Investigating the Effect of Qubit Type on Quantum Computing Viability

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This experiment investigated the characteristics of the decoherence of qubits in photonic quantum computers and the effects of decoherence on the superimposed state of the qubit. Three different tests were run to characterize decoherence and test the hypothesis, comparing photonic qubits to superconducting qubits. The first test showed the decay rate of a qubit based on T1 decoherence. This test characterized the T1 decoherence for both types of qubits. Additionally this test investigated the differing effects of increasing qubits numbers for both types of qubits. The second test, a T2 Hahn test, showed the effect of echoes on the overall decoherence of a qubit from an excited state. This test was run for both types of qubits with a range of qubits numbers from two to eight qubits. The photonic quantum computers saw not only lower decoherence but with increasing qubits numbers greater gain in stability per qubit added to the system. The number of qubits were shown to decrease the decay rate of the quantum computers with greater effect in the photonic system. The decay rate of the qubit was graphed as a function of the number of echoes to find the average change in the decay rate per echo. The third test performed was a T2 Ramsey test which investigated the qubit oscillations after failing to land in a perfect excited state. In this test it was observed that photonic qubits decayed along the z axis at a lower rate than did superimposed qubits. Overall it was observed that photonic quantum computers are able to decrease decoherence compared to superconducting quantum computers additionally they are able to gain more stability from increasing qubit numbers per computer then are superconducting quantum computers.

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