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Qubit decoherence and phase correction in Gaussian white-noise environment

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One of the main obstacles for implementing qubits in real experiments is the detrimental effects of environmental noises. Qubits in noisy environments can decohere quickly, i.e., losing their capability in processing quantum information. In this work, we are interested in analyzing the decoherence and possible ways to correct the phase errors due to the Gaussian white-noise. We consider a single logical qubit and investigate the qubit decoherence depending on different parameters of the white noise. We show analytical results of the qubit decoherence and verify them with numerical simulations. Moreover, we present a possible noise measurement and phase correction protocol that can be applied to estimate the effect of noise on the logical qubit. The quality of phase estimation does vary depending on the sensitivity to noise and the number of qubit probes used in measuring the unknown noise.

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