

# CURRICULUM VITAE



## Dr. Michael David Towler

*Visiting Researcher/Ex-Royal Society Research Fellow (University of Cambridge)*  
*Research Associate (UCL)*  
*College Lecturer (Emmanuel College, Cambridge)*  
*Director (Apuan Alps Centre for Physics, Italy)*

I am a physicist working both in Cambridge and at University College London, whose main focus is the use of quantum-mechanical techniques to simulate the properties of condensed matter from first principles. I am an author of sixty scientific articles and book chapters, and have written a number of international-class software programs used widely around the world. For many years a Royal Society research fellow in the Cavendish TCM Group and an Emmanuel College Lecturer, I am also the founder and director of the internationally known 'Apuan Alps Centre for Physics' conference centre in Italy, where I have hosted eighteen major events including my own series of quantum physics summer schools. An experienced public speaker and educator, I have given many talks all over the world along with graduate lecture courses and thousands of small group supervisions over fifteen years in Cambridge.

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**Relevant web pages:**

[www.tcm.phy.cam.ac.uk/~mdt26](http://www.tcm.phy.cam.ac.uk/~mdt26)

[www.vallico.net/tti/tti.html](http://www.vallico.net/tti/tti.html)

[www.tcm.phy.cam.ac.uk/~mdt26/casino.html](http://www.tcm.phy.cam.ac.uk/~mdt26/casino.html)

## Secondary and University Education

11 'O' levels – all grade A (1986)

4 'A' levels – all grade A (1988) [one awarded national prize for best 'A' level paper in U.K.]

1 'S' level – grade 1 (1988)

1988-1994 Bristol University

B.Sc. 1st class (1991)

Ph.D. (1994)

## Academic posts

EC Human Capital and Mobility Individual Research Fellowship

University of Torino, Italy in the group of Roberto Dovesi (Nov 1994–Dec 1996)

Postdoctoral research associate (Dec 1996–Oct 2000)

Theory of Condensed Matter group, University of Cambridge

Lloyd's Fellowship (Oct 2000–Oct 2002)

Theory of Condensed Matter group, University of Cambridge

Royal Society Research Fellowship (Oct 2002–Oct 2010)

Theory of Condensed Matter group, University of Cambridge

College Lecturer, (Oct 2002–present)

Emmanuel College, University of Cambridge

Research associate (Oct 2010–present)

University College London

Although an employee of UCL since last year, I continue to work mainly from my Cambridge office in the TCM group where I am a 'Visiting Researcher'. I go to UCL once a week.

## Additional academic and business experience

Studentship with BASF, Ludwigshafen, Germany (Summer 1992).

Laboratory Fellowship at Pacific Northwest Laboratory, Washington, U.S.A. (Summer 1994).

Summer placements, Computational Materials Science Group, Daresbury Lab. (1991–94).

I have attended the following schools and training workshops:

1. European Summer School in Quantum Chemistry, Tjörnarp, Sweden (August 1995).
2. Research Workshop on Condensed Matter Physics: "*Local density functional and beyond*",

Trieste, Italy (June 1996).

3. Fourth Sostrup Summer School “*Quantum chemistry and molecular properties*”, Denmark (July 1996).

4. “*Physics of Insulators*” workshop, Aspen Centre for Physics, Aspen, U.S.A. (3 weeks June/July 1998).

5. “*Best practice in HPC software development*” (Oxford, October 2009).

6. “*Innovation and the business of science*” (Three modules: Science and the Economy, Leadership, Entrepreneurship), Royal Society, London (2009).

7. “*Introduction to CUDA programming on NVIDIA GPUs*”, Numerical Algorithms Group, Oxford (May 2011).

I organized international workshops entitled “*Diffusion Monte Carlo*” in September 2002 at CECAM in Lyon, France, and “*The quantum Monte Carlo method*” at RMIT University, Melbourne, Australia in January 2003.

I have created and developed my own science institute, conference centre and events venue - the ‘Apuan Alps Centre for Physics’ - in the mountain village of Vallico Sotto, Italy. Since it opened in 2005 almost 350 scientists from around the world have passed through the Institute (many of them repeatedly) whilst attending the 18 major events that I have organized there.

I am the originator and organizer of the conference series “*Quantum Monte Carlo in the Apuan Alps*” held each year since July 2005 in Vallico Sotto, and of the annual “*Quantum Monte Carlo and the CASINO program*” summer schools at the same venue beginning in August 2006. My Institute also hosted two independent workshops “*KKR and many-body applications*” and “*Nucleic Acids Function*”, along with the 2006 “*CASTEP Festival*”. In late August 2010 I organized a workshop “*21st-century directions in de Broglie-Bohm theory and beyond*” with Antony Valentini, when over 60 people visited Vallico Sotto including many of the world’s leading quantum physicists.

I have given over 50 talks at international conferences, workshops and university seminars, and have produced 60 publications with over 1300 citations and a h-index of 20. I am the chief developer of the well-known quantum Monte Carlo software package ‘CASINO’ (used by hundreds of scientists around the world) and the de Broglie-Bohm code ‘LOUIS’.

In October 2010 I was invited by the BBC to be a contributing presenter for their new series “*The Wonders of the Universe*”, for which I was to film various scenes in Namibia (though in the end I was unable to do so because of problems with work visas).

## Teaching experience

1991–3 : Undergraduate supervisor, University of Bristol.

1995 : Lecturer, EEC HCM Summer School “*Hartree-Fock theory of the electronic structure of solids*” (for graduate students), Villa Gualino, Torino, Italy.

1997-2011 : Undergraduate supervisions in Cambridge in the following subjects: Mathematics for Natural Sciences (1st year); Mathematics for Natural Sciences (2nd year); IA and IB physics, including Thermodynamics, ‘Oscillations, Waves and Optics’, Electromagnetism,

Statistical Physics, Quantum Physics (1st and 2nd year); Quantum Mechanics, Solid State Physics, Theoretical Physics (3rd and 4th years). For the last ten years I have held a position as ‘College Lecturer’ at Emmanuel College.

2000 : Lecturer, Summer School “*Modelling in solid state chemistry*” (for graduate students), University of Torino, Italy.

2004 : Lecturer, Winter School “*Quantum Monte Carlo*”, ICTP Trieste.

2006-2011 : Lecturer and Organizer, Summer Schools “*Quantum Monte Carlo and the CASINO program I-VI*”, Vallico Sotto, Italy.

2009 : Gave eight-lecture graduate course in the Cavendish Laboratory, entitled “*De Broglie-Bohm pilot-wave theory and the foundations of quantum mechanics*”. Available online at [www.tcm.phy.cam.ac.uk/~mdt26/pilot\\_waves.html](http://www.tcm.phy.cam.ac.uk/~mdt26/pilot_waves.html).

2012 : Invited instructor, “*Band structure meets many-body theory*” summer school, Vienna, Austria.

Where I have been made aware of the opinions and official evaluations of students and others, I have observed that my teaching and lecturing abilities have been widely praised.

As a Royal Society Research Fellow I supervised two Ph.D. students and a postdoc in my own Cambridge group, and was indirectly responsible for assisting many others. A final year undergraduate student did a six-month project with me which resulted in the publication of a paper with his name on it in the Proceedings of the Royal Society.

## **Administrative and management experience**

### *Cavendish Laboratory*

1. I was a member of the staff committee of the TCM group for almost a decade, and have thus already played a significant role in the administration of the group.
2. I have conducted interviews with various students looking to work in the TCM group.
3. For seven years I organized and chaired a weekly meeting known as the ‘Electronic Structure Discussion Group’, which brought together almost all the people in Cambridge interested in computational electronic structure theory (including groups from the physics, engineering, chemistry, earth sciences, and biology departments) together with various individuals from institutions in London. There was sufficient interest that each week I was able to organize one long 40-minute talk and one or two short 20-minute talks, with considerable accompanying discussion. Although I passed on the responsibility for this to someone else for several years, I have recently revived it and the meetings continue to be successful.
4. I am responsible for maintaining various websites highlighting the work of members of the TCM group.
5. I am responsible for the various TCM libraries, including the maintenance of online catalogues.
6. In 2000 I was given a 1000 GBP *ex gratia* payment by the group in recognition of my having invented, designed and overseen the construction of a new TCM coffee bar/library area.

### *Emmanuel College*

1. Since becoming a College Lecturer in 2002, I have been significantly involved in committee work, most notably with the Buildings and Services committee and the Master and Tutors' committee. As a College fellow it is also obligatory for me to attend meetings of the Governing Body.
2. For three years (2003-2006), I was the College internal auditor. This involved attending almost all committee meetings, examining accounts produced by the College Accountant, and writing a short report thereon.
3. I have acted as a Tutor, with responsibility for the welfare of large numbers of students. This involves regular meetings with the students, and being their first port of call for advice.
4. At the end of each Michaelmas term I conduct interviews with school students wishing to study Natural Sciences at Emmanuel. This involves gauging their competence in physics and writing large numbers of reports.
5. I have evaluated various applications for College Fellowships in physics.

### *Apuan Alps Centre for Physics*

1. I am the founder and director of the Apuan Alps Centre for Physics. The Centre is situated in a 15th-century monastery in the mountain village of Vallico Sotto in the Tuscan Apuan Alps, Italy. It serves mainly as a venue for international conferences and summer schools. (See [www.vallico.net/tti/tti.html](http://www.vallico.net/tti/tti.html)).
2. Although the Institute is largely philanthropic in nature, with costs to visitors made as small as possible, I have needed to do a considerable amount of fundraising to run the place (I secured grants from Psi-k, CCP9, the Royal Society, as well as TCM itself). In addition to carrying out routine refurbishment, I have gradually equipped the place with all the paraphernalia required of a modern events venue.
3. By making use of other accommodation in the village, the Institute is capable of running meetings of over 65 people (the last big one, '*21st-century directions in de Broglie-Bohm theory and beyond*' in August 2010 came very close to that number). Since 2004, I have organized and hosted 18 conferences and summer schools almost entirely by myself (with help in teaching provided by two colleagues from Cambridge).

### **Talks presented**

*Invited talks marked with \*.*

1. The defect chemistry of lithium niobate (Bristol, U.K., 1993)
2. The physics of Mott insulators (Bristol, U.K., 1993)
3. The physics of Mott insulators (Birmingham, U.K., 1994)
4. Equations of state at high pressures and elevated temperatures (Colorado Springs, U.S.A., 1994)
5. The use and optimization of Gaussian basis sets in periodic Hartree-Fock calculations (Torino, Italy, 1995)
6. The transactional interpretation of quantum mechanics (Cambridge, U.K., 1997)
7. Strongly correlated materials in electronic structure theory (Cambridge, U.K., 1997)

8. Strongly correlated materials in electronic structure theory (Aspen, U.S.A., 1998)
9. Quantum Monte Carlo calculations of excited states (Aspen, U.S.A., 1998)
10. Quantum Monte Carlo calculations of crystalline materials (Leicester, U.K., 1999)
- 11\*. Overview of research in electronic structure theory in the Cambridge TCM group (for international assessment panel, Cambridge, U.K., 2000)
12. Non-collinear spins from first principles (Cambridge, U.K., 2000)
- 13\*. An introduction to the the quantum Monte Carlo method (Torino, Italy, 2000)
- 14\*. The basis set problem in solid-state electronic structure theory (Torino, Italy, 2000)
15. An introduction to the quantum Monte Carlo method (Cambridge, U.K., 2000)
- 16\*. The CASINO program : QMC in molecular quantum chemistry and condensed matter physics (Trento, Italy, 2001)
17. Metal-insulator transitions (Cambridge, U.K., 2001)
- 18\*. The quantum Monte Carlo method (Melbourne, Australia, 2003, three lectures)
- 19\*. Metal-insulator transitions (Melbourne, Australia, 2003)
20. The fermion sign problem (Cambridge, U.K., 2003)
- 21\*. Quantum Monte Carlo and materials physics (Tsukuba, Japan, 2003)
22. Coupled quantum Monte Carlo and molecular dynamics (Cambridge, U.K., 2004)
- 23\*. Quantum Monte Carlo : practical issues, solid-state applications and the CASINO programme (Trieste, Italy, 2004, three lectures)
24. Quantum Monte Carlo and the metal-insulator transition (Vallico Sotto, Italy, 2005)
25. Localized orbitals and localized basis sets (Vallico Sotto, Italy, 2005)
26. Recent progress in quantum Monte Carlo methods (Lyon, France, 2005)
27. The calculation of expectation values in quantum Monte Carlo (Vallico Sotto, Italy, 2006)
- 28\*. Recent developments in quantum Monte Carlo: moving the atoms (Thomas Young Centre, London, U.K., 2007)
29. Another look at pilot wave theory (Cambridge, Italy, 2008)
30. De Broglie and Bohm's solution to the QM interpretation problem, together with reflections on possible connections with quantum Monte Carlo (Vallico Sotto, Italy, 2008)
31. An introduction to pilot-wave theory (Cambridge, U.K., 2009)
32. Pilot waves and the classical limit. Derivation and justification of the theory (Cambridge, U.K., 2009)
33. Elementary wave mechanics and pilot waves, with nice examples (Cambridge, U.K., 2009)
34. The theory of measurement and the origin of randomness (Cambridge, U.K., 2009)

35. Nonlocality, relativistic spacetime, and quantum equilibrium (Cambridge, U.K., 2009)
36. Calculating things with quantum trajectories (Cambridge, U.K., 2009)
37. Not even wrong (Cambridge, U.K., 2009)
38. Bohmian metaphysics: the implicate order and other arcana (Cambridge, U.K., 2009)
39. Quantum Monte Carlo - is it of any use in quantum chemistry? (Oxford, U.K., 2009)
40. Pilot waves, Feynman path integrals, and quantum Monte Carlo (Vallico Sotto, Italy, 2009)
- 41\*. The return of pilot waves, or, why Bohr, Heisenberg, Pauli, Born, Schrödinger, Oppenheimer, Feynman, Wheeler, von Neumann and Einstein were all wrong about quantum mechanics (Cambridge University Physical Society, Cambridge, U.K., 2009) [Note to the worried: the organizers specifically asked me to be (quote) ‘amusing and controversial’].
- 42\*. Quantum Monte Carlo - a practical solution to the correlation problem in electronic structure calculations (Torino, Italy, 2009)
43. Exchange, antisymmetry, and Pauli repulsion (Cambridge, U.K., 2010)
44. Dynamical relaxation to quantum equilibrium: introducing the LOUIS code (Cambridge, U.K., 2010)
45. The magic of moving nodes (Vallico Sotto, Italy, 2010)
46. 21st-century directions in de Broglie-Bohm theory and beyond - an introduction (Vallico Sotto, Italy, 2010)
47. Origin of the Born rule (Vallico Sotto, Italy, 2010)
- 48\*. A dangerous but enlightening journey (Basil Hiley at 75 Fest, Helsinki, Finland, 2010)
- 49\*. Quantum Monte Carlo - a practical solution to the correlation problem in electronic structure calculations (Vienna University of Technology, Austria, 2010)
- 50\*. The quantum theory of de Broglie and Bohm (Chemisch Physikalische Gesellschaft, Vienna, Austria, 2010)
51. Quantum Monte Carlo - a practical solution to the correlation problem in electronic structure calculations (Queen Mary University, London, 2011)
52. The Coriolis force (Queen Mary University, London, 2011)
- 53\*. Further results in out-of-equilibrium quantum physics (Clemson University, U.S.A., 2011)
- 54\*. The quantum theory of de Broglie and Bohm (Oxford University Physics Society, 2011)
- 55\*. Numerical simulations of the emergence of quantum mechanics (University of Vienna, Austria, 2011)
56. Perfect parallel scaling for quantum Monte Carlo on hundreds of thousands of cores (Cambridge, U.K., 2011)
- 57\*. The quantum theory of de Broglie and Bohm: twists and turns in quantum foundations (University College, London, High Energy Physics group, 2012)

58\*. Quantum Monte Carlo, density functional theory, and many-body physics (“*Band structure meets many-body theory*” summer school, Vienna University, Austria, 2012)

### Conferences attended

1. Various CCP5 Polar Solids meetings, Oxford, U.K. (1991–1995)
2. AIRAPT/APS conference on high pressure science and technology, Colorado Springs, U.S.A. (1994)
3. Total energy and force methods, Trieste, Italy (1995)
4. Psi-k Conference, Schwäbisch Gmünd, Germany (1997)
5. Total energy methods to study the dynamics of surface processes, Corfu, Greece (1997)
6. Electronic structure theory and simulations, Trieste, Italy (1999)
7. WATOC99, Imperial College, London, U.K. (1999)
8. Psi-k Conference, Schwäbisch Gmünd, Germany (2000)
9. Total energy and force methods, Trieste, Italy (2001)
10. DFT 2001, The Royal Institution, London, U.K. (2001)
11. Quantum Monte Carlo - recent advances and common problems in condensed matter and field theory, Trento, Italy (2001)
12. Local orbitals and linear scaling, Lyon, France (2001)
13. Electronic structure of materials, Tenerife, Spain (2002)
14. Condensed matter and materials physics 2002, Brighton, U.K. (2002)
15. Molecular and solid state quantum chemistry, Daresbury, U.K. (2003)
16. The fermion sign problem, Lyon, France (2003)
17. XIII Workshop on Computational Materials Science, Sardinia, Italy (2003)
18. Position operator  $\mathbf{r}$  in extended systems within DFT and HF, Lyon, France (2003)
19. CCP9 conference, Daresbury, U.K. (2004)
20. Total energy and force methods, Trieste, Italy (2005)
21. Quantum Monte Carlo in the Apuan Alps, Vallico Sotto, Italy (2005)
22. Psi-k Conference, Schwäbisch Gmünd, Germany (2005)
23. *Ab initio* simulation methods beyond density functional theory, Lyon, France (2005)
24. Quantum Monte Carlo in the Apuan Alps II, Vallico Sotto, Italy (2006)
25. Quantum Monte Carlo in the Apuan Alps III, Vallico Sotto, Italy (2007)
26. Quantum Monte Carlo in the Apuan Alps IV, Vallico Sotto, Italy (2008)
27. Quantum Monte Carlo in the Apuan Alps V, Vallico Sotto, Italy (2009)

28. New perspectives on the quantum state, Perimeter Institute, Waterloo, Canada (2009)
29. Quantum Monte Carlo in the Apuan Alps VI, Vallico Sotto, Italy (2010)
30. 21st-century directions in de Broglie-Bohm theory and beyond, Vallico Sotto, Italy (2010)
31. Toward an algebra of process. A symposium in honour of Basil J. Hiley, Helsinki, Finland (2010)
32. New frontiers in quantum foundations, Clemson University, U.S.A. (2011)
33. Askloster symposium, Sweden (2011)
34. Emergent quantum mechanics, University of Vienna, Austria (2011)
35. Band structure meets many-body theory, Vienna University of Technology, Austria (2012)

### **Other relevant skills**

Languages: Italian (fluent) French, German (adequate)

Computing: Extensive experience of numerical programming and large scale program development on workstations and large parallel machines using Fortran, C, MPI, OpenMP, CUDA etc. together with various Unix/Linux scripting languages. Experienced in web design.

### **Publications and citation data**

61 publications listed on separate sheet (9 with over 50 citations)

Total number of citations: 1314

Total number of citing articles: 989

Average citations per item: 23.89

h-index: 20

### **Referees**

(1) Dario Alfe\*, Department of Earth Sciences and Department of Physics and Astronomy, University College London, Gower Street, London, WC1E 6BT, U.K.

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\* Current employer.