Curriculum Vitae
David Collins

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Education

- **PhD**, December 1997, University of Texas at Austin.
  Supervisor: Prof. Cécile DeWitt-Morette.
  Specialization: Mathematical Physics, Functional Integration.
- **BSc (Hons)**, April 1989, Rhodes University, Grahamstown, South Africa.
  Major: Physics Minor: Mathematics. Awarded with distinction.

Theses

- *Two-state Quantum Systems Interacting with Their Environments: A Functional Integral Approach*, PhD thesis, University of Texas at Austin (1997).
- *The Use of Groups in Physics with Special Reference to SO(3) and the Euclidean Group*, Honours thesis, Rhodes University (1989).

Work Experience

- **Professor**, Physics, Colorado Mesa University (previously Mesa State College), August 2006 – present.
  - Taught various undergraduate physics courses.
  - Supervised undergraduate research and independent study.
- **Visiting Assistant Professor**, Physics, Bucknell University, August 2003 – May 2006.
  - Taught various undergraduate physics courses.
  - Supervised undergraduate research and independent study.
- **Postdoctoral Research Associate**, Physics, Carnegie Mellon University, August 2000 – July 2003.
  - Faculty Supervisor: Prof. R. B. Griffiths.
  - Investigated theoretical quantum computation and quantum information.
- **Postdoctoral Research Associate**, Electrical and Computer Engineering, North Carolina State University, January 1998 – March 2000.
  - Faculty Supervisors: Prof. Ki Wook Kim, Prof. William C. Holton.
  - Investigated theoretical quantum computation and experimental NMR quantum computation.
- **Physicist**, Optical Engineering Section, Division of Production Technology, CSIR (formerly the Council for Scientific and Industrial Research), Pretoria, South Africa, January 1988 – March 1988.
  - Devised an algorithm for the computation of the point transfer function of an optical system.

Teaching Experience

- **Professor**, Physics, Colorado Mesa University/Mesa State College, 2006 – present.
  - *Physics 100:* Conceptual physics course.
  - *Physics 111:* Introductory algebra-based physics course.
  - *Physics 111L:* Introductory algebra-based physics laboratory.
  - *Physics 112:* Introductory algebra-based physics course.
  - *Physics 112L:* Introductory algebra-based physics laboratory.
  - *Physics 131:* Introductory calculus-based physics course.
  - *Physics 131L:* Introductory calculus-based physics laboratory.
  - *Physics 132:* Introductory calculus-based physics course.
  - *Physics 132L:* Introductory calculus-based physics laboratory.
  - *Physics 230:* Intermediate thermodynamics, waves and relativity course.
  - *Physics 231:* Intermediate modern physics course.
  - *Physics 252:* Intermediate laboratory.
  - *Physics 311:* Upper division electromagnetism course.
  - *Physics 312:* Upper division electromagnetism course.
  - *Physics 321:* Upper division quantum mechanics course.
  - *Physics 362:* Upper division thermal and statistical physics course.
  - *Physics 396:* Upper division topics course (quantum optics).
  - *Physics 396:* Upper division topics course (quantum information).
  - *Physics 422:* Upper division quantum mechanics course.
  - *Physics 473:* Upper division optics course.
  - *Essl 290:* Intermediate level interdisciplinary course (time keeping).
- **Visiting Assistant Professor**, Physics, Bucknell University, 2003 – 2006.
  - *Physics 309:* Upper division condensed matter physics course.
  - *Physics 332:* Upper division quantum mechanics course.
  - *Physics 222:* Sophomore level modern physics course.
  - *Physics 141:* Introductory level physical science course for non-majors.
  - *Physics 329:* Upper division physics laboratory.
  - *Astronomy 101 Laboratory:* Freshman level astronomy laboratory for non-majors.
  - *Physics 211/212 Laboratory:* Freshman level physics laboratory.
  - *Physics 211/212 Problem Session:* Discussion sessions for freshman level physics course.
  - *Independent Study and Undergraduate Research:* Supervised undergraduate students in independent study and research in quantum information.
- **Co-Instructor**, Physics, Carnegie Mellon University, 2001 – 2003.
  - *Quantum Information and Quantum Computation:* Upper division undergraduate/ graduate physics elective course.
  - Supervisor: Prof. R. B. Griffiths (course organizer).
- **Undergraduate Research Supervision**, Physics, Carnegie Mellon University, 2001 – 2002.
  - Supervised undergraduate physics research projects in pulse sequence design for NMR quantum computation.
- **Assistant Instructor**, Physics, University of Texas, 1993 – 1997.
  - *Physical Science 303, 304:* Introductory level physical science for non-science majors.
  - Supervisor: Prof. Peter R. Antoniewicz.

- **Teaching Assistant**, Physics, University of Texas, 1991 – 1993.
  - *Physics 102M, 102N Laboratories:* Freshman level for science (non-physics) majors.
  - Supervisors: Prof. J. David Gavenda (Phy 102M), Prof. Thomas A. Griffy (Phy 102N).
- **Tutor**, Physics, Rhodes University, 1989 – 1991.
  - *Physics IP/IL Tutorials:* Discussion sessions for freshman level course for science (non-physics) majors.

Research Interests

My primary research area is quantum computation and quantum information. Currently, I investigate methods for estimating parameters that govern quantum processes. I have also investigated implementations of quantum algorithms on ensembles of quantum systems, such as those used in solution state nuclear magnetic resonance (NMR). My work is mostly theoretical, although I have conducted NMR experiments demonstrating quantum information processing. Other research interests include aspects of the foundations of quantum mechanics.

Publications

Undergraduate students are indicated by an asterisk (*).

1. *Connecting optical intensities and electric fields using a triple interferometer*, David Collins and Justin Endicott*, Preprint arXiv:2008.12641 (2020).
2. *Qubit-channel metrology with very noisy initial states*, David Collins, Phys. Rev. A **99**, 012123 (2019).
3. *Depolarizing channel parameter estimation using noisy initial states*, David Collins and Jaimie Stephens*, Phys. Rev. A **92**, 032324 (2016).
4. *Mixed state Pauli channel parameter estimation*, David Collins, Phys. Rev. A **87**, 032301 (2013).
5. *Probing the qudit depolarizing channel,* Michael Frey, David Collins, and Karl Gerlach, J. Phys. A: Math. Theor. **44**, 205306 (2011).
6. *Discrimination of unitary transformations in the Deutsch-Jozsa algorithm: Implications for thermal-equilibrium-ensemble implementations,* David Collins, Phys. Rev. A **81**, 052323 (2010).
7. *Quantum Fisher information and the qudit depolarization channel,* Michael Frey and David Collins, appears in *Quantum Information and Computation VII*, ed. Eric Donker, et. al., Proceedings of SPIE Volume 7342 (2009).
8. *Discrimination of unitary transformations and quantum algorithms,* David Collins, appears in *Quantum Communication, Measurement and Computing (QCMC)*, AIP Conference Proceedings 1110 (2009). Preprint arXiv:0811.1359 (2008).
9. *Statistical comparison of ensemble implementations of Grover's search algorithm to classical sequential searches,* Tomasz M. Kott* and David Collins, Phys. Rev. A **77**, 052314 (2008).
10. *Polarization requirements for ensemble implementations of quantum algorithms with a single bit output*, Brandon M. Anderson* and David Collins, Phys. Rev. A. **72**, 042337 (2005).
11. *Scaling issues in ensemble implementations of the Deutsch-Jozsa algorithm*, Arvind and David Collins, Phys. Rev. A. **68**, 052301 (2003).

12. *Shortening Grover's search algorithm for an expectation value quantum computer*, David Collins, Proceedings of the Sixth International Conference on Quantum Communication, Measurement and Computing (QCMC'02), Eds J. H. Shapiro and O. Hirota, (Rinton Press, 2003).
13. *Modified Grover's algorithm for an expectation value quantum computer,* David Collins, Phys. Rev. A. **65**, 052321 (2002).
14. *Orchestrating an NMR quantum computation: the N=3 Deutsch-Jozsa algorithm,* David Collins, K. W. Kim, W. C. Holton, H. Sierzputowska-Gracz, and E. O. Stejskal, Preprint quant-ph/0105045 (2001).
15. *NMR quantum computation with indirectly coupled gates,* David Collins, K. W. Kim, W. C. Holton, H. Sierzputowska-Gracz, and E. O. Stejskal, Phys. Rev. A **62** 022304 (2000).
16. *Deutsch-Jozsa algorithm as a test of quantum computation,* David Collins, K. W. Kim, and W. C. Holton, Phys. Rev. A. **58**, 1633 (1998).
17. *A Rigorous Mathematical Foundation of Functional Integration,* Cartier, P., Dewitt-Morette, C., Wurm, A. and Collins, D. Contains an appendix on Functional Integration Over Complex Poisson Paths prepared by D. Collins. *Functional Integration: Basics and Applications*, Eds C. DeWitt-Morette, P. Cartier and A. Folacci, (Plenum Press, New York, 1997).

Conference Presentations

Undergraduate students are indicated by an asterisk (*).

1. *Qubit Channel Parameter Estimation with Noisy Initial States,* David Collins, Invited presentation at Advances in Information Geometry Conference, Tokyo, Japan (2020). *This conference was canceled as a result of the COVID-19 epidemic.*
2. *Optimal Estimation of Single Qubit Quantum Evolution Parameters,* David Collins and Michael Frey, APS March Meeting, Portland, Oregon (2010).
3. *Enhanced Estimation of Quantum Evolution Parameters with Entangled States,* David Collins and Michael Frey, APS Four Corners Section Meeting, Golden, Colorado (2009).
4. *Performance Requirements for Ensemble Implementations of Quantum Algorithms,* David Collins, Brandon Anderson* and Tomasz M. Kott*, APS Four Corners Meeting, Logan, Utah (2006).
5. *Polarization Requirements for Ensemble Implementations of Quantum Algorithms with a Single Bit Output,* Brandon Anderson* and David Collins, APS March Meeting, Baltimore, Maryland (2006).
6. *Statistical Performance of Ensemble Quantum Computers in Search Algorithms,* David Collins and Tomek Kott*, APS March Meeting, Baltimore, Maryland (2006).
7. *Could Quantum Computing Aid Functional Integration?,* David Collins, Invited presentation at the MSRI workshop "The Feynman Integral Along with Related Topics and Applications," Berkeley, California (2002).
8. *NMR Quantum Computation with Indirectly Coupled Gates,* David Collins, W. C. Holton, K. W. Kim, H. Sierzputowska-Gracz, and E. O. Stejskal, APS March Meeting, Minneapolis, Minnesota (1999).
9. *Deutsch-Jozsa Algorithm on a NMR Quantum Computer: Issues and Progress,* David Collins, W. C. Holton, K. W. Kim, H. Sierzputowska-Gracz, and E. O. Stejskal, APS Centennial Meeting, Atlanta, Georgia (1999).

10. *Using NMR to Implement a Quantum Computer,* David Collins, H. Sierzputowska-Gracz, W. C. Holton, K. W. Kim and E. O. Stejskal, Triangle Magnetic Resonance Group meeting, Chapel Hill, North Carolina (1998).
11. *A Refinement of the Deutsch-Jozsa Algorithm,* David Collins, K. W. Kim and W. C. Holton, DARPA Ultrascale Computing principle investigators' meeting, Tucson, Arizona (1998).
12. *Spinor Structures: A New Approach,* David Collins, F. A. M. Frescura, and G. Lubczonok, 26th Annual Seminar on Theoretical Physics, Bloemfontein, South Africa. Published in the conference proceedings (1991).
13. *Moving Frames and Accelerated Observers in Special Relativity,* David Collins and F. A. M. Frescura, 25th Annual Seminar on Theoretical Physics, Port Elizabeth, South Africa. Published in the conference proceedings (1990).

Conference Posters

1. *Qubit Channel Parameter Estimation with Very Noisy Initial States* David Collins, 22nd Annual Conference on Quantum Information Processing (QIP), Boulder, CO (2019). Similar poster of earlier work presented at 20th Annual SQuInT Workshop, Santa Fe, NM (2018).
2. *Quantum Channel Parameter Estimation with Noisy Initial States* David Collins and Jaimie Stephens*, 18th Annual SQuInT Workshop, Albuquerque, NM (2016).
3. *Enhanced Noisy Depolarizing Channel Parameter Estimation* David Collins and Jaimie Stephens*, 9th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2014), Singapore (2014).
4. *Correlated Quantum States and Enhanced Mixed State Pauli Channel Parameter Estimation,* David Collins, International Conference on Quantum Information and Quantum Computing, Bangalore, India (2013).
5. *No Advantage to Entanglement in Bit-Flip Parameter Estimation,* David Collins and Michael Frey, International Conference on Quantum Information, Ottawa, Canada (2011).
6. *Discrimination of Unitary Transformations and Quantum Algorithms,* David Collins, 9th International Conference on Quantum Communication, Measurement and Computing, Calgary, Canada (2008).
7. *Scaling Issues in Ensemble Quantum Algorithms,* David Collins and Arvind, Quantum Information and Quantum Control Conference, Toronto, Canada (2004).
8. *Shortening Grover's Search Algorithm for an Expectation Value Quantum Computer,* David Collins, 6th International Conference on Quantum Communication, Measurement and Computing, Cambridge, Massachusetts (2002).
9. *NMR Quantum Computation with Indirectly Coupled Gates,* David Collins, W. C. Holton, K. W. Kim, H. Sierzputowska-Gracz, and E. O. Stejskal, 41st Experimental Nuclear Magnetic Conference, Pacific Grove, California (2000).
10. *Deutsch-Jozsa Algorithm on a NMR Quantum Computer,* David Collins, W. C. Holton, K. W. Kim, H. Sierzputowska-Gracz, and E. O. Stejskal, Triangle Magnetic Resonance Group meeting, Research Triangle Park, North Carolina (1999).
11. *Deutsch-Jozsa Algorithm on a NMR Quantum Computer: Issues and Progress,* David Collins, W. C. Holton, K. W. Kim, H. Sierzputowska-Gracz, and E. O. Stejskal, Conference on Quantum Information Processing and NMR, Cambridge. Massachusetts (1999).

Workshops Attended

1. Quantum Undergraduate Education and Scientific Training, Virtual Workshop, June 2021.
2. AAPT Workshop for New Physics and Astronomy Faculty, Greenbelt, Maryland, June 2008.
3. 15th Waterloo NMR Summer School, University of Waterloo, Waterloo, Ontario, Canada, June 1999.
4. Quantum Computations Tutorial, APS March Meeting, Los Angeles, California, March 1998.
5. NATO ASI Functional Integration: Basics and Applications, Cargese, Corsica, France, September 1996. Funding provided by Collectivité Territorial de Corse.

Professional Organizations

1. Member: American Physical Society.