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Bichromatically driven single and coupled Floquet qubits

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Abstract: We investigate the driving regimes and dephasing lifetimes for bichromatically driven single and coupled qubits with Floquet theory. We compare the rotating-wave approximation in analysing Floquet-quasienergies with the scope of generalized van Vleck perturbation theory.

In recent times, a wide range of superconducting system- based platforms with high lifetimes and that are minimally affected by 1/f noise are being developed. In this talk, our recent and ongoing efforts to characterize single and two coupled qubits, acted upon by two external periodic drives, which we call Floquet qubits [1,2], will be discussed. We derive analytic expressions for the Floquet quasienergy gap in case of bichromatically driven single qubit and two coupled qubits. We apply the Rotating Wave Approximation (RWA) to study the multi-photon resonance in Floquet qubits and show that the RWA is a valid approximation only in strong driving regime. To address weak to intermediate driving regimes, we calculate the effects of the AC-Stark shift and power broadening on the Floquet quasienergies for both single and coupled qubit systems using the Generalized Van Vleck (GVV) perturbation theory. This approach shows an excellent agreement with the numerical simulations. Considering the superconducting qubit architecture fluxonium, we explore the

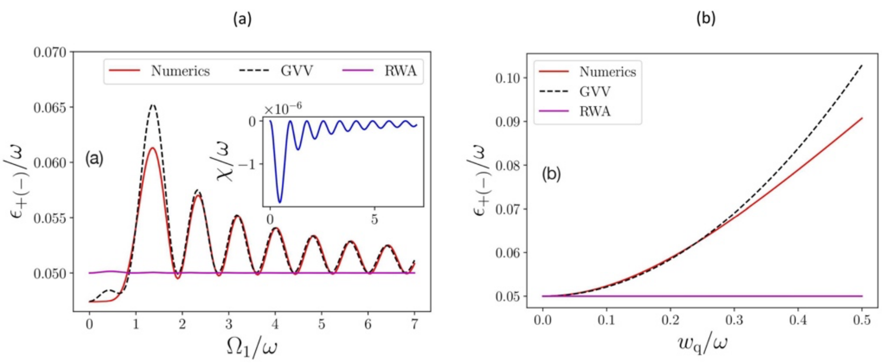

Fig. 1 Lowest positive Floquet quasienergy is plotted as a function of (a) drive strength Ω_1 for $w_q = 0.1\omega$ and (b) w_q for $\Omega_1 = 6.5\omega$.

conditions to obtain higher dephasing lifetimes for the Floquet qubits coupled to an environment. We specifically find that inclusion of an external drive offers more opportunities to protect the state of the qubit and that bichromatic driving opens even more avenues to do so as compared to its monochromatic counterpart.

Example References

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