Reducing the Quantum Queue: Tulane Researcher Proposes Smarter Hardware Sharing

March 9th, 2026

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Using a quantum computer today often means waiting. Sometimes that means waiting behind hundreds, even a thousand other users.

“Most of the time, the waiting time is much longer than the actual execution time,” said Jiyuan Wang, Assistant Professor of Computer Science at Tulane University.

That inefficiency is what Wang and his collaborators set out to address.

Quantum computers remain scarce. Major providers such as IBM operate a limited number of machines worldwide, each with a fixed number of qubits, the quantum equivalent of classical bits. But most jobs do not use all of those qubits.

“If IBM has 100 qubits and you only use 60, what happens to the other 40?” Wang explained. “Right now, the next user just waits.”

Current systems typically run jobs one at a time. Even if parts of the hardware sit idle, other users must remain in line until the entire job finishes. On some platforms, queue times can stretch to hundreds of jobs. In many cases, the waiting period far exceeds the actual computation time.

Wang’s research proposes a different approach. Instead of forcing users to take turns, his system allows multiple users to share quantum hardware at the same time. As one job releases qubits, those resources can shift dynamically to another job still running. The result is better utilization and shorter overall wait times.

The concept sounds simple, but quantum hardware makes it complicated.

Unlike classical computer chips, where processing units are essentially identical, qubits vary in quality. Some have higher error rates. Some are positioned in ways that make them harder to connect efficiently with others. Sharing them carelessly can introduce extra noise and reduce performance.

To explain the challenge, Wang offers a relatable analogy.

Imagine two apartment buildings that need access to a shared supermarket. If the store is placed in the right location, both buildings benefit. If it is placed too close to one building, the other pays the price in inconvenience. The placement decision affects everyone.

Quantum chips work in a similar way. Shared qubits must be positioned carefully so that both users can access them efficiently without increasing computational cost or error.

“You need to identify which qubits are good to share,” Wang said. “And make sure the sharing does not bring too much additional cost.”

The research sits within what scientists call the NISQ era, short for Noisy Intermediate-Scale Quantum computing. Today’s quantum machines are powerful but imperfect. They contain fewer than a thousand qubits and operate with measurable error rates. Researchers across physics and computer science are working simultaneously to reduce hardware noise and design smarter software that can function effectively despite those imperfections.

“We know we have imperfect hardware,” Wang said. “So how do we perfectly utilize imperfect hardware?”

Improving scheduling may sound like an infrastructure problem, but it has broader implications. Faster and more efficient access to quantum machines could accelerate research in materials science, optimization, database search, and artificial intelligence. Some researchers are even exploring the idea of quantum-enhanced AI models that could train more efficiently using quantum processors.

The project began while Wang was completing his Ph.D. at UCLA. He and fellow doctoral researchers developed the idea collaboratively, helping each other with code, experiments, and formalizing the theory behind the scheduling system.

“We work like two Ph.D. students helping with each other’s code, experiments, and ideas,” he said.

After joining Tulane last fall, Wang continued the research while transitioning from graduate researcher to faculty member. As a first-year assistant professor, he is building his own research group while maintaining collaborations with colleagues at UCLA, the University of Texas at Dallas, and UC Riverside. He expects to begin mentoring his own doctoral students soon.

The collaboration also grew from his teaching. In his quantum computing course at Tulane, Wang invited one of his former colleagues to present the research. Students asked detailed questions about how IBM’s current scheduling system works and how jobs are prioritized. Those classroom discussions helped sharpen the team’s thinking.

“The students understand,” Wang said. “They raise questions. And those questions give us inspiration.”

Quantum computing remains an emerging field, with hardware and software evolving together. While building larger and more stable machines is critical, Wang believes improving how existing systems are used is just as important.

By reducing the quantum queue and enabling intelligent hardware sharing, his work tackles one of the field’s most practical bottlenecks. As quantum computing moves closer to real-world applications, smarter scheduling may play a quiet but essential role in unlocking its full potential.