimeter, condensate upgrade, Cls Robins and Close</i>	\$220,000
2013	Australian National University Major Equipment Committee Grant <i>High power fibre lasers for atomic physics, Cl Robins</i>	\$110,000
2012-2015	Intelligence Community grant <i>Atom interferometry, Cls Robins and Close</i>	\$450,000
2011/2012	Defence Science and Technology Organisation, Special Projects <i>State of the art gravimeter, Cls Robins and Close</i>	\$980,000
2011-2014	Australian Research Council Discovery Project DP110100925 <i>Precision inertial sensing with cold atoms, Cls Robins and Close</i>	\$340,000
2010	Australian National University Major Equipment Committee Grant <i>The Squeezed Atom Laser Facility, Cls Robins and Close</i>	\$285,000
2010-2015	Australian Research Council Discovery Project DP1096349 <i>Advanced Atomic Sources for Precision Measurement, Cls Robins and Close</i>	\$530,000
2008	Australian Research Council, LIEF grant, LE0882531 <i>Quantum limited single atom detectors</i>	\$350,000
2008	Defence Science and Technology Organisation, Special Projects <i>Single Atom Detection, Cls Robins and Close</i>	\$80,000
2007-2010	Australian Centre for Quantum-Atom-Optics extension <i>Australian Research Council Centre of Excellence scheme</i>	\$6 Million
2006	Australian National University Major Equipment Committee Grant <i>A pumped atom laser: turning on the atom tap, Cls Robins and Close</i>	\$250,000
2004-2008	Australian Research Council Postdoctoral Fellowship, DP0450073 <i>The first pumped atom laser Cl Robins</i>	\$210,000
2004	Australian Academy of Science International Travel Award	\$7,500
2003	ACT Government commercialization grant	\$130,000
2000-2003	Australian National University Graduate Award	\$75,000

invited conference & university presentations

2015	Advances in cold atom interferometry BEC2015, September 5-11, Spain	N. P. Robins
2015	A solitonic atom interferometer and other advances in cold atom interferometry Robins ICOLS, June 28-July 3, Singapore	N. P.
2014	Atom interferometry with Bose-condensed atoms: prospects for precision measurement Frontiers in matter wave optics, Crete, Greece	N. P. Robins
2013	Inspiring students to teach themselves - don't MOOC it up! CMBE & CPMS June Teaching and Learning Colloquium	N. P. Robins
2012	Active learning approaches to teaching Physics CMBE & CPMS June Teaching and Learning Colloquium	N. P. Robins
2011	From Apples to Atoms July Physics Colloquium, University of Queensland	N. P. Robins
2010	Fire engines and cold coffee Conference of the National Australian Science Teachers Association	N. P. Robins
2010	The application of atom lasers to precision measurement Frontiers in matter wave optics, Crete, Greece	N. P. Robins
2010	Free space and trapped interferometry with ultra cold atoms Precision matter wave optics, QUEST-symposium, Hannover, Germany	N. P. Robins
2010	Free space and trapped interferometry with ultra cold atoms International Atomlaser workshop, Centre de Physique, Les Houches, France	N. P. Robins
2008	A pumped atom laser International Commission for Optics (ICO) Congress	N. P. Robins
2005	A continuous Raman output-coupler for an atom laser XVII International Conference on Laser Spectroscopy (ICOLS), June 19-24, Cairngorms National Park, Scotland	N. P. Robins
2005	Limits to the flux of a continuous atom laser Workshop on Quantum engineering with photons, atoms and molecules, Feb 14-17, Centre de Physique, Les Houches, France	N. P. Robins

higher degree supervision

current	Mr. Mahasen Sooriyabandara, PhD candidate <i>Modelling of higher order nonlinearities in cold atom systems</i>	supervisor
current	Mr. Patrick Everitt, PhD candidate <i>Generating exotic topological structures in quantum gases</i>	supervisor
current	Ms. Manju Perumbil, PhD candidate <i>Extreme laser cooling</i>	supervisor
current	Mr. Shayne Bennetts, PhD candidate <i>A continuous atom laser</i>	supervisor
current	Mr. Roman Khakimov, PhD candidate <i>Single atom interferometry</i>	advisor
current	Mr. Kyle Hardman, PhD candidate <i>Precision measurements of gravity with a BEC</i>	supervisor
current	Ms. Kate Ferguson, PhD candidate <i>Cavity Enhanced Rephased Spontaneous Emission</i>	advisor
current	Mr. Gordon McDonald, PhD candidate <i>Atom interferometry in an optical waveguide</i>	supervisor
2012	Dr. Paul Altin, PhD <i>The role of interactions in interferometry with Bose-condensed atoms</i> J G Crawford Prize for best PhD thesis at ANU 2013	supervisor
2012	Dr. John Debs, PhD <i>The Application of Bose-Einstein Condensates to Inertial Sensing</i>	supervisor
2012	Dr. Rachel Poldy, PhD <i>Detection of atoms with a high finesse cavity</i>	advisor
2011	Dr. Daniel Doering, PhD <i>Interferometry and precision measurements with Bose-condensed atoms</i>	supervisor
2010	Dr. Matthew Jeppesen, PhD <i>Development of the atom laser</i>	supervisor
2009	Dr. Julien Dugue, PhD <i>Ultra-cold atomic sources for interferometry and atomic physics</i>	advisor

educational contributions - honours supervision

2015	Mr. Lachlan Whichello <i>Frequency and phase locking diode lasers for atomic physics applications</i>	supervisor
2015	Mr. Ciaran Quinlivan <i>Projection sideband cooling of neutral atoms</i>	supervisor
2014	Mr. Christopher van der Spek <i>Optimisation of an External Cavity Diode Laser System for Commercial Applications</i>	supervisor
2014	Mr. Patrick Everitt <i>matter wave metamaterials</i>	supervisor
2013	Ms. Sharmila Sane <i>Wavefront Correction for Optimised Light Delivery into Brain Tissue</i>	physics co-supervisor

2012	Ms. Hannah Keal <i>Atom Interferometry in an Optical Waveguide</i>	supervisor
2012	Mr. David Johnston <i>Detection of Rubidium 87 Atoms in an Atom Interferometer</i>	supervisor
2010	Mr. Thomas Barter, University Medal <i>Measuring Gravity with a Bose-Einstein Condensate</i>	supervisor
2009	Mr. Gordon McDonald, University Medal <i>Detecting Atomic Shot Noise On Ultra-cold Atom Clouds</i>	supervisor
2007	Mr. Paul Altin, University Medal <i>Evaporative cooling of 85Rb</i>	supervisor
2007	Ms. Finn Lattimore, University Medal <i>An optical conveyor belt for neutral atoms</i>	supervisor
2005	Ms. Adele Morrison, University Medal <i>Flux Limitations of Continuous Atom Lasers</i>	supervisor

educational contributions - courses

2014, S1	Honours course exchange program Convener of a national honours course exchange program, delivering and receiving lectures and assessment material online, including ANU, UWA and Monash, James Cook Uni	convener
2014, S1	PHYS1001 - Foundations of Physics First year physics course based around studio teaching and inquiry driven learning, approximately 100 students from a large range of backgrounds.	convener
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2013, S1	PHYS1001 - Foundations of Physics First year physics course based around studio teaching and inquiry driven learning, approximately 100 students from a large range of backgrounds.	convener
2012, S1	PHYS1001 - Foundations of Physics A newly designed first year physics course based around studio teaching and inquiry driven learning, approximately 100 students from a large range of backgrounds.	convener
2012, S1	Honours course exchange program Convener of a national honours course exchange program, delivering and receiving lectures and assessment material online, including ANU, UWA and Monash, James Cook Uni	convener
2011, S1	PHYS1001 - Foundations of Physics Co-teaching Foundations of Physics with Prof. Craig Savage, with the aim of improving, and measuring, student learning outcomes using new alternative teaching strategies & technologies.	lecturer
2011, S1	Honours course exchange program Convener of a national honours course exchange program, delivering and receiving lectures and assessment material online, including ANU, UWA and Monash.	convener
2010, S1	Honours course exchange pilot program Organised and implemented an exchange of the honours electrodynamics course between ANU and UWA.	convener

2010 S2	Physics Honours Organising lecturers, recruitment, lecture timetabling, scholarships and website content	co-convener
2010, S2	1st-year technology in teaching project(FTP) Participated in the development of a program to apply new forms of teaching technology to first year teaching, and through it enhanced learning outcomes for students. I am co-author of a successful ANU teaching grant titled "Active Lectures Using Web 2 Technology."	investigator
2010, S1	Photonics Masters supervisor Mr. Sami Alharthi, "Single bubble sonoluminescence"	supervisor
2009, S2	Physics Honours Honours convener and coordinator in Physics. Including the reorganisation and revitalisation of physics honours in 2009, for a course start in 2010.	co-convener
2007-2009	PHYS3031 - Atomic Physics Third year Atomic Physics and Atom/Light interactions.18 Lectures on modern atomic physics. This course includes an innovation "instruction-free" laboratory course developed by myself and Professor John Close over 3 years.	Lecturer

educational contributions - independent supervision of full unit 'advanced studies' courses

2015	Elliot Lovell <i>Laser cooling and ion trapping</i>	
2014	Lachlan Wichello <i>Building an atom based gravity sensor</i>	
2014	Sam Needham <i>Modelling matter wave meta materials</i>	
2014	Max Proft <i>Building fractal structures with interferometry</i>	
2014	Ciaron Quinlivan <i>Construction of fibre laser amplifiers</i>	
2013/14	Jiao Geng <i>Cold atom quantum memories</i>	co-supervised with Dr. B. Buchler and Dr. P.K.Lam
2013	Jack Drury <i>Building a magneto optical trap</i>	co-supervisor with Prof. K. Baldwin
2013	Ciaron Quinlivan <i>Building a magneto optical trap</i>	
2013	Alan Yin <i>Lasers in atomic physics</i>	
2012	Emilio Pace <i>Magneto optical trapping</i>	
2012	Sharmilla Sane <i>Frequency doubled fibre laser for cooling and trapping Rb</i>	
2011	Daniel Comber Todd <i>Coupled RLC circuits and the tesla coil</i>	
2011	Anne-Charlotte Gervais <i>Building and characterising a 2D magneto optical trap</i>	French Intern - ENS
2011	Marc-Antoine Buchet <i>Electronics control systems for atomic physics experiments</i>	French Intern - ENS

- 2011 **Hannah Keal**
Waveguide atom interferometry
- 2010 **Zeying Chen**
Synthetic gauge fields for atoms
- 2010 **Daniel Higginbottom**
Measuring temperature in a MOT
- 2009 **Thomas Barter**
Trapped atom interferometry
- 2008 **Justin Bewsher**
Sonoluminescence
- 2008 **Alex Davies**
Shot noise limited imaging of cold atoms
- 2008 **Andrew Horsley**
Making a Bose-Einstein condensate of dilute alkali atoms
- 2007 **Alex Davies**
Open source software for computer control of experiments
- 2007 **Benjamin Sparkes**
External cavity diode lasers

Service

- 2015 **New Physical Sciences Building Committee**
- 2014 **Rethinking Physical Science Education Committee**
Outline the principles of a new, dedicated ANU undergraduate degree in the physical sciences: for now called the BPS (Bachelor of Physical Sciences). Assume we start with a clean slate and are unconstrained by existing programs, practices and policies. We should incorporate best education practice and aim to offer to the world something unique.
- 2011 **Security cleared scientific advisor**
I advise sections of the Australian Defence Force, including the Defence Science and Technology Organisation, on matters relating to applications of my research.
- 2010 **Summer Scholars program**
Developed a new aspect of the physics summer scholars social program, by taking students caving, sailing and bushwalking. We found that this enhanced the student's view of ANU, furthered their scientific network, and allowed a more detailed and useful interaction between the students and academics. Student feedback was excellent. This idea has now been adopted widely across the university.
- 2010 **Honours Scholarships**
One key suggestion put forward in the redesign of the physics honours year was that students need financial support to assist them to focus on their studies. The Dunbar Scholarships, introduced in 2011, fulfil this role, providing up to \$25k for students to study at ANU
- From 2008 **Laser safety officer** DQS
I am laser safety officer at Physics North, and through this role I strive to make my own labs, and the labs of my colleagues, safe and well managed. I am aware of, and implement, university policy in OH&S.

From 2008 **Scientists in schools**

Ainslie Primary School

I run outreach programs for students from kindergarten to year 6. These involve lunchtime demonstrations, short hands on courses on robotics and electronics.

From 2004 **Peer review of scholarly work, including ARC grants**

I regularly review papers for scholarly journals, and have recently begun assessing Australian Research Council grants.

research publications

1. Y. W. Cho, G. T. Campbell, J. L. Everett, J. Bernu, D. B. Higginbottom, M. T. Cao, J. Geng, N. P. Robins, P. K. Lam, and B. C. Buchler, Highly efficient optical quantum memory with long coherence time in cold atoms *Optica* **3**, 100 (2016).
2. D. B. Higginbottom, J. Geng, G. T. Campbell, M. Hosseini, M. T. Cao, B. M. Sparkes, J. Bernu, N. P. Robins, P. K. Lam and B. C. Buchler, Dual-rail optical gradient echo memory *Optics Express* **23** 24937 (2015).
3. Gordon D. McDonald, Carlos C. N. Kuhn, Kyle S. Hardman, Shayne Bennetts, Patrick J. Everitt, Paul A. Altin, John E. Debs, John D. Close, Nicholas P. Robins. A Bright Solitonic Matter-Wave Interferometer *Phys. Rev. Lett.* **113**, 013002 (2014).
4. C.C.N. Kuhn, G.D. McDonald, K.S. Hardman, S. Bennetts, P.J. Everitt, P.A. Altin, J.E. Debs, J.D. Close, and N.P. Robins. A Bose-condensed, simultaneous dual species Mach-Zehnder atom interferometer, *New J. Phys.* **16** 073035 (2014).
5. G. D. McDonald, C. C. N. Kuhn, S. Bennetts, J. E. Debs, K. S. Hardman, J. D. Close, N. P. Robins, A faster scaling in acceleration-sensitive atom interferometers *EPL* **105** 63001 (2014).
6. Kyle S. Hardman, Carlos C. N. Kuhn, Gordon D. McDonald, John E. Debs, Shayne Bennetts, John D. Close, Nicholas P. Robins, The Role of Source Coherence in Atom Interferometry, *Phys. Rev. A* **89**, 023626 (2014).
7. K. S. Hardman, S. Bennetts, J. E. Debs, C. C. N. Kuhn, G. D. McDonald, N. P. Robins Construction and Characterization of External Cavity Diode Lasers for Atomic Physics *J. Vis. Exp.* **86**, e51184 (2014).
8. Shayne Bennetts, Kyle S. Hardman, John E. Debs, Gordon D. McDonald, Carlos C. N. Kuhn, John D. Close and Nicholas P Robins, External Cavity Diode Lasers with 5kHz Linewidths and 200nm tuning range at 1.55 μ m, *Optics Express*, **22**, 10642 (2014).
9. J Geng, G T Campbell, J Bernu, D B Higginbottom, B M Sparkes, S M Assad, W P Zhang, N P Robins, P K Lam, and B C Buchler. Electromagnetically induced transparency and four-wave mixing in a cold atomic ensemble with large optical depth. *New J Phys*, **16** 113053 (2014).
10. B. M. Sparkes, J. Bernu, M. Hosseini, J. Geng, Q. Glorieux, P. A. Altin, P. K. Lam, N. P. Robins, and B. C. Buchler, An ultra-high optical depth cold atomic ensemble for quantum memories, *Journal of Physics: Conference Series* **467** 012009 (2013).
11. Gordon D. McDonald, Carlos C. N. Kuhn, Shayne Bennetts, John E. Debs, Kyle S. Hardman, John D. Close, Nicholas P. Robins, 80hk Momentum Separation with Bloch Oscillations in an Optically Guided Atom Interferometer *Phys. Rev. A* **88**, 053620 (2013).
12. K. S. Hardman, S. Bennetts, J. E. Debs, C. C. N. Kuhn, G. D. McDonald, N. P. Robins, Construction and Characterization of External Cavity Diode Lasers for Atomic Physics, *J. Vis. Exp.*, accepted for publication July 2013.
13. B M Sparkes, J Bernu, M Hosseini, J Geng, Q Glorieux, P A Altin, P K Lam, N P Robins and B C Buchler, Gradient echo memory in an ultra-high optical depth cold atomic ensemble, *New J. Phys.* **15** 085027 (2013).

14. **(invited article)** N. P. Robins, P. A. Altin, J. E. Debs, J. D. Close, Atom lasers: production, properties and prospects for precision inertial measurement, *Physics Reports*, **529**, 265 (2013).
15. **(invited article)** J. E. Debs, N. P. Robins, and J. D. Close, Measuring Mass in Seconds, *Science* **339**, 532 (2013).
16. G. D. McDonald, H. Keal, P. A. Altin, J. E. Debs, S. Bennetts, C. C. N. Kuhn, K. S. Hardman, M. T. Johnsson, J. D. Close, N. P. Robins, Optically guided linear Mach Zehnder atom interferometer, *Phys. Rev. A* **87**, (2013) 013632
17. P. A. Altin, M. T. Johnsson, V. Negnevitsky, G. R. Dennis, R. P. Anderson, J. E. Debs, S. S. Szigeti, K. S. Hardman, S. Bennetts, G. D. McDonald, L. D. Turner, J. D. Close, N. P. Robins, Precision atomic gravimeter based on Bragg diffraction, *New J. Phys.* **15** (2013) 023009.
18. R. Poldy, B. C. Buchler, P. A. Altin, N. P. Robins, and J. D. Close, Feasibility of squeezing measurements with cavity-based atom detection, *Phys. Rev. A* **86**, 043806 (2012).
19. J. D. Close, R. Poldy, B. C. Buchler, and N. P. Robins, A Single Atom in An Optical Cavity: An Open-Quantum System, *Fundamentals of Picoscience*, Klaus D. Sattler. 2012.
20. **(invited article)** J. Close and N. Robins, Precision Measurement with Cold Atoms, *Physics* **5**, 26 (2012).
21. S. S. Sané, S. Bennetts, J. E. Debs, C. C. N. Kuhn, G. D. McDonald, P. A. Altin, J. D. Close, N. P. Robins, 11 W narrow linewidth laser source at 780nm for laser cooling and manipulation of Rubidium, *Optics Express*, April (2012)
22. S.S. Szigeti, J.E. Debs, J.J. Hope, N.P. Robins, and J.D. Close, Why momentum width matters for atom interferometry with Bragg pulses, *N. J. Phys.* **14** 023009 (2012).
23. P.A. Altin, G.R. Dennis, G.D. McDonald, D. Dring, J.E. Debs, J.D. Close, C.M. Savage, and N.P. Robins, Collapse and three-body loss in a Rb-85 Bose-Einstein condensate, *Phys. Rev. A* **84**, 033632 (2011).
24. J.E. Debs, P.A. Altin, T.H. Barter, D. Doering, G.R. Dennis, G.D. McDonald, J.D. Close, and N.P. Robins, Cold-atom gravimetry with a Bose-Einstein condensate, *Phys. Rev. A* **84**, 033610 (2011).
25. P.A. Altin, G. McDonald, D. Doering, J.E. Debs, T. Barter, N.P. Robins, J.D. Close, S.A. Haine, T.M. Hanna, and R.P. Anderson, Optically trapped atom interferometry using the clock transition of large Rb-87 Bose-Einstein condensates *New J. Phys.* **13**, 065020 (2011).
26. P.A. Altin, G. McDonald, D. Doering, J.E. Debs, T. Barter, N.P. Robins, J.D. Close, S.A. Haine, T.M. Hanna, and R.P. Anderson, Addendum to Optically trapped atom interferometry using the clock transition of large Rb-87 Bose-Einstein condensates, *New J. Phys.* **13**, 119401 (2011).
27. P.A. Altin, N.P. Robins, D. Dring, J.E. Debs, R. Poldy, C. Figl and J.D. Close, 85Rb tunable-interaction Bose-Einstein condensate machine, *Rev. Sci. Instr.* **81**, 063103 (2010).
28. D. Doering, G. McDonald, J.E. Debs, C. Figl, P.A. Altin, H.-A. Bachor, N.P. Robins, J.D. Close, Quantum projection noise limited interferometry with coherent atoms in a Ramsey type setup, *Phys. Rev. A* **81**, 013618 (2010).
29. P. A. Altin, N. P. Robins, R. Poldy, J. E. Debs, D. Doering, C. Figl, and J. D. Close, Measurement of inelastic losses in a sample of ultracold 85Rb, *Phys. Rev. A* **81**, 012713 (2010).
30. J.E. Debs, D. Doering, P.A. Altin, C. Figl, J. Dugue, M. Jeppesen, J.T. Schultz, N.P. Robins, and J.D. Close, Experimental comparison of Raman and RF outcouplers for high flux atom lasers, *Phys. Rev. A* **81**, 013618 (2010).

31. D. Doering, J. E. Debs, N. P. Robins, C. Figl, P. A. Altin, and J. D. Close, Ramsey interferometry with an atom laser, *Optics Express*, **17**, 20661 (2009).
32. J. T. Schultz, S. Abend, D Doering, J. E. Debs, P. A. Altin, J. D. White, N. P. Robins, J. D. Close, Coherent 455 nm beam production in a cesium vapor, *Optics Letters*, **34** 2321-2323 (2009).
33. D. Doering, G. R. Dennis, N. P. Robins, M. Jeppesen, C. Figl, J. J. Hope, and J. D. Close, Pulsed pumping of a Bose-Einstein condensate, *Phys. Rev. A* **79**, 063630 (2009).
34. J. E. Debs, D. Doering, N. P. Robins, C. Figl, P. A. Altin, and J. D. Close, A two-state Raman coupler for coherent atom optics, *Optics Express* **17** 2319-2325 (2009).
35. J. Debs, N. Robins, A. Lance, M. Kruger, and J. Close, Piezo-locking a diode laser with saturated absorption spectroscopy, *Applied Optics*, **47** 5163-5166 (2008).
36. D. Doering, N.P. Robins, C. Figl, J.D. Close, Probing a Bose-Einstein condensate with an atom laser, *Optics Express*, **16**, 13893-13900 (2008).
37. N. P. Robins, C. Figl, M. Jeppesen, G. R. Dennis, J. D. Close, A pumped atom laser, *Nature Physics* **4**, 731 - 736 (2008).
38. M. Jeppesen, J. Dugue, G. R. Dennis, M. T. Johnsson, C. Figl, N. P. Robins, and J. D. Close, Approaching the Heisenberg limit in an atom laser, *Phys. Rev. A* **77**, 063618 (2008).
39. J. Dugue, G. Dennis, M. Jeppesen, M. T. Johnsson, C. Figl, N. P. Robins, and J. D. Close, Multibeam atom laser: Coherent atom beam splitting from a single far detuned laser, *Phys. Rev. A* **77**, 031603 (2008).
40. J. Dugue, N. P. Robins, C. Figl, M. Jeppesen, P. Summers, M. T. Johnsson, J. J. Hope, and J. D. Close, Investigation and comparison of multistate and two-state atom laser-output couplers, *Phys. Rev. A* **75**, 053602 (2007).
41. J. Dugue, M. Jeppesen, C. Figl, N. P. Robins, J. D. Close, A High Flux Atom Laser for Interferometry, *Proceedings of the International Conference on Quantum Electronics and Laser Science (Cleo/QELS)*, Baltimore, Maryland (2007).
42. Mattias Johnsson, Simon Haine, Joseph Hope, Nick Robins, Cristina Figl, Matthew Jeppesen, Julien Dugue, and John Close, Semiclassical limits to the linewidth of an atom laser *Phys. Rev. A* **75**, 043618 (2007).
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