Investigating the Effect of Qubit Entanglement on Quantum Decoherence

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This experiment investigated the characteristics of the decoherence of qubits in quantum computers and the effects of decoherence on the superimposed state of the qubit. Four different tests were run to characterize decoherence and test the hypothesis. The first test showed the decay rate of a qubit based on T1 decoherence. This test characterized the T1 decoherence and created a baseline for comparison with the Tphi test. 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 with a range of echoes from zero to five. The number of echoes were shown to decrease the decay rate of the qubit with the greatest change between zero and one echoes. 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. The decay rate of the qubit in the third test was compared to the decay rate of a composite T2 Ramsey/T1 test in the fourth experiment, the Tphi experiment. The Tphi experiment measures the T2 Ramsey and the T1 at the same time. This measurement is then compared to the original T2 Ramsey to determine how isolation affects the decoherence of the qubit. The t-test results indicated that isolation significantly affects decoherence, on average.

Awards Won:
Air Force Research Laboratory on behalf of the United States Air Force: Glass trophy and USAF medal for each recipient
Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category, FOR 2023 ONLY: EBED WILL HAVE TWO