

Investigating the Use of Parallel Computing With Quantum Computers

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Quantum computers are integral to progress in computational capability but are limited by decoherence. This research investigated characteristics of qubit decoherence in systems of parallel quantum computers and evaluated the extent to which parallel processing affects the efficiency and stability of the quantum system. Three different tests were run to characterize decoherence as a function of the number of computers run in parallel. The first experiment measured the dependence of the decay rate of a quantum system based on T_1 decoherence and the number of computers run in parallel. Testing showed that T_1 decoherence was only marginally affected by the use of multi-computer processing. The second test, a T_2 Hahn test, showed the effect of increasing the number of computers run in parallel on the overall decay of a qubit from an excited state. This test was conducted with up to eight computers run in parallel. As the number of computers run in parallel increased, the decay rate of the qubit decreased, with the maximum difference achieved when four computers were used. The benefit margin was much less for more than four computers run. The third test performed was a T_2 Ramsey test which investigated the resulting oscillations of the qubit after it failed to land in a perfect excited state. The use of parallel computing significantly decreased the T_2 Ramsey decoherence, with the greatest reduction achieved when three computers were run in parallel. Statistical tests indicated that the use of parallel computing led to a significant reduction in the decay rate for T_2 Hahn and T_2 Ramsey for all parallel circuits tested. The reduction of T_1 decoherence was less effective, requiring at least 4 computers run in parallel to be significant.