

Mile Gu, Nanyang Assistant Professor

School of Mathematical and Physical Sciences
Nanyang Technological University
gumile@ntu.edu.sg



Website: www.milegu.org

Nationality: New Zealand

RESEARCH HIGHLIGHTS:

High impact research, including 4 in various Nature/Science journals, highlights in Nature, Science (6 separate occasions), and various online and print media.

- Demonstration of quantum discord is a physical resource. Published in *Nature Physics* **8**, 671–675, highlighted in *Nature Photonics* **6**, 724–725, and awarded *Research Highlight of the Month*, January 2013 at the National University of Singapore.
- Proved that quantum mechanics can build simpler model of reality. Published in *Nature Comm.* **3**, 762, 1133–1135. Invited guest article in *New Scientist*, Issue 2995.
- Demonstration of emergent laws – macroscopic laws that cannot be derived from microscopic principles. Published in *Physica D.* 238, 835–839 and highlighted in *Nature* **459**, 332–334 and *New Scientist* 2676.
- Jointly proposed continuous variable cluster state computation – a new model of quantum computation that has 400+ combined citations, starting a new research direction. See *Phys. Rev. A* **79**, 062318 and *Phys. Rev. Lett.*, 97(11):11050.
- Jointly proved that methods of General Relativity can be applied to find optimal quantum algorithms. Published in *Science*, 311(5764):1133–1135 and highlighted in *Science Perspectives on the same issue*.

PROFESSIONAL HISTORY:

- 02/2016 - Present **Nanyang Assistant Professor (Tenure-Track)**, School of Mathematical and Physical Sciences, Nanyang Technological University, Singapore.
- 11/2013 - 01/2016 **Assistant Professor (Tenure-Track)**, Center for Quantum Information, Institute for Interdisciplinary Information Sciences, Tsinghua University, China.
- 10/2009 - 11/2013 **Research Fellow**, Centre for Quantum Technologies, National University of Singapore
- 2/2009 - 10/2009 **Research Assistant**, Centre for Quantum Technologies, National University of Singapore

EDUCATION:

- 02/2005 - 11/2009 **PhD** (Quantum Complexity, Emergence and Measurement by Computation), University of Queensland, Brisbane, Australia. Supervisors: Michael Nielsen, Tim Ralph, Andrew Doherty
- 02/2003 - 02/2005 **Masters in Physics** (Quantum Optics) 1st Class Honors, Auckland University, New Zealand, Supervisors: Scott Parkins, Howard Carmichael
- 02/2001 - 12/2002 **Bachelor of Science** (Triple Major, in Physics, Computer Science and Applied Mathematics) Auckland University, Auckland, New Zealand.

SELECTED AWARDS:

- 2016** *National Research Foundation Fellow* – National Research Foundation, Singapore
- 2013** *China Young 1000 Talent* - Central Organizing Committee of China
- 2013** *Research Highlight of the Month (January)* – National University of Singapore
- 2006-2009** *Australian Postgraduate Award* - University of Queensland
- 2005** *Distinguished Scholar Award*, University of Queensland

SELECTED GRANTS:

- 2016-2021** *Enhancing the Efficiency of Modelling and Simulating Complex Systems via Quantum Mechanics*
2,606,400 SGD (National Research Foundation, Singapore) **Role:** Principle Investigator
- 2016-2019** *Quantum Physics and Complexity* (Australian Research Council, Australia) **Role:** Co-Investigator
540,800 AUD
- 2015-2017** *Occam's Quantum Mechanical Razor: Can Quantum theory admit the Simplest Understanding of Reality?* (The John Templeton Foundation) **Role:** Principle Investigator
246,100 USD
- 2014** *Using Discord to Preserve the Benefits of Entanglement-Breaking Noise*
200,000 CNY (National Natural Science Foundation of China) **Role:** Principle Investigator
- 2014-2016** *Young 1000 Talent Award* (Organization Department of the CPC Central Committee)
3,000,000 CNY **Role:** Principle Investigator

SELECTED MEDIA AND PRESS:

- "Zen and the art of quantum complexity." *New Scientist*, 2995, (2014)
- "Quantum optics: Discord in the Ranks." *Nature Photonics: News and Views* 6.11 (2012).
- "Why nature is not the sum of its parts." *New Scientist* 200.2676 (2008)
- "Computation: The edge of reductionism." *Nature: News and Views* 459.7245 (2009): 332-334.
- "Implementing a Quantum Computation by Free Fall." *Science Perspectives*, 311.5764 (2006)

SCIENTIFIC PRESENTATIONS AND OUTREACH:

- **35+ Invited Talks and Lectures** at various conferences, workshops and academic institutions (e.g. the Australian Institute of Physics Congress; the FQXi Workshop on Quantum Measurements and Sequential Complexity, CQIC Colloquium, University of Toronto; Clarendon Laboratories Seminar Series Oxford)
- I wrote several *Invited articles* for popular media, including *New Scientist*, *the Foundational Questions Institute (FQXi)*, *University of Queensland Infinity Magazine*, and *Book Reviews for Physics Today*

TEACHING AND MENTORING

- **Course Architect for 'Physics of Information'**, a unique course at the Institute for Interdisciplinary Sciences aim to integrate physics and information theory at IIS. **Course Lecturer** of Advanced information Physics, Physics of Information, General Physics 2 at Tsinghua University.
- **Supervision** of 3 PhD Students (2 at Tsinghua, currently transferring to NTU; 1 at NUS jointly with Vlatko) and many undergraduate projects (at Tsinghua and NUS).

PROFESSIONAL SERVICES:

- **PhD Enrolment Assessor** for the Institute for Information Sciences, 2013 – 2015
- **Referee** for many international journals (Physics Rev Lett, Nature Photonics, Phys. Rev. Lett., Phys Rev X, New Journal of Physics), 2008 – present
- **Committee** for redesigning the Physics Technical Proficiency Test at NTU, 2016.
- **Lead Organizer** for ‘Interdisciplinary Frontiers in Quantum Information’ workshop, at Tsinghua, 2016

SELECTED TALKS AND COLLOQUIUMS

- 2015-11: School of Physics Invited Lecture, Peking University Beijing (INVITED)
 2015-08: 24th Annual International Laser Physics Workshop, Shanghai (INVITED)
 2015-04: New Directions in Foundations of Physics, Washington (INVITED)
 2015-01: 5th Quantum Information Science Workshop, Hong Kong (INVITED)
 2014-12: Australian Institute of Physics Congress, Canberra, Australia (INVITED)
 2014-12: Relativistic Quantum Information Workshop, Brisbane, Australia (INVITED)
 2014-09: FQXi Workshop on Quantum Sequential measurements and complexity, Siegen, Germany (INVITED)
 2014-05: CQIQC Colloquium, University of Toronto, Canada (INVITED)
 2014-01: 4th Quantum Information Science Workshop, Hong Kong (INVITED)
 2013-12: East Lake Forum for Outstanding Young Scholars, Wuhan, China (INVITED)
 2013-11: College of Optoelectronics Colloquium, Tianjin University, China (INVITED)
 2012-07: QCMC 2012, Vienna, Austria (HOT TOPIC TALK)
 2012-06: Clarendon Laboratory Seminar, Oxford University, United Kingdom. (INVITED)
 2012-04: Department of Physics Seminar, University of Queensland, Brisbane, Australia (INVITED)
 2011-10: Institute of Theoretical Physics Seminar, Chinese Academy of Science, China. (INVITED)
 2011-03: Quantum Simulations Workshop, Benasque, Spain. (INVITED)
 2010-06: Physics Departmental Seminar, University of Lund, Sweden. (INVITED)
 2010-05: Quantum Control Seminar Series, Australian National University, Australia. (INVITED)
 2009-01: Quantum Technology in Biological Systems Workshop, Singapore (INVITED)

LIST OF PUBLICATIONS

Refereed

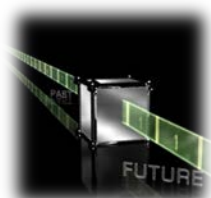
NOTES:

Starred entries indicate research that I am corresponding and/or first author

Citation counts are based on Google Scholar as of 1/1/2016

1. **Christian Weedbook, Stefano Pirandola, Jayne Thompson, Vlatko Vedral, and Mile Gu***. *Discord empowered quantum illumination* (Accepted for publication in *New Journal of Physics*).
2. **Su, Hong-Yi, Changliang Ren, Jing-Ling Chen, Fu-Lin Zhang, Chunfeng Wu, Zhen-Peng Xu, Mile Gu, Sai Vinjanampathy, and Leong Chuan Kwek**. "Beating the Clauser-Horne-Shimony-Holt and the Svetlichny games with optimal states." *Physical Review A* 93, 022110, 2016:
3. **Xiao Yuan, Syed M. Assad, Jayne Thompson, Jing Yan Haw, Vlatko Vedral, Timothy C. Ralph, Ping Koy Lam, Christian Weedbrook and Mile Gu*** *Replicating the benefits of closed timelike curves without breaking causality*". *Nature Partner Journal: Quantum Information* 1, 15007, 2015 (Named Research Highlight in *Nature Physics* 12, 20). **Top 1% of all publications by Altmetric**

4. **F. Franchini, J. Cui, L. Amico, H. Fan, M. Gu, V. Korepin, L. Kwek, V. Vedral.** *Local convertibility and edge states in quantum many body systems*, Phys. Rev. X 4, 041028 2014
5. **M. de Almeida, M Gu, A Fedrizzi, M.A. Broome, T.C. Ralph, A. White.** *Entanglement-free certification of entangling gates*, Physical Review A 89, 042323, 2014
6. **S.Sridharan, M. McEneaney, M.Gu, M. James.** *A reduced complexity min-plus solution method to the optimal control of closed quantum systems*. Applied Mathematics & Optimization, 1-42, 2014
7. **Tan, Ryan, Daniel R. Terno, Jayne Thompson, Vlatko Vedral, and Mile Gu*** *Towards Quantifying Complexity with Quantum Mechanics*. EPJ Plus 129, 9, 1-12, 2014
8. **X. Cai, C. Weedbrook, Z. Su, M. Chen, M. Gu, M. Zhu, L. Li, N. Liu, C. Lu, J. Pan.** *Experimental Quantum Computing to Solve Systems of Linear Equations* Phys. Rev. Lett, 2013, **25+ Citations**.
9. **J. Cui, L. Amico, H. Fan, M. Gu, A. Hamma, V. Vedral.** *Local characterization of 1d topologically ordered states*. Phys. Rev. B. 88, 125117, 2013 **18 Citations**.
10. **M. Gu, H. Chrzanowski, S. Assad, T. Symul, K. Modi, T. C.Ralph, V.Vedral, P.K. Lam***. *Observing the operational significance of discord consumption*, Nature Physics 8, 671–675, 2012. **150+ Citations** (Featured on Nature Photonics, and New Scientist)
11. **M. Gu, K. Wiesner, E. Rieper, V. Vedral*** *Quantum Mechanics can reduce the complexity of classical models*. Nature Communications 3, 762, 2012 (Featured in New Scientist)
12. **J. Cui, M. Gu, L.C. Kwek, M.F. Santos, H. Fan, V. Vedral.** *Quantum phases with differing computational power*. Nature Communications 3, 812, 2012. **40+ Citations**.
13. **K. Modi, M. Gu.*** *Coherent and Incoherent Contents of Correlations*, International Journal of Modern Physics B, 27, 2012.
14. **M. Gu, Alvaro Perales.*** *Encoding Universal Computation in the Ground States of Ising Lattices*, Phys. Rev. E. 86, 1:011116, 2012.



COVER IMAGE FOR THE PAPER 'OCCAM'S QUANTUM RAZOR'. PUBLISHED IN NAT. COMM 3, 762

15. **K. Wiesner, M Gu, E. Rieper, V. Vedral.** *Information-theoretic bound on the energy cost of stochastic simulation*, Proceedings of the Royal Society A, 468, 4058–4066
16. **M. Gu, C.Weedbrook, P. van Loock, and N.Menicucci, Timothy C. Ralph.*** *Computing with continuous variable clusters*. Phys. Rev. A, 79:063218, 2009. **110+ Citations**
17. **S. Sridharan, M. Gu, M.R. James, W. M. McEneaney.** *Reduced-complexity numerical method for optimal gate synthesis*. Phys. Rev. A, 82:042319, 2010. **17 Citations.**
18. **S. Sridharan, M. Gu, M.R. James, W. M. McEneaney** *An efficient computational method for the optimal control of higher dimensional quantum systems*. 2010 49th IEEE Conference on Decision and Control (CDC), 2010.
19. **M. Gu, C.Weedbrook, A. Perales, and M. Nielsen.*** *More really is different*. Physica D. 238, 835-839, 2009. **20+ Citations.** (Featured on Nature News and Views, and New Scientist)
20. **P. van Loock, C.Weedbrook, and M. Gu.** *Building Gaussian cluster states by linear optics*. Phys. Rev. A, 76(3):032321, 2007. **100+ Citations.**
21. **S. Sridharan, M. Gu, and M. James.** *Gate complexity using dynamic programming*. Phys. Rev. A, 78(5):052327, 2008.
22. **M. Gu, A. Doherty, and M. Nielsen.*** *Quantum control via geometry: An explicit example*. Phys. Rev. A, 78(3):032327, 2008.
23. **NC Menicucci, P Van Loock, M Gu, C Weedbrook, TC Ralph, MA Nielsen.** *Universal quantum computation with continuous-variable cluster states*. Physical review letters 97 (11), 110501. **280+ Citations.**
24. **M. Nielsen, M. Dowling, M. Gu, and A. Doherty.** *Quantum computation as geometry*. Science, 311(5764):1133–1135, 2006. **90+ Citations.**
25. **M. Nielsen, M. Dowling, M. Gu, and A. Doherty.** *Optimal control, geometry, and quantum computing*. Phys. Rev. A, 311(5764):062323, 2006. **40+ Citations**
26. **M. Gu, and A. S Parkins, and H. J. Carmichael.*** *Entangled-state cycles from conditional quantum evolution*. Phys. Rev. A. 93:043813, 2006.

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27. **Stephen Clark, Amy Peng, Mile Gu, and Scott Parkins.** *Unconditional Preparation of Entanglement between Atoms in Cascaded Optical Cavities.* Phys.Rev.Lett. 91:177901, 2003. **100+ Citations**

Other Creative Works

28. **Gu, Mile.*** *Computing with Quantum Cats: From Colossus to Qubits:* Review Physics Today 68, 1 46-47. 2015
29. **Gu, Mile, and Vlatko Vedral.*** *Zen and the art of quantum complexity.* New Scientist 224, 2995, 28-29. 2014

Preprint

30. **B. Yadin, J. Ma, D. Girolami, M. Gu, V. Vedral,** Quantum processes which do not use coherence *arXiv:1512.02085*
31. **W. Suen, J Thompson, A. Garner, V. Vedral, M. Gu,*** The classical-quantum divergence of complexity in the Ising spin chain, *arXiv:1511.05738*
32. **J. Ma, B. Yadin, D. Girolami, V. Vedral, M. Gu,*** *Converting Coherence to Quantum Correlations* *arXiv:1510.06179*
33. **H. Cable, M. Gu, K. Modi,** *Power of One Bit of Quantum Information in Quantum Metrology,* *arXiv:1504.02460*
34. **J. Thompson, M. Gu, P. Kurzynski, S.Y. Lee, D. Kaszlikowski,** *Delayed Choice Contextuality: A way to rule out Contextual Hidden Variables,* *arXiv:1506.05493*
35. **A.Cabello, M. Gu, O Gühne, J.Å. Larsson, K. Wiesner,** *Thermodynamical cost of some interpretations of quantum theory,* *arXiv:1509.0364, 2015*
36. **Garner, J. Thompson, V. Vedral, M. Gu,*** *When is simpler thermodynamically better?* *arXiv:1510.00010, 2015*
37. **N. Liu, J. Thompson, C. Weedbrook, S. Lloyd, V Vedral, M. Gu, K. Modi,** *The power of one qumode,* *arXiv:1510.0475, 2015*
38. **J. Thompson, M Gu, K Modi, V Vedral,*** *Quantum Computing with Black-box Subroutines,* *arXiv preprint arXiv:1310.2927, 2013*

39. **O. Dahlsten, A. Garner, J Thompson, M Gu, V Vedral**, *Particle exchange in post-quantum theories*, arXiv preprint arXiv:1307.2529, 2013