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Dr. Matthew John Davis

Career objective

To become a lecturer/researcher in theoretical physics at a leading research-based university, preferably in Australia or New Zealand.

Employment

5/2002–present University of Queensland Brisbane, Australia.

University of Queensland Postdoctoral Fellow

- Supervisor: Professor Peter Drummond
- Research duties only.

3/2001–4/2002 University of Oxford Oxford, United Kingdom.

Engineering and Physical Sciences Research Council Postdoctoral Fellow in Theoretical Physics

- Supervisor: Professor Keith Burnett.
- Research duties only.

Education

10/1997–3/2001 University of Oxford Oxford, United Kingdom.

D.Phil., awarded October 2001.

- Thesis title: "Dynamics of Bose-Einstein condensation."
- Supervisor: Professor Keith Burnett.
- Awarded Commonwealth Scholarship, North Senior Scholarship.

1993–1996 University of Otago Dunedin, New Zealand.

B. Sc. (Hons), first class in physics, awarded May 1997.

- Supervisor: Professor Rob Ballagh.
- Awarded 1996 Prince of Wales Prize, 1996 Royal Society Prize.

1988–1992 Marlborough Boys' College Blenheim, New Zealand.

'A' bursary

- Dux Litterarum., New Zealand Top Scholar Bursary Physics Exam 1992.

Referees

1. Professor Keith Burnett k.burnett1@physics.ox.ac.uk
Clarendon Laboratory, Department of Physics, University of Oxford, Parks Rd, Oxford OX1 3PU, United Kingdom.
Phone: +44 1865 272 372 Fax: +44 1865 272 375

2. Professor Rob Ballagh ballagh@physics.otago.ac.nz
Department of Physics, University of Otago, PO Box 56, Dunedin, New Zealand.
Phone: +64 3 479 7793 Fax: +64 3 479 0964

3. Professor Crispin Gardiner crispin.gardiner@vuw.ac.nz
School of Chemical and Physical Science, Victoria University of Wellington, Wellington, New Zealand.
Phone: +64 4 495 5233 x8049 Fax: +64 4 463 5237

Teaching experience

- Supervised undergraduate visiting student for three month project, University of Queensland, 2002.
- Assisted with supervision of first year PhD students at the University of Oxford, 2000-1.
- Lab demonstrator for first year physics, University of Otago, 1997.
- Designed and ran tutorials in first year physics for Arana Hall, Studholme Hall, St Margaret's College, and Dalmore Hall, University of Otago, from 1994-6.
- Tutor for second year engineering mathematics, University of Otago, 1995.

Current research interests: atom optics and Bose-Einstein condensation

- Methods for dynamical calculations of thermal quantum fields; incorporating
  - ⇒ Classical mean field description of Bose gases at finite temperature.
  - ⇒ Coupling kinetic description of high energy modes to field theory for lower energy modes.
  - ⇒ Application to representing thermal effects in experimental systems.
  - ⇒ Shift in critical temperature of homogeneous Bose with interaction strength.
  - ⇒ Collapse dynamics of a Bose gas with attractive interactions.
- Static field theory calculations for trapped Bose gases.
  - ⇒ Possibility of Evans-Rashid transition (analogous to BCS pairing).
- Thermodynamic quantities for microcanonical systems.
- Superfluid to Mott insulator quantum phase transition in a Bose gas.

Academic distinctions

1998
- North Senior Scholarship, St John's College, University of Oxford.

1997
- Commonwealth Scholarship to St John's College, University of Oxford.
- William Georgetti Scholarship.
- TV2 New Zealand Young Achievers Award.

1996
- Prince of Wales Prize.
  "Awarded annually by the University ... to the most outstanding student completing an undergraduate degree. Qualities in addition to academic performance may be taken into account in awarding the prize."
- Otago Branch of the Royal Society of New Zealand Prize.
  "Awarded annually ... to the student adjudged to have demonstrated outstanding ability in the final year of the course of Bachelor of Science with Honours ... as measured by performance in the annual examinations and in particular the research component."
- University of Otago Postgraduate Scholarship, Beverly Bursary in Physics.

1995
- Beverly Bursary in Physics, Beverly Scholarship in Physics, Staff Prize in Mathematics.
- Australian National University Vacation Scholarship in Theoretical Physics.

1994
- Beverly Bursary in Physics, Robert Jack/New Zealand Institute of Physics Prize.

1993
- New Zealand Institute of Chemistry Prize.

Professional affiliations

Associate Member of the Institute of Physics, joined in 1998.

Research funding

Applied for two Australian Research Council Discovery Grants for 2003:

- "Computational thermal dynamics of Bose-Einstein condensates and atom lasers." **Dr Matthew John Davis** (as an Early Career Researcher.)
- "Quantum Atom Optics and Single Atom Detection with Micro-Bose-Einstein Condensates." Prof Halina Rubinsztein-Dunlop, **Dr Matthew John Davis**, Dr Catherine Audrey Holmes, A/Prof Norman Richard Heckenberg, Prof Gerard James Milburn, Dr Keith Charles Schwab.

Applied for UQ ECR grant for 2003:

- "Application of novel computational techniques to Bose-Einstein condensates in optical lattices" **Dr M.J. Davis** and Dr J.F. Corney.

Publications

- "Simulations of thermal Bose fields in the classical limit", **M. J. Davis**, S. A. Morgan and K. Burnett, submitted to Phys. Rev. A, cond-mat/0201571 (2002).
- "Energy dependent scattering and the Gross-Pitaevskii equation in two dimensional Bose-Einstein condensates", M.D. Lee, S.A. Morgan, **M.J. Davis**, and K. Burnett, Phys. Rev. A **65**, 022706 (2002).
- "Growth of Bose-Einstein condensates from thermal vapor", M. Köhl, **M.J. Davis**, C.W. Gardiner, T.W. Hänsch, and T. Esslinger, Phys. Rev. Lett. **88**, 080402 (2002).
- "Growth of a Bose-Einstein condensate: A detailed comparison of theory and experiment", **M. J. Davis** and C. W. Gardiner, J. Phys. B **35**, 733 (2002).
- "Dynamics of thermal Bose fields in the classical limit", **M. J. Davis**, R. J. Ballagh and K. Burnett, J. Phys. B **34**, 4487 (2001).
- "Simulations of Bose fields at finite temperature", **M. J. Davis**, S. A. Morgan and K. Burnett, Phys. Rev. Lett. **87**, 160402 (2001).
- "Quantum Kinetic Theory VII: The effect of vapor dynamics on condensate growth", **M. J. Davis**, C. W. Gardiner and R. J. Ballagh, Phys. Rev. A **62**, 063608 (2000).
- "Effects of temperature upon the collapse of a Bose-Einstein condensate in a gas with attractive interactions", **M. J. Davis**, D. A. W. Hutchinson and E. Zaremba, J. Phys. B **32**, 3993-9 (1999)
- "Quantum Kinetic Theory of Condensate Growth: Comparison of Theory and Experiment", C. W. Gardiner, M. D. Lee, R. J. Ballagh, **M. J. Davis**, and P. Zoller, Phys. Rev. Lett. **81**, 5266-9 (1998).
- "Kinetics of Bose-Einstein Condensation in a Trap", C. W. Gardiner, P. Zoller, R. J. Ballagh, and **M. J. Davis**, Phys. Rev. Lett. **79**, 1793-7 (1997).

Conference Presentations (presenting author)

- "Investigation of the pairing transition in a trapped Bose gas" (poster). International Conference on Atomic Physics, Boston, USA (Jul 2002).
- "Thermal dynamics of Bose-Einstein condensation" (talk). Australasian Conference on Optics, Lasers and Spectroscopy, Brisbane, Australia (Dec 2001).
- "Thermal dynamics of Bose-Einstein condensation" (poster). Conference on Bose-Einstein Condensation, San Feliu de Guixols, Spain (Sep 2001).
- "Dynamics of Bose-Einstein condensation at finite temperature" (poster). Euroconference on Atom Lasers and Interferometry, Corsica, France (July 2000).
- "Mixing and the Gross-Pitaevskii Equation" (poster). European Conference on Bose-Einstein Condensation, San Feliu de Guixols, Spain (Sep 1999).
- "Bose-Einstein Condensates with Attractive Interactions" (talk). Euroconference on Slow Collisions between Laser manipulated systems, Crete, Greece (May 1999).
- "Growth of a Bose-Einstein Condensate from Evaporative Cooling" (poster). Australasian Conference on Optics, Lasers and Spectroscopy, Christchurch, New Zealand (Dec 1998).