Abstract Submitted
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The validity of the RWA and gate operation speedup by violating RWA in resonant-driven qubit systems[1] YANG SONG, Condensed Matter Theory Center, Dept. of Physics, Univ. of Maryland — The rotating wave approximation (RWA) is ubiquitously used in understanding (quasi)resonant driven systems and designing pulses for state evolution. Following the practice in atomic and NMR physics, a wide range of semiconducting qubit systems are driven resonantly to manipulate the qubit, including single-spin/resonant exchange (RX)/various singlet-triplet(ST)/spin-charge hybrid qubits. The purpose of this talk is twofold: (I) Examine the validity of RWA in different qubit systems and analyze the error in terms of quantum computation; (II) Present faster gate operations by going into RWA-invalid regime for resonant-driven qubits (esp. for ST and RX types). We measure the RWA-induced infidelity and discuss it in view of the fault-tolerant error correction threshold and operation speeds. Applying the analytical extension (two orders higher than RWA) greatly reduces the infidelity, in the regime where the RWA is attempted to be used. Moreover, we show that the resonant-driven system is not limited by the Rabi-like weak coupling limit and the associated slow gate speed, much smaller than the level splitting (e.g., the small Zeeman energy gradient in ST qubits). We demonstrate the universal one qubit gates for driving strength up to a few level splitting, achieving fast control with only simple sinusoidal pulses. We also solve for the 'shifted sinusoidal' pulses needed for ST qubits where the exchange coupling cannot change signs.

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