Quantum Computing Research Statement

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I lead a small group that connects scientific curiosity with practical needs: *where can quantum computing make an impact, and how do we establish that through evidence?*

Research

Our work spans quantum optimisation, hybrid quantum–classical methods, hardware benchmarking and the use of artificial intelligence to support experimentation. Across these areas, we investigate how computational methods can help address difficult planning and decision-making problems. We develop a library of codes and data for the community available at SMU-Quantum

One strand of our research examines how quantum optimisation algorithms perform on physical processors. In our study published in the top-tier journal called *Quantum Science and Technology*, we evaluated several approaches across four problem families on IBM Heron hardware. It demonstrates how noise, circuit size and the way a problem is represented affect the quality of the results. Identifying these constraints tells us where improvements are needed and helps guide subsequent experiments.

We are also exploring how AI can assist quantum research. Our `AutoQResearch` framework uses a language model to guide the search for adaptive quantum optimisation strategies within a controlled evaluation process. The work was presented at the IEEE Quantum Week 2026, connects quantum algorithm development with AI-assisted experimentation. The paper can be found in AutoQResearch.

We developed a very fast algorithm that enables us to solve constrained optimization problems using the Variational Quantum Eigensolver and fast sampling. The paper was published at the IEEE Quantum Week 2025, and reported by the popular quantum news and research agency Quantum Zeitgeist on April 26, 2026. A journal version of the paper is under review.

Recently I wrote a survey paper (with the help of AI) on how AI and Quantum Computing can collaborate to solve complex optimization problems. The paper can be found here.

Besides academic research, we are interested in demonstrating real-world impact. In the following we provide two examples:

Evidence of Impact

(1) Benchmarking Quantum Advantage

We are also on the world radar screen in terms of competing to demonstrate quantum advantage. To illustrate, we recently completed experiments on two 98-qubit peaked circuits, P11 and P12, using Quantinuum's Helios-1 quantum hardware. The recovered answers were externally accepted, and the results are now listed on the Quantum Advantage Tracker, which also recognises Singapore Management University among its contributing organisations. Seeing SMU represented in this international benchmarking effort is a meaningful milestone for us. It gives our work visibility within a community that is actively testing the capabilities of quantum and classical computing. Quantum Advantage Tracker

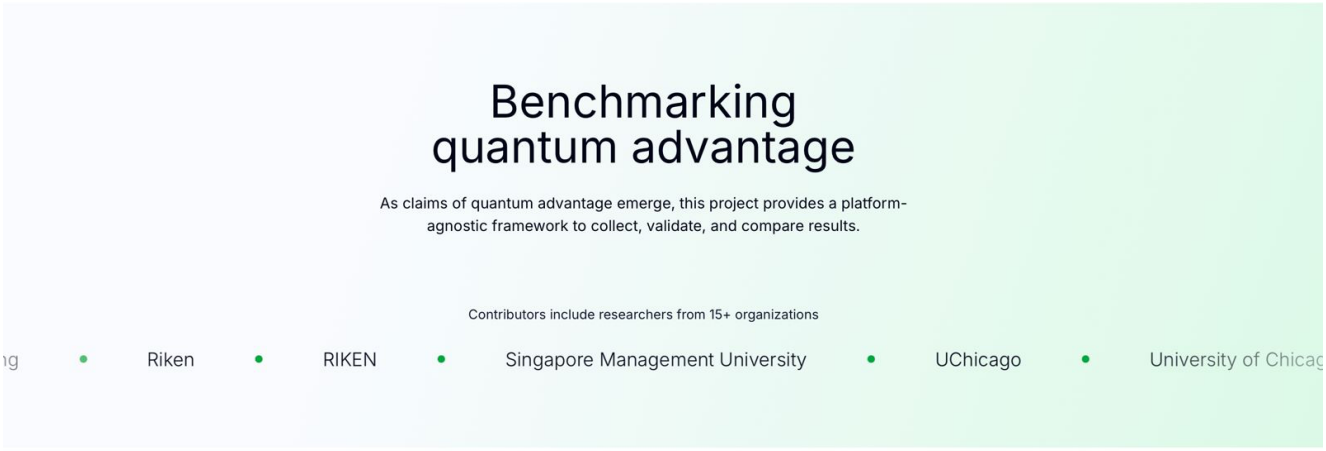


Figure 1. Singapore Management University is listed among the contributing organisations on the Quantum Advantage Tracker.

In layman terms, a peaked circuit is designed so that a particular sequence of zeros and ones stands out among its possible outputs. The task is to recover that sequence. Noise in quantum hardware can weaken this signal and introduce errors into the measured outputs, making recovery more challenging. One distinctive aspect of our implementation is the small number of measurements used. A "shot" is one execution and measurement of a circuit. In the published BlueQubit-led experiments on Quantinuum H2, the researchers reported a 56-qubit circuit with 17 exact matches to the target among 2,000 shots, and another with five exact matches among 1,000 shots. Our Helios-1 experiments recovered the accepted answers for the two 98-qubit circuits using **50 shots for P11 and 200 shots for P12**. Published H2 experiments, our hardware recovery record.

An important part of the work was making the process inspectable. We preserved the circuits, raw hardware records, analysis procedures and supporting evidence in a public repository so that others can examine how the results were obtained and reproduce the recovery analysis. For us, that transparency is part of the scientific contribution.

We also want to be precise about what these results demonstrate. They establish successful recovery of verifiable answers from quantum hardware samples. A claim of quantum advantage requires additional evidence of a benefit over strong classical methods. Our submissions make no standalone advantage claim; they contribute experimental evidence to that continuing assessment.

(2) Supply chain planning and SWITCH 2026

Finally, we demonstrate that our work is gaining industry attention.

Supply-chain planning remains an important application area for our research. Decisions about inventory and procurement become difficult when demand is uncertain and suppliers may fail to deliver. With collaborators such as IBM, we have studied quantum methods for simulation-based optimisation and risk-aware inventory planning, including problems involving multiple unreliable suppliers. These studies have been published in multiple venues, including 5 papers in IEEE Quantum Computing and Engineering conference (2024-2026), and 2 papers at AAAI 2026. It lets us explore the potential of quantum methods in settings grounded in business decisions. Simulation-based optimisation, risk-aware inventory planning.

Our research has also won two tranches of grants of $300k each from NRF (one through the Quantum Engineering Programme and another via the National Quantum Office through National Quantum Computing Hub). Under these grants, we have the opportunity to work with IBM and ST Logistics respectively to translate the algorithms we developed to solve their supply chain inventory optimization problem.

Our work will be featured at SWITCH 2026, where **Monit Sharma**, a researcher under Prof Lau, will deliver **"Planning for the Unknown: Exploring Quantum Computing for Supply Chains with Quantinuum quantum hardware."** He is a featured speaker at Quantinuum's enterprise workshop, **"From Quantum Curiosity to Enterprise Readiness,"** taking place on **28 October 2026 at Marina Bay Sands**.



Figure 2. Quantinuum's SWITCH 2026 enterprise workshop features Monit Sharma representing SMU. The workshop runs from 9am to 12pm on 28 October at Marina Bay Sands, Begonia Main 2, Level 3.

The event offers an opportunity to connect our research with organisations considering how quantum computing might fit into their operations. We hope to help make that discussion concrete by linking supply-chain questions with what we can investigate on quantum hardware today.

Reflection

What we value about working at SMU is the connection between research and practical decision-making. The peaked-circuit experiments, our optimisation studies and our work on supply-chain uncertainty address different aspects of the same challenge: developing methods we can test, understand and build upon. Through our work, open research and engagement with the wider community, we hope to contribute both to the progress of quantum computing and to SMU's growing visibility in that area.

Appendix: Quantum Advantage Tracker entries

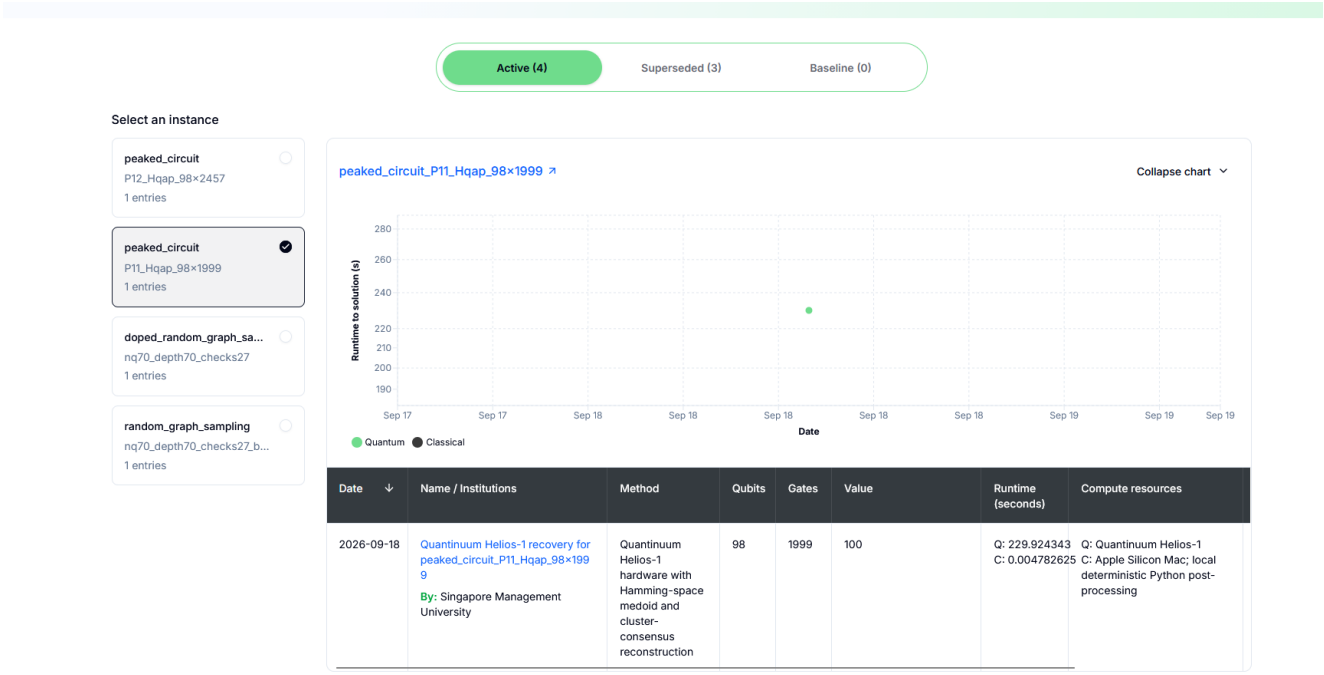


Figure 3. The P11 entry credits Singapore Management University and records recovery for a 98-qubit circuit with 1,999 gates.



Figure 4. The P12 entry credits Singapore Management University and records recovery for a 98-qubit circuit with 2,457 gates.

These listings document accepted recovery results and do not establish a standalone quantum advantage claim. View the tracker entries.