Cruise Control for a Qubit

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Abstract

A qubit or a quantum bit is the most basic quantum two-state system. It could be realized physically by a tiny superconducting charge which has reduced sensitivity to charge noise, called a transmon. Such a system can be restricted to just two quantum state: ground state and the first excited state at ultra-cold temperatures. Now, a microwave field is required to drive the qubit in a cycle between the two states 'in phase' with an external clock. However, due to quantum fluctuations, the qubit becomes out of phase within microseconds. A feedback control loop has to be employed to modulate the cycle. It inhibits the decay of Rabi oscillations, allowing it to persist. Just like classical systems, continuously monitoring the system and adjusting its dynamics turns out to be a useful method in spite of the fact that for quantum systems continuous measurement induces further fluctuations. In this talk, I will elaborate the continuous feedback control using a microwave probe field method used by Vijay *et al.*. I shall briefly discuss its efficiency in achieving the objective. The advantages and applications of attaining a reliable qubit cycle would be summarized. Further, I shall mention some other recent experiments that have proven to be much more efficient.

References:

1. Stabilizing Rabi oscillations in a superconducting qubit using quantum feedback; Vijay, R. *et al.* *Nature* 490, 77-80 (2012)