# Holonomic quantum gates for a single qubit

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In the present work we discuss universal set of single qubit holonomic quantum gates based on the geometric phase that the qubit wave function acquires after a cyclic evolution. The proposed scheme utilizes ultrafast linearly-chirped pulses and provides a possibility to substantially suppress transient population of the ancillary state in a generic three-level system.

We present the analytic expression of the evolution operator of the single qubit wave function, which provides a clear geometrical interpretation of qubit dynamics. The analytic expression of the evolution operator describes the Raman excitation of the three-level $\Lambda$-system with a large single-photon detuning and allow us to design universal set of holonomic single-qubit gates that are solely based on the geometrical phase. The estimated time scale of the proposed operation is in the range of several picoseconds due to linearly chirping. Here we discuss non-Abelian character of the proposed scheme and compare our results with recently developed methods. The advantage of the proposed method is that it gives additional possibility to substantially suppress the detrimental transient population of the ancillary excited state that can facilitate implementation of high-fidelity quantum logic gates in the presence of decoherence.