David Neilson
BSc(Hons) *Melb.*, MS, PhD *S.U.N.Y. Stony Brook*

Professore Ordinario di chiara fama
University of Camerino, Italy

Career Summary

David Neilson is author of more than 100 refereed research articles, review chapters in books and refereed conference reports and editor of a number of review books.
He serves on International Advisory Committees for Conference series including

- *(Chair, Program Committee) International Conferences on Recent Progress in Many Body Theories (RPMBT)*
- *(Chair, Program Committee) International Conferences on Strongly Coupled Coulomb Systems* (SCCS)
  International Workshops on Condensed Matter Theories (CMT)

He is organiser of international conferences including:

- *Strongly Coupled Coulomb Systems Conference*, Camerino, 2008
- *International Conference on Recent challenges in novel quantum systems*, Camerino 2005
- *Frontiers of Science & Technology Workshop on Soft Condensed Matter and Nanoscale Physics*, Sydney 2003
- *Australian Institute of Physics National Congress*, Sydney, 2002
- International *Workshops on Condensed Matter Theories* Canberra, 2002
- *Tenth International Conference on Recent Progress in Many Body Theories*, Sydney 1997
- CECAM *Workshop on Coupled Bilayers of Electrons*, Villa Gualino, Turin, 1999

He was convenor of the annual series
Gordon Godfrey Workshops on Recent Advances in Condensed Matter Theory, Sydney from its first meeting in 1991.
He is a Fellow of the *Australian Institute of Physics*, a member of the *American Physical Society* and the *Institute of Physics* (U.K.).

Born in Sydney, David Neilson did his schooling at *Geelong Grammar School*. He studied Physics and Mathematics at the *University of Melbourne*, graduating with a B.Sc. with First Class Honours in 1968 under the supervision of Geoffrey Opat. He went to New York on a Fulbright scholarship in 1969 and completed an M.S. degree in High Energy Particle Physics and Field Theory under the supervision of Ben Lee at the *State University of New York at Stony Brook* in 1971. He then switched his research activities to Condensed Matter Physics, working with Gerald Brown jointly at *Stony Brook* and at the *Niels Bohr Institute* in Copenhagen. His doctoral project was on the Many Body Problem for the strongly interacting quantum system of electrons in solids. Obtaining his Ph.D. in 1974 he took an N.S.F. research Fellowship *at Northwestern University* in Chicago working with Chia-Wei Woo on the quantum solidification of Helium and on the possibility of the solidification of nuclear matter under the intense pressures found in neutron stars.

In 1975 he took up a position of Assistant Professor at the *University of Southern California* in Los Angeles and in 1978 he moved to the *University of New South Wales* in Sydney as Senior Lecturer (Assistant Professor). From 1985-1994 he was Associate Professor, and from 1995 until 2003 Professor of Physics at *New South Wales*. He maintains his ties with New South Wales as a Visiting Professor. He has held visiting positions at the *Niels Bohr Institute*, (NORDITA Fellow), at the *Max Planck Institute*, Stuttgart (Research Scientist), at *Nottingham University* (S.E.R.C. Visiting Fellow), at the *International Centre for Theoretical Physics*, Trieste, Italy (Research Director), Université de Paris VI (Visiting Fellow), and the *Scuola Normale Superiore*, Pisa (Visiting Professor).

In 2003 David Neilson accepted a chiara fama Professorship in Italy and took up a Chair of Physics at the historic *University of Camerino* (founded 1336). He is also Research Associate with the National Enterprise for *NanoScience and NanoTechnology* (NEST) Centre at Scuola Normale Superiore in Pisa.

Research Interests

David Neilson has wide experience in the field of semiconductor theory and has studied exotic quantum phases of the low-dimensional systems found in semiconductor devices. His recent work has been on *superfluidity in graphene bilayer devices, quantum transport in disordered two-dimensional mesoscopic electron systems,* the *electron glass at finite temperatures in disordered two-dimensional electron systems*, *superconductivity in coupled electron-hole bilayers*, on whether the bifurcation observed at finite temperature in the *metal-insulator transition* phenomenon can be described by a suitable scaling theory, and on whether a unified physical picture for two-dimensional transport over the full range of temperature and density can be developed for the *metal-insulator transition* phenomenon in two-dimensions. He has predicted new states of matter for *electrons in coupled bilayers* in the form of a coupled electron crystalline solid or a charge density waves. Reference [37], with over 100 citations, has stimulated a large number of follow-up studies of bi-layers in zero magnetic field). The predictions that a coupled crystal does form at relatively high densities were confirmed in numerical simulation studies. There has been a CECAM (France) conference devoted to coupled bi-layers in zero magnetic field resulting from Ref. [37]. He developed comprehensive *diagrammatic many-body calculations* incorporating functional conserving techniques for conduction electrons. He developed a quantum generalization of the classical glass equations with applications to conduction electrons, extended it to include impurities in interacting electron 2D layers, and showed that this could lead to a transition to a *solid electron glass* state]. He has worked on ground state, localization and transport properties in *disordered electron 2D systems*. He has studied the effect of *strong correlations between electron spins* in electron systems at low density. He has studied the decisive effect that impurities have on the ground state of interacting electrons in quasi *one-dimensional quantum wires*. Before taking up his chiara fama Chair in Italy in 2003, David Neilson had had continuous funding as Chief Investigator of Major Research Grants from the Australian Research Council for an uninterrupted period of 25 years from 1978.

Selected Publications

Here are representative examples of David Neilson's 140 publications

1. *High-Temperature Superfluidity in Double-Bilayer Graphene,* A. Perali, D. Neilson and A. R. Hamilton, Phys. Rev. Letters **110**, 146803-1 - 146803-5 (2013)
2. *Quantum Glass Transition at Finite Temperature in Two-Dimensional Electron Layers*, David Neilson, Alexander R. Hamilton and Jagdish S Thakur, Int. J. Mod Phys. B **27**, 1347004-1 – 1347004-13 (2013)
3. *Proceedings of the International Conference on Strongly Coupled Coulomb Systems 2011, Budapest, Hungary,* Zolt´an Donk´o, Peter Hartmann and David Neilson (eds.) , Contrib. Plasma Physics **52**, 6 (2012)
4. *Dissipative processes in low density strongly interacting 2D electron systems*, D. Neilson, chapter 9 in book *Condensed Matter Theories* Vol. **25**, edited by Eduardo V Ludeña, Raymond F Bishop and Peter Iza, ISBN: 978-981-4340-78-6 (World Scientific, Singapore, 2011)
5. *Anomalous transport in mesoscopic inhomogeneous two-dimensional electron systems at low temperature*, D. Neilson and A.R. Hamilton, Phys. Rev. B15 **82**, 035310 (2010)
6. *Dissipative processes in low density strongly interacting 2D electron systems*, D. Neilson, Int. J. Mod. Phys. B **24,** 4946-4960 (2010)
7. *Metal–insulator transition in 2D as a quantum phase transition*, D.J.W. Geldart and D. Neilson, J. Phys. A **42**, 214011 (2009)
8. *Quantum tunnelling and hopping between metallic domains in disordered two-dimensional mesoscopic electron systems*, D. Neilson and A.R. Hamilton, J. Phys. A **42**, 214012 (2009)
9. *Tunneling and Hopping Between Domains in the Metal-Insulator Transition in Two- Dimensions*, David Neilson and Alex Hamilton, Int. J. Mod. Phys. **22**, 4565 – 4571 (2008)
10. *Special issue on new developments in strongly coupled Coulomb systems*, David Neilson and Gaetano Senatore, J. Phys. A Math. Theor. **42**, 210301 (2009)
11. *Quantum critical point description of the 2D metal insulator transition*, D.J.W. Geldart and D. Neilson, Physica E: Low-dimensional Systems and Nanostructures, **40,** 1182 (2008)
12. *Metal-Insulator Phenomena in 2D: A Unified Scaling Picture*, D. Neilson and D.J.W. Geldart, chapter 11 in book, Condensed Matter Theories Vol. **21**, edited by Hisazumi Akai, Hiroshi Toki and F. Bary Malik (Nova, New York 2007)
13. *Quantum critical behavior in insulating region of the 2D metal insulator transition*, D.J.W. Geldart and D. Neilson, Phys. Rev. B15 **76**, 193304 (2007)
14. *Electron Gas In High-Field Nanoscopic Transport: Metallic Carbon Nanotubes*, F. Green and D. Neilson, Int. J. Mod. Physics B **21**, 2181 – 2190 (2007)
15. *Effects of density imbalance on the BCS-BEC crossover in semiconductor electron-hole bilayers*, P. Pieri, D. Neilson, and G. C. Strinati,, Phys. Rev. B **75**, 113301 (2007)
16. *Temperature dependent resistivity in the low resistance region for diffusive transport in two-dimensions*, D.J.W. Geldart and D. Neilson, Phys. Rev. B **70**, 235336 (2004)
17. *Two-component scaling near the metal-insulator bifurcation in two dimensions*, D.J.W. Geldart and D. Neilson, Phys. Rev. B **67**, 205309 (2003)
18. *Density dependence of critical magnetic fields at the metal-insulator bifurcation in two dimensions*, D.J.W. Geldart and D. Neilson, Phys. Rev. B **67**, 045310 (2003)
19. *Characterizing the metal-insulator transitions in 2D*, D. Neilson, J.S. Thakur and E. Tosatti, Aust. J. Phys. **53**, 531 (2000)
20. *The effect of spin alignment on the metal-insulator transition in two-dimensional systems*, J.S. Thakur and D. Neilson, J. Phys. Cond. Matt. **12**, 4483 (2000)
21. *Phase diagram of the metal-insulator transition in two-dimensional electronic systems*, J.S. Thakur and D. Neilson, Phys. Rev. B Rapid Comm. **59**, R5280 (1999)
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23. *Superconductivity in a correlated disordered two-dimensional electron gas*, J.S. Thakur and D. Neilson, Phys. Rev. B **58**, 13717-13720 (1998)
24. *Finite Temperature Correlations on Plasmon and Coulomb Drag in Coupled Quantum Wells*, Lerwen Liu, D. Neilson and L. Swierkowski, Physica B **249-251**, 937-940 (1998)
25. *Exciton and Charge Density Wave Formation in Spatially Separated Electron Hole Liquids*, Lerwen Liu, L. Swierkowski and D. Neilson, Physica B **249-251**, 594-597 (1998)
26. *Superconducting pairing in coupled electron-hole layers*, J.S. Thakur, D. Neilson and M.P. Das, Phys. Rev. B **57**, 1801-1804, (1998)
27. *Freezing of Strongly correlated Electrons in Bilayer Systems with Weak Disorder*, J.S. Thakur and D. Neilson, Prog. Theor. Phys. **126**, 339 (1997)
28. *Electron correlations in thin disordered quantum wires*, J.S. Thakur and D. Neilson, Phys. Rev. B **56**, 4679 (1997)
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37. *Electron Liquids in Coupled Quantum Wells*, (with L. Swierkowski and J. Szymanski), Acta Phys. Pol. **43**, (1993).
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52. *Emission of Thermal Positrons from Metal Surfaces,* (with R.M. Nieminen and J. Szymanski), Phys. Rev. A **33**, 1567 – 1571 (1986).
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73. *Positron Annihilation and Electron Correlations in Metals*, (with A.D. Jackson), Phys. Rev. B **12**, 1689 - 1706 (1975).
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Contact Details

Address
Department of Physics
University of Camerino
via Madonna delle Carceri, 9
Camerino (MC) 62032
Italy

Email dneilson at ftml.net
Phone +39 0737402519
FAX +39 0737402853
Mobile +39 3204381336
Skype david.neilson