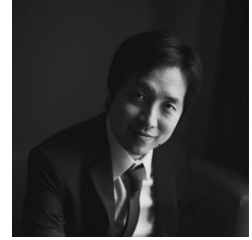


## Mile Gu

Associate Professor and Deputy Director  
Nanyang Quantum Hub, School of Physical and Mathematical Sciences  
Nanyang Technological University



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**Contact No** 94599507

**Nationality** New Zealand (Singapore PR).

### CURRENT POSITIONS

- 03/2024 - Present** **Deputy Director**, Nanyang Quantum Hub, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore
- 07/2021 - Present** **Associate Professor**, Nanyang Quantum Hub, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore.
- 07/2021 - Present** **Research Associate Professor**, Centre for Quantum Technologies, National University of Singapore

### EMPLOYMENT HISTORY:

- 02/2016 – 06/2021** **Nanyang Assistant Professor**, Complexity Institute and the School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore. (80%)
- 11/2013 - 01/2016** **Assistant Professor**, 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

### ACADEMIC QUALIFICATIONS:

- 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) *1<sup>st</sup> 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.

## RESEARCH HIGHLIGHTS:

- **Quantum-Enhanced Modeling and Simulation** - Discovered quantum-enhanced models of stochastic processes that can generate futures in quantum superposition ([Phys. Rev. Lett. 120, 240502](#)), quantum-enhanced models for retrodiction ([Phys. Rev. X 8, 031013](#)) and quantum models with reduced memory dimension ([Phys. Rev. Lett. 125, 260501](#)). These developments catalyzed a new cross-disciplinary path of research that bridges quantum and complexity science.
- **Limits of Resource-Constrained Quantum Technology** – Discovered ultimate limits to quantum-error mitigation ([npj Quantum Inf 8, 114](#)), quantum-sensing limits under energetic constraints ([Optica 7, 771-774](#)), and identified universal benchmarks for quantum memory ([npj Quantum Inf 7, 108](#)) that has been used to test record-breaking ion-trap quantum computers ([Nat. Commun 12, 233](#)). Derived bounds on how certain resources can be interconverted ([Phys. Rev. Lett. 116,160407](#)) with a subsequent experiment in [Phys. Rev. Lett. 121, 050401](#).
- **Thermodynamics of Information Processing** – Pioneered links between information encoding and energy ([Phys. Rev. Lett. 122, 060601](#)) and developed means to understand non-classicality and free energy in continuous variable systems ([Phys. Rev. X 8, 041038](#) and [npj Quantum Info 7, 9](#)). Derived bounds on energy efficiency beyond Landaur's Limit ([Phys. Rev. A 104, 012214](#), awarded Excellent Contributed Talk at **QC40**), links between predictive modelling and energy harvesting ([New J. Phys. 24 083040](#)) and identify 'thermodynamic observables' that tell us how much free energy a machine can extract from a give state ([PRX Quantum 5, 030318](#))
- **Realizing Quantum Protocols in Near-Term Devices** – I worked with multiple experimental groups to realize design and realize various quantum protocols my research inspired. This includes optical quantum devices for memory-efficient stochastic simulation ([Science Advances 3, 2, e1601302](#)), enhanced dimensional reduction ([Phys. Rev. X 9, 041013](#)), neural networks in integrated optics ([Nature comm 13.1,1044](#)), estimating the trace of exponentially large matrices in both local ([Phys. Rev. Lett. 123, 220501](#)) and distributed scenarios ([Nat. Comm 10, 4692](#)).
- **Quantum-Enhanced Radar and Sensing** – I have both developed fundable theory in understanding the limits of quantum-enhanced sensing and new domains in which such technologies are used. Key results include identifying ultimate capabilities of quantum-enhanced target detection ([Optica 7, 771](#)) and identifying methods to approach such limits ([Phys. Rev. A 103, 062413](#)). In the latter, I illustrate quantum-advantaged gain sensing ([Phys. Rev. Lett. 128, 180506](#)) and target detect under covert conditions ([Phys. Rev.Lett. 133, 110801](#)).

Overall output of 100+ publications/proceedings, including 17 in Physical Review Letters, 6 in Physical Review X, 8 in Nature Communications, 2 in PRX Quantum, 1 in Nature Physics, 1 in Nature Photonics, 1 in Science, 1 in Science Advances and 7 in npj Quantum Information. 7000+ citations with H-index of 36 ([Google Scholar](#)).

## SELECTED AWARDS:

- 2025 CQT Principal Investigator** - Center for Quantum Technologies, Singapore
- 2024 National Research Foundation Investigator** – National Research Foundation, Singapore
- 2023 CQT Fellow** – Center for Quantum Technologies, Singapore
- 2020 Winner of 2020 Quantum Pitch** – IBM Singapore
- 2019 SPMS Teaching Excellence Award** – Nanyang Technological University, Singapore
- 2019 SPMS Young Researcher Award** – Nanyang Technological University, Singapore
- 2019 UWA Institute of Advanced Studies Visiting Fellow** – University of Western Australia, Australia
- 2016 National Research Foundation Fellow** – National Research Foundation, Singapore
- 2013 China Young 1000 Talent** - Central Organizing Committee of China

## SELECTED MAJOR GRANTS

Selection of external grants (500k SGD+, where I am the main PI)

- |                                   |                                                                                                                                                                                  |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2024-2029</b><br>3,248,700 SGD | <b>Performing Complex Adaptive Tasks More Efficiently with Autonomous Quantum Agents</b><br>National Research Foundation <b>Role:</b> Principal Investigator                     |
| <b>2022-2025</b><br>1,372,272 SGD | <b>Quantum-Enhanced Modelling of Financial Time-Series Data for Rare Event Forecasting, NRF-QEP</b> <b>Role:</b> Principal Investigator                                          |
| <b>2022-2025</b><br>756,067 SGD   | <b>Precision reflectance sensing in noisy environments via quantum illumination – Ministry of Education, Singapore</b> <b>Role:</b> Principal Investigator                       |
| <b>2020-2022</b><br>427,819 SGD   | <b>Validation of Near-Future Quantum Technologies (VanQuTe) – National Research Foundation, Singapore</b> <b>Role:</b> Principal Investigator                                    |
| <b>2016-2022</b><br>2,606,400 SGD | <b>Enhancing the Efficiency of Modelling and Simulating Complex Systems via Quantum Mechanics</b><br>National Research Foundation, Singapore <b>Role:</b> Principal Investigator |

## SELECTED INVITED TALKS

Presented invited talks/colloquium/panelist on 40+ occasions, a selection includes:

1. **Invited talk** at Quantum Errors, Sensing and Control: Principles, Applications and Engineerin (Q-ESCAPE 2024), Shenzhen, China, 2024
2. **Invited talk** at the IBM Future of High Performance Computing with Quantum Workshop, SCA 2023 Singapore, 27/02/2023
3. **Invited talk** at Australia Institute of Physics Congress (AIP2022), Adelaide 11/12/2022
4. **Invited opening talk** at International Conference on Quantum Computing (ICQC), Seoul, 29/06/2022
5. **Invited talk** at Frontiers in Science: A Conference in honour of Prof CN Yang at 100, Singapore 08/06/2022
6. **Invited talk** at the 'Quantum: Industry Meets Academia' workshop, Shanghai, 21/09/2019
7. **Invited talk and panellist** at the 6<sup>th</sup> International FQXi Conference, Tuscany, Italy, 20/07/2019
8. **Invited talk and panellist** at SCA2019 (Supercomputing Asia 2019) Singapore, 13/03/2019

## SELECTED RECENT PUBLICATIONS (LAST 5 YEARS):

Authors who are or were my students or postdocs are underlined.

1. Minjeong Song, Varun Narasimhachar, Bartosz Regula, Thomas J. Elliott, and Mile Gu, Causal Classification of Spatiotemporal Quantum Correlations, *Phys. Rev. Lett.* **133**, 110202, 2024
2. Guo Yao Tham, Ranjith Nair, Mile Gu. "Quantum limits of covert target detection." *Phys. Rev. Lett.* **133**, 110801, 2024
3. Ryuji Takagi, Xiao Yuan, Bartosz Regula, Mile Gu, Virtual quantum resource distillation. *Physical Review Letters* **132**, 050203, 2024
4. Ryuji Takagi, Hiroyasu Tajima, Mile Gu, Universal sampling lower bounds for quantum error mitigation, *Physical Review Letters* **131** (21), 210602, 2024
5. Yunlong Xiao, Yuxiang Yang, Ximing Wang, Qing Liu, Mile Gu, Quantum Uncertainty Principles for Measurements with Interventions, *Physical Review Letters*, **130**, 240201, 2023

6. Ryuji Takagi, Suguru Endo, Shintaro Minagawa, and Mile Gu. Fundamental limits of quantum error mitigation. *npj Quantum Information* 8, 1 1-11, 2022
7. Thomas J Elliott, Mile Gu, Andrew Garner, Jayne Thompson, Quantum adaptive agents with efficient long-term memories, *Physical Review X* 12 (1), 011007, 2022
8. Ranjith Nair and Mile Gu. Fundamental limits of quantum illumination, *Optica* 7, 7, pp. 771-774, 2020
9. Thomas J. Elliott, Chengran Yang, Felix C. Binder, Andrew J. P. Garner, Jayne Thompson, Mile Gu, Extreme Dimensional Compression with Quantum Modeling, *Physica Review Letters*. 125, 260501, 2020
10. Farzad Ghafari, Nora Tischler, Carlo Di Franco, Jayne Thompson, Mile Gu and Geoff Pryde, *Interfering Trajectories in experimental quantum enhanced stochastic simulation*, *Nature Communications*, 10, 1630, 2019

Full Publication List Available at my Google Scholar Account [<https://scholar.google.com/citations?user=ZBDAbY4AAAAJ>]

## IP AND PATENTS

Authors who are or were my students or postdocs are underlined.

- Jianjun Chen, Chengran Yang; Carsten Blank; Mile Gu, *A Quantum Machine for Error-Reduced Probability Estimation in Forecasting of Stochastic Processes*, Singapore provisional patent application, 10202500065Y. Jan 8, 2025.
- Ximing Wang, Chengran Yang, Mile Gu. *Variational decoupling for circuit compilation*. Singapore provisional patent application, 10202303382Q. November 29, 2023.