

Joint CQSE & NCTS Special Seminar

2023
Aug. 22, Tuesday

TIME Aug. 22, 2023, 2:30~3:30pm
TITLE Hamiltonian Phase Error in Resonantly Driven CNOT Gate
Above the Fault-Tolerant Threshold
SPEAKER Mr. Yi-Hsien Wu (The Quantum Functional System Research
Group, RIKEN, Japan)
PLACE NCTS Physics Lecture Hall, 4F, Chee-Chun Leung
Cosmology Hall, NTU
ONLINE <https://nationaltaiwanuniversity-zbn.my.webex.com/>



Abstract:

Electron spin qubits are a promising platform for scalable quantum processors due to their long coherence time and the compatibility with semiconductor industrial processes. To achieve a large scale quantum processor, quantum error correction needs to be implemented and this requires the quantum gate fidelities of the processor to be above a certain fault-tolerant threshold. By obtaining a detailed understanding of our quantum gates we can use this knowledge to improve the gate fidelity. In this work we demonstrate a simple yet reliable calibration procedure for a high-fidelity controlled-rotation gate in an exchange-always-on Silicon quantum processor, allowing operation above the fault-tolerance threshold of quantum error correction. We find that the fidelity of our uncalibrated controlled-rotation gate is limited by coherent errors in the form of controlled-phases due to an off-resonant driving. We present a method to measure and compensate for the effect of these phase errors to improve our gate fidelity. We then evaluate the improved gate fidelities by randomized benchmark and gate-set tomography protocols. The experimental results are compared with gate-set-tomography results with simulated data. The simulated data matches well with the experimental one, indicating the error measured in experiment is the error we assumed in our simulation. Finally, we use our phase compensation protocol to implement a virtual, high-fidelity controlled-phase gate.

Biography Brief:

Yi-Hsien Wu received his bachelor's degree from Department of Physics, National

Central University. He is now a PhD. Student at the Department of Physics, National Taiwan University under supervision of Prof. Hsi-Sheng Goan, and is also studying as an International Program Associate at the Quantum Functional System Research Group, RIKEN, Japan. His research interests include quantum dot experiments and Silicon spin qubits.

